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Electrical World

111

A Review of Current Progress in Electricity
and Its Practical Applications

Volume LXXV

January 3 to June 26, 1920

157052
5/11/20

McGRAW-HILL COMPANY, Inc.
Tenth Avenue and Thirty-sixth Street
NEW YORK CITY

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January—June, 1920

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 75 New York, Saturday, January 3, 1920 *Number* 1

A Possible Engineer-President

THE suggestion of Herbert C. Hoover's name for President of the United States is one that is sure to be heard again before the candidates are finally chosen. There is something in it that appeals to engineers, irrespective of their political affiliations, not only because of the splendid accomplishments of Mr Hoover but also because every group of men likes to see one of its own number attain high place. Of the twenty-seven men elected Presidents of the United States, twenty-one had at some period of their lives been lawyers, but only one had ever been an engineer. He, however, was the first and greatest of the Chief Magistrates.

There is one thing that sets Mr. Hoover's work in Europe apart from that of most of the other men who won world-wide fame in the fight against autocracy. They by a cruel compulsion were forced to serve the cause of civilization by destruction. Hoover's work was constructive. While Foch and Haig and Pershing, backed by the civil leaders of their respective nations, forged with sad hearts the thunderbolts of war and as a fearful necessity sent army after army to the shambles, Hoover's part was to conserve human life behind the lines and to build up shattered morale. His task was in direct line with the traditions of his profession, which is instinct with the impulse to build and to save, not to consume or destroy.

The electrical industry has advanced so rapidly and has grown to its present huge proportions because engineers have steadily forced development by continually making changes in the direction of improvement. Types come and go not because they are defective in themselves but because they do not meet changes in conditions.

Wanted—Incentives to Initiative

IT is needless to descant on the condition in which the steam railroads and electric street railways of the country find themselves. Icabod is written across the face of both. Denied adequate rates to offset rising costs, there could be but one outcome—failure, and with that went all semblance of service to the public. Government control and operation offers no solution, for the national government overtook to run the steam railroads effecting all economies which singleness of control make possible, only to pile up a huge deficit despite increased rates and inferior service, and is willing now to return the railroads to private ownership again next March. While the electric public utilities have not yet come to such a sorry plight, they will soon head in that direction if increased rates are not quickly forthcoming. Already they begin to show signs of fatigue from the strain of trying to make both ends meet at a time when conditions are worse than they were during the war. Huge investments for new equipment and extensions are necessary to meet the pressing demands for service, but the earnings of the utilities are such that they cannot command these additional moneys except at pawnbroker rates. The eventual outcome of such a situation is to bring about a condition comparable to that under government ownership, where everything appertaining to the business is permitted to drift. Great opportunities confront the industry, the greatest in years, but because of lack of funds it cannot avail itself of them, and yet if these opportunities are not grasped the whole community suffers as well. Gone is the incentive to that initiative under which the electric public utilities went forward by leaps and bounds, and if the old-time vigor is to be resurrected greater returns must be forthcoming as an inducement for financial aid and as a reward for efficient management.

Near the height of the coal shortage in wartime, it was to a central station instead of to a munitions plant that a preferential supply of fuel was scheduled by the authorities in one of the Atlantic seaboard states. Could there have been a better illustration of the essential character of the electric central station industry?

A Study in Theater Lighting

THE architect and the illuminating engineer often get squarely at odds in important lighting work. The former has small regard for efficiency, sometimes, too, for adequancy, while the latter not infrequently is oblivious of harmonious effect. Now and then, more and more we are glad to say, they really get together and produce very interesting results. An example of such coöperation is exhibited in L. D. Morgan's account of the illumination of a new theater in Milwaukee. The striking feature of the design is that the whole lighting scheme is indirect, and the colors used in decoration were planned not only to harmonize but to do so without too great loss of efficiency as diffusing surfaces.

Perhaps the most interesting item is the use of what may be described as an indirect chandelier for the illumination of the main body of the auditorium. It is a gracefully modelled affair fully twelve feet in diameter and carrying 24 lamps, eighteen of 500 watts, the rest of 200 watts. In addition there are three 500-watt reflector lamps concealed in it for lighting the proscenium arch while a group of small lamps hidden below it serve to light the structure itself, thus relieving the darkening effect that would otherwise be inevitable. The lighting of the galleries and foyer is carried out with indirect fixtures of the more usual kind suspended by single rods while more decorative designs appear elsewhere. The whole design appears to be beautifully consistent. It would be interesting to learn the actual energy provided for the various areas, so as to gain some idea of the real coefficient of utilization reached, merely as a matter of engineering interest. In a place like this efficiency is, to tell the truth, a secondary consideration since the cost of energy for lighting is a very trivial proportion of the overhead expense. The whole design is most interesting as an especially complete example of carefully studied indirect lighting.

The amount of new industrial and mercantile building construction now under way in America despite the drawbacks of the labor situation affords the best possible evidence of the fundamental soundness of our affairs. While thousands display unrest and indifference as the war fever subsides, millions more are working steadily and thus are keeping out of the newspapers. In planning for the future let us not make the mistake of considering the exceptional situation to be universal.

Oil Well Pumping With Induction Motors

AS TIME has gone on induction motors have gradually elbowed direct-current machines out of the road in many paths in which the latter hitherto maintained supremacy. The first accusation against the induction motor was that it could not start without excessive current. The second that it demanded abnormally high current all the time whether starting or running. The third that it had invariable speed. If one stops to consider a moment, speed variation in electric motors involves a rather high degree of specialization whatever the type of machine or the nature of the operating current. A series direct-current motor can be subjected to speed regulation by a series resistance, involving considerable loss of energy if the variations are to be wide, or by some species of commutation leading to considerable complication in the controller, as was the case in the early street car motors. In neither case will it hold a uniform speed at varying load at any point of its regulation. The shunt-wound direct-current motor is essentially a constant-speed machine, capable of being varied over a fair range by field commutation with its accompanying requirements of very liberal size and extra precautions against possible sparking. Even so the performance is not equally good at the high and low speeds and where a large variation is required, in the ratio of say 2 or 3 to 1 with heavy loads and good regulation at each speed, one is driven to still further complications in the way of multiple-voltage supply, or in some cases to Ward-Leonard control or something very like it. With the induction motor the case is very similar. One can get perfectly smooth regulation by a rheostatic control of the secondary or to a limited extent by increasing the slip through lowered primary voltage. In case of necessity one can do better than with any ordinary direct current arrangement by changing the number of poles in the induction machine as is done for instance in electrically driven ships.

In our current issue W. G. Taylor gives a very interesting instance of meeting the requirements of large speed variation in oil-well pumping. For this purpose induction motors proved highly desirable. In the various operations connected with working oil wells a considerable variation in speed is necessary. One motor now furnished for this purpose has a stator wound for either six-pole or twelve-pole operation. By providing the rotor with a simple drum controller putting resistance in the secondary, either speed permits of a reduction of 50 per cent while still giving full-load torque. That is, a machine will operate from 1200 r.p.m. down to 300 with ample flexibility of control, and two of the speeds, 1200 and 600 are highly efficient since they require no armature resistance. With a motor of this kind protected by a circuit breaker having automatic under-voltage and inverse-time-limit overload releases, it is quite easy fully to meet the speed requirement of an oil-well drive. The severity of the work is relieved by counterbalancing the walking beam which is a regular part of oil-well pumping equipment, so that not only are the variations in current reduced, but the load is relieved to the extent of actually reducing the consumption of energy by no inconsiderable amount.

Better records of interconnection results are needed in order to press the advantages of energy interchange to their economic limit. Load plots and plant performance graphs should supplement the drab "bought and sold" records of the accounting department, otherwise water and fuel may be wasted, unit labor costs increased and equipment handled in amateurish fashion.

Changes in Transmission Lines

A VALUABLE study of distribution economics is that presented in the current issue by Messrs. Reyneau and Seelye. The concrete problem investigated is reconstruction for the purpose of shortening lines with due regard of the possible value of material displaced. The condition is one which arises not infrequently, especially where there have been radical changes in the distribution system, as for instance, those due to the establishment of new stations or substations. In the last analysis economy of change requires that the added cost due to the constructorial changes shall be at least offset by the lessened losses of energy. The writers starting from this basis work out the necessary formulas for carrying out the needful computations. These as in the case of formulas for maximum economy of a transmission line involve many quantities to be estimated and given their proper values for the case in hand, and they will then lead to a definite result, based on the above criterion.

The chief difficulty in applying any such formulas whether for old or new lines lies in the difficulty of correct assumptions of value in advance of the work, and, even more generally, in the fact that the result is rigorous for only one epoch, that for which the working values of the variables are assumed. For example, a transmission line designed for maximum economy in 1914 will now vary far from the best result as of 1919, and in 1925 the situation will be still different. It takes, therefore, besides correct formulas, something very like the prophetic instinct to judge the probable economics of the situation over a term of years. To one with the necessary judgment and experience the methods here sketched out will prove extremely useful. They are worked out with a thoroughness and care that leaves little to be desired and the practical examples studied are thoroughly typical of the situations which turn up in actual practice, and concerning which definite decisions have to be made.

Expansion of service by a public utility or manufacturer adds to the liability account for the time being, but when directed by farsighted brains the "turnover" will generally be found to warrant the undertaking. In electric service we seem always to be standing on the threshold of a new era, and those who have combined faith and courage in the past have often reaped their due rewards.

Thermal Conductivity of Underground Ducts

IT HAS been said that refinement in power-plant design has reached a state far in advance of distribution and transmission-line development. In the matter of conduit systems for underground cables, for example, there appear to be no data regarding the thermal conductivity of duct materials in common use. It is with pleasure, therefore, that we present this week an article by W. S. Wilder giving pioneer experiments on the thermal conductivity of underground duct materials. As pointed out by Mr. Wilder, the cross-section of underground cables for a given load and temperature rise will vary in nearly inverse ratio to the conductivity of the duct material, neglecting the effect of the concrete and other items. This assumption, of course, may not approximate the fact, but it is, nevertheless, of great importance to determine experimentally just what effect the duct material does have on the current-carrying capacity of underground cables under common operating conditions.

Although the data presented in this paper indicate that one duct material may have a considerably higher conductivity than another, the results can scarcely be considered conclusive. Their value lies more in the fact that they point out the need for investigation of this subject and give a general method of experimental procedure. This matter should receive the attention of engineers responsible for extensive underground systems where test data may be secured under actual operating conditions.

"More light for the same money," "It's not the light you use, but the light you waste, that causes high bills," "Learn to read your own meters," and other slogans have driven home to millions the thought of cost in connection with things electrical. This is all right so far as it goes; but with it should go a positive sales psychology based on the idea of convenience.

Ventilation of Induction Motors

IN THE early days of electric machine design attention had to be concentrated on securing output, and the internal losses in those relatively small machines necessarily received scant consideration. The main enendeavor was to provide a machine which would give the required power. As a consequence the internal losses were apt to reach large values. Before the rotor core bodies were laminated some of them ran very hot, as may well be surmised from modern knowledge of the subject. It was soon found that the size of the internal losses began to limit output. Attention had then to be bestowed upon reducing the losses. A great step forward was taken in laminating the steel undergoing cyclic magnetization. This enabled larger machines to be built, and the difficulty of dissipating the heat loss then soon made itself disagreeably felt. Another great step was taken when the rotor was hollowed and ventilating ducts were provided in its surface, so that heated air could be thrown out radially, during rotation, by centrifugal force. This was probably the first great advance in forced ventilation.

During recent years, with increasing outputs and consequent increased internal losses, the dissipation of the heat by means of simple ventilating ducts has proved insufficient, and more powerful means of forced ventilation have had to be provided. In some large machines elaborate ventilating systems have had to be designed and constructed. Whereas in the early machines radiation was principally relied upon to dissipate the heat, now radiation plays a relatively small part in the process. Forced convection is the main source of cooling. The importance which proper ventilation has assumed in modern high-speed induction motors was pointed out by Fraser Jeffrey in an article appearing in the ELECTRICAL WORLD for Nov. 29-Dec. 6, page 988. It will be noticed that in the case of a 1000-hp. motor the steady dissipation of 35 kw., under rated load, requires about 2 cu.m. of air per second to be driven through the carcasses of the stator and rotor. This means, of course, that such a machine is a great air heater when in full operation, and it would not be surprising to find that this byproduct of electric power generation may be utilized commercially for supplying warm air to buildings. Electric-railway tunnels and subways to-day receive their needed warmth in winter from the heat rejected by the traveling motors.

Should this period in which the industry is chronically oversold continue for a long time salesmanship will become a lost art. Sales wits are already losing their vigor for lack of exercise. Some salesmen realize this and are keeping in trim for the day ahead when a buyers' market must again prevail.

Deterioration of Lighting Deserves Attention

DETERIORATION in illumination from using lamps beyond their useful period of life or from not paying enough attention to the accumulation of dust and other substances on reflecting surfaces is quite generally overlooked, and yet the expense of preventing it is more than offset by the results obtained. The second cause of deterioration in lighting is really the most serious.

While the average light output of the gas-filled lamp during its life is less than 5 per cent below the initial output, four weeks of lack of attention to reflectors will cut down the lighting from 10 to 25 per cent and sometimes nearly double even the last amount.

Attention to cleanliness, therefore, saves useful light to a very marked degree. Lamps neglected may be actually running at a virtual efficiency fully a third below the normal figure. To take account of the practical depreciation even when fixtures are cleaned once a month, Ward Harrison and H. H. Magdsick have made use of a depreciation factor of from 1.2 to 1.4. This enters very simply into the calculation of the total lumens required, and its use will insure maintenance of good lighting for reasonable periods between "cleans."

Artistic and Utilitarian Theater Lighting

Architects, Illuminating Engineers and Contractors Jointly Study Lighting of Vaudeville Stage in Milwaukee and Apply Harmonious Combination of Ideas Through Use of Concealed Light Sources

BY LYMAN DAY MORGAN

ARCHITECTS have long bemoaned the fact that the average electrical illuminating engineer is likely to view lighting work solely as a technical problem. This tendency, architects believe, influences the engineer to overlook all other considerations in favor of purely utilitarian lighting. An architect of national prominence remarked: "That electrical fellow's idea of a building is merely a structure to house lighting equipment." When the engineer was informed of this he made the criticism of the architectural profession in general: "Those fellows design very beautiful interiors and then sometimes ruin them by hiding all of their work back of a lot of wrought-iron holders for glaring light spaces." Both of these mutual critics were more or less right. The result was that up to ten years ago it was extremely rare to find an interior artistically treated as far as lighting results were concerned. This was especially true of theater auditoriums. Architects spent months in planning minor details to bring about a thoroughly harmonious and artistic treatment in the interior decoration of theaters and then hid these effects behind rows of bare lamps or immense chandeliers which ruined the very effects that they were striving for. Illumination can be treated simultaneously from the utilitarian and the artistic standpoint if architect and engineer can get together early enough in the planning of the interior.

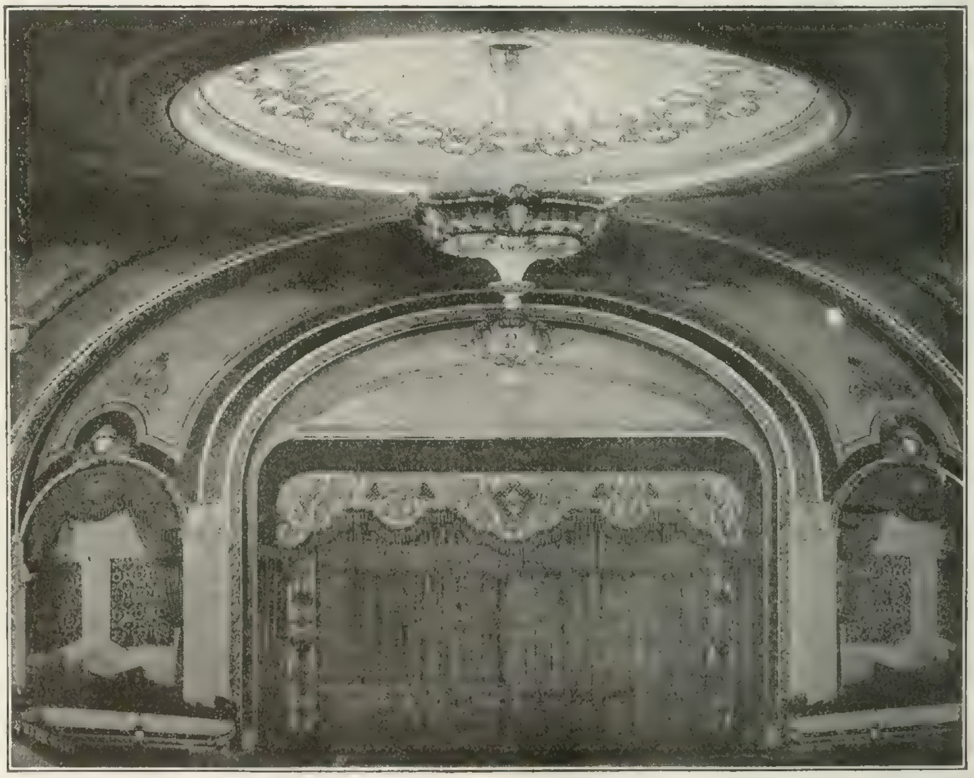


FIG. 1—MAIN FIXTURE LIGHTS AUDITORIUM AND IS ITSELF LIGHTED BY AUXILIARY LAMPS

The illumination of the Palace Theater at Milwaukee affords one instance in which this work was taken into as much consideration in the original planning of the building as was the structural steel. It was not left until the last minute, as is too often the case in buildings of this kind. The results, which are shown in some of the accompanying pictures, really speak for themselves. It appears important, however, to point out some of the problems involved, since this is one of the most modern theaters in the Middle West and is said to be the largest in that section devoted exclusively to vaudeville.

LIGHTING FOR VAUDEVILLE STAGE SHOULD BE FLEXIBLE

Where a theater is to be used for one purpose, such as the presentation of motion pictures, illumination is a comparatively easy problem. However, diversity of program, such as opening with motion pictures and possibly closing with a drama, with a monologist sandwiched in between, requires great flexibility of illumination. The combination of various conditions has been met at the Palace Theater by the use of concealed sources entirely. To accomplish this the architect had to plan his interior so that the ceiling could be used as a diffusing surface, which, of course, meant the use of a light color in order to keep down the consumption of energy. It was not necessary, however, to have a white ceiling and light-buff side walls. Colors were so combined that wherever one having a low coefficient of reflection was used another with a high coefficient of reflection was worked in to balance the loss.

The decorative treatment in the theater has been described as "lavish" by interior decorators. Combinations of white, golden brown, orange, blue and black have been so successfully made that no one is conscious of an attempt to handle the color treatment from anything but the artistic standpoint. The decorative treatment, however, is so handled that, notwithstanding the high color absorption of the deep orange and blues, the indirect lighting is hardly less efficient than a direct-lighting scheme of the same intensity would have been. There is not an unconcealed light source in the entire auditorium nor on the stage. The architect has even provided footlights so carefully designed that from the last seat in the gallery their glow is not objectionable.

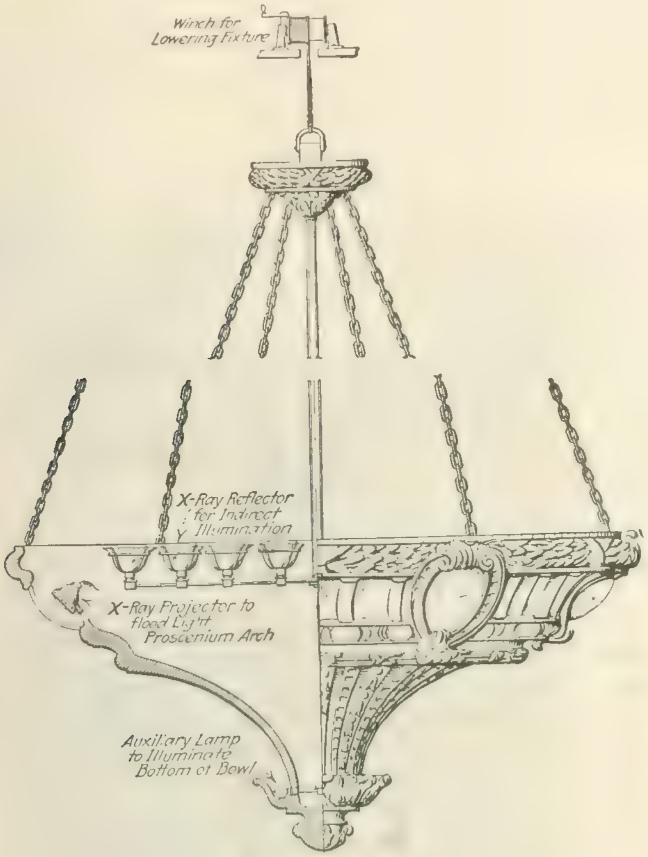

Winch for Lowering Fixture
X-Ray Reflector for Indirect Illumination
X-Ray Projector to flood Light Proscenium Arch
Auxiliary Lamp to Illuminate Bottom of Bowl

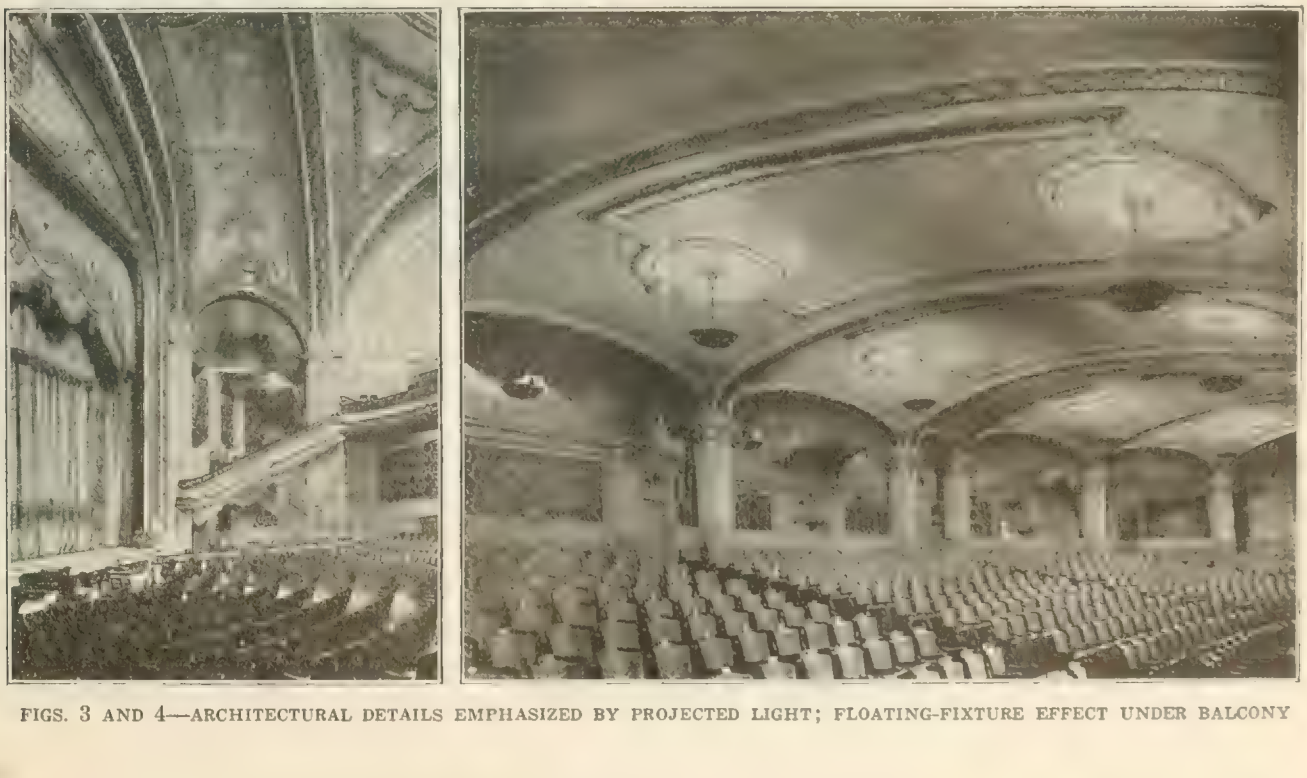
FIG. 2—PANELS THROUGH WHICH LIGHT IS PROJECTED ON THE PROCENIUM ARCH

The outer lobby, in order to attract the passer-by, is brilliantly illuminated by direct lighting. From this lobby a long foyer extends to the inner one. In order that the eye may accommodate itself to the change from daylight to the relatively dim illumination in the inner lobby the intensity is graduated. A 20 ft.-candle intensity is provided in the outer lobby and approximately a 5 ft.-candle intensity in the inner. The auditorium, when all lamps are burning, has an intensity of about 5 ft.-candles. This can be dimmed to less than 0.01 ft.-candle, which gives sufficient light for finding seats during the performance without interfering with the projection of motion pictures.

DESIGN OF LARGE CEILING FIXTURE

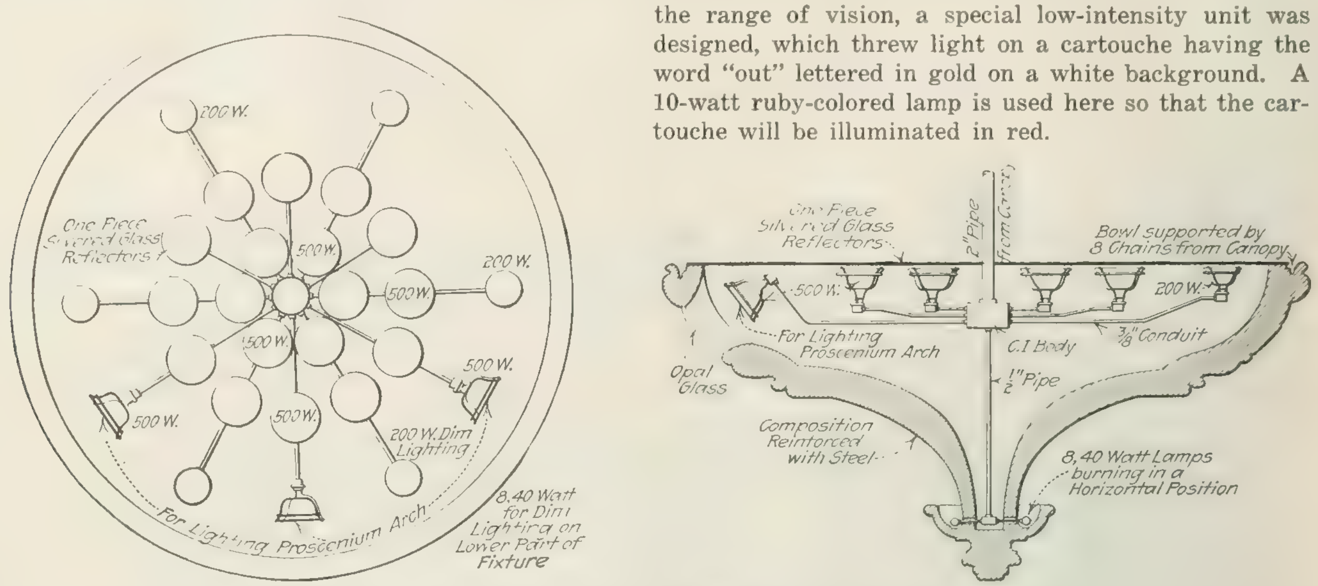
A single balcony extends to about the center of the auditorium. The upper section of this balcony—in fact, the entire auditorium with the exception of a small section of the rear—is illuminated by a single composition fixture of unique design. It is shaped somewhat like an inverted cone, is 12 ft. (3.6 m.) in diameter and 8 ft. (2.4 m.) deep. It weighs approximately 3600 lb. (1630 kg.). In order to overcome the objection to a huge indirect lighting fixture, dark on the under side, seen against a brightly illuminated ceiling, a small bowl 40 in. (100 cm.) in diameter was placed at the apex of the cone. Eight 40-watt lamps installed in this smaller bowl illuminate the lower surface of the fixture to about the same intensity as the ceiling. At the same time these small lamps provide sufficient illumination for finding seats when pictures are being shown. These lamps are connected with an emergency circuit and burn during the entire performance. Three 500-watt units are concealed back of three glass-paneled cartouches in the periphery of the fixture to project light through the panels and illuminate the proscenium arch.

On account of the size of this fixture it was necessary to build it in three parts to get it through the doors. It has a steel framework carrying a composition material applied to metal lath. After the three parts were assembled and bolted together the seams were painted with plaster of paris. Huge hand winches, permanently installed over the auditorium ceiling, raise and lower the fixture for cleaning and lamp renewals. To further facilitate the renewal of the lamps a ladder and a trap door above the fixture have been provided, so that it is



FIGS. 3 AND 4—ARCHITECTURAL DETAILS EMPHASIZED BY PROJECTED LIGHT; FLOATING-FIXTURE EFFECT UNDER BALCONY

not always necessary to lower it. The lighting equipment of the fixture is shown in the line drawing. There are six 200-watt units and eighteen 500-watt units.


200 W.
One Piece Silvered Glass Reflectors
500 W.
200 W.
500 W.
500 W.
500 W.
500 W.
500 W.
200 W. Dim Lighting
For Lighting Proscenium Arch
8, 40 Watt for Dim Lighting on Lower Part of Fixture
One Piece Silvered Glass Reflectors
2" Pipe from Canopy
Bowl supported by 8 Chains from Canopy
500 W.
200 W.
For Lighting Proscenium Arch
C. I Body
3/8" Conduit
Opal Glass
1/2" Pipe
Composition Reinforced with Steel
8, 40 Watt Lamps burning in a Horizontal Position

FIGS. 5 AND 6—DETAILS OF DESIGN FOR LIGHTING EQUIPMENT IN FIXTURE

Separate switches to provide flexibility of light are installed on the stage.

LIGHTING UNDER BALCONY, IN FOYERS AND ON STAIRS

Underneath the balcony and in both the upstairs and the main foyers indirect lighting units with four 100-watt gas-filled lamps, burning horizontally in an especially designed horizontal reflector, furnish the illumination. Fixtures under the balcony are supported by a single rod, giving the appearance of floating fixtures and eliminating any "fixture-showroom" effect. The same design is used in the foyer, but there the fixtures are supported by four rods from the ceiling. Heavy opal-glass hemispheres illuminate the passages and stairways. The lighting of the treads of the balcony stairs is from an indirect source in the side walls, with baffleplates so arranged that the light cast on the stairs causes the treads to be seen in silhouette rather than by direct illumination.

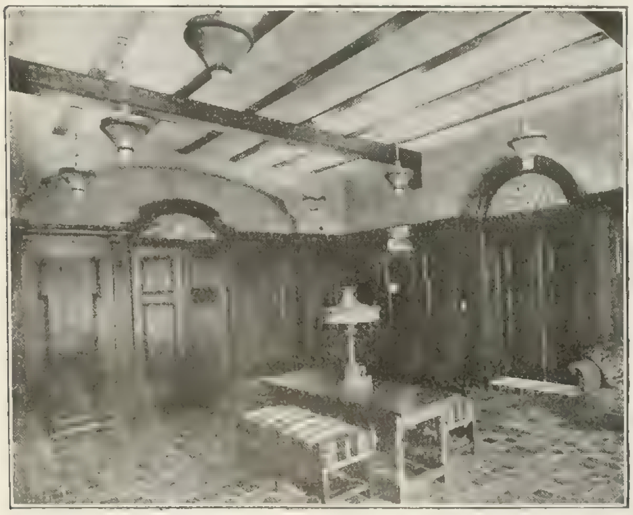


FIG. 7—MEN'S ROOM WITH INVERTED SILK-SHADE FIXTURES

All exit lights have been carefully designed to comply with city ordinances and at the same time to harmonize with the indirect-lighting scheme as well as the general color effect. Where the city ordinances required certain light sources which would have been in the range of vision, a special low-intensity unit was designed, which threw light on a cartouche having the word "out" lettered in gold on a white background. A 10-watt ruby-colored lamp is used here so that the cartouche will be illuminated in red.

The men's room is treated in German Renaissance style. Indirect fixtures were installed there, using a scheme that may be best described as inverted silk shades. In order to carry out the period treatment in the women's room a large chandelier was installed. This fixture, especially designed for the room, harmonizes with the Adam period decoration.

It is noteworthy in connection with the entire illumination scheme that there is not a non-standard lamp used in the theater. Any dealer, therefore, can supply lamps for renewals upon short notice and the theater is not forced to carry a large stock.

The theater was designed and planned under the personal supervision of Mr. Rose, of Kirchoff & Rose, Majestic Building, Milwaukee. All of the electrical work was conducted by George F. Rohn, electrical contractor, Milwaukee, who also supplied the lighting fixtures. The fixtures were designed by Wilmer E. Snow, of the National X-Ray Reflector Company, Chicago, under the supervision of Mr. Rose.

PLASTIC FIRE BRICK MADE IN POWER PLANT

Life of Brick Work Increased 30 per Cent. by Use of This Plaster for Surfacing and Repairing Boiler Furnace Walls

Nearly 30 per cent is added to the life of boiler walls and furnace arches in the station of the Indianapolis Light and Heat Company by the use of inexpensively made plastic fire brick. The plaster is made as follows: Four parts of coarsely ground fire brick, one part of broken-up asbestos, and one part of fire clay, are mixed with a saturated solution of salt water to form a thin dough. After it has stood for 24 hours, and then has been thoroughly worked, it can be applied to the bridge, side walls and arches so as to form a smooth covering and stop any holes. By careful inspection and timely use of this plaster a considerable saving of money for brickwork is effected.

Transmission-Line Reconstruction

Methods and Economic Principles Involved in Analyzing the Cost of Improvements, Rebuilding, Replacement and Other Similar Problems on Transmission Lines—Utilization of Old Materials

BY P. O. REYNEAU[*] AND H. P. SEELYE

IN THE Dec. 27, 1919, issue of the *Electrical World* the authors presented a general method of analyzing the cost of reconstructing a transmission line where the material to be displaced was still serviceable. In this issue it intended to show how this general method can be applied to a few specific problems, namely shortening a line already in service, using part of old equipment in its original location, and choice of transmission route.

ECONOMY OF SHORTENING A LINE

Assume, for example, a line several years old which is in good condition and of sufficient capacity to care for the predicted load up to the probable length of its life. Since its construction, however, conditions have so changed that it is now possible to reduce its length considerably by using a more direct route in some places. The question arises whether or not it would be economical to rebuild those portions of the line by the shorter routes. In order to determine this it is necessary to compare the annual cost of the present installation with the total annual cost chargeable to the reconstructed installation if the change is made. These annual costs may be determined by use of the general equations previously developed.

The present annual cost charged to the section of the line under consideration is:

Annual cost of old line =

$$\begin{aligned} g & \begin{bmatrix} \text{cost of material in old line} \\ + \text{cost of labor in old line} \end{bmatrix} \\ & + \text{cost of superintendence, repairs, patrolling, etc.} \\ & + \text{cost of energy loss in old line,} \end{aligned}$$

where g represents the percentage to be charged each year against the total investment for interest, taxes, insurance and depreciation. As explained before, g is different for the different items, depending on their characteristics and term of life. The expression "$g \times$ (any quantity)" merely indicates that it is the annual charge against that quantity which is being considered.

The annual cost in case the old line is replaced by the new section would be:

Annual cost of reconstructed line =

$$\begin{aligned} & \begin{bmatrix} \text{present value of labor in old line} \\ + \text{cost of material in new line} \\ + \text{cost of labor in new line} \\ + \text{cost of labor removing old line} \end{bmatrix} \\ & + \text{cost of superintendence, repairs, patrolling, etc.} \\ & + \text{cost of energy loss on new line.} \end{aligned}$$

It would be economical, then, to undertake the new construction only if the annual cost of the reconstructed line, thus computed, is less than that of the old line. The added construction cost must be offset by the reduced energy loss. The limiting case is when the two annual costs are equal—

Annual cost of reconstructed line =
annual cost of old line.

It is evident, however, that several of the items in both annual costs are practically the same, so for the purpose of this comparison they may be eliminated. Since the reconstructed section is but a small part of the line as a whole, its useful life must be assumed to be that remaining in the old line. Hence the annual charges against the "present value of labor in old line," which is part of the "annual cost of the reconstructed line," will be practically equal to the annual charges against "cost of labor in old line," which is part of the "annual cost of old line." The cost of "superintendence, repairs, patrolling, etc.," will be practically the same for both, unless the difference in length is large. The equation then reduces to

$$\begin{aligned} g & \begin{bmatrix} \text{cost of material in reconstructed line} \\ + \text{cost of labor in reconstructed line} \\ + \text{cost of labor removing old line} \end{bmatrix} \\ & + \text{cost of energy loss on reconstructed line} = \\ g & \quad (\text{cost of material in old line}) \\ & + \text{cost of energy loss on old line} \end{aligned}$$

The cost of material and labor in the new line will, of course, include the cost of any private right-of-way which it is necessary to purchase and of any other extra expense connected with the construction.

A system of symbols will be adopted, conforming to those used in the article referred to at the beginning of this discussion.

Let L_2 = length in miles of the new section to be built.
L_6 = length in miles of the old section to be replaced.
kw. = load in kilowatts.
L_4 = the length in miles of right-of-way to be purchased.
N = number of new corners necessary in reconstructed line.
C_r = cost per mile for right-of-way.

The details of the computation of unit costs used here need not be given as they would apply to only one particular case. The figures used are based on a line at 46,000 volts, single construction, on wooden poles, with No. 0 bare copper wire, energy costing 1 cent per kilowatt-hour. The annual cost on such new construction introduced into an old line will vary somewhat with the age of the line as explained above. However, since such a reconstruction would probably not be considered except during the early life of the line, and, of course, the shorter the remaining useful life assumed the greater the salvage value of the new material at the end of that life, this may be assumed to be constant for any age. This assumption would also be favored by the probability that this new section would be used, at least in part, beyond the life of the rest of the line.

The unit costs are then assumed to be as follows:—

Annual charges on material and labor in reconstructed line, per mile	\$360.00
Annual charges on cost of labor, removing old line, per mile	30.00
Annual charges on cost of material on old line, per mile	225.00
Annual cost of energy loss, per mile	$0.69/10^5\ \text{kw.}^2$
Annual cost of new corner	40.00
Annual cost of right-of-way, per mile	0.08

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[*] Distribution engineer the Detroit Edison Company.

Substituting these values, the equation for determining economy becomes:

$$360L^2 + 40N + 0.08C_rL_4 + 30L_6 + (0.69\ \text{kw.}^2/10^5)$$
$$L_2 = 225L_6 + (0.69/10^5\ \text{kw.}^2)\ L_6$$
$$165L^2 + 40N + 0.08C_rL_4 = (L_6 - L_2)\ [0.69/10^5\ \text{kw.}^2 + 195] \qquad (1)$$

There are too many variables to exhibit this equation as a curve. The limiting values, however, can be so expressed. If no right-of-way need be purchased and no new corners are added, the greatest length of a new line, L_2, in order to effect a saving of one mile ($L_6 - L_2 = 1$) would be

$$\frac{L_2}{L_6 - L_2} = \frac{0.69/10^5\ \text{kw.}^2 + 195}{165} = \frac{0.418\ \text{kw.}^2}{10^7} + 1.18. \qquad (2)$$

This is plotted in curve *A*. This curve shows the greatest length of new construction which could be economically built under the most favorable conditions; that is, normal line construction cost with no corners and no other extra expense for right-of-way, etc., for each mile subtracted thereby from the total length of the line. If such other extra expense is necessary, the value of $L_2 / (L_6 - L_2)$ will be less, as may be seen from the equation (1). Hence this curve may be used as a test. If the length of new line under consideration is greater than that shown by the curve, it will not be economical to build it. If it is less, the exact economy must be determined from equation (1). For example, as a rather extreme case, suppose there are extra corners necessary and the total distance, L_2, will be on private right-of-way costing $35 per mile per year:

$$\frac{L_2}{L_6 - L_2} = \frac{0.345\ \text{kw.}^2}{10^7} + 0.975 - \frac{0.2N}{L_6 - L_2}. \qquad (3)$$

If the last term is omitted, this equation may be plotted as shown by the curve B, and gives the economical values of $L_2 / (L_6 - L_2)$ (new construction per mile saved) when the extra construction cost is fairly large. For extra corners $0.2/(L_6 - L_2)$ miles must be subtracted from the value shown by the curve for each additional corner. Of course, there might be other extra costs for more poles, higher poles, etc., which have not been especially constructed here. These could be included in the same manner, however.

The economy for any particular loading on such a line may now be readily discovered from the curves and equations. If, for example, under the conditions assumed, the load is 6000 kw., for no corners and no cost of right-of-way, according to curve A, the new construction could be built for 2.7 miles (3.3 km.) for each mile saved thereby, or, say, 8.1 miles (13 km.) in order to save 3 miles (4.8 km.) In case the new construction requires private right-of-way, as per curve B, 2.2 miles (3.4 km.) may be built for each mile saved, or 6.6 miles (10.4 km.) to save 3 miles. If two extra corners were necessary, the figure would be 1.8 miles (2.5 km.) for only 1 mile (1.6 km.) saved, or for 3 miles, 2.067 per mile, or 6.2 miles (9.9 km.), and so forth.

There is thus displayed a tangible method of exhibiting the economy of shortening an old line by reconstruction. For any particular system, of course, the costs must be derived independently. From them similar curves can be drawn and applied to the solution of such problems.

Another characteristic problem of this general nature is the following. In building a new line to replace an old one which is not worn out it may be possible to use a considerable length of the old line poles or other materials in place. However, some shortening of the length of the line might be accomplished by using a more direct route on entirely new construction. How far from the direct route may the line diverge economically in order to use this old line material?

The solution is again reached by a comparison of the annual costs on the two routes using the general equation already developed. This comparison, however, may be considerably simplified, as in the preceding problem, by making use of certain short cuts which reduce the number of terms to be considered. The "present value of labor in old line" is a cost chargeable to the reconstructed line as a whole. It will be the same no matter whether the old material is used in place or not. Hence it may be omitted in the comparison of economy of the two methods of construction on any section of line where the use of old material is considered. The "cost of labor removing the old line" is also chargeable to the new line as a whole, and it might be somewhat difficult to apportion properly the amount to be charged to any particular section. This may be avoided if it is considered, for the comparative costs, that this item is the same amount for both alternative constructions and hence may be omitted from both. Since, however, some of the old material left in place will reduce the actual amount of this item in the one case, the cost represented by the old materials used must be adjusted by subtracting from their present value the amount which it would have cost to remove them. It is seen that this method is equivalent to charging both alternatives with the proper share of the "cost of removing old line" and then subtracting from one the removal cost eliminated by the use of the old material in place. It is also equivalent to considering that old material in place should be charged at its warehouse value, which is its present value as material, if available, less the cost of making it available or removing it to the warehouse. The adjusted annual costs of the reconstructed line on old poles, and of new construction, per mile may be thus obtained and are convenient figures to use in all such economic comparisons. It must always be borne in mind, however, that these are adjusted costs and are not the true annual costs chargeable to the line.

The comparison of the annual costs of the two routes may now be made by comparing the values obtained from the expression

$$g\ [\text{cost of material and labor (adjusted cost)}] + \text{cost of energy loss},$$

with the proper selection of g, for both alternatives.

The following symbols have been used:

L_1 = length in miles of the old pole line which can be used.
L_2 = length in miles of the alternative new line.
L_3 = length in miles of the new construction necessary to supplement the old pole line, i.e., bringing the line from the new route to the old if necessary.
N = the number of new 90-deg. corner constructions saved by using the more direct route.
kw. = load carried in kilowatts.
a = age of old pole line in years.
C_e = cost of energy per kilowatt-hour.
L_4 = length, in miles, of right-of-way to be purchased.
C_r = purchase price per mile of right-of-way.

The figures here given are based on an old line on untreated wood poles, new line on treated poles; voltage of reconstructed line 46,000 volts, necessitating new cross-arms and insulators throughout; wire No. 0 bare copper on both old and reconstructed lines.

The annual charges obtained under these conditions are as follows:

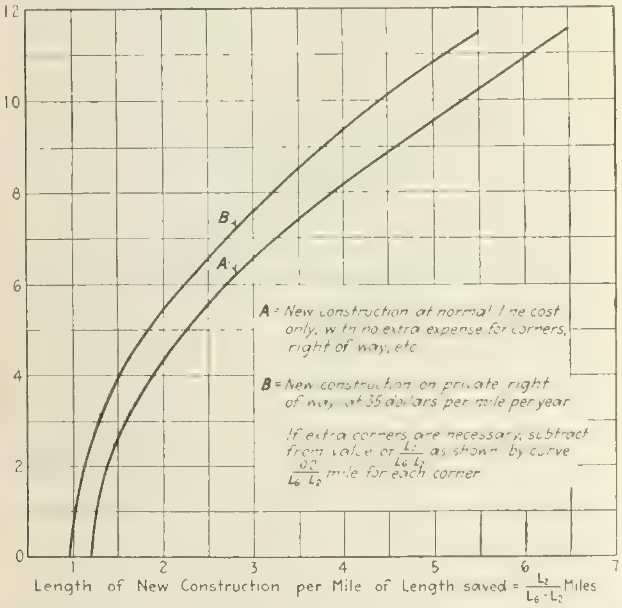
Annual charges on new construction, per mile	\$350
Annual charges on reconstruction on old poles, per mile	$(3350—260a + 3.2a^2)/15—818a$
Annual charges on energy loss	$\frac{69}{10^5}$ kw ^{2} Ce
Annual charges on corner construction	\$38

It is now a question of whether the annual cost on $L_1 + L_3$ is greater or less than on L_2 using the above figures. It would be advantageous to divert to the old pole line when

$$L_1\left(\frac{3350 - 260a + 3.2a^2}{15\,a} + \frac{69\text{ kw.}^2\,C_e}{10^5}\right)$$
$$+ L_3\left(350 + \frac{69\text{ kw.}^2\,C_e}{10^5}\right) + 38N < L_2\left(350 + \frac{69\text{ kw.}^2\,C_e}{10^5}\right).$$

$$L_1 < \frac{(L_2 - L_3)\left(350 + \frac{69\text{ kw.}^2}{10^5}C_e\right) - 38N + 0.08\,L_4 C_r}{\frac{3350 - 260a + 3.2a^2}{15\,a} + \frac{69\text{ kw.}^2\,C_e}{10^5}} \qquad (4)$$

An example of the use of this equation would be in such a case as that of a line following a private right-of-way instead of a highway, thereby eliminating four corners and considerable distance. If we assume the old line to be five years old ($a = 5$) and $C_e = 0.01$ and right-of-way at \$35 per mile per year, the equation would become for that particular case with $L_4 = L_2$: $L_3 = 0$: $N = 4$:



MAXIMUM ECONOMICAL LENGTH OF NEW LINE THAT CAN BE CONSTRUCTED TO REPLACE OLD LINE PER MILE OF LINE ELIMINATED

$$L_1 < \frac{L_2\left(350 + \frac{0.69\text{ kw.}^2}{10^5}\right) - 152 + 35\,L_2}{\frac{3350 - 1300 + 80}{10} + \frac{0.69\text{ kw.}^2}{10^5}}$$

$$L_1 < \frac{L_2\left(385 + \frac{0.69\text{ kw.}^2}{10^5}\right) - 152}{\frac{0.69\text{ kw.}^2}{10^5} + 213}, \qquad (5)$$

which is easily solved for known values of L_1, L_2 and the load and the relative economy thus determined. If L_1 is greater than the second member, the economy evidently lies in the new route; if less, in the old one. No curve could be plotted which would be of any great value in this instance since there are so many variables in the expression which are fixed for only one particular problem or condition.

APPLICATION OF METHOD TO CHOICE OF TRANSMISSION ROUTE

There is a very useful application of the principles of this last problem in the choice of a route for a transmission line as a whole. When there are several alternative routes a condition similar to the following concrete example is very often encountered. Power was to be transmitted to a distance of approximately 30 miles (48 km.) from the central station. There were three routes available for the new line, no one of which had any evident marked advantage over the others. Each one included a different amount of private right-of-way, of old pole line, of new construction, of corners, and of distance over which the construction cost would be excessive on account of high trees and other obstructions. The comparatvie economy of the three routes was displayed, by use of the adjusted annual costs explained above, and tabulated as shown in the table:

ADJUSTED ANNUAL COSTS

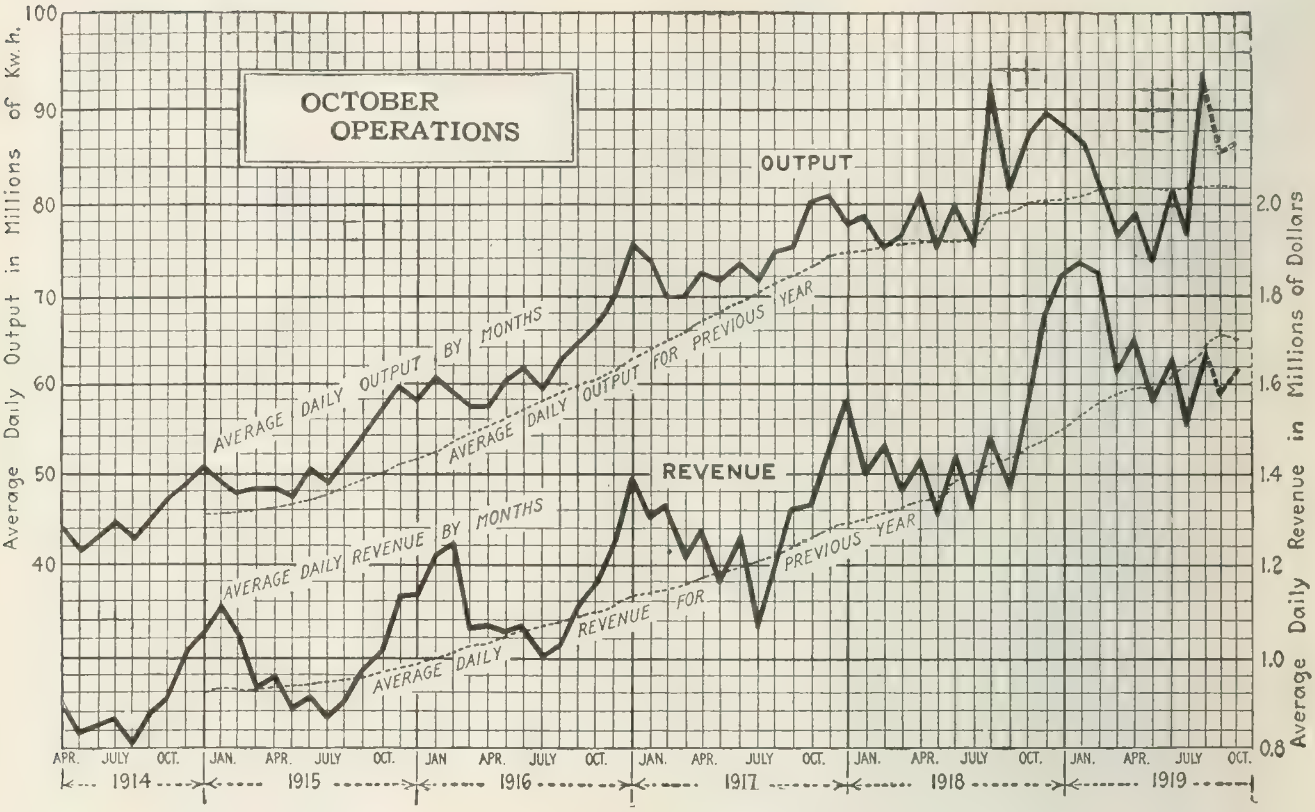
Item	Route A		Route B		Route C	
New construction at \$350 per mile	21 miles,	\$7,360	19 miles,	\$6,650	22 miles	\$7,700
Reconstruction on old poles at \$213 per mile	8 miles,	1,710	12 miles,	2,560	6 miles,	1,280
Right-of-way at \$35 per mile............	6 miles,	210	4 miles,	140	10 miles,	350
Corners at \$38 each...	Nine,	342	Seven,	266	Seven,	266
Energy loss, 4,000 kw load at \$110 per mile.	29 miles,	3,190	31 miles,	3,410	28 miles,	3,080
Difficult construction..	3 miles		2½ miles		3 miles	
Total.............		\$12,812		\$13,026		\$12.676

It is evident that route C is the most economical even though it requires the purchase of more private right-of-way and uses less of the old pole line, since it is somewhat shorter and some corners are eliminated. The extra cost of difficult construction is rather hard to calculate without a detailed layout of the line. It can be estimated, however. In the instance under notice the amount of extra construction was so nearly equal in each case that this was not thought necessary.

As has been explained in previous articles on this subject, there are some other features of such a line that cannot be included in such a cost analysis and which might have considerable weight in the determination of a route. One route might be more accessible for patrolling and repairs than the others. The proximity to a railroad might effect the construction cost considerably. The shelter afforded the line against severe storms might be a large factor for consideration. These points can, however, be weighed against the advantage in cost alone, and the most advantageous route will usually be evident.

This points to the advantage of greater care in the selection of the routes for new lines in new territory even though at the time it may seem advisable, on account of light load, to keep the construction cost at a count of light load, to keep the construction cost down.

Output Increases Despite Strikes



A HIGHLY favorable rate of increase in central station production is indicated from the returns received by the ELECTRICAL WORLD for the month of October. The scale of increase which had its origin in March of this year is steadily advancing. On the basis of the figures received the estimate for the whole industry is: revenue, $50,500,000; output, 2,680,000,000 kilowatt-hours.

Although labor troubles were general throughout the country during October, tending to reduce production and indirectly reduce the power requirements of central stations, yet it appears probable that the usual seasonal increase in electric lighting requirements has overcome this reduction, giving a 6 per cent increase over a similar period for last year. A substantial increase in revenue is especially noticeable in the New England and Atlantic States.

During October there were 15,627,926 active cotton

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Industry Represented	New England States			Percentage of Industry Represented	Atlantic States			Percentage of Industry Represented	Central States			Percentage of Industry Represented	Pacific and Mountain States		
			1918	1917	Per Cent Increase		1918	1917	Per Cent Increase		1918	1917	Per Cent Increase		1918	1917	Per Cent Increase
REVENUE	Nov.	64	$3,695,000	$3,238,000	14.1	55	$11,877,000	$10,400,000	14.2	50	$9,277,000	$7,704,000	20.4	81	$5,034,000	$4,552,000	10.6
	Dec.	64	4,097,000	3,449,000	18.7	55	11,927,000	10,199,000	16.9	50	10,781,000	8,836,000	22.0	79	5,253,000	4,644,000	13.1
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan.	63	4,253,000	3,443,000	23.5	60	13,444,000	11,168,000	20.3	47	10,410,000	8,484,000	22.7	77	5,187,000	4,494,000	15.4
	Feb.	63	3,895,000	3,048,000	27.7	53	10,894,000	8,943,000	21.8	45	9,305,000	7,484,000	24.3	73	4,036,000	3,618,000	11.5
	March	64	3,608,000	3,044,000	18.4	58	11,731,000	10,244,000	14.5	47	9,012,000	7,447,000	21.0	81	4,218,000	3,685,000	14.4
	April	64	3,473,000	2,964,000	17.2	51	11,408,000	10,114,000	12.7	47	8,420,000	6,981,000	20.5	76	4,328,000	3,755,000	15.3
	May	62	3,194,000	2,800,000	14.0	51	9,430,000	8,571,000	10.0	47	8,297,000	6,888,000	20.4	77	5,468,000	4,764,000	14.7
	June	64	3,321,000	2,925,000	13.3	55	10,535,000	9,478,000	11.2	50	8,757,000	7,504,000	16.7	78	5,516,000	4,767,000	15.8
	July	61	3,329,000	2,949,000	13.0	50	9,319,000	8,375,000	11.8	50	8,854,000	7,442,000	18.0	79	4,214,000	3,756,000	12.3
	Aug.	64	3,579,000	3,192,000	12.2	59	11,401,000	10,490,000	8.3	49	9,469,000	8,260,000	14.5	79	5,415,000	4,930,000	10.0
	Sept.	64	3,705,000	2,285,000	16.2	63	10,619,000	9,380,000	13.2	41	7,407,000	6,530,000	13.4	79	5,313,000	4,530,000	12.8
	Oct.	63	3,603,000	2,929,000	22.9	56	10,646,000	8,877,000	20.2	37	7,315,000	6,470,000	13.0	65	3,674,000	3,360,000	9.3
KW.-HR. OUTPUT			1918	1917			1918	1917			1918	1917			1918	1917	
	Nov.	64	138,559,000	123,033,000	12.6	55	542,799,000	495,812,000	9.4	50	444,012,000	396,665,000	11.9	81	403,566,000	368,237,000	9.6
	Dec.	64	145,543,000	129,838,000	12.1	55	405,253,000	421,973,000	12.6	50	489,864,000	443,544,000	10.4	79	428,906,000	374,906,000	14.6
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan.	63	143,254,000	124,632,000	14.9	60	525,322,000	458,545,000	14.5	47	463,394,000	403,127,000	14.9	77	390,690,000	371,156,000	5.2
	Feb.	63	128,660,000	109,993,000	17.0	53	406,702,000	374,958,000	8.4	45	426,965,000	378,992,000	12.6	73	287,479,000	293,492,000	-2.0
	March	64	125,510,000	124,707,000	0.7	58	459,166,000	461,096,000	-0.4	47	442,591,000	423,802,000	4.4	81	330,714,000	331,769,000	-3.0
	April	64	123,211,000	118,322,000	4.1	51	382,282,000	369,701,000	3.4	47	373,116,000	345,213,000	8.1	76	328,925,000	333,405,000	-1.0
	May	62	120,949,000	122,531,000	-1.3	51	362,207,000	383,860,000	5.6	47	389,805,000	375,944,000	3.6	77	382,637,000	385,543,000	-0.7
	June	64	127,355,000	119,946,000	6.3	55	406,102,000	417,441,000	-2.7	50	417,942,000	386,422,000	8.4	78	445,814,000	443,209,000	0.6
	July	61	139,133,000	129,639,000	7.4	50	373,105,000	378,053,000	-1.5	50	428,370,000	408,165,000	5.0	79	366,275,000	365,263,000	0.3
	Aug.	64	148,442,000	143,100,000	3.4	59	595,812,000	625,000,000	-4.8	49	470,475,000	445,000,000	6.0	79	444,026,000	465,518,000	-4.8
	Sept.	64	141,742,000	139,200,000	1.9	63	561,241,000	580,500,000	3.3	41	330,934,000	295,100,000	12.0	79	411,551,000	412,282,000	-0.2
	Oct.	63	132,816,000	121,800,000	9.0	56	569,057,000	544,500,000	4.5	37	335,335,000	300,500,000	11.5	65	299,813,000	293,100,000	2.2

spindles in the New England States, an increase of 5.1 per cent over October of 1918. The labor troubles of one kind or another, however, were still under way in the textile industry tending to materially reduce the energy consumption of this industry. Prosperous conditions in other lines of industry and additional calls for current for illumination appears to have offset these adverse conditions.

October pig iron production was the smallest since February, 1915, and it will probably be some time before production reaches the level attained before the strike. Furnaces in blast on Nov. 1 had a daily capacity of 65,625 gross tons, as compared with 50,100 gross tons on Oct. 1, 1919, and 113,000 on Nov. 1, 1918. When the steel strike was at its strongest it brought production of steel down to about 50 per cent of normal. At the end of October production was about 60 per cent, or perhaps a trifle more. The Mahoning Valley, in Ohio, which represents about 10 per cent of the country's steel production, was closed tight until the middle of October, and at the end of the month production in this district was only about 15 to 20 per cent of its capacity.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Industry Represented	Revenue from the Sale of Energy			Kw.-Hr. Output		
		1918	1917	Per Cent Increase	1918	1917	Per Cent Increase
Nov.	57	$29,883,000	$25,894,000	15.4	1,528,836,000	1,383,747,000	10.5
Dec.	56	32,058,000	27,128,000	18.1	1,539,161,000	1,369,542,000	12.3
		1919	1918		1919	1918	
Jan.	57	33,294,000	27,589,000	20.6	1,522,660,000	1,357,460,000	12.1
Feb.	54	28,130,000	23,162,000	21.4	1,249,806,000	1,157,275,000	7.9
Mar.	57	28,569,000	24,420,000	16.8	1,357,981,000	1,341,374,000	1.2
Apr.	54	27,629,000	23,814,000	15.9	1,278,273,000	1,240,842,000	2.9
May	55	26,389,000	23,023,000	14.6	1,255,598,000	1,267,878,000	—1.0
June	57	28,129,000	24,676,000	13.8	1,397,213,000	1,367,018,000	2.2
July	55	25,716,000	22,523,000	12.5	1,306,883,000	1,281,120,000	2.1
Aug.	58	29,864,000	26,590,000	12.7	1,658,755,000	1,672,000,000	—0.8
Sept.	56	27,044,000	22,870,000	18.0	1,445,468,000	1,380,900,000	4.8
Oct.	50	25,238,000	21,637,000	16.3	1,337,021,000	1,259,900,000	6.2

The large silk mills of Pennsylvania were also seriously affected by strikes during the month and the textile industry in the neighborhood of Chicago was operating at not over 50 per cent capacity. Despite these industrial handicaps the utilities in the Atlantic and Central states showed a substantial increase.

The ship yard strike continued in full force on the Pacific Coast during October, but the effects were not sufficient to offset the increased call for power in Southern California and the copper regions, as well as the generally improved industrial conditions in Washington.

OPERATING DATA ON AN ELECTRIC BRASS FURNACE

Yellow Metal Melted with a Loss Less Than 1 per Cent—Effect of Sunday Closing on Furnace Economy

Although not operating under ideal conditions for the greatest economy, the 105-kw. Bailey brass furnace at the plant of the Hays Manufacturing Company, Erie, Pa., has consistently shown that the guaranteed production can be obtained without any trouble. However, as this plant operates only five and a half days each week, it cannot be expected that the furnace will work with the best economy possible. The melting period is from 6 a.m. to 3:30 p.m. for five days and from 6 a.m. to 9 a.m. on Saturdays. To insure efficient operation of the furnace during working hours, it is preheated between the hours of 3 a.m. and 6 a.m. on every week day excepting Monday. The furnace is started up at 11 p.m. on Sunday if it has not been opened for addition of resistor material. In this case an additional three hours of preheating is provided on Sunday. This is usually necessary every three weeks.

The yellow metal which is poured at 2200 deg. Fahr, (1200 deg. C.), is made up of 75 per cent copper, 4 per cent lead, 1 per cent tin and 20 per cent zinc. After having kept an accurate account for a period of two weeks of the metal charged and the metal poured, the Hays company found that the actual loss in metal was about 1 per cent after the first month of operation. In addition there is an absorption of metal by lining which may be lost temporarily but is regained when the temperature of the furnace is high enough to melt it. This accounts for a high kilowatt-hour-per-ton rate on one day and a small rate on another date.

Reference to the accompanying table shows the effect of the non-working period on the furnace economy. Between the time the furnace is shut off at 9 a.m. Saturday and when it is again started there will be some radiation. This necessitates preheating the furnace at a rate of 130 kw. for seven hours before starting up the beginning of the week and three hours before starting up on week days. The power input is maintained at 130 kw. at all times during the preheating and actual heating periods excepting during the charging and pouring intervals.

PERFORMANCE OF ELECTRIC FURNACE MELTING YELOW METAL

Date	Weight Charged, Lb.	Energy Used Kw.-Hr.	Kw.-Hr. Per Ton Charged
Tuesday, Sept. 2, 1919	6,180	2,568	803
Sept. 3, 1919	6,376	1,656	518
Sept. 4, 1919	6,344	1,608	510
Sept. 5, 1919	6,306	1,752	556
Sept. 6, 1919	3,010	1,032	688
Monday, Sept. 8, 1919	6,309	2,304	731
Sept. 9, 1919	6,343	1,632	511
Sept. 10, 1919	6,130	1,608	527
Sept. 11, 1919	6,335	1,632	511
Sept. 12, 1919	6,366	1,632	510
Sept. 13, 1919	2,062	720	686
Monday, Sept. 15, 1919	6,353	2,328	728
Sept. 16, 1919	6,343	1,560	495
Sept. 17, 1919	6,370	1,608	503
Sept. 18, 1919	6,045	1,464	488
Sept. 19, 1919	6,186	1,488	480
Sept. 20, 1919	2,456	912	729
Monday, Sept. 22, 1919	6,112	2,207	723
Sept. 23, 1919	6,032	1,488	496
Sept. 24, 1919	6,069	1,464	480
Sept. 25, 1919	6,064	1,560	511
Sept. 26, 1919	6,038	1,488	496
Sept. 27, 1919	2,389	864	720
Monday, Sept. 29, 1919	5,512	2,136	777
Sept. 30, 1919	5,443	1,320	489
Summary for month	139,173	40,032	575

During the period immediately preceding the month of September the method of operating was slightly different. Then the policy was to maintain the input at 105 kw. Much better economy is obtained by the present method and the product is considerably improved by the higher temperature obtained.

If the furnace were operated twenty-four hours a day for seven days, the efficiency would be greatly increased because the 400 kw.-hr. used for preheating each morning would be saved. However, the accompanying data give an idea of what can be expected of a furnace operating under working conditions which are typical of those in the present-day industrial plant.

Requirements for Induction Motor Service

Showing It Is Practicable to Require Only 125 Per Cent Full Load Current-Carrying Capacity in Spite of High Starting Current—Change in Code Suggested

THERE appears to be an opportunity to employ some common sense engineering to save the induction motor buying public from spending money needlessly. Rules for induction motor service leads now followed in some of the principal cities of the country are antiquated. They confuse the questions of protection against high starting currents with that of protection against overloads and they confuse the question of fusing with the question of wiring. This has resulted in the establishment of induction motor service requirements that are needlessly severe. Constructive thinking which has been done on this topic indicates now that economy without sacrificing safety is possible. Hence the economy is desirable.

To secure an accurate view of what this economy will mean, consider the various kinds of equipment and material installed between the mains and the induction motor under ordinary conditions. Beginning at the mains there are (1) fuses, (2) wire, (3) conduit, (4) elbows, (5) a knife switch, (6) a compensator, (7) conduit fittings and (8) connectors at the motor. Even a 25 per cent reduction in requirements would effect a substantial saving in the cost of considerable of this equipment, especially if the service is long and the motor large. It is the purpose of this article, therefore, to point out the practicability of adopting a standard service requirement of 25 per cent overload for the service installation.

The first step in the solution of this problem, in the opinion of V. H. Tousley, chief electrical inspector for the city of Chicago, is to separate the subject of fusing from that of the size of wires. In commenting on this Mr. Tousley said: "The fusing of an alternating current motor should be determined by the normal running current and should be regulated as follows: (a) by the starting fuse if such fuse does not exceed the normal running current by a certain specified amount, this value to be somewhat below the maximum current at which such motor may operate for an indefinite time; (b) by running fuses, or, in lieu thereof, overload releases on motor starting boxes; (c) by time-limit circuit breakers or relays.

"The size of wire should be determined solely on a basis of the normal running current and without regard to starting currents, the wire to be of a size to provide for 125 per cent of the normal running current of the motor.

"In order to devise a wiring table based on this rule it will be necessary (1) to classify motors into groups according to their horsepower, using groups where the characteristics fundamental to the table are somewhat similar; (2) to classify motors into groups where the combined efficiencies and power factors are similar."

Agreeing in this general program is F. A. Barron of the General Electric Company who said: "The first step in the solution of this problem is to separate the question of starting fuse capacities from that of copper capacities for the reason that starting fuse capacities are fixed by their overload time lag and ability to carry the momentary starting current of the motor without melting. It seems impossible to avoid a certain amount of over fusing, especially in motors which have two current capacities so far apart as in motors of the induction type, therefore we feel strongly that the fine print note table in rule 8-c National Electrical Code should be retained for fuses and the explanation therein should be changed to refer to fuse capacities instead of wire sizes.

"We believe also that the capacity of copper for branch circuits of induction motors may safely be figured on about 125 per cent of the motor name plate rating and selected from table A, rule 18, National Electrical Code, especially if potential drop in branch circuits is also included in the copper capacities."

Another substantiating point of view comes from S. Glen Vinson, secretary and general manager of the Ideal Electric Company. He said he believed the present underwriter's rules covering induction motor installation would benefit by changing and standardization, and continued: "Ordinarily, a motor is figured for an overload maximum of 25 per cent; the conductors are practically all concealed and are figured on temperatures from 40 deg. C. to 55 deg. C., whereas open wiring or service lines are figured on temperature rise of about 8 deg. C. to 10 deg. C. fully exposed to radiation. It seems to us that a service should be capable of carrying overload capacity in excess of that of the motor without any injury whatever."

A point that should not be overlooked in this connection is the fact that all present installations are demonstrating the safety of using smaller copper in induction motor services. Between the motor and the compensator is a section of wire which is usually very much smaller than that which would be used if the installation were figured at 125 per cent full load current. If a smaller wire will suffice here, the question is often asked why it will not also be satisfactory for the entire service.

WIRING AND FUSING ARE SEPARATE PROBLEMS

To assist in carrying out his thought that wiring and fusing should be considered separately Mr. Tousley of Chicago makes the following additional points and presents a particularly convincing table. Mr. Tousley wrote: "The questions of the fusing of a motor and the size of wire should be entirely separate and distinct.

"The fusing of a motor is determined by the normal current taken by this motor and should in all cases be determined by the amount of current normally taken by the motor and not by the amount of current taken at starting. A motor may be protected in any of the following ways: (a) By the starting fuse if such fuse is not of a capacity much greater than the normal running current of the motor; (b) by running fuses; (c) by time-limit relays; it being understood that overload releases may take the place of running fuses.

"The size of wire to be used should depend on the normal running current plus an overload of reasonable amount. This has been determined as 25 per cent over the normal current of the motor. The carrying capacity of a wire is restricted by the amount of heat generated in that wire. It is a fact, easily proven, that the short intervals of time during which a wire is overloaded by the starting current are such as to have no appreciable effect on the heating of the wire.

"It is also a fact that the size of fuse protecting a wire has, so far as short circuit is concerned, no effect on the wire from a safety standpoint. In other words, it makes no difference whether a No. 14 wire is protected by a 15 amp. fuse or by a 30 amp. fuse. It is just as safe in the latter case as in the former. The Code permits overfusing so that I do not see how there can be any objection to overfusing in the case of alternating current motors.

"The use of large wire is objectionable. First, because it apparently sanctions an overfusing of the motor; second, because it is a useless expenditure of money. Inspectors cannot overlook this feature. Witness the agitation for concentric wire.

"The use of the horsepower rating of motors in making inspection rules and tables has resulted in a great deal of confusion owing to the fact that the current under normal full load conditions is not the same for all horsepowers or for all types of motors. Experience has proven, however, that for practical use a table based on horsepower ratings is very desirable from an inspection standpoint. Our department has used such tables for years.

"If we are convinced of the fact that a wire of 25 per cent over the normal running current of alternating current motors is satisfactory, then we may devise a wiring table by classifying alternating-current motors into groups having similar efficiencies and power factors, again subdividing these into groups of motors under these various classifications.

"Published herewith is a table which will illustrate this point. The first column indicates the horsepower of a series of motors. The second shows the current on a basis of 90 per cent efficiency and 85 per cent power factor, this giving a combined efficiency and power factor of 76 per cent. This is the basis of the present Chicago rules.

SUGGESTED SIZE OF FUSES AND WIRE TO USE WITH DIFFERENT MOTORS

Motor Data							National Electrical Code Rules, Rubber Covered Wire — 250% —		— 200% —			125 Per Cent Average Efficiency and Power Factor					
Size in Hp.	Amp. at 90% Efficiency and 85% Power Factor Equals 76% Combined Efficiency	Size of Wire Required by Chicago Rules	Size of Fuse Required by Chicago Rules (Amp.)	General Electric Rating in Amp., on 60 Cycle, 220 Volt, Slow Speed Induction Motors	General Electric Combined Efficiency and Power Factor in Per Cent	Average Combined Efficiency and Power Factor for Group	Amp.	Size Wire, Table B	Amp	Size Wire, Table B	Overload Per Cent, Rubber-Covered Wire	Amp.	Size Wire (Rubber Covered)	Size Fuse, Table B	N. E. L. A. Requirements' in Amp.	Size Wire, B *	
1	3	14	23	4 8	41	.	12	14	.		.	4 8	14	20	13	14	
2	5	14	23	9.8	40	..	24	12	..	...	204	9.8	14	20	26	12	
3	8	14	23	109	54	50	27	10	.	.	230	146	14	20	39	8	250
5	13	12	30	16	61	..	40	8		..	220	244	10	30	65	6	
7.5	19	8	53	24	60	..	60	6	.	.	210	36	8	50	97	3	
10	26	6	75	34	57	..	..	..	68	6	147	37	6	70	90	4	
15	38	4	105	44	67	..	..	..	88	4	159	56	5	80	135	1	
20	51	3	120	59	66	65	..	..	118	2	152	75	3	100	180	0	195
25	64	1	150	76	65	..	..	..	152	1	131	94	1	150	225	2/0	
30	77	0	188	..	..	.	..	..	.	.	.	112	0	200	270	3/0	
36	90	00	225	105	65	..	..	..	210	00	142	121	0	200	210	2/0	
50	128	4/0	263	150	65	..	..	..	300	200	133	172	3/0	275	300	200	
75	192	350	450	205	73	..	..	..	410	300	138	258	300	400	450	400	
100	256	500	600	282	70	71	..	..	564	500	191	345	500	600	600	500	180
150	384	900	900	418	70		..		836	800	131	517	800	840	900	900	
200	512	1300	1155	556	71	..	.		1112	1200	131	693	1100	1080	1200	1300	
250	640	1800	1455												1500	1700	
300	768	2-900	1800												1800		

"The third column gives the size of wire required by the Chicago Rules and the third column the size of fuse allowed. Under the heading General Electric Rating is given the rating of full load current of General Electric Company motors. In the next two columns is given the combined efficiency and power factor of each size of motor and of each group of motors.

"The next four columns give figures calculated on the basis of the Code ruling and using the General Electric figures for current. The column headed 'overhead rubber covered wires %' shows the carrying capacity of the wire required by the code rule in per cent of the General Electric ratings. This percentage runs from 204 per cent in the smaller size motor to 131 per cent in the larger size motors.

"The next two columns show the current and size of wire to be used on a basis of 125 per cent over the normal full-load current of motors of the various groups. The normal full-load current is calculated on a basis of the General Electric ratings for efficiency and power factor as shown for the average of the three groups.

"The column showing the values at 125 per cent overload for the average efficiencies as shown by the General Electric tables is not greatly different from the figures shown by the Chicago rules. This is due to the fact that while the combined efficiency and power factor assumed by Chicago is higher (76 per cent) we require a wire of 150 per cent of the normal capacity."

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* 125 per cent of the normal current on a basis of the combined efficiency and power factor shown by

$$\text{G. E. Tables } \frac{746}{220\times 1\ 73} = 1\ 96 \times \frac{125}{50} = 250 \text{ per cent, etc.}$$

Thermal Conductivity of Underground Ducts

A Preliminary Study, Though Not Quantitatively Conclusive, Suggests the Importance of Investigating Thermal Properties of Conduits Upon Which the Load Capacity of Underground Cables Depends—Testing Methods Are Described

BY WILLARD S. WILDER
Milwaukee, Wis.

THE capacity of underground cables is limited by the maximum temperature which the cable may reach without damage to the insulation. In the case of rubber this limit is fixed at 60 deg. C. (140 deg. F.) by the A. I. E. E. rules. When the cable is laid in underground ducts the heat developed can be passed off at a rate depending to a considerable extent upon the thermal conductivity of the duct system. In general, cables laid underground will have to be larger, for the same load, than cables used in open air, since their confinement in the ducts eliminates any possible cooling by convection currents of air. In Europe the practice is quite general to lay cables directly in the earth, permitting a greater current density due to the readiness with which the heat developed is passed off through the earth.

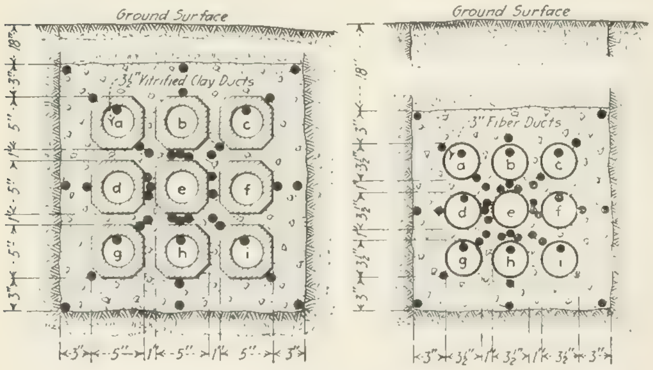


FIG. 1—CROSS-SECTIONS OF TILE AND FIBER DUCT SYSTEMS UNDER TEST

Any heat liberated in such a cable must pass from the conductor through the insulation to the lead sheath, from which it must be dissipated by radiation or conduction. The possibility of dissipation by convection is very small since the cables are surrounded by dead air. Placing the cable in a good conducting medium will materially increase the carrying capacity by removing the heat from the cable so fast that the temperature will not rise to an excessive value. Numerous experiments have been carried out to remove the heat developed, examples being those of flooding the ducts with water, blowing air through them or filling the ducts with vaseline or oil. While these plans will remove the heat from the cables more rapidly than is possible with the dead air, there is little to be gained unless the material of the conduit run is a good conductor of heat, permitting it to escape to the surrounding earth without much increase in temperature.

The purpose of the investigation undertaken by the writer was to determine whether there exists a great enough difference between the heat conductivity of tile and fiber duct to make a saving in cable investments possible by the use of the better duct. Since the construction and maintenance costs are nearly the same for conduit runs built of the two duct materials, any saving due to better heat conductivity of one material would be a clear gain and worth considering when the amount of copper saved is considered.

In order to investigate the saving effected by the use of a duct material having good thermal conductivity, consider two conduit runs, one laid with duct material *A* and the other with material *B*, the construction for the two runs being identical except that duct material *A* has a 10 per cent greater heat conductivity than material *B*. The heat produced by an electric current is given by

$$H = k I^2 R . \qquad (1)$$

Since conduit run *A* is a 10 per cent better conductor of heat than *B*,

$$H_b = H_a 0.9. \qquad (2)$$

$$k_b I_b^2 R_b = 0.9 k_a I_a^2 R_a. \qquad (3)$$

If the cables are to have the same carrying capacity,

$$I_a^2 = 1_b^2; \qquad (4)$$

therefore

$$R_b = k 0.9 R_a. \qquad (5)$$

The size of cable necessary is determined by its resistance from the following formula:

$$R = cL/A. \qquad (6)$$

For copper cables of equal length *C* and *L* will be equal and

$$I/A_b = k 0.9/A_a \qquad (7)$$

$$A_b = k 1.11 A_a. \qquad (8)$$

This shows that for the same load the cable laid in duct material *B*, which has a 10 per cent lower thermal conductivity than material *A*, will have to be 1.11 times as large. With copper selling at a high price, such a saving will amount to a great deal on the initial investment of an installation.

PREPARATION OF DUCT SYSTEMS FOR TEST

In order to determine the temperature rise in typical conduit lines tile and fiber ducts were laid end to end and the conductors carrying the heating current were pulled through the two systems in series. These conduit runs were made with nine ducts arranged as shown in plates 1 and 2. The length of each run was made 9 ft. (2.7 m.), giving a distance of 4.5 ft. (1.4 m.) each side of the middle section where the temperature was measured, this being considered enough to eliminate any error due to the cooling of the ends. The entire length of the run was 23.5 ft. (7.2 m.), giving 1.5 ft. (0.46 m.) between sections and 2 ft. (0.61 m.) at each end for access to the ducts for the purpose of drawing wires through them. The conduit runs were over 15 ft. (4.6 m.) from any building walls so that errors due to heat from that source were removed. The ducts were laid in a concrete mixture of 1:3:5 and were placed 1 in. (2.5 cm.) apart, the joint being staggered. The trench in which the ducts were laid was about 4 ft. (1.2 m.) deep, the concrete and the ducts being at the bottom and covered by 1.5 ft. (0.46 m.) of earth. After inserting the heater ribbons through the ducts, the ends of each duct run were plugged with asbestos wool to prevent heat loss from the interior. Boards were then laid over the openings at the middle and ends of the duct section, and the whole run was covered under a large snow drift, which served to keep the heat in the ducts and to prevent the circulation of cooling air.

The fiber duct used in these tests was the standard 3-in. (7.6-cm.) socket joint conduit with the interior diameter of 3 in. and a wall thickness of ⅜ in. (9.4 mm.), making the external diameter 3¾ in. (9.5 cm.). The external radiating surface of the duct was 11.8 sq.in. (76 sq.cm.) per inch length or 141 sq.in. (910 sq.cm.) per duct foot. The tile duct had a bore of 3⅜ in. (8.5 cm.), the outside surfaces being in the form of a square with the corners cut off and having a wall thickness of ⅝ in. (15.9 mm.). The radiating surface was thus 17 sq.in. (110 sq.cm.) per inch length, or 204 sq.in. (1320 sq.cm.) per duct foot.

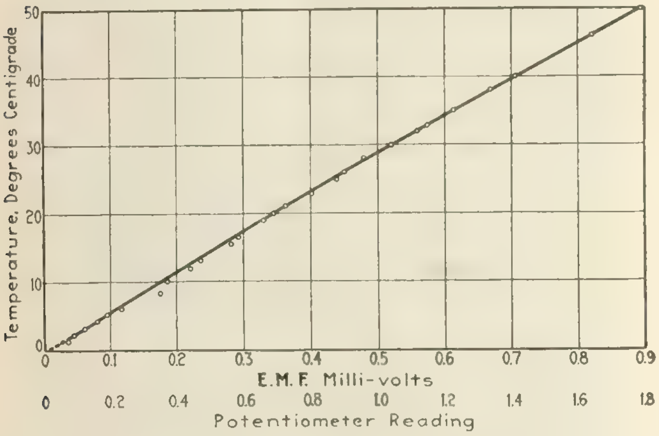


FIG. 2—CALIBRATION CURVE FOR THERMOCOUPLES

Thermocouples were chosen as the best means for measuring the temperatures through the cross-sections of the ducts. They were distributed throughout the cross-section of each conduit run as shown in Fig. 1. The thermocouples were made of No. 20 copper wires soldered with a drop of solder to No. 20 "Advance" wires of the Driver-Harris Company. Care was taken in making the couples to twist the wires together at the tips and secure a solid joint by dipping the tips in molten solder. A couple made in this manner and with these materials was found to be very sensitive to slight changes in temperature and to produce an electromotive force of about 0.017 millivolts per degree change in temperature. In order to use the thermocouples to indicate temperatures it was necessary to calibrate them with the base joint at a constant temperature and the couple at a known temperature, always keeping the base joint, when using the couple, at the same temperature for which it was calibrated. Two wires from each couple were run through the ground, the copper wire being extended through a cable to a switch in the building, the "Advance" wires soldered to brass boxes to form the base joints, these boxes being at the surface of the ground above the duct sections.

A test couple was then made up in the same manner as the other couples, one end being dipped in ice water and the other in a beaker of oil. The temperature of the oil was varied by the heating coil, and the emfs. of the couple and the corresponding readings of the standard thermometer which was immersed in the oil were noted. The calibration curve as shown in Fig. 2 was thus obtained and was found to check the points obtained previously in the calibration of the couples for the runs. Convenient testing arrangements enable the operator to take readings on any of the thermocouples at will.

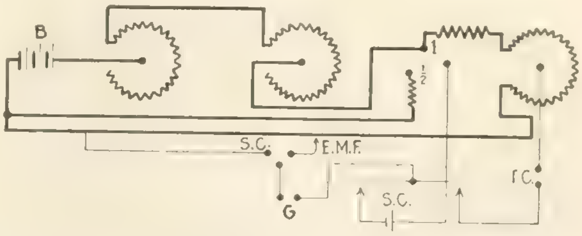


FIG. 3—SIMPLIFIED DIAGRAM OF POTENTIOMETER CIRCUIT

A potentiometer and galvanometer were employed to measure the emfs. of the couples, since this method took no current from the couples, with resulting errors due to potential drop in the leads. The potentiometer was one constructed especially for thermocouple work, the connections being shown in Fig. 3. The galvanometer was of the moving-coil type manufactured by the Tinsley Company. A Weston standard cell was used for the standard emf. and a storage battery for the source of current to produce the potential drop.

The conduit runs were heated by two ½-in. (12.7-mm.) ribbons placed in parallel through the middle duct of each section. This heating ribbon was of "Nichrome" and had a resistance of 103 ohms per 1000 ft. (340 ohms per km.). The energy for heating ribbon was obtained from the city supply stepped down from 110 to 55 volts.

For further tests one and one-half sections of tile and fiber duct were placed in sand and tested as a check upon the results obtained from the conduit runs laid in earth. In this case the interiors of the sections were heated by Nichrome ribbons as in the conduit runs, but the temperatures inside and out were measured with mercury thermometers. To produce uniform conditions about the ducts they were placed on end in a pail and surrounded by a sheet-metal cylinder of 10 in. (25

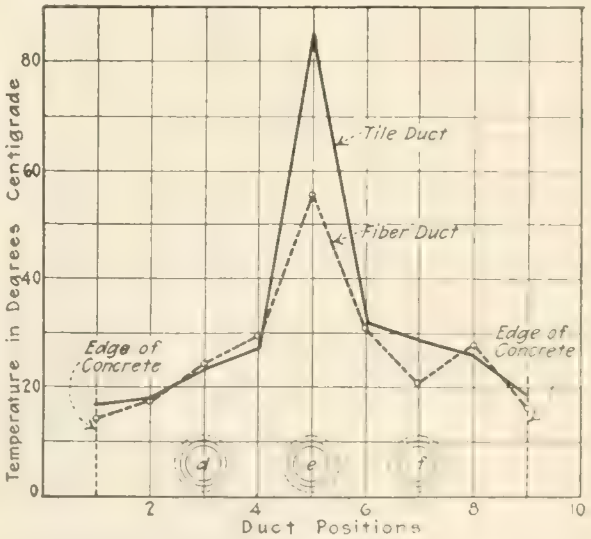


FIG. 4—TEMPERATURE GRADIENT THROUGH CENTER OF DUCTS *d*, *e* AND *f*

cm.) diameter, the space between the cylinders and the ducts being filled with sand. The interiors of the ducts were left empty and the ends plugged with asbestos paper.

Possible Interpretation of Results

Data were obtained from which it was possible to plot curves showing the temperature variation through duct sections in different directions. Fig. 4 shows such curves through the centers of the ducts *d*, *e* and *f* in each case. These data are the average of seven temperature readings taken over a period of eleven days after the temperature conditions throughout the conduit runs had become constant.

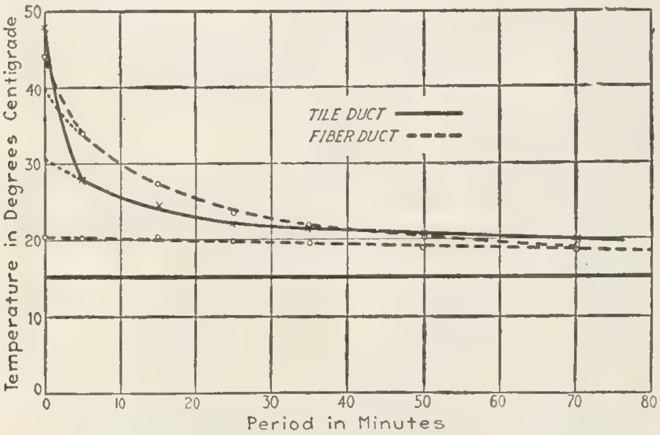
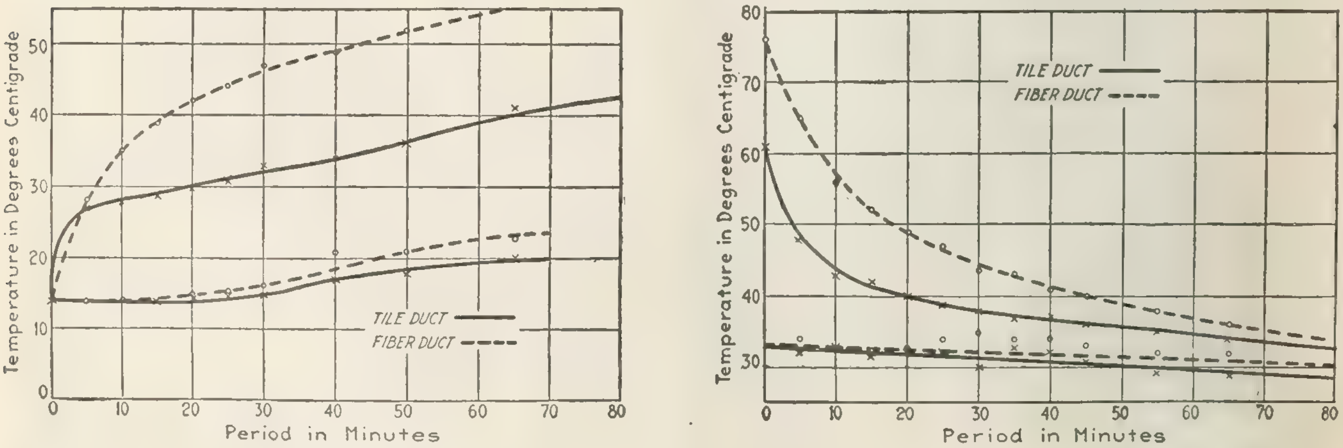


FIG. 5—COOLING CURVES FOR DUCT LINES IN CONCRETE
Short dotted lines indicate possible maximum temperature in center duct *e*

While the curves indicate a much higher temperature at the interior of the tile duct than for the fiber duct, later curves show that the interior of the fiber duct was the warmer, the wrong indication to these plates being due to closer proximity of the thermocouple to the heater ribbons in the tile duct than in the fiber duct. The temperature gradients from the interior to the exterior of the conduit runs are seen to be slightly steeper for the fiber-duct conduits run than for the tile. This would indicate a more uniform temperature through the tile-duct section than the fiber-duct section, or a better conductivity for the tile conduit run. Since the greater part of the duct sections were concrete, the conduit forming only a small percentage of the whole section, any results obtained from these curves are very similar for both sections.

Fig. 5 shows the temperature drop with time, after turning off the heat in the ducts. The upper curves, which show the temperature drop in the middle duct where the heater ribbon was placed, indicate how the position of the couples relative to the heater ribbons caused an error in the indications of the temperatures of the middle ducts, as shown in Fig. 4. Five minutes after the current was turned off, which was ample time for the ribbon to cool down to the temperature of the ducts, the interior of the tile duct was much cooler than the interior of the fiber duct, the extended dotted lines representing the possible initial temperatures. The temperatures fell in both ducts, but more rapidly in the fiber duct, and after forty-five minutes the temperature in the fiber duct was less than that in the tile duct. Since, for the same length of duct, the volume of material in the tile duct is much greater than in the fiber duct, the heat stored in the tile duct is not conducted away as rapidly as that stored in the fiber duct, with the result that the fiber duct should cool off sooner than the tile duct, as the curves indicate. The lower set of curves show the temperature drop with time in the concrete immediately surrounding the ducts. Since the radiating surface of the tile duct is much greater than the fiber duct, the temperature at a given point in the concrete near the tile duct should be lower than at a similar point in the fiber duct. The lower set of curves show the temperature in the concrete about the fiber duct to be greater than in the concrete about the tile duct, the temperature about the fiber duct decreasing as the duct cools off, while the temperature about the tile duct is nearly constant because of the heat stored in it.

Fig. 6 shows the temperature rise in the 1.5-ft. (3.75-cm.) duct sections after turning on the heat in the ribbon through the center of the sections. In this case the ducts were surrounded by sand, but the interiors contained dead air, the heater ribbons being held in place with asbestos plugs in the ends of the ducts. The upper curves, which show the temperature rise on the interior of the ducts, indicate a greater temperature in the interior of the fiber duct than in the tile duct, showing that the tile duct conducts the heat away more rapidly than the fiber duct, thereby keeping the interior cooler. In the tests on the short duct sections the heater rib-



FIGS. 6 AND 7—HEATING AND COOLING CURVES FOR SHORT DUCT LENGTHS IN SAND

bons for each duct were in series which eliminated any errors due to more heat being formed in one duct than in the other. The lower curves show the heat rise in the sand about the duct sections and show how the greater radiating surface of the tile duct makes the temperature at a point near its surface cooler than a similar point near the fiber duct.

The drop in temperatures inside and outside of the ducts after turning off the current in the heater ribbons are shown in Fig. 7. The upper curves show the temperature drop with time in the interiors of the ducts and indicate that in each case the tile duct conducts the heat away more rapidly, making the interiors of the tile ducts cooler than the interiors of the fiber ducts. In each case the heat stored in the material of the ducts keeps the tile duct warmer for a longer period than the fiber duct, because of the greater amount of material in the tile duct. The lower curves in this plate show how the temperature in the sand about the ducts decreases with time.

While a quantitative analysis of the heat conductivity of the two materials would be very desirable and would give exact data relative to the saving effected by the use of one kind of duct, it would be very difficult to make such an analysis with the degree of accuracy required for such computations. Since the material of the duct forms but a very small part of the total material separating the cable and the surrounding earth, means for measuring the temperatures in the ducts very accurately would have to be employed and very accurate data relative to the amount of heat generated in the ducts and passing through the conduit would have to be obtained. Experiments similar to this investigation carried out on a commercial basis should be of great importance and give information of an interesting and valuable nature. Two similar conduit runs, one of tile duct and one of fiber duct, laid under like conditions and of commercial lengths, should be employed. The cables in the ducts could be those supplying power to a load and the power loss in a given length of duct noted by wattmeters. The average temperatures through the lengths of ducts should be noted and a comparison made between the temperature rise and heat losses in the tile and fiber conduit runs.

APPLYING MOTORS TO OIL-WELL PUMPING

Two-Speed Variable-speed Motor with Control Apparatus Connected Is Mounted on Skids and Hauled Out to Well Ready to Operate

BY W. G. TAYLOR

Power and Mining Engineering Department, General Electric Company

THE two-speed slip-ring induction motor with both speeds variable has proved to be especially adaptable to pumping, pulling, bailing, cleaning out, swabbing and other work connected with oil-well pumping. Besides improving on engine drive in many respects, such as by increasing production due to more uniform pumping motion and fewer shut-downs, reducing rod breakage, lowering operating costs and affording greater convenience in operation, it possesses all the flexibility of engine drive.

Pumping the well requires continuous operation of the motor usually for weeks at a time without change or shut-down, with a low power demand and at a comparatively low speed of the rig. Under these conditions high efficiency is desirable, and speed control is necessary to adjust the number of strokes per minute to changing conditions at each well. Pulling rods and tubing, which is necessary at intervals to clean out the well or replace broken or worn parts, as well as all of the other roustabout work, is done at high speed to save time and get the well back on a producing basis without unnecessary delay. All of this duty demands the characteristics of a high-torque hoist motor. The two-speed variable-speed oil-well motor has these two widely different characteristics combined in one machine.

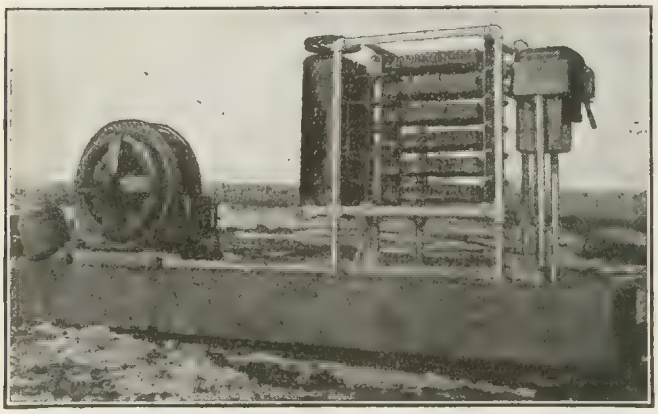
OIL-WELL OPERATED BY 30/15-HP. TWO-SPEED VARIABLE-SPEED MOTOR. NOTE COUNTERWEIGHT ON WALKING BEAM

Although a number of wells of moderate depth have been equipped with motors rated at 25/8 hp. or 25/10 hp., the machine which meets the greatest variety of conditions is rated at 30/15 hp. The higher rating is developed at a synchronous speed of 1200 r.p.m. for pulling, bailing and similar work and the lower rating at 600 r.p.m. for pumping duty. By means of a pole-changing switch mounted on the frame of the motor the speed is readily changed as desired for the work to be done, one position connecting the stator windings for six-pole operation and the opposite throw for twelve poles.

In the particular motor which the writer has in mind the rotor is wound six-phase, requiring six collector rings, and is built to run safely at double speed, or 2400 r.p.m., which is a measure of prevention against damage in case an operator carelessly allows the speed to become excessive when lowering tubing into the well. Speed variation on either the six-pole or twelve-pole connection is obtained by a drum controller and secondary resistance, giving a speed reduction of 50 per cent at full-load torque at either high speed or low speed, with ten points of control, all being running points. The resistors are specially designed for the heavy duty. The controller is installed near the motor and operated by a rope wheel from the "headache post" at the derrick.

An automatic device in the base of the controller, actuated by a coil in series with the primary circuit of the motor, prevents the controller from being moved past the fourth point until after the current has dropped below a predetermined value. An unskilled operator is thus prevented from abusing the equipment and is at the same time automatically taught to handle the controller in the proper manner to obtain the best results.

The motor is fully protected by a triple-pole oil circuit breaker equipped with automatic under-voltage release and two-coil series inverse- time-limit overload trip. The overload trip coils are double-wound in order to provide protection on both pumping and pulling duty. These coils are electrically interconnected with the pole-changing switch on the motor frame in such a manner that whenever the latter is thrown to either the high-speed or the low-speed position the coils are connected to trip the switch at an overload corresponding to the motor rating in use. This method of interlocking makes it impossible for the motor to be left without adequate protection, particularly when running unattended on low speed for pumping.


TWO-SPEED MOTOR, CONTROLLER AND RESISTANCE GRIDS MOUNTED ON SKIDS

Many of the installations in Kansas are equipped with an ammeter, mounted on the cover of the oil circuit breaker. This makes it easy, to counterbalance the well to give minimum fluctuations of input to the motor and also serves as in indication of the condition of the well when pumping. The ammeter is not in circuit when the motor is connected for high speed. A watt-hour meter is also installed at each well on most leases. This enables the operation of the well to be more closely watched from month to month.

The walking beam on the standard rig is actuated by a crank on the shaft of the band wheel, and the latter is belted directly to the engine when steam or gas is the motive power. With motor drive it is necessary, on account of the higher speed, to interpose a countershaft, which is usually installed where an engine would be placed. The motor is belted to the countershaft and is usually placed between the latter and the band wheel, so that both belts will pull in the same direction on the countershaft. This method cannot always be followed, however, when an engine is being replaced by a motor, as it is then necessary to make the complete electrical installation before the engine is shut down, so as to avoid loss in production by any unnecesary delay in changing over to electric operation. Generally the countershaft can be placed in front of or behind the engine pulley and the motor lined up to it from either the front or the rear, depending upon the space available and the amount of alteration necessary to the building. In California it is becoming the practice to install an engine temporarily on the derrick floor, or a back-geared motor near the band wheel, using a short belt, thus permitting the old engine to be entirely removed before the electrical equipment is put in place.

The control equipment is all mounted on a pipe or angle-iron framework, with the resistors inside the frame and the controller and an oil switch on the outside. This makes a neat and compact arrangement which is very readily accessible.

On the majority of wells the motor and the framework carrying the control equipment are mounted on skids consisting of two heavy timbers bolted together. The complete outfit is thus wired up at the shop and brought as a unit to the well, where it is a small matter to connect the incoming lines after the motor is lined up. This greatly facilitates the work of installation. Small concrete blocks are put in as supports for the skids, and a large block supports the countershaft.

The wiring is put in steel conduit throughout. The incoming lines first pass through a fused triple-pole lever switch which is used as a disconnecting switch and which is placed in a galvanized-steel cabinet that can be locked to prevent tampering. This cabinet is generally mounted on the wall, but it can be readily placed on the pipe framework with the other control apparatus.

It was mentioned in a foregoing paragraph that the wells are counterbalanced. This is accomplished by suspending a heavy weight, consisting of a box of scrap iron, broken concrete or rock, from an extension of the walking beam, this box being carried on the outer end of a heavy timber which has a fulcrum on a post in the ground. In Oklahoma an improved counterweight is now being introduced, this consisting of a concrete block supported from an extension of the crank end of the walking beam by an iron pipe hooked to an eye bolt imbedded in the concrete. The upper end is hooked to a stirrup hanging from the walking-beam extension.

TRANSFORMER BANK SERVING OIL-WELL HOUSE

Counterweights not only reduce the fluctuation of current input to the motor but actually reduce the kilowatt-hour consumption as much as 20 or 22 per cent.

Developing Electrically in England

"Electrical Development Association (Great Britain and Ireland)" Makes an Appeal on Social as Well as Economic Grounds for Installation of Electricity and Large Utilization of Appliances in Housing Projects

From James M. Wakeman, General Manager
Society for Electrical Development

REPLYING to the request made by the ELECTRICAL WORLD for comment upon the formation of the Electrical Development Association of Great Britain and Ireland: Some of the men whose names appear upon the executive committee of that association have for some time past been in communication with the Society for Electrical Development, Inc., of New York. Several months ago one of them asked for our booklets upon the "Aims and Achievements of the Society," "The Story of Electrical Prosperity Week," "How a Three-Billion-Dollar Industry Pulled Together in America's Electrical Week," and other pamphlets setting forth our activities.

More recently J. W. Beauchamp, their secretary, wrote: "You may be sure that my governing committee have been greatly stimulated by the work which your association has carried out in America, and it has been realized for a very long while that similar work should be undertaken in this country."

This correspondence shows that the British have been for some time past considering the advisability of carrying on in Great Britain the same kind of development work we have been employing for the past five years, and it is evident that as soon as the war ended they got busy.

I should like to point out the fact that the recognition by the electrical men of Great Britain of the advisability of such work in their country emphasizes the necessity of its continuance in the United States. Now more than ever before such coöperative work as that done by the society offers great assurance of profitable returns to live, wide-awake, progressive concerns that support and use the society.

Now more than ever before such work is needed to facilitate the extension of business and to develop a spirit of harmony and coöperation within the trade and toward the public. We are all interested in the cultivation of new fields of endeavor, the promotion of better business methods and the formation of correct public opinion.

I sincerely hope that both these organizations will receive the hearty support their constructive and progressive purpose merits.

IT IS usual for workers in the American electrical industry to be confident that new worlds to conquer for electrical application lie just ahead. There are additional or untried forms of application; there are large fields which are scarcely touched, as in railroad electrification. But while the new markets invite exploration there are still the old lines of activity, in which patient, untiring work yields sure results. It pays to remember that the saturation point has not been achieved in the districts reached by service lines or accessible by short extensions to such lines. Canvass among householders may not bring great returns for every ounce of effort, but it is still a road of expansion. It will add to the total number of customers and steadily to a more general use of appliances by those served. It means, furthermore, a strengthening of the position of the central-station company as the ideal economic producer of power for the entire community.

England's present position in electrical development is very different from that of this country, but its concern over unutilized opportunities is one of the most interesting events in a world-wide view of the industry. From whatever point the action of the British is regarded, it is one that promises better and more rapid electrical progress. It foreshadows increased use of electrical energy for lighting and power, broader markets for appliances, demand for apparatus and supplies to promote generation in larger units and distribution to the wider areas where electricity will be introduced. What is done in the British Isles will also be an educational stimulus to continental Europe and to the British colonies all over the world.

The work of the English Electrical Development Association follows in some respects the path of the earlier Society for Electrical Development of this country. It is especially illuminating to find the arguments advanced in the British Isles for the installation of electricity in housing prospects. What would be regarded in this country as elemental is considered of first importance in the "right tight little isles." Looking at the earnest determination with which the new English association attacks the question of electrification of homes, it is natural to recall earlier stages of the industry in this country. And this recollection leads to the suggestion advanced above, that there are still fertile fields for cultivation in this country, the value of which need not be miscalculated in order to be judged worthy of attention.

A review of publications of the Electrical Development Association (Great Britain and Ireland), of which J. W. Beauchamp, London, is director and secretary, shows that the social advantage of electricity in making happier homes is thoroughly realized by our English cousins. In a pamphlet on "Housing Construction and Electricity Supply" it is stated: "The demand for war workers in certain localities altered the distribution of the people, led to overcrowding and revealed the shortcomings and inconveniences of the average working-class house." And here is a reflection which leads to the recommendation that on any important building scheme the supply of electricity, as of water, should be made available before work is commenced:

"Impatience in regard to the progress of slum demolition and new construction is a contributory cause of unrest, and attention to this work, and particularly to the internal design and equipment of the new houses, is more likely to produce results quickly and assist in restoring contentment and productivity than many of the other schemes of social reform to which so much time is being devoted."

"Artificial light and mechanical power" are suggested in a way which reads strangely to one used to the wholesale adaptation of electricity where labor can be saved or time economized in this country.

Says the English association:

> Where electricity can be obtained for artificial lighting no other system is likely to be adopted, and its influence upon design should be taken advantage of. With this illuminant some reduction may be made in the height of rooms, and consequently in the cost of construction; lamps may be fixed close to the ceilings and advantage taken of their reflecting character to reduce expenditure upon shades and fittings; lighting and extinguishing from any convenient point or several points can be effected, and the provision of small power lamps over fireplaces, sinks and in other positions where household work is carried on makes for convenience, helps to reduce accidents and breakages and simplifies the task of the architect by providing him with a means of lighting which entails no special provision for ventilation, can be used in close proximity to ceilings and walls, is available in any power from a pilot light upward, can be operated from a distance, does not introduce the use of matches, flame or the risk of dirt inseparable from any other illuminant. . . .
>
> The necessary ventilation can be provided more scientifically and more cheaply when buildings are being constructed, and if in some of these small rooms the fireplaces and chimney breast were omitted, the reduction in the cost of construction would be considerable, in some cases sufficient to pay for the whole of the electrical equipment. There appears to be a case for constructing houses of this class without fireplaces excepting in the main living and cooking rooms. These may be provided with stoves adapted to consume coal, coke and refuse and combined with the hot-water system of the house. If such appliances are properly installed and associated with electric cooking ranges, while some of the other rooms are permanently fitted with electric heating, the remainder being equipped with plugs so that portable electric fires can be used in them, the result is a dwelling with many labor-saving features, one in which the cost of maintenance and decoration will be low, the occupants' furnishings will be preserved and the housework reduced in every possible way.

E.D.A.

J. W. Beauchamp,
Director and Secretary

THE ELECTRICAL DEVELOPMENT ASSOCIATION.
(Great Britain and Ireland.)

Associations of Supply, Manufacturing, and Contracting Interests
represented on Managing Committee.

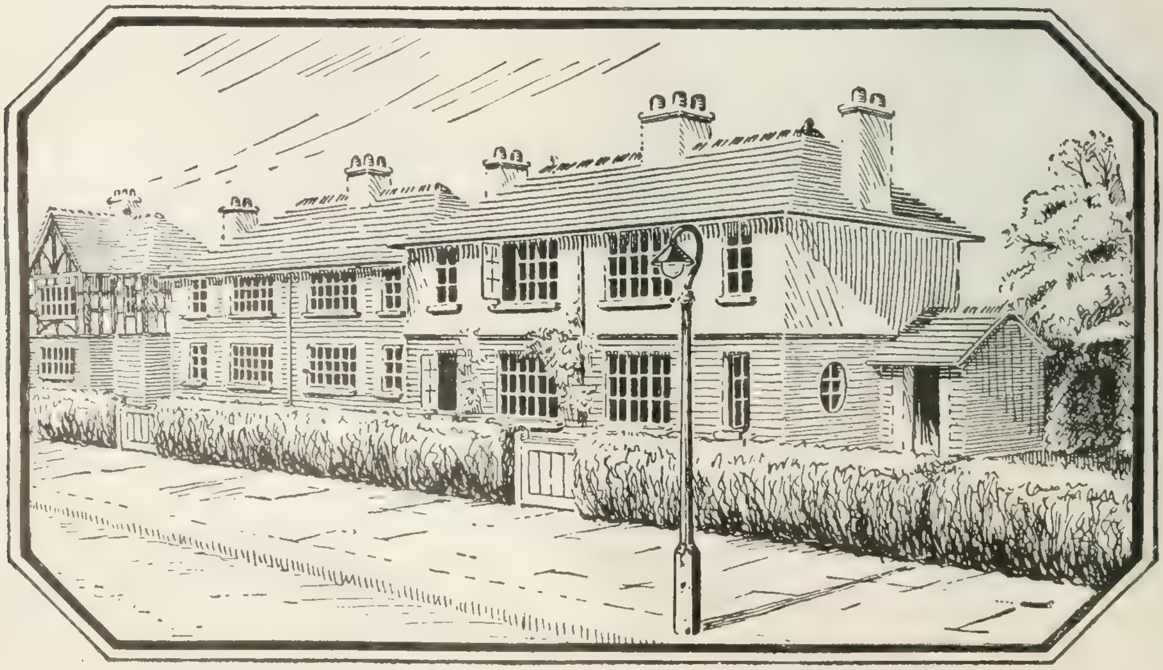
The Institution of Electrical Engineers.

The Incorporated Municipal Electrical Association.
The Conference of Chief Officials of London Electric Supply Companies.
The Incorporated Association of Electric Power Companies.

The British Electrical and Allied Manufacturers' Association, Inc.
The Electrical Contractors' Association
The Cable Makers' Association
The Electric Lamp Manufacturers Association.

In one letter the association outlines its representation of the three sections of the industry, "Supply, manufacturing and contracting." It shows the need of a coöperative movement in an argument similar to that which is advanced in this country for coördination of the industry.

"Urgent questions lie before the industry in regard to reducing the cost of installation and apparatus, simplifying mains and service work, and exploring the possibilities of new methods and amended regulations," the association says. "These essential objects will follow more rapidly from intensified demand for electricity supply than any other cause, and money spent on cultivating new and additional business cannot fail to react to the advantage of the industry and of the consumers, by stimulating the development of new methods and designs and assisting in standardization of apparatus and production in bulk, which is needed to meet the increase in cost of all classes of electrical work."



STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

SUBMERGED TURBINE BEARINGS LUBRICATED FROM MAIN FLOOR

The Installation of a Grease Gun System of Piping Prevents Premature Wear and Breakdown in the Gate Rigging

In order to reduce wear on the bearings of reach rods and operating rods of the double-runner water turbine, at the Holtwood plant of the Pennsylvania Water & Power Company, which are submerged and inaccessible, a grease gun with a system of piping was designed so that grease could be forced from the gun barrel (situated on the generator floor) through piping to the submerged bearings. This arrangement of piping solved the problem of keeping these bearings properly lubricated and preventing premature wear and breakdown in the gate rigging.

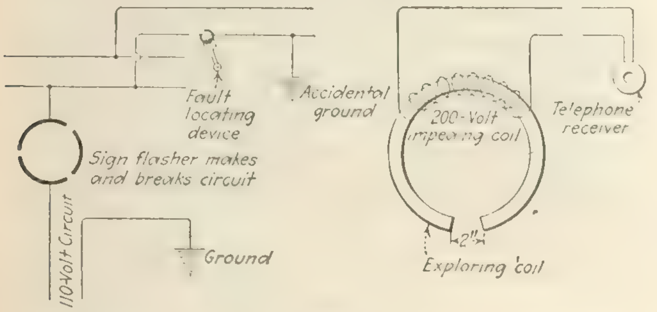
All previous efforts and devices to keep submerged bearings lubricated at this station had been unsuccessful. Corrosion had been rapid and the attendant increase in maintenance was considerable. All units with submerged bearings are now equipped with grease guns. N. B. Higgins.

Baltimore, Md.

METHOD OF LOCATING GROUND ON A DISTRIBUTION SYSTEM

A Home Made Device that Can Be Conveniently Used by Line Men in Locating Ground on Overhead Lines

The accompanying illustration shows the method used by a Southern company by which an ordinary sign flasher can be used to produce an audible signal that will aid line men by means of an exploring coil to locate grounds on overhead lines. The flasher is connected to a 110-volt circuit with one side of the circuit grounded. The line man then goes over the system, starting from the power station, and explores the lines with a small exploring coil and telephone receiver. By means of this exploring coil, the make and break of the circuit by the flasher can be distinctly heard up to the point where the line is grounded. Beyond that point no sound is heard. In this way, the actual ground can be easily located.



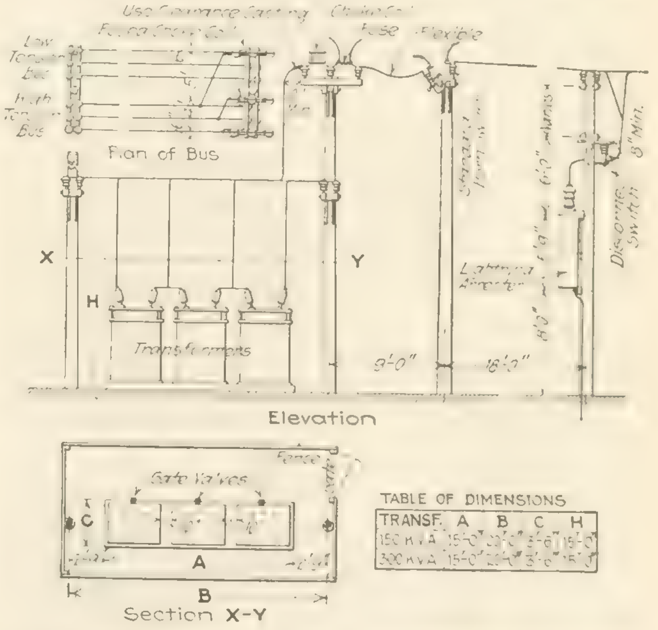
PRINCIPLE OF GROUND DETECTING DEVICE AND METHOD OF USING

The exploring coil used in this case was a home-made one, consisting of an old arc-lamp reactance with a section sawed out about 2 in. wide. On this coil a 200-volt impeding coil from an old Fort Wayne wattmeter was inserted, with the terminus connected to a watch case telephone receiver.

STANDARDIZED LAYOUT FOR OUTDOOR SUBSTATIONS

Used for Serving Industrial Plants when Various Sizes of Transformers Are Needed—Apparatus Arranged in Units

Replacement of any part of the standard outdoor transformer substations installed by the West Penn Power Company of Pittsburgh, Pa., is possible without interfering with the rest of the layout. Sometimes during the life of a station, according to A. W. Cartwright, superintendent of construction, new conditions develop which require additions or a change of location not foreseen at the time of the original installation. With the arrangement shown changes can be made without an entire redesign of the station.



STANDARD 25,000 VOLT OUTDOOR TRANSFORMER SUBSTATION

The standard layout involves three poles which support the apparatus. On one, which also serves as a support for the high and low-tension buses, are installed a choke coil and a fused horn gap. From these wires run to a standard horn switch on a second pole and from there circuits lead to a third pole which supports the lightning arrestor.

GROUNDING SPECIFICATIONS FOR DISTRIBUTING CIRCUITS

Methods of Making Grounds on Alternating-Current Distribution Circuits Not Exceeding 250 Volts to Ground

Specifications based on the requirements of the National Board of Fire Underwriters have been drafted by the Carolina Power & Light Company and the Yadkin River Power Company to cover grounding of alternating-current distribution circuits operating at not more than 250 volts to ground. Some of these specifications given by L. V. Sutton follow:

Ground connections of overhead circuits should be at line poles, and one such connection should be made at the pole next to the transformer pole. Where this is not practicable connections may be made to service loops, in which case a separate ground connection should be placed upon each service.

Ground connections for lightning arrestors which will be on transformer pole should be installed and maintained separate from those for secondary distributing circuits. Transformer tanks should not be grounded.

Ground wires should be of copper and not smaller than No. 6 B. & S. gage and should be larger than No. 6 when the grounded feeder is larger. Ground wires on poles should be protected by wood molding or other permanent insulating covering throughout their entire length.

The only thoroughly reliable ground connection is to metallic pipes of an extensive water-supply system.

Ground connections, when underground, must not be made to heating or refrigerating systems or pipes other than water pipes. Inside buildings such pipes may be used when they constitute parts of complete metallic systems of piping which in turn connect directly to water-piping systems. Ground connections must never be made to gas pipes.

Connections to pipes within buildings may be made with any form of grounding clamp meeting the requirements of the National Electrical Code, but care must be taken that such connections are made outside of meters. The connection to underground water pipes should be made by sweating the ground wire into a lug attached to an approved type of clamp and by firmly bolting the clamp to the pipe after all scale and rust had been removed; or connection may also be made by soldering the ground connection into a brass plug, which is tightly screwed into the pipe. When pipes can be drained the connection may be made by serving or wrapping the wire securely around the pipe and soldering. The joint should be painted with acid-proof paint.

Ground connections should always be made to water-piping system when the nearest available water pipe is not more than 100 ft. (30 m.) distant, except where it would be necessary to tear up cement pavement, etc., to reach the pipe. In addition to this ground connection, a single-pipe ground should be made at the foot of the pole and both grounds connected in multiple.

In making a pipe ground use a 1-in. (25-mm.) galvanized-iron pipe 8 ft. (2.5 m.) long, driving its full length into the ground. A 2-ft. (0.6-m.) length of tile should be placed around pipe flush with surface of the ground. This tile should be kept filled to within an inch or so of the top with salt crystals.

Two 8-ft. (2.5-m.) pipe grounds should be installed at all places where ground connection cannot be made to water-piping system or a ground to permanent water depth installed. When installing the two pipe grounds one pipe should be located near the molding on the pole and the other pipe on the opposite side of pole, at least 5 ft. (1.5 m.) distant from the first ground if practicable. Both grounds should be set in tile and treated with salt.

In connecting a ground wire to a driven pipe ground use a standard ground cap that will screw on the end of the pipe and which has a small cup on its side in which the wire can be soldered If such a cap is not available, push a cork stopper or small wad of waste about 3 in. (7.5 cm.) down the pipe, scrape bare the end of the ground wire, double it back and insert it in the end of the pipe, and then fill the end of the pipe with solder.

Where secondary lines exceed 500 ft. (150 m.) in length a ground should be made every 500 ft, except in cases where the secondary is on the same street with the street railway, when but one ground should be made, this being situated at the pole next to the transformer pole. The ground must be made on the neutral wherever a neutral is accessible, otherwise one side of the secondary circuit must be grounded.

PREVENTING FUEL LOSSES DUE TO FAULTY INSULATION

Chart Shows Heat Loss Through Insulated and Non-Insulated Walls—Sixty Per cent of Heat Loss Is Preventable

Losses due to radiaton from boiler settings often greatly reduce economy in steam power generation. It is rather difficult to estimate the exact heat losses due to faulty insulation, owing to the fact that changes therein are seldom made without remodeling the entire furnace construction. When the Universal Gas and Electrical Company of San Francisco for instance, insulated their boilers, they replaced their oil burners and made other changes at about the same time. Accordingly it is impossible to determine exactly what proportion of the fuel saving effected was directly due to better

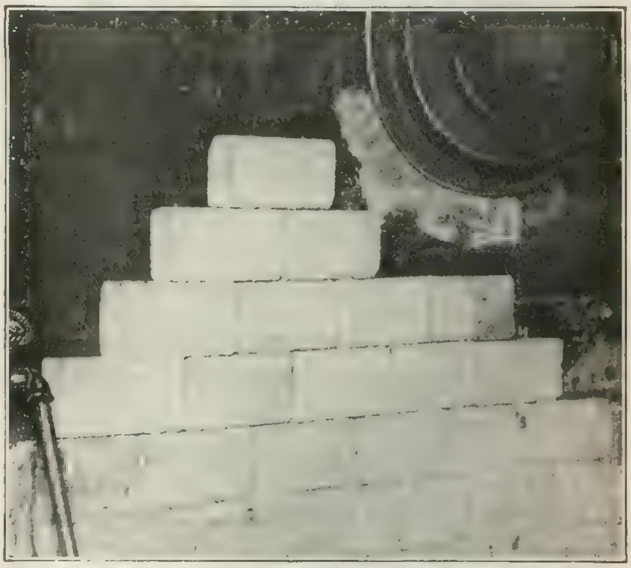


FIG. 1—SECTION OF BOILER SETTING BEING COVERED WITH INSULATING BRICK

DIAGRAM SHOWING HEAT FLOW, TEMPERATURE GRADIENTS AND FUEL LOSS IN UNINSULATED AND INSULATED FURNACE WALLS

Fuel Losses per 1000 Sq.Ft. per Hr. of Radiating Surface

Wall	Fuel	Loss per 1000 Sq.ft. per Hr., B.t.u.	Lbs Coal Loss per 1000 Sq.ft.	Gals Oil Loss per 1000 Sq.ft.	Cu.Ft. Gas Loss per 1000 Sq.ft.	Calorific Value
Uninsulated	Coal	840,000	70			12,000 B.t.u. per lb.
Insulated	Coal	314,000	26		. .	12,000 B.t.u. per lb.
Uninsulated...	Oil	840,000	..	5.8	..	145,000 B.t.u. per gal.
Insulated. .	Oil	314,000	.	2.2	. .	145,000 B.t.u. per gal.
Uninsulated	Gas	840,000		.	1400	600 B.t.u. per cu.ft.
Insulated.....	Gas	314,000			523	600 B.t.u. per cu.ft.

insulation. Proper insulation of boiler walls, however, will eliminate, it is estimated, at least sixty percent of the preventable heat losses through boiler walls. It is possible to calculate exactly what heat loss is incurred through insulated and non-insulated walls as shown in the accompanying chart and table. Where the loss of 840,000 B.t.u. (96,000 Cal. per kg.) is recorded through the non-insulated setting, this was reduced to 314,000 B.t.u. (36,000 Cal. per kg.) with adequate insulation. This represents a saving of 44,000 lb. (20,000 kg.) of coal, 3600 gal. (13,500 l.) of fuel oil or 877,000 cu.ft. (25,000 cu. m.) of gas per unit of radiating surface.

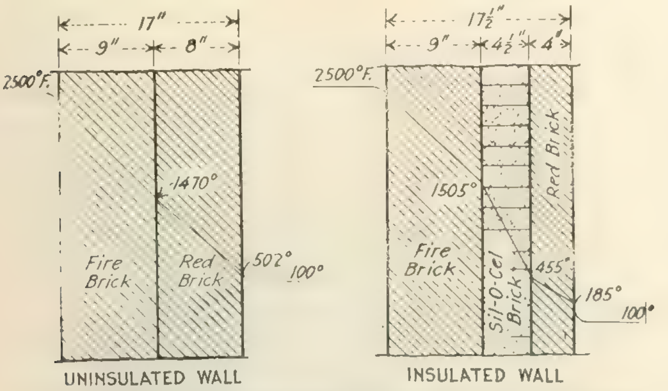
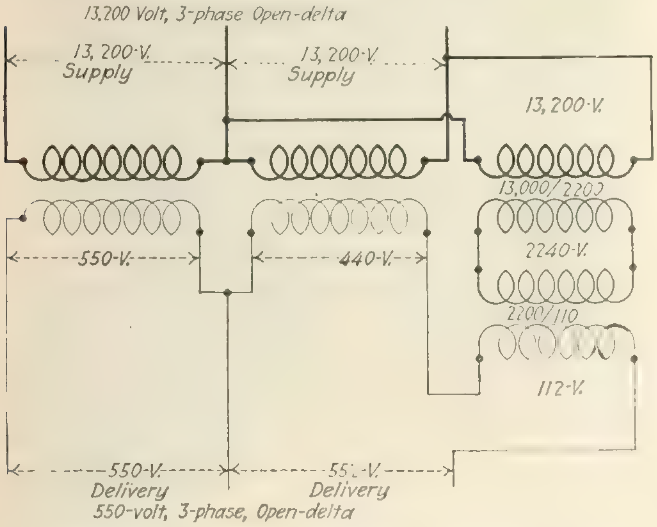


FIG. V—CHART FOR DETERMINING HEAT LOSS IN INSULATED AND NON-INSULATED WALLS

EMERGENCY CONNECTION FOR COTTON MILL TRANSFORMERS

How Three Odd Voltage Transformers Were Successfully Connected to Carry an Emergency 3-phase Load of 600 kw. at a Cotton Mill

On one occasion, when a southern central station company was called upon to furnish emergency service for a 600-kw. load to a cotton mill during the war, a problem was solved in an interesting manner with three transformers of different voltages. On account of the urgency of the connection and the impossibility of securing new transformers to carry the load within the time required, an inspection was made of the windings of three transformers which were of different voltage ratings, in order to determine the possibility of adapting the windings to an emergency connection. It was found that one of the transformers was provided with 110-volt taps on the secondary side, while the secondary voltages of the other two transformers were 440 and 550, as shown in the accompanying illustration. By connecting the 110-volt secondary of one transformer in series with the 440-volt secondary so as to boost the voltage, it was possible to secure a voltage on the secondary side of approximately 550 volts, which was satisfactory for the mill service. The diagram of connections as made in this emergency is shown in the accompanying illustration.

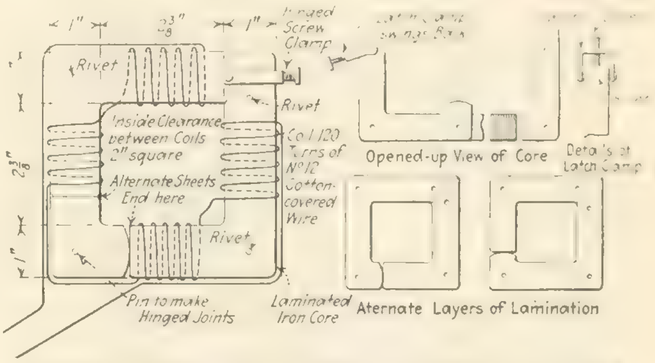


THREE ODD-VOLTAGE TRANSFORMERS CONNECTED TO GIVE APPROXIMATELY BALANCED THREE-PHASE CONDITIONS

CURRENT TRANSFORMER FOR TESTING OF CABLES

Simple and Fairly Accurate Instrument Which Can Be Used Without Taking the Distribution Feeder Out of Service

So many advantages are obtained by testing apparatus or circuits without taking them out of service that any method for doing this that can be devised is usually worth while. The split-core transformer shown herewith enables this to be done. The important point in its construction being to obtain cleanly mortised joints where the core opens, in order to secure a good magnetic circuit. Low reluctance is a requisite of the current transformer core. While the home-made transformer will not have the accuracy of the manufactured transformer, it will be inexpensive, it will be accurate enough for all the purposes of the troubleman, and it may be made in any size desired.


1"
2⅜"
1"
Hinged Screw Clamp
Rivet
Rivet
Inside Clearance between Coils 2" square
Coil 120 Turns of No. 12 Cotton-covered Wire
Alternate Sheets End here
Rivet
2⅜"
1"
Pin to make Hinged Joints
Laminated Iron Core
Opened-up View of Core
Details of Latch Clamp
Aternate Layers of Lamination

PORTABLE CURRENT TRANSFORMER FOR TESTING FOR CABLE FAULTS WITHOUT DE-ENERGIZING CIRCUIT

In the figure a convenient size of split-core transformer is shown. It consists of a hinged laminated iron core and one winding. The core has a cross-section of 1 sq.in. (6.5 sq.cm.) and is made up of varnished sheet iron. One corner of the core is hinged, the diagonal corner opening and being fastened by a screw clamp slotted into the core. The winding consists of one layer of No. 12 B. & S. gage cotton-covered copper wire. A layer of tape over the core separates the winding from the iron, and several layers of tape insulate the winding on the outside. The whole transformer is a little more than 6 in. (15 cm.) square.

The ammeter and its leads used with the transformer must be calibrated with it. If there are no laboratory facilities available to do this, the percentage of error of the device may be obtained by clamping the transformer on different conductors each carrying a known current. This factor may be used as a constant by which to multiply the readings of the ammeter.

Philadelphia, Pa. FRANK GILLOOLY.

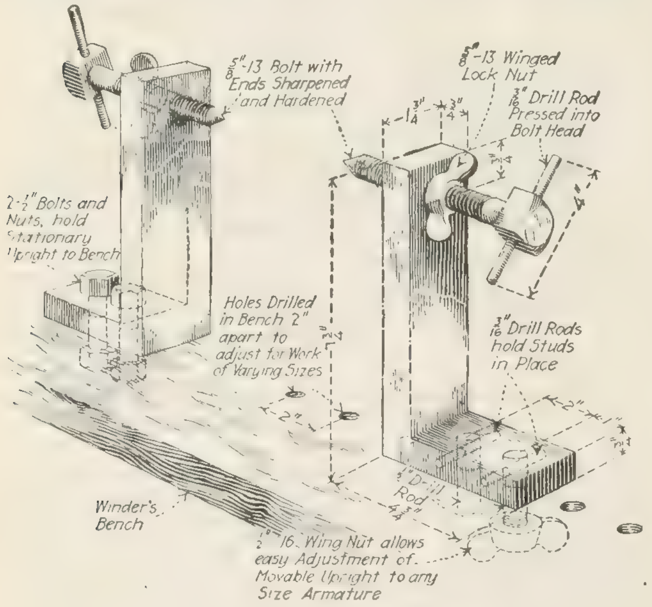
INDUSTRIAL APPLICATIONS

The Economical Utilization of Electrical Energy in Mills and Factories,
Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

ADJUSTABLE ARMATURE STAND FOR LARGE REPAIR SHOP

Is Set on Each Winder's Bench to Be Used for Holding Armatures of Motors Rated at 5 Hp. Down to the Size Used in Fan Motors

For supporting small armatures that are to be wound and tested, a large repair shop in the east has provided adjustable bench stands for each of its workmen. The support consists of two ¾ in. by 1¾ in. (2 cm. by 4.5 cm.) pieces of cold rolled steel, one piece being fastened permanently to the bench and the other piece being movable. The accompanying illustration shows the positions of the fixed piece and the movable one. The two are identical with the exception that the movable piece is provided with two ½-in. (1.3 cm.) studs, one of which is threaded on the end, and which projects about ⅜ in. (1 cm.) below. A wing nut permits the easy shifting of the stand.



⅝"-13 Bolt with Ends Sharpened and Hardened
⅝"-13 Winged Lock Nut
1¾"
¾"
3/16" Drill Rod Pressed into Bolt Head
2-½" Bolts and Nuts, hold Stationary Upright to Bench
Holes Drilled in Bench 2" apart to adjust for Work of Varying Sizes
3/16" Drill Rods hold Studs in Place
2"
2"
¾" Drill Rod
4¾"
Winder's Bench
½"-16 Wing Nut allows easy Adjustment of Movable Upright to any Size Armature

ADJUSTABLE STAND FOR SMALL ARMATURES

The left-hand upright is fastened to the bench permanently. To the right of it is a series of $\frac{9}{16}$-in. (14 mm.) holes 2 in. (5 cm.) between centers for attaching the right-hand upright. Enough holes are drilled to accommodate armatures with shafts from 2 in. to 24 in. (5 cm. to 60 cm.) in length. Two hexagon head ⅝-in. (16-mm.) machine screws with cone points support various lengths of shafts between the uprights. The ends of the bolts are ground to shape and hardened; a piece of $\frac{3}{16}$-in. (5-mm.) round cold-rolled steel about 4 in. (10 cm.) long is put through the head of the bolt to serve as a handle. The two ⅝-in. (16 mm.) wings nuts are used as lock nuts to prevent the centre bolts from loosening.

This stand will accommodate armatures from motors rated at 5 hp. down to armatures such as used in fan motors.

New York, N. Y. **C. A. Johnson.**

PORTABLE-TESTING OUTFIT USED IN POWER SURVEY

By Its Use, the Motor-Rating of One Factory Has Been Decreased by 150 Hp.—Dummy Fuses Facilitate Connection of Meters in the Line

Because the Robbins & Myers Company manufactures motors it has been very easy for the operating departments to become over-motored, particularly during the war period when machines were running night and day at top speed and there was no time to question what size motor was best adapted to a particular drive. At that time it was considered good policy, in view of the fact that new machinery was being purchased wherever it could be found, to put on each line shaft a motor large enough to take care of any probable future growth. When the armistice was signed, however, and the necessity for high-speed production became less, the load also became less with the result that the power factor of the entire plant was reduced considerably. Obviously the remedy for low power factor was to reduce the connected horsepower, so tests upon each motor were made in order that all machines be correctly motored. Smaller ones could be installed if needed or they could be re-arranged to operate to the best advantage.

The instruments available for the testing consisted of a portable recording wattmeter, a portable recording power-factor meter, an ammeter with 5-amp. scale, a voltmeter and a tachometer. In addition there were three instrument transformers each with ratios of 100, 50 and 25 to 5 amps. These were connected to the motor line through leads terminating in switchboard plugs. The transformer secondaries are connected—the two outside ones—to the current coils of the wattmeter and the middle one to the ammeter and to the current coil of the power-factor meter, which are in series. In these circuits are placed "broken-back" switches which allow the measuring of current in any phase without opening the secondaries. It was found necessary to meter each phase because the voltage was slightly unbalanced and reading the power-factor meter would be incorrect. By measuring the power-factor of all of the three phases and averaging the readings the true power-factor was obtained. In front of the transformers is a heavy protecting switch and a set of fuses connected so that the fuses are always in circuit whether the switch is open or closed. The portable meters rest on a pad of ¾-in. (1.9 cm.) felt, the combination being mounted on a rolling meter table with swiveled, rubber-tired wheels. Nearly all connections are back of the board.

For connecting the current coils of the meter in the line dummy fuses are used. In each end of them are tapered holes reamed to receive the switchboard plugs. With this arrangment it is a very simple matter to connect the meter leads to any size of dummy fuse, to take out one running fuse at a time from a motor circuit and to slip the dummy in its place. For convenience, and to avoid mistakes, the wooden handles of the switchboard plugs are painted different colors for "line" and "load" so that the wattmeter connections are always correct.

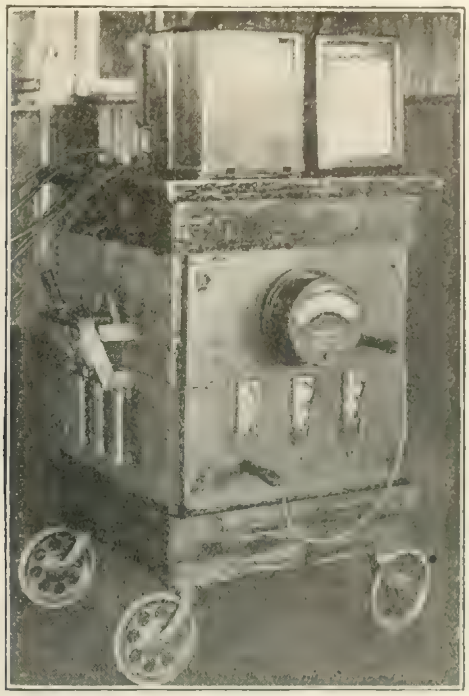


FIG. 1—PORTABLE CART CARRIES METERS AND INSTRUMENT TRANSFORMERS

Potential leads of power-factor meter have test clips attached so that they may be changed to make the meter read correctly. The meter rests on a ⅜-in. felt pad.

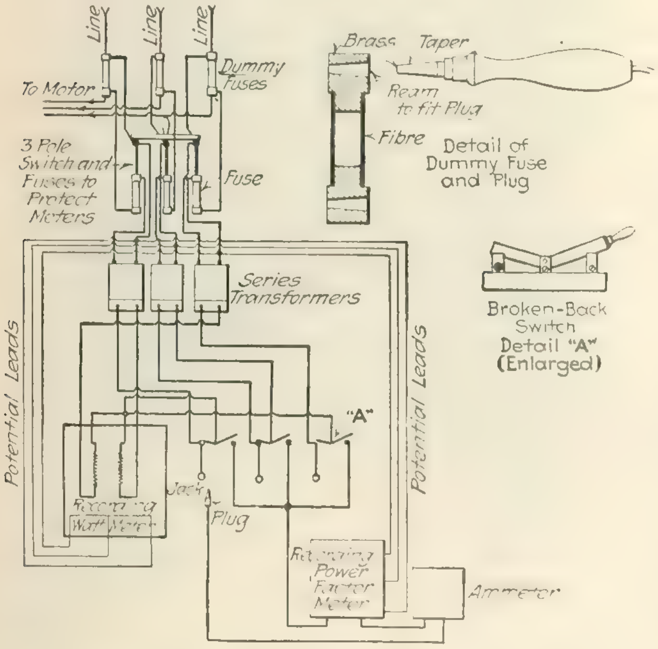


FIG. 2—WIRING DIAGRAM OF METERS AND TRANSFORMERS ON PUSH-CART

No data is available at this time upon the savings effected because the work is not completed but it has been possible to eliminate more than 150 connected horsepower in the first few months of the test despite increasing power requirements due to greatly increased production. As a matter of fact, production is on the increase and the changing of the motors and fitting them to their loads is responsible for the fact that the power bill has increased only slightly.

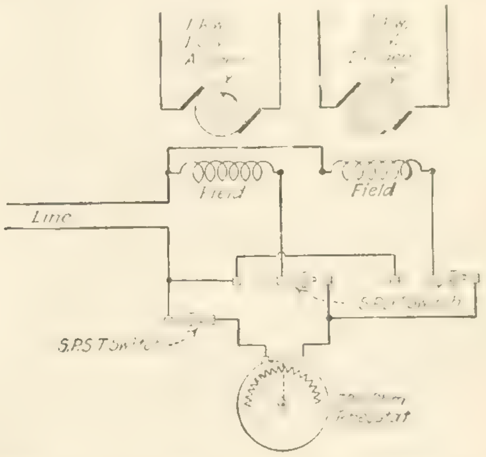
THE ROBBINS & MYERS CO., R. F. MCNETT,
Springfield, Ohio. Supervisor of Power.

ONE RHEOSTAT USED FOR TWO GENERATOR FIELDS

It Is Employed to Regulate Voltage of Both a 1-kw. 110-Volt Alternator and a ½-kw. 12-Volt Direct-Current Generator

In a motor repair shop located in a 110-240-volt direct-current district a 1-kw. 110-volt alternating current generator and a ½-kw. 12-volt direct-current generator have been installed for testing the repaired motors. As both machines are not used simultaneously one rheostat is employed to regulate the voltage of both machines. The generators are attached mechanically to the main power shaft of the shop. The field of either machine may be connected to this 300-ohm resistance or directly to the line by switches as shown in the diagram. The voltage may be varied from 110 volts to 50 volts alternating current and from 12 volts to 5 volts direct current. The actual connections in the shop differ from those shown here in that flexible leads are used in place of the single-pole double-throw switches.

Chicago, Ill. C. W. GODING.



SWITCHING THAT PERMITS USING ONE RHEOSTAT FOR TWO GENERATORS

COAL-BRIDGE TROLLEY RE-DESIGNED IN FIELD

Heavy Current Burnt Hub of Skeleton Trolley Wheels Supplied with Bridge so Solid Wheels with Brush Contacts Were Made on the Job

The current for a 9-ton coal-handling bridge operated by the Calumet & Hecla Mining Company was originally collected by two skeleton trolley wheels, but the current in passing to the shaft around which the trolley wheels rotated burned the hubs seriously.

This was caused by the fact that severe service had caused excessive play between the bushing and trolley pin, allowing the formation of arcs. With 800 amp. and a potential of 550 volts the arcing pitted the hubs of the trolley wheels so severely that the bridge had to be taken out of service.

SUBSTANTIAL TYPE OF COAL-BRIDGE TROLLEY HARP MADE IN THE FIELD

The new trolleys which were designed on the job to meet the requirements of the service, are of cast gun metal with graphite bushings. Solid construction instead of the skeleton form previously used was employed and metal brushes used to collect the current instead of allowing the current to flow from the bushing to the shaft.

Although the new two-wheel trolley harp weighs more and costs more than the one which was furnished with the bridge, the homemade outfit is considered to be more economical.

Fred. E. Therrein,
Lake Linden, Mich. Chief Electrician.

MEASURING ENERGY WITHOUT TAPPING LINE

Using Main Cable as Ammeter Shunt Obviates Necessity of Interrupting Production when Motor Tests Are to Be Made

Usually when motor tests are to be made in industrial plants production must be stopped until an ammeter or wattmeter is inserted in the line. Various methods have been devised for minimizing this loss such as the use of dummy fuses, but each method usually entails some interruption of the work. Such delaying of work has been completely avoided in one industrial plant by using a millivoltmeter to measure the current. Instead of opening the circuit to insert the meter, the cable to the motor is utilized as a shunt for the millivoltmeter.

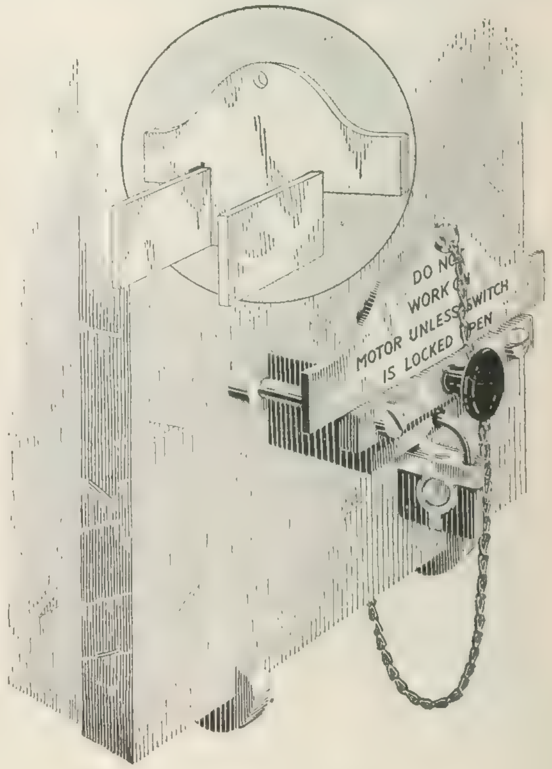
Since the load was known to be about 400 amperes and the available meter (100-millivolt scale) was most accurate near the center of the scale, it was decided to make the length of the cable shunt such that a current of 1000 amp. would cause a full-scale deflection (100 millivolts). This length was calculated from the knowledge that the resistance of the cable [500,000 circ.mil. (253.5 sq.mm.) stranded copper] is 0.0222 ohm per 1000 ft. (0.0728 ohm per km.) at a temperature of about 100 deg. Fahr. (40 deg. C.). In other words to produce full-scale deflection (100 millivolts) with 1000 amp. a shunt resistance of 0.0001 ohm was necessary, or 4.5 ft. (1.4 m.) of cable. The insulation was then removed at points 4.5 ft. apart and the exact distance marked lightly on the conductor with a file. To take readings the meter leads were touched to these two points and the millivolt scale multiplied by 10 to obtain the current.

The accuracy of this method depends upon the temperature of the cable to a great extent, but where a motor is operating continuously the temperature will be fairly uniform. Five degrees Fahr. (2.8 deg. C.) increase in temperature will increase the resistance and the reading 1 per cent approximately.

SAFETY-SWITCH BLOCK PREVENTS MOTOR STARTING

Locking Aluminum Block in Switch Handle Prevents Accidental Closing of Circuit on Which Men Are Working

For the protection of men working on connected motors and lines, an aluminum switch block is being used in the factory of the American Can Company at Chicago. This device is applied to the safety switch of the type having a pull handle fastened to two small iron rods which slide through the face of the switch box. When the block is locked in place the switch cannot be closed. The usual procedure is to have the foreman insert the padlock and to keep the key. Only when he is assured that all men are off the line can the switch be closed. To prevent loss of the block a chain fastens the block to the switch box.



ALUMINUM BLOCK HOLDS SWITCH OPEN

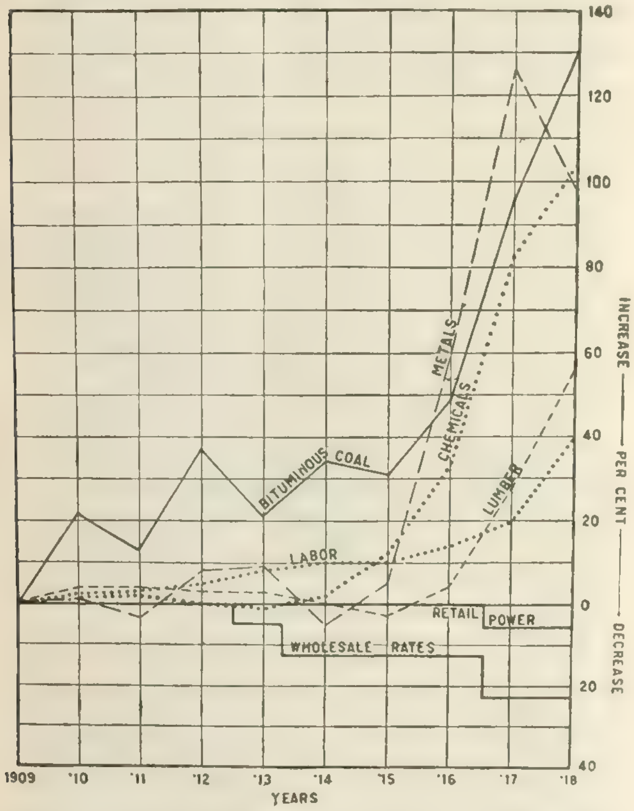
CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Methods for Increasing the Use of Electric Light, Power and Heat

ELECTRIC POWER COST VERSUS COST OF OTHER COMMODITIES

Increased Cost of Factory Materials and Labor Contrasted with Decreased Cost of Central Station Power For Last Ten Years

The decrease in the cost of central-station power since 1909, while prices of practically all other commodities have increased tremendously is shown in the accompanying curves. Even during the World War the power rates were low. Although these curves include only to the end of 1918, power rates have not been raised in many places, although the cost of everything else has increased since that time.



COST OF FACTORY MATERIALS AND COST OF ELECTRICITY

The factors which made these reductions possible are a gradual improvement of load factor, an increasing volume of business, increased efficiency in generating equipment, and an increase in the density of power users. These same influences are still in operation. Although no one can tell how long they will offset the increase in cost of labor and materials necessary for producing central-station power, they will still continue to keep the cost of power low compared with practically all other commodities.

The curves were prepared from government data by George H. Jones, power engineer of the Commonwealth Edison Company, Chicago, and were presented in a paper read before a joint meeting of the American Institute of Electrical Engineers, the electrical section of the Western Society of Engineers, and the Illuminating Engineering Society in Chicago, Nov. 24, 1919.

FLAT RATES DEFENDED IN CAPE COD HEARING

Central Station Customers Vote Against Establishment of Steam Reserve Plant at Higher Rates

Details of Increased Cost

The Buzzards Bay Electric Company, Falmouth, Mass., serves the major portion of Cape Cod south of the Cape Cod Canal, purchasing energy at the Canal from the Southeastern Massachusetts Electric Company, which in turn buys electricity from the New Bedford Gas & Edison Light Company.

During June to September, inclusive, the rate for power, heating and cooking service is 35 cents per kw-hour, and for the balance of the year a discount of 40 per cent is applied, the peak load of the system coming in August. A 5 per cent discount is allowed for 10-day payment, and there is a minimum seasonal charge of $9 which must be paid before service is supplied. Residence lighting is supplied on a flat rate throughout the territory, which covers nearly as large an area as that served by the Boston Edison company. The commercial lighting rates are based on a charge of $1 per month for the first 25-watt unit connected, 80 cents per month for the second, and 60 cents per month for each additional unit of this size, residential capacity being figured at not less than 75 watts or less than one-third of the total watts connected; hotels and boarding houses at not less than two-thirds the connected wattage, and stores and shops at 100 per cent of the connected lighting load.

The company's rates and efforts to provide satisfactory service were defended at a hearing in Falmouth recently by Eugene Carpenter, the treasurer, before the Massachusetts Gas and Electric Light Commission. Considerable dissatisfaction was expressed relative to interruptions of service and various speakers urged that a meter system be installed for commercial lighting users. A circular letter was sent some weeks ago to all customers, offering to establish an immediately available steam reserve service at its 950-kw. Falmouth station, at present shut down, if the patrons were willing to accept a discount of 10 per cent instead of 40 per cent on their bills for the eight non-summer months of the year.

The replies indicated that only 6.5 per cent desired to have the Falmouth steam plant started to float on the system or be held in immediate readiness for service; 8 per cent were undecided or would not object to a cut in the discount for this purpose, and 85.5 per cent preferred to continue the present rate without putting the Falmouth plant into commission for emergency use.

On behalf of the company it was brought out that many of the interruptions complained of would be eliminated in future by the recent installation of a third 2300-volt submarine cable at the canal crossing, and by increasing the distance between the line wires and the steel towers on the line between New Bedford and the canal district. Plans are also afoot for the sectionalization of portions of the line traversing the Cape south of the canal, to permit segregation of trouble.

Costs of Line Material

An interesting tabulation of the increased cost of line material met by the company between 1912-13 and the present time was presented by Mr. Carpenter, who said in part:

> To give an idea of some of the adverse conditions which vitally affected our business we submit a table of 15 items which we use in quite large quantities in making extensions, connecting customers, etc. It will be noted in the total that the present prices (and this does not take into consideration the much higher prices that we were obliged to pay during the war) are 108% more than they were in 1912-13. Present freight rates are more than double.

	Cost 1912-13	Now
35-ft. chestnut poles	$5.25	$11.75
30-ft. chestnut poles	4.00	8.00
Copper wire per 100 lb	15.80	32.25
No. 44 insulators, each	.0368	.1300
Strain insulators, each	.1000	.1565
Cross arm braces	.1908	.3651
Anchor rods	.2148	.4866
12-in. through bolts, each	.0458	.1185
14-in. through bolts, each	.0540	.1323
16-in. through bolts, each	.0851	.1460
Galvanized square washers, each	.0117	.1214
Galvanized pole steps, each	.0357	.0727
Galvanized house brackets, each	.0850	.1900
Galvanized stranded guy wire per 100 ft.	.0780	.1875
Locust pins, each	.0220	.0500
	$26.0097	$54.1566

In explanation of the difficulties the company is laboring under in its thinly settled territory, Mr. Carpenter said that the war had brought about a shortage of labor available for transmission line maintenance, and the cost of coal delivered to the company at tidewater on Vineyard Sound had risen from $6.64 to $12.50, with no immediate prospect of any marked reduction. The energy now purchased indirectly from New Bedford costs the Buzzards Bay company about 2 cents per kw.-hr., and about 2,000,000 kw.-hr. will be absorbed at the canal metering point this year. Conditions have now improved in regard to inspection and many of the difficulties encountered over 90 miles of line have been eliminated. Mr. Carpenter said it would cost over $30,000 to install meters throughout the system. About three-eighths of the customers are summer visitors. Last August there were 2751 customers. The gross earnings are $104,760, of which commercial lighting represents $83,077; street lighting, $14,023; and power, $7659. In the course of his statement Mr. Carpenter said:

"Electric service is a highly organized business, differing from any other that we know of in that the demands of the customers are manufactured and supplied instant by instant. This we believe is so in no other line of business; we must wait our turn at stores; we wait for a train, then if it be late we must wait until it has made up its lost time. We wait for our mail; we must wait for the operator and a free line when we telephone; but an electric customer throws in his switch at any minute, night or day, and any day in the month and he must be served with anything that he wishes instantly or our service has failed, at least in part, and we certainly have always endeavored to keep these failures at the minimum point."

The board took the case under advisement.

ELECTRIC REFRIGERATORS AS NUMEROUS AS PIANOS

Central-Station Man Foresees the Day When a Motor-Driven Refrigerator Will Be in Almost Every Home

Central-station men who have been interested in the many attempts to develop motor-driven refrigerators will be interested in the following letter from Robert Montgomery, commercial manager of the Louisville (Ky.) Gas & Electric Company:

> For some years we have realized the value of domestic refrigeration as a revenue producer. These little machines will have a demand of less than half that of an electric flatiron and therefore require no special wiring or additional transformer capacity, nor do they cause any fluctuations on the secondary line. The motor operates intermittently, being controlled by a thermostat in the ice-box. This intermittent operation is continuous throughout the twenty-hours; therefore the load factor is considerably above that of any household appliance.
>
> In an ordinary residence the monthly consumption will amount to from 100 kw.-hr. to 200 kw.-hr. This produces almost as much revenue as an electric range without the large investment necessary for increase in line capacity and transformers. I might say for your information that we have connected more than 100 electric ranges this year and the average cost per range for increasing line capacity and additional transformers has been over $150.
>
> For the last four years we have been anxious to encourage the sale of domestic refrigerating machines, but until a short time ago we could find no machine which we felt like recommending to our customers. However, during the last year a number of manufacturers have apparently overcome many of the defects, and there are undoubtedly three or four reliable machines on the market at the present time. One of these is the Kelvinator, manufactured by the Kelvinator Corporation, Detroit.
>
> The Ream-Thomas Company, a Louisville firm, secured the exclusive agency for these machines in the States of Kentucky and Tennessee, with headquarters in Louisville and Memphis. This concern sent a number of men to Detroit, where they were thoroughly educated in the factory, and these men are now acting as salesmen and service men in Louisville, Memphis and other cities in this territory.
>
> The Louisville Gas & Electric Company has no connection whatever with the Ream-Thomas Company; the Kelvinator Corporation or with the sale of the machines other than the co-operation we give to all local electrical dealers who encourage the use of energy-consuming appliances. We do not hesitate, however, to recommend the Kelvinator to our customers, for the reason that one of our own men spent a month in Detroit investigating the machine and while there called at nearly one hundred residences where the machines were in actual operation. The Ream-Thomas company has had one of these machines in operation in the model kitchen of our display room for some time, and it has operated perfectly, without even a minor adjustment.
>
> Six of these machines were sold from our office the first day the machine was put on display, and the Ream-Thomas company is more concerned about the factory furnishing enough machines than about the sale of them.
>
> Personally, I am enthusiastic over the possibilities in domestic refrigeration, for a machine of this charcater is needed in every home in America. Everybody wants the machine; therefore the sale depends entirely upon whether or not the "prospect" is financially able to purchase one. A piano costs as much as a domestic refrigerating machine, and as there must be at least eight million pianos

in the United States, I can see no reason why there should not be eight million domestic refrigerating machines in use. The latter will certainly contribute considerably more to the health, happiness and convenience of the family (and the neighbors), and I understand that the refrigerating machines can be bought on the time-payment plan in most places, the same as a piano.

The Kelvinator Corporation has organized its sales plan along the lines generally used by automobile manufacturers. It sells its machine on sight draft, bill of lading attached, and usually gets 20 per cent down payment on all orders. It has not as a rule picked central stations to distribute its goods but has picked, rather, concerns with specialty selling experience or concerns that will employ men who will specialize on motor-driven refrigerators. In every case, however, the local organization has sought the co-operation of the central station.

A METHOD FOR MAKING FARM LINES PAY A PROFIT

Keep Investment Out of Lines and Charge Enough to Cover 50 per Cent Line Losses Which Data Show Will Occur

BY H. H. HENLEY
Sterling Electric Company

Farmers have been educated to use electricity by the small isolated plant. Now they want something more than the small plant. They want power and the elimination of plant attention. To accomplish this the farmer realizes he must connect to some available power line.

To get power and light on a larger scale than can be obtained from the small isolated plant, the farmer will invest in a service connection an amount of money at least equal to the cost of a private plant. If he would generate as much energy with a private plant as he wants to use from a power line the cost, including depreciation and maintenance, would be much more than he could purchase energy for, even though he paid a flat 15-cent per kilowatt-hour rate.

LIMITED OBLIGATION

In serving this business the central station should not have money invested in farm lines or assume any maintenance obligations beyond the natural life of the pole lines. Transformer core losses should be covered with a high minimum rate or if this is objectionable the metering equipment should be on the primary side of transformers. Statistics which the writer has compiled show that the actual energy used by rural consumers is only 40 per cent to 45 per cent of the energy required for the line. The balance is core loss and transformer inefficiency. It is a fact that a large farm line development gives an ideal load factor on account of the large transformer core losses, but these losses must be paid for.

During this year the writer had been personally connected with the development and installation of a large number of farm lines. In one county, we developed and installed nearly $50,000 of farm services. All of the developments of this county were accomplished by organizing stock companies among the farmers to purchase current wholesale from the central station. On this job, metering equipment is installed at the point of connection to the power line. One of these developments paid the power company over $200 for energy in October on the basis of 4½ cents per three-phase, 2300-volt circuits on 30-ft. (9-m.) poles, three- phase, 2300-volt circuits on 30 ft. (9 m.) poles, with 200 ft. (60 m.) spacing, using No. 6 bare hard-drawn copper conductors. The lines are insulated for future "Y" connection should the load or distance demand it.

Where it is thought advisable for the central station to own and operate a farm line, the farmers served should stand the entire investment unless there are towns beyond that the company wishes to serve. Then it may be advisable for the company to invest only the amount of money in the line that the revenue from the town will support. By this method a great many small towns are served that without taking the farmers into consideration could never support the necessary investment to install a high voltage line to serve them.

We are developing a line at this time that will serve eventually about 400 farmers on a main line which is 60 miles (95 km.) long and 20 miles (32 km.) of single-phase laterals. In this case, seven towns are to be served. Farmers are now entering into contracts to pay $400 connection charge which includes only a transformer located on main line nearest their buildings. The consumer will stand the additional expense of building his secondaries from the transformer to his buildings. The main line will be 22,000-volt, three-phase circuit on 35-ft. (10-m.) poles with 250 ft. (76 m.) spacing, carrying No. 10 bare copper conductors. A single-phase 2200-volt secondary line will be installed on a lower cross-arm to serve the farmers.

INSIST ON STANDARD CONSTRUCTION

This is a flexible arrangement, as the 2200-volt line may be sectionized and additional 22,000/2200-volt transformers may be installed to take care of natural growth. When the single-phase lines leave the main line as laterals they will be constructed to permit adding the third conductor later and raising the potential to 4000-volt "Y".

Single-phase 2200-volt metering equipment will be installed on the transformer pole. It will consist of a meter and current transformer inclosed in a wooden box. No potential transformer is required, as available 110-volt potential can be taken from the secondary side of the transformer.

As to a policy on building these lines it seems best for a power company to insist on standard construction and to refuse to allow the farmers to organize and buy materials and install their own lines. Trouble is sure to result if this is done because when the line is completed it is not likely to equal a good rural telephone line in quality.

Personally the writer prefers lines of lower voltages as standard because less telephone interference exists and because core losses are lower. Eventually an electric service line may be expected on every road in the country where a rural telephone line exists and the industry must get started along the right lines if this business is to be handled at what would be a satisfactory profit.

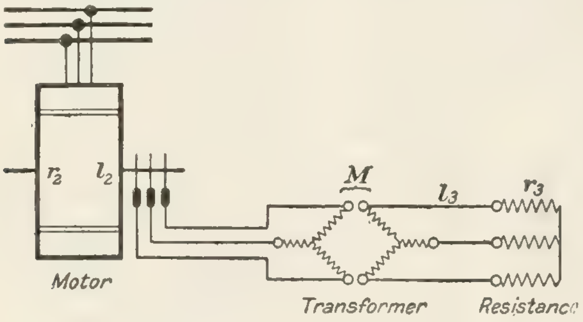
Central stations will find the rural customer not only a ready customer but one that will pay a profit provided he is required to carry the investment and pay for the loss of energy due to distance and the necessary use of individual transformers.

DIGEST OF ELECTRICAL LITERATURE

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Starting of Asynchronous Motors by Means of Tertiary Eddy Currents. — R. RUDENBERG. — Considering methods of arranging induction motors for high starting torque and small slip under load, the author decribes a method which uses the properties of a variable frequency transformer, and this is inserted in the circuit of the rotor and not in that of the stator. The method is shown diagrammatically in the illustration. The secondary circuit of the motor is connected through the transformer with a tertiary circuit, in which a considerable resistance is inserted. When at rest the rotor winding receives the full frequency of the network, so that the transformer produces a very small effect on the current. The resistance which is not variable produces almost exactly the same effect that it would if it were directly connected to the slip-rings. It can therefore be of such magnitude as to allow of the generation of a large starting torque. In the neighborhood of synchronism there is, however, a low frequency in the circuit of the rotor. The induction effect through the transformer is therefore lost especially as the resistance is great in comparison to the self-induction. Under these conditions the only effect in the rotor circuit is that produced by the secondary conductor resistance, which is small, so that the tertiary resistance can be regarded as being wholly without effect. The apparent ohmic resistance of this arrangement is therefore automatically dependent on the frequency of the slip. It is a better plan to abandon the use of a transformer, however, to utilize the leakage field of the rotor which exists in every motor. At the start the leakage field is considerable and has high frequency; it is therefore especially useful for producing induction effects. Broad metallic rings may be used projecting at the sides of the rotor. It is still simpler, however, to use the squirrel cage form of construction and to imbed the tertiary conductors in the slot.—The London *Electrician*, Oct. 10, 1919.



FUNDAMENTAL SCHEME OF INDUCTION MOTOR CONTROL

A Giant Transformer.—The Allg. Elektr. Ges. have recently completed the work on a transformer for 60,000 kva. to be used at the Goldenbergwerk plant for transformation from 110,000 volt to 13,500 volt. The total weight of the unit is 116,000 kg. and the height is over 17 ft. (5.2 m.). 40,000 kg. of 0.3 mm. transformer plate was used in constructing the core, which has three legs of elliptical section. The winding is of aluminum, and weighs but 4,000 kg. The coil-losses are 434 kw., and the core-loss "only" 126 kw., which corresponds to an efficiency of 99.07 per cent.—*Helios*, Feb. 23, 1919.

Spring Thrust Bearings and Cooling Coils on Large Vertical Generators.—T. W. GORDON.—The author states that for many years one of the limiting features of large vertical machines was the need of a simple thrust bearing. He states that such a bearing has been developed and is in use in the Cedars Rapids power station. The bearings referred to have now been in operation for a sufficient length of time to demonstrate their success.—*General Electric Review,* Nov., 1919.

Designs of Larger Vertical Alternating-Current, Waterwheel-Driven Generators.—M. C. OLSON.—The author calls attention to some of the special features that have to be considered in the mechanical and electrical design of large hydro-electric generators. Such machines are being constructed in sizes up to 32,500 kv.-a. capacity and there seems to be no insurmountable difficulty in building much larger units should occasion demand.—*General Electric Review,* Nov., 1919.

Generation, Transmission and Distribution

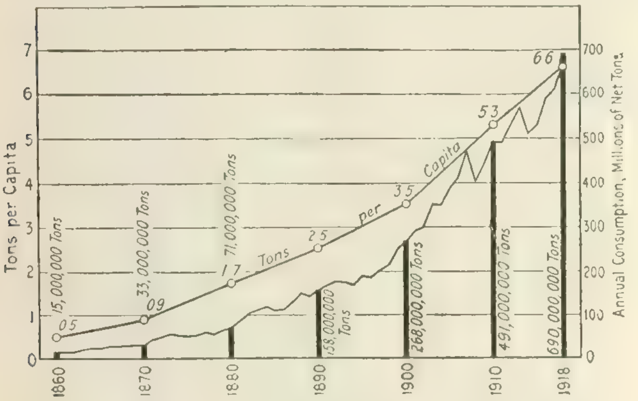
Some Fundamentals of Engineering Economics.—D. B. RUSHMORE.—The author sketches the evolution of power as a substitute for human toil. That research and invention be encouraged is emphasized as a condition precedent to our continued development along the lines of material betterment. An interesting summary of the primary horsepower used by the leading manufacturing industries of the country is as follows:

Agricultural implements	121,428
Automobiles including bodies and parts	173,684
Boots and shoes, including cut stock and findings	112,929
Boots and shoes, rubber	24,621
Brass, bronze and copper products	122,700
Bread and other bakery products	107,771
Brick and tile	470,758
Cars and general shop construction and repairs by steam railroad companies	433,994
Cement	490,402
Chemicals	282,385
Copper, tin and sheet-iron products	75,263
Cotton goods, including cotton small wares	1,585,953
Electrical machinery, apparatus and supplies	227,731
Fertilizers	114,281
Flour-mill and grist-mill products	822,384
Foundry and machine shop products	1,129,768
Ice, manufactured	461,988
Iron and steel blast furnaces	1,222,273
Iron and steel, steel works and rolling mills	2,706,553
Leather, tanned, curried and finished	172,712
Lumber and timber products	2,796,902
Paper and wood pulp	1.621,154
Printing and publishing	335,210
Slaughtering and meat packing	260,996
Smelting and refining copper	194,980
Woolen, worsted and felt goods and wool-hats	398,367
Total all industries	22,547,574

General Electric Review, Nov., 1919.

Transmission Line Poles of Reinforced Concrete.—M. FOERSTER.—The poles are hollow and are made in lengths of 40 ft. (12 m.) and any desired wall thickness, by pouring mortar into a long wooden form, containing the necessary structure of reinforcing steelbars, the entire form being rotated at high speed in a special centrifugal machine. The normal poles are designed to stand a pull of 400 kg. (880 lb.) with a factor of safety of 4, corner-poles being built double, up to 60 ft. (18 m.) long, and by the same factor of safety, will stand a pull of 3000 kg. (6600 lb.) at the top. Poles of this type are said to be used by the thousands in Germany, and recently 370 were provided for a 25-mile (40 km.) 60-kv-transmission line near Dresden.—*Elektroteknische Zeitschrift*, Apr. 24, 1919.

Power Transmission and Industrial Development.—ROSS J. MCCLELLAND.—The author tells what the functions of transmission systems are and deals with our power resources showing in what directions it is feasible to look for economies. The vital improvements resulting from a far reaching and interconnected transmission system may be briefly summarized as follows: (1) Maximum efficiency of power generation and economy of investment. (2) Bringing within economic range other important measures of national economy such as extensive water power development, railroad electrification and recovery of valuable coal by-products. (3) Stimulation of industry generally and development of new specialized industries due to assurance of adequate power supply over the entire region involved. (4) Great extension of areas suitable for industrial development and consequent checking of present tendency toward excessive localization of industry.—*General Electric Review*, Nov., 1919.



THE INCREASE IN COAL CONSUMPTION SINCE 1860

Traction

Preventing the Breakage of Armature Leads on Railway Motors.—A. L. BROMALL.—This paper may be summarized as follows:

To overcome trouble with broken leads.

1. Reduce the vibrations as much as possible by (a) discarding badly worn gears and pinions, (b) repairing track having broken joints or bad crossovers which cause severe jolts to the motor, (c) eliminating flat wheels, (d) supporting the motor nose as flexibly as possible, (e) discarding badly worn axle and armature bearings, (f) giving each motor a running test at high speed after being repaired to see that they are not out of balance.

2. Increase the resistance of the armature leads so that they can resist vibration by (a) reducing the possible movement of the leads as follows: (1) Eliminate all cases of loose corse and commutators, (2) locate the leads so that they naturally support each other, (3) hot band the armature, (4) dip and bake in varnish or treat with some other material to cement the leads thoroughly in place, (5) locate the bands so as to give the whole end winding and leads a distributed support, (6) reband the armature after it has been in service and the insulation dried out in order to take up any looseness which may have developed. (b) Strengthening the lead to withstand vibration as follows: (1) eliminate all possible bends, (2) make all bends on as large a radius as possible, (3) do not nick or scratch the leads, (4) remove sharp edges of the commutator slot, (5) surround the copper lead with a thin phosphor bronze sleeve (where the construction permits).—The *Electric Journal*, Oct., 1919.

Comparison of Low-Speed and High-Speed Interurban Freight Locomotives.—D. C. HERSHBERGER.—The writer states that adequate energy supply and the service to be performed are the two important factors which influence the selection of locomotives of proper speed characteristics and hauling capacity. The overall economies are determined largely by the character of service to be performed and the power supply available. A fast engine may economize in time on the road, but lose this advantage by making it necessary to provide additional power equipment and feeder capacity. The low-speed engine may perform the service without additional power equipment, but interferes with passenger traffic in day operation.—The *Electric Journal*, Oct., 1919.

Installations, Systems and Appliances

Main Hoists for Open Hearth Ladle Cranes.—W. W. GARRETT, JR.—The writer points out the advantages of using two motors in series instead of a single motor. He states that in case of failure of one motor the hoist may still be operated with the other. Other advantages are that it will be easier to reverse the motors as they will have less tendency to race. Braking from two separate units will be more positive, commutation of current peeks will be more easily accomplished and the motors in series will act as a double booster to the line when the hoist is running down. He states that in his opinion the two motor series scheme is by far the safest, cheapest and most dependable.—*Proceedings at the Association of Iron and Steel Electrical Engineers*, Oct., 1919.

Electro Percussive Welding.—ETHAN VIALL.—This method of welding, while nearly fifteen years old, is not very generally known excepting in some electrical concerns, where it is used for joining wires. Its possible uses for many processes in jewelry or similar manufacturing have not yet been extensively tried. The author describes actual tests on two No. 18 B. & S. aluminum wires using an oscillograph which shows that the power being expended at the weld reaches a value of 23 kw. for an instant. However, the entire weld is made in 0.0012 seconds and the total energy used at the weld is 0.0000023 kw.-hr. Cost of this weld, figured at 10 cents per kw.-hr., would be twelve millionths of a cent.—The *American Machinist*, Nov. 13. 1919.

Electrophysics and Magnetism

Surges on a System of Parallel Conductors.—H. M. PLEIJEL.—In what forms the latest link in a chain of articles on the application of Heaviside's operator method to problems regarding surges, or traveling waves, on lines, the author takes up the question of the effect of switching on one line upon the electrical conditions of a neighboring line. If a loaded telephone line (2) runs parallel to a transmission line (1), and a high constant potential is suddenly applied to (1) while the home end of (2) is grounded, there will the ordinary charging-surge traveling in over (1), while in (2) *two* waves appear, propagated with different speeds, so that the result is a rectangular voltage impulse, the tail of which travels slower than the head, which causes the impulse to broaden out as it goes along the line. Through reflections at the ends interesting beat phenomena may occur. In general, this holds for ordinary unloaded lines that if the secondary lines are freed at both ends, their presence will not affect the voltage distribution on the primary line, where switching occurs; the currents on the secondary lines will be zero at all points; and the voltages may under all conditions be derived directly from the electrostatic expressions in terms of potential coefficients. If the secondary lines are grounded at both ends, the voltage must be identically zero, and an intermediate ground will have no effect. The theory is extended to cases with alternating e.m.f.s. and expressions are given, which permit of a direct application of the Heaviside expansion theorem to problems of damped alternating voltages.—*Teknisk Tidskrift, Elektroteknik,* July and September, 1919.

The New Physics.—A. C. CREHORE.—This is the first of a series of articles by the author dealing with the underlying theory of electricity and magnetism in which he takes up the elementary considerations which lead to the development of the fundamental electrostatic systems and electromagnetic units.—The *Journal of Electricity,* Nov. 15, 1919.

Electrochemistry and Batteries

Electrolysis of Sulphate of Lead in the Storage Cell.—PAUL BARY.—If the charged plates of a lead accumulator are put into pure dilute sulphuric acid, very weak discharge effects are obtained. However, if the plates are removed, and put into acid containing sulphate of lead in dissolved form, the normal discharge effects occur. From this and a series of other observations the author draws the conclusion that the electrolysis of sulphate of lead is of vital importance for the action of the lead accumulator cell.—*Revue Général d'Electricité,* Aug. 16, 1919.

Units, Measurements and Instruments

A Graphically Recording Frequency Meter.—KEINATH.—The vibrating-reed type of frequency meter cannot be used for graphical recording, nor for the actuating of relays. A special pointer instrument therefore has been devised by the Siemens-Halske A. G. It is a dynamometer with fixed iron cored coils S, and a moving coil with two windings, s_1 and s_2. s_1 is short-circuited through a suitable impedance, and thus furnishes the restoring torque. No directive springs are used. S and s_2 are connected through two condensers, to the mains. At the normal frequency, the currents in S and s_2 are just 90 deg. out of phase, and the moving coil stands at right angles to the field, but when the frequency varies, the phase relations will change, and the coil will deflect. The meters are made for normal frequencies from 10 to 10,000 p.p.s. with ranges from 2 to 5 per cent, are independent of temperature, and are claimed to be practically free from errors due to a variation in voltage of 10 per cent.—*Helios,* March 9, 1919.

Telegraphy, Telephony, and Signals

Propagation of Telegraphic Impulses on Loaded Lines.—R. HOLM.—Expressions for voltage and current at a given point on an infinitely long smooth line are derived by integrating the equation of propagation by the Riemann method. The results are shown in a series of diagrams for particular cases. The problem of a periodically loaded line is then attacked, approximate expressions for the form of the wave front being arrived at by a consideration of the successive deformations of the wave in passing from one loading coil to the next. A method for estimating the inaccuracy of the result is given.—*Archiv für Elektrotechnik,* Feb. 7, 1919.

A New High Power Telephone Transmitter.—A novel type of carbon granule transmitter, designed to have especially good cooling, and employing several co-acting microphone-buttons, has been developed by the Swedish Tagtelefon Company, with a view to providing a reliable high-current transmitter for moving train telephony. In order to obtain high amplitude of vibration over a relatively large surface, the diaphragm is made of rectangular form, and is clamped along two edges, while the other two edges are free to swing. The microphone-buttons are placed in a row, in the middle part of the diaphragm, where the amplitude is a maximum. The mouthpiece is of a peculiar form, and directs the incoming sound waves in a symmetrical way against the diaphragm, thereby avoiding the occurrence of higher modes of vibration. The microphone may be directly adapted to the standard Swedish telephone apparatus, the transmitter, when in use, being plugged to the direct-current lighting mains.—*Elektroteknisk Tidskrift,* May 1, 1919.

Use of Three-Electrode Vacuum Tubes for Radio Telegraphy and Telephony.—C. GUTTON.—As a continuation of a previous article on the theory of vacuum-tube oscillators, the author here gives a description of the electrical arrangements of vacuum-tube transmitting sets for radio-telegraphy, used in France during the war. A discussion of the advantages of heterodyne reception is given, and of the application of vacuum-tubes to radio telephony.—*Revue Général d'Electricité,* Sept. 20, 1919.

On the Goniometric Functions Applicable to Directive Aerials.—A. BLONDEL.—The writer indicates the manner in which the phase differences of the electromotive forces induced in the two vertical or nearly vertical parts of the measuring aerial necessitates important corrections, when the dimensions of the loop or frame are not very small compared with the wave length employed. It is important to study these in order to realize the difficulties which attend the use of short wave lengths in the radiogoniometric work. This is the first issue of the *Radio Review,* of which it is said to be the sole aim to record the scientific developments in radio telegraphy and of those branches of allied sciences which are related to that subject.—The *Radio Review,* October, 1919.

Rapid Telegraphy.—MONTORIOL.—The article deals at great length with the various systems for automatic telegraphy and multiplex telegraphy in use and discusses their practical applications and limitations with especial reference to the traffic conditions obtaining in France. A critical comparison of different systems leads the author to the conclusion that the French Baudot system is superior to, or at least as good as any of the English or American systems for high speed telegraphy.—*Bulletin de la Société Française des Électriciens,* June, 1919.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

News in Brief

Summary of Important Happenings in the Industry During the Week

At the beginning of the new year the electrical industry, having taken stock, finds that it has carried some of its problems forward from 1919. The enormous 1919 totals of business make an impressive record and every effort will be made to excel them in 1920. Heavy demands for production are reaching all branches of the industry and the manufacturers, central stations and distribution organizations will stimulate their powers to the utmost to provide the needed materials and service. There is no disposition in the industry to minimize the difficulties ahead, but there is strong purpose to meet them squarely and to work them out sanely and with satisfactory results to the companies and workers as well as to the great consuming public on whom the welfare and progress of all really rest.

Stockholders of the Consolidated Gas Company of New York have authorized a new issue of $25,000,000 of 5-year 7 per cent convertible bonds. They are secured by deposit as collateral of $35,000,000 capital stock of the New York Edison Company. The issue has been underwritten by the National City Bank, New York, and is offered to stockholders for subscription.

The South Norwalk Electric Works of the Second Taxing District of the City of Norwalk, Conn., has increased its rates. Its reason is the "continued and advancing high cost of the essentials requisite to the production and supplying of electrical energy."

On Dec. 30 the Electric Club of Chicago voted to lease permanent club rooms in the Morrison Hotel. What was the country's largest electrical lunch club, with a membership of 800, graduated by this move into permanent quarters. The club will have its quarters furnished with up-to-date equipment at an annual rental of $15,000. The club dues will be raised from $5 to $30 per year.

In the week ended Dec. 20, according to the report of the United States Geological Survey, the production of bituminous coal amounted to 86.4 per cent. of normal.

The Merchants' Heat & Light Company, Indianapolis, has given its employees of six months' service or more life insurance policies of $500 to $1,500, according to the term of employment.

In the opinion of H. M. Byllesby & Company, the year 1920 will witness a continuation of the present commercial prosperity, marked by industrial expansion and construction activities.

The National Industrial Conference Board finds that there has been an increase of 80 per cent to 85 per cent in the cost of living between July, 1914, and November, 1919. The board finds an advance of 10.4 per cent since November, 1918, and of 13.5 per cent since March, 1919. Clothing shows the largest increase, 135 per cent and food is next with 92 per cent.

With the Christmas purchasing over, jobbers are giving more attention to their regular supply lines. Seasonal goods upset the electrical market to some extent, but jobbers' shelves are virtually cleared of all their stock of that material so they will have little to hold over till next season. Shipments are bad on flexible non-metallic conduit, flexible armored conductor and low-voltage porcelain, but are better on some schedule material.

Price advances have occurred in condulets, fir cross-arms, safety switches and some line hardware. Certain jobbers have advanced their prices on porcelain because of the short supply. Wire stocks are in fair shape.

Heavy building reports are coming in from virtually all districts, placing 1919 building far above that for any previous year and predicting even greater work in the year just opening. Over $14,000,000 has just been appropriated by the City of New York for 14 new piers at Staten Island.

In its end-of-the-year review of business and crop conditions the committee on statistics of the Chamber of Commerce of the United States predicts sustained industrial activity. The committee emphasizes the hopefulness of the manufacturing industry generally, which although encountering constant labor troubles and shortage of fuel and materials, has orders in excess of its capacity for production within any reasonable time.

The Supreme Court of the State of Illinois has affirmed the decision of the lower court holding that the Illinois Public Utilities Commission has authority to fix rates regardless of rates fixed by franchise ordinances.

The advisory committee conducting the California Electrical Co-operative campaign advises that bonuses be paid to the sales force in order to encourage wider sale of electric appliances.

It is announced in London that a scheme of imperial wireless communication is being prepared under supervision of the Secretary of the Colonies. It is stated that the plan is to link up all of Britain's overseas possessions for commercial purposes.

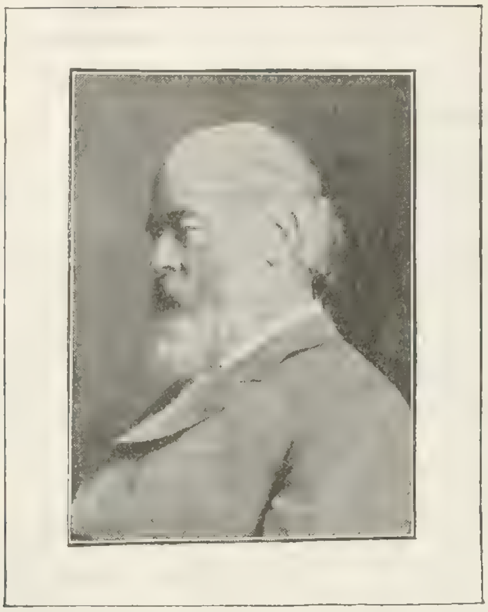
Public Utility Commissioner Retallack, in a decision affecting the British Columbia Electric Railway Company, Ltd., Vancouver, B. C., holds that the principle of requiring security or payment from the consumer for an extension involving a cost greater than the usual outlay of supplying one consumer and out of proportion to the revenue to be derived is a just and reasonable one.

Among the large projects contemplated throughout the country are: The construction of a large steam-driven power plant at the Ludlowville, N. Y., plant of the International Salt Company, 2 Rector Street, New York, N. Y., to cost with equipment about $250,000. Contract has been awarded to R. H. Beaumont, 315 Arch Street, Philadelphia, Pa.

A company has been incorporated to operate the first all-electric steel mill in the country, construction of which will begin in February. The plant is to be located on a site between Girard and Warren Streets, Youngstown, Ohio, which is to be the base of a larger plant later, and will be equipped with two electric smelters and will also have 10 and 16-in. rolling mills. The company is capitalized at $1,500,000 and proposes to manufacture finer grades of steel, vanadium, chrome and nickel steel, for use in automobile parts, locomotive parts and cutlery. L. J. Campbell, formerly vice-president of the Youngstown Sheet & Tube Company, will have charge of the plant.

A collection of about 230 samples of electrical supplies of German, Japanese, Chinese, Danish, English and Argentine manufacture has been placed on exhibition in the rooms of the Associated Manufacturers of Electrical Supplies, New York. These samples were gathered by agents of the Bureau of Foreign and Domestic Commerce in South America, the West Indies, Japan, China, New Zealand and Vladivostok. After correspondence between the Bureau and Charles E. Dustin, general secretary of the Associated Manufacturers, they have been loaned to the organization of the Department of Commerce.

SIR OLIVER LODGE



The eminent English scientist and lecturer on electrophysics who it is announced will make a visit to this country in January. He will lecture during his stay in the United States.

BYLLESBY & COMPANY LOOK FOR PROSPERITY IN 1920

Forecast a Large Amount of Construction in the New Year to Meet the Expanding Demand for Electrical Energy

A review of conditions during 1919 has been issued by H. M. Byllesby & Company. In their opinion the year 1920 will see a continuation of the present commercial prosperity, marked by industrial expansion and construction activities. They say in part:

During 1919 H. M. Byllesby & Company lodged its large engineering and management business in a distinct but closely allied organization—the Byllesby Engineering and Management Corporation—and extended its scope as an investment house underwriting and dealing in diversified securities, including the financing of industrial enterprises. In addition to the New York offices, branches were acquired in Boston, Providence, Madison, Wis., and Evansville, Ind.

The year witnessed the firm's entry into the oil business, in the acquirement, through Standard Gas & Electric Company, of the majority common stock interest of Shaffer Oil and Refining Company.

In the past the Byllesby interests have been identified with the financing, development and management of electric and gas companies, particularly the former. All of the companies will be conducted broadly, as in the past, as subsidiaries of Standard Gas & Electric Company. Their record during the war was highly creditable from the standpoint both of the investor and the consumers served in the 460 cities and towns with 2,200,000 population in 16 states. These companies in 1918, by means of additional volume of business and rate increases, held their net earnings about even with the preceding year, despite unprecedented advances in operating expenses. In 1919 the volume of business continued to increase rapidly and there was a pronounced gain in both gross and net earnings.

During the war and reconstruction periods the customer-ownership, or home financing, policy which the Byllesby companies popularized, proved invaluable as a method of supplemental financing for additions and extensions to the properties. The improvements enabled the taking on of large quantities of new business, and the latter made it possible to increase earnings. In the meantime the original purpose of customer-ownership—the bettering of relations with the public—has also been successful.

During 1919, up to and including Dec. 24, Byllesby companies sold $3,220,100 of their preferred stock direct to customers, the number of sales for the year being 5,356, or an average of a little over six shares to an investor. Compared with 1918, this is an increase of 47 per cent in the volume of stock sold and 24 per cent in the number of purchasers.

The volume of service now demanded from the electric companies is crowding generating and transmission capacities to the limit. This means a large amount of construction during 1920. At the Byllesby properties not far from 85,000 horsepower additional in steam turbine generating equipment is to be installed.

Well managed electric and gas companies have amply proven their stability under the most extraordinary conditions, their ability to confine increases in selling costs to a much smaller margin than the increased prices of commodities and wages, their power to obtain new capital for enlargements and their title to the full confidence of the investor. They also bear the distinction that no charge of profiteering can successfully be brought against them.

15,000 HP. WATER POWER DEVELOPMENT IN WISCONSIN

Plant to Supply 45,000,000 Kw.-Hrs. per Year to Several Cities in Northern Wisconsin and Michigan Will Operate at 68 Ft. Head

The Big Falls (Wis.) Water Power Company, L. E. Myers, president, is about ready to proceed with the construction of a dam and power house at Big Falls, Rusk County, Wis., for the purpose of converting into electrical energy the large water power at that place which has never yet been developed. The Big Falls of the Flambeau River located about 14 miles (22 km.) upstream from Ladysmith, Wis., consists of three pitches, all within a distance of about 0.75 mile (1.2 km.). It is proposed to construct the dam in such a manner as to take advantage of the fall in these three pitches, obtaining thereby a head of about 68 ft. (21 m.) feet.

The drainage area above Big Falls is about 1900 sq. miles (492,000 hectares), and a careful study of the stream flow data available for several years indicates that it will be possible to deliver to the various points of consumption about 45,000,000 kw.-hrs. per year after allowing for losses of generation and transmission.

It is proposed to install four generating units of 5,000 hp. ultimate capacity each with the necessary auxiliary equipment. The power will be transmitted over a double-circuit three-phase transmission line to Ladysmith, Wis., Ashland, Wis., and to the Ironwood and Bessemer Railway and Light Company, which serves several communities in Wisconsin and in the Northern Peninsula of Michigan.

Test holes sunk at various points on the site of the proposed dam show that foundations can be obtained on solid rock. The stream at this point is confined within high rock walls which offer an opportunity to build a substantial structure at a cost which it is said will make the enterprise profitable.

The companies to which this power will be delivered are already operating several steam and hydraulic plants, and it is expected that the combination of these various units with the proposed plant at Big Falls will result in important operating economies.

SIGNAL CORPS WAR WORK WAS BASED ON AMERICAN PRACTICE

Major General Squier Reports on the Accomplishments of the War Period and Pays Tribute to American Commercial Methods

Many interesting facts are given in the report of Major General George O. Squier, chief signal officer of the Army, rendered to the Secretary of War and covering the fiscal year 1919. Certain developments of the two preceding fiscal years which could not be disclosed previously on account of the war are also described.

Prior to the entrance of this country into the war General Squier came to New York and had a conference with Theodore N. Vail and John J Carty, American Telephone & Telegraph Company, and Newcomb Carlton, Western Union Telegraph Company. The problem was discussed of how men and equipment could be picked from these organizations and similar utilities without crippling essential service in the United States. Immediately upon the outbreak of the war several of the leading engineers and executives in the commercial telephone and telegraph companies were commissioned and they began the active work of selection and organization in their own offices. With the loyal co-operation of the companies it was possible to send to Europe in the first months of the war twelve battalions of the best-trained men this country could produce.

General Squier calls special attention to the extent to which specialization has gone under the impetus of war in the matter of electrical intercommunication. The special laboratory fully equipped for radio development at Little Silver, N. J., grew to be one of the largest in the world and the site has been recommended for purchase for the permanent use of the Signal Corps.

TRIBUTE FROM GENERAL PERSHING

The following tribute to the Signal Corps by General Pershing is included in the report:

> Now that active operations have ceased, I desire to congratulate the officers and men of the Signal Corps in France on their work, which stands out as one of the great accomplishments of the American Expeditionary Forces—the result of a happy combination of wise planning and bold execution with the splendid technical qualities of thousands of men from the great commerical telephone, telegraph, and electrical enterprises of America. It is a striking example of the wisdom of placing highly skilled technical men in the places where their experience and skill will count the most.

In discussing radio progress during the war General Squire says:

> The big development was of the vacuum tube used extensively in practically all modern radio apparatus. Previous to the war all vacuum tubes were strictly a laboratory proposition, impossible to produce in quantity and of an almost prohibitive cost. No facilities existed for quantity production either in the United States or abroad. Certain manufacturers had been experimenting in a private capacity with ballast lamps and regulator tubes in a small way. Believing it the part of wisdom to avail itself of even such limited experience and facilities, the Procurement Division entered into negotiations toward the development of various types of such vacuum tubes as a commercial production. Prices of the tubes in the beginning were an unknown quantity, but subsequent manufacture and competition between two or three concerns standardized the cost to the government of the various tubes running from \$1.50 for the cheapest up to \$11 Satisfactory production and delivery was being obtained at the time of the armistice.

MAINTAINING UNINTERRUPTED COMMUNICATION

In view of the necessity of maintaining uninterrupted electrical communication between Washington and the American Expeditionary Force, notwithstanding possible enemy activity, various measures were considered. The report says in part on this subject:

> The studies which were conducted and the experiments and tests which were made in the United States were numerous and many of them highly scientific in character. In general, the problem consisted, first, in providing radio stations of sufficiently high power to secure the best attainable signals even under favorable conditions; second, in finding measures to insure continuity of radio service at times of serious static disturbances; and, third, to devise plans whereby, in the event of intentional interference on the part of the enemy, the radio signals might not be confused or obliterated by arbitrary signals transmitted for the purpose from high-power enemy stations.
>
> To meet the first condition the Navy Department undertook to complete, as rapidly as possible, a new high-power station at Annapolis, Md., and to rapidly increase to the fullest extent practicable the power of all of the existing trans-Atlantic stations. In addition to this, the Navy designed and undertook the eretcion of a high-power station near Bordeaux, in France, which was intended to be the most powerful station which had yet been constructed.
>
> To meet the second condition, tests were made by the Navy at various naval radio stations on the Atlantic coast to determine those locations in which the least static disturbances were likely to prevail. Corresponding investigations were made on an extensive scale by the Signal Corps, which sent numerous expeditions to different parts of the United States to make electrical and meteorological observations; to determine the intensity of static disturbances and their relation to meterological conditions; the degree of intensity of signals received; and to get all other scientific data obtainable, which might bear upon the problem.
>
> To meet the third condition, intentional interference, numerous scientific methods were tested and studied at the Navy stations and elsewhere.
>
> As a result a comprehensive plan was adopted whereby, in case of necessity, receiving stations at Newfoundland in the north, and along the Atlantic coast of the United States and elsewhere, and throughout the United States as far west even as the Pacific, might be employed.
>
> A second phase of the transatlantic communcations' problem consisted, not in preventing the enemy from interrupting our communications, but in determining in what manner and to what extent the enemy countries themselves were utilizing transatlantic electrical communications.
>
> A third phase of these transatlantic communications was developed by the Chief Signal Officer, who directed Colonel Carty to study the possibility of sending messages in plain English from the War Department at Washington to the American Expeditionary Forces in France and England in such a manner that they could not be intercepted by the enemy, the object of this being to save valuable time which was being consumed in coding and decoding cablegrams.
>
> Colonel Carty undertook this study as directed and gave his attention, first, to the remarkable printing telegraph system which had recently been perfected in the United States.
>
> At the request of Colonel Carty the engineers of the American Telephone & Telegraph Company continued their researches into the possibility of obtaining secrecy by some modification of the printing telegraph. These engineers, co-operating with Lieut. Col. J. O. Mauborgne. Signal Corps, conducted a series of experiments, and finally devised apparatus whereby a message written in plain English could be quickly enciphered, printed in plain letters upon a page similar to the printing of a typewriter, and

transmitted over a telegraph line and received at the distant end. This printed cipher telegram being copied upon the deciphering machine will finally appear in plain English.

The cipher produced by this apparatus when used in accordance with the method of the Signal Corps has thus far successfully resisted all the efforts of cipher experts to break it.

An interesting chapter is devoted to the telephone and telegraph system of the American Expeditionary Forces. In part this story is as follows:

The problem presented by Colonel Russel [of the American Expeditionary Forces.—Eds.] was the construction of a telephone and telegraph line 400 miles long, extending from the west coast of France and across that country to some point not given, and to construct this line so that it might fit into an ultimate telephone and telegraph system extending to distances and places in the British Islands and on the Continent of Europe at that time unknown.

Notwithstanding that very remarkable results had been obtained in America with the new apparatus and methods which had recently been developed for long-distance telephony and telegraphy, these methods and this apparatus were of such recent origin, and so scientific and complicated and delicate in their working, that the propriety of specifying them for use in the theater of war presented a grave problem for decision. While they had given good results in the United States, these results were obtained under conditions where they were under the care of large numbers of well-trained, scientific personnel, and where repair parts, renewals, and shop experts, and manufacturing resources of all kinds were immediately available. None of these favorable conditions existed in Europe. In fact, so new were the methods and apparatus that they were not even known to the European nations.

Furthermore, the strain imposed upon signaling systems by the unavoidable conditions of war presents obstacles never encountered during commercial operations.

After considering the whole question in conference with Colonel Carty, Colonel Russel, notwithstanding all of the complexities and difficulties of the situation, decided to adopt in toto the latest American scientific methods. This decision was of fundamental importance. It was an expression of confidence in American enterprise and scientific skill. While it involved numberless possibilities of failure, if carried to a successful conclusion it promised brilliant results.

Instead of using the heaviest gage of telephone wire, wire of half the weight of copper per mile was decided upon. Instead of loading start coils, a new device, the telephone repeater was chosen. In view of the absolute necessity of obtaining the maximum traffic over each wire, it was decided to build the lines so as to employ phantom circuits. It was decided to adopt the composite system of simultaneous telephoning and telegraphing whereby each of the two wires which composed a telephone circuit may be employed as a duplex telegraph circuit without interfering with the telephone conversations.

Another method, the simplex, was also specified, whereby the two wires of the telephone circuit might both together be employed for any form of telegraph which might be required. In addition to this, a form of printing telegraph just perfected was included in the plans. In its practical working this printing telegraph was found to solve the great problem of shortage of skilled Morse telegraph operators, which was continued until the end of hostilities.

With the adoption of all of these radically new devices, it was evident that only by the providing of most expert personnel and by complete co-operation of the office of the Chief Signal Officer of the Army at Washington with the Signal Corps in France could success be assured. Notwithstanding many serious difficulties, the necessary personnel and apparatus was provided, and the results which were obtained by those in charge of the telephone and telegraph system, American Expeditionary Forces, were in the highest degree successful and exceeded all expectations.

Further extracts from the report of General Squier will be printed in a later issue of the ELECTRICAL WORLD.

W. L. R. EMMET IS AWARDED THE EDISON MEDAL FOR 1919

Consulting Engineer Receives the Honor "For Inventions and Developments of Electrical Apparatus and Prime Movers"

W. L. R. Emmet, consulting engineer of the General Electric Company, has been awarded the Edison medal for 1919 "for inventions and development of electrical apparatus and prime movers." A formal report of this action has been made to the board of directors of the American Institute of Electrical Engineers by the Edison medal committee. The medal will be presented at a later date.

Award of this medal is made annually by a committee of 24 Institute members "for meritorious achievement in electrical science, electrical engineering or the electrical arts." The medal was founded by the Edison Medal Association, composed of friends and associates of Edison.

W. L. R. EMMET

Mr. Emmet was born at Pelham, N. Y., on July 10, 1859. He was graduated from the United States Naval Academy in 1881. During the Spanish-American war he re-entered the navy and served as navigator on the U. S. S. *Justin*. His principal civil employment has been with the Sprague Electric Railway & Motor Company and the General Electric Company. He has made a number of inventions and has taken a large part in development. He is known internationally for his activities in furthering the application of electrical energy to ship propulsion. Frank J. Sprague stated in an interview printed in the ELECTRICAL WORLD in 1916 that the development of electric ship propulsion was due more to the individual efforts of Mr. Emmet than to anybody else.

WE HAVE seen examples of government operation of public utilities and should be convinced that in a democracy private initiative and management, fairly regulated or supervised, will continue to be the more progressive and efficient, leaving government to exercise its proper and limited function of administering the laws to protect lives and property and assure, in so far as humanly possible, an equal opportunity for all to enjoy the fruits of labor by brain and brawn.—*Herbert A. Wagner.*

Vernon (Vt.) Hydroelectric Plant of New England Power Company

Present capacity, 20,000 kw. in eight 2500-kw. units; extension rating, 12,000 kva. in two 6000-kva. units. This is the first plant built by the company, about a decade ago, on the Connecticut River between the Vermont and New Hampshire shores about 6 miles south of Brattleboro, Vt. It is the largest hydroelectric station of the system, which, however, has grown to an installed capacity totaling about 100,000 hp. The stations of this system save the burning of nearly half a million tons of coal annually in New England.

STEAM VS. ELECTRIC DRIVE IN STEEL ROLLING MILLS

Mill Representatives Speak in Superlative Terms Regarding Advantages of Motor Drive—Valuable Cost and Performance Data Presented

"Steam versus electric drive in steel mills" was a topic that brought forth considerable valuable discussion at the Pittsburgh meeting of the Association of Iron & Steel Engineers, on Saturday evening, Dec. 20. Practically all of the remarks which were made pointed to the superiority of motor drive, and it is interesting to note that the steel mill representatives who spoke gave it their hearty and sincere support backed by performance data and cost records.

From an electrical point of view the most interesting discussions were contributed by G. E. Stoltz, Westinghouse Electric & Manufacturing Company, K. A. Pauly, General Electric Company, Mr. Sieberts, Bethlehem Steel Company, and E. S. Jeffries, Steel Company of Canada. Others took part in the discussions but their remarks pertained to performance of steam-driven mills only.

Mr. Stoltz presented some interesting motion picture comparisons of steam and electric drive and emphasized the principal advantages of the latter. He called attention to one steel mill where steel was formerly rolled for $1.08 per ton with steam drive, that is now doing the work with motor drive for 27 cents per ton. The electric drive will justify itself in 3¼ years and after that will pay an income of $100,000 a year. In one of the Youngstown reversing roughers one pass is made every 3⅓ sec. with electric drive.

Mr. Sieberts showed some curves indicating the speed variations, work done and utilized, acceleration losses, etc., in engine-driven mills which permitted some interesting analyses and conclusions. He called attention to the shortage of comprehensive data on performance of rolling mills but referred to one installation where the relative unit costs were 76 cents per ton for electric drive and $1.33 for steam. This difference will permit a saving of $684,000 a year in this particular mill. Space economy was referred to as one of the chief advantages of electric drive.

While motor-driven rolling mills, so far, do not roll so high a tonnage as engine-driven mills, there is no reason why they can't, in Mr. Pauly's opinion. In fact, it is on this basis that they will be used still more extensively because the economy and convenience of using them is pretty well known already in a general way. Inertia of rotating mass is the inherent handicap of motor-driven mills, but despite this motors at the Trumbull Steel Company's plant can reverse from 90 r.p.m. in one direction to 90 in the opposite in 3 sec., while at one of the Bethlehem Steel Company's plants the motors reverse from 94 to 94 r.p.m. in 2 sec. At the former plant 20 x 22-in. (50 x 55-cm.) ingots have been rolled to 6½-in. (16.5-cm.) billets in 57½ sec. At the Sparrows Point plant of the latter company, 21 x 43-in. (53 x 109-cm.) ingots weighing 16,500 lb. (7,480 kg.) have been rolled to 10 x 38-in. (25 x 97-cm.) slabs in 1 min. and 38 sec. From the same stock the motor-driven mills have rolled 330 tons of 10 x 40 in. (25 x 100-cm.) slabs in 1 hr.

Some very valuable cost and performance data were presented by Mr. Jefferies taken over a period of 6½ years under actual operating conditions. He also recited the opinions of works manager, master mechanic, vice president and others at the Hamilton, Ont., plant of his company, all of whom spoke most highly of electric drive for rolling mills. For a 34-in. (86-cm.) reversing mill turning out finished billets measuring about 5 x 5 in. (12 x 12 cm.) the total length of delays with the electrically driven mill for the last 4½ years has been only 11 hr. and 35 min., or 1 min. for every 2,000 tons rolled. The energy required for rolling was only about four times that required for the auxiliaries. Including all power cost, maintenance overhead, etc., the unit cost is only 32.7c. per ton; 32.1 kw.-hr. were required per net ton.

For the entire period of 6½ years, the first year and a half of which was spent in getting on a normal operating basis, the expenses ranked about as shown in the following table:

	Cents	Per Cent of Total
Average total operating cost per ton	16.8	49
Interest on investment per ton	4.6	13
Depreciation per ton	3.8	11
Total main drive expense per ton	25.2	73
Miscellaneous expense per ton	8.9	27
Total	34.1	100

For a 18-in. (46-cm.) 4-stand mill driven by 1,600-hp. motor and rolling 697,000 net tons in 6½ years the unit expense per ton was 22c. Of this 1.3 per cent was for repairs and maintenance, 11.3 per cent for labor, 76.8 per cent for power and 8.6 per cent for interest and depreciation. The repairs on a rod and wire mill having ten 12-in. (30-cm.) roughing stands, and six 10-in. (25-cm.) finishing stands was about the same percentage (1.7 per cent) of the unit cost, but interest and depreciation ran higher (15.9 per cent), labor lower (4.4 per cent) and power cost about the same (78 per cent).

In general the chief advantages of motor-driven rolling mills are low cost of maintenance, and operation, relatively small delays, small stand-by expense, facility with which they can be started, ideal control, constant turning moment and low real estate charge incurred.

LARGER TOTALS IN THE BITUMINOUS COAL OUTPUT

Geological Survey Reports Production at 86.4 per Cent of Normal During the Week Ended Dec. 20—General Resumption of Work

According to the report of the United States Geological Survey the production of bituminous coal was at 70 per cent of normal on Dec. 15. The situation continued to improve throughout the week ended Dec. 20, the output for the week as a whole amounting to 86.4 per cent of normal. The trend of production during the period of the strike ranged from 29.6 per cent of normal in the first week, Nov. 2, to 48 per cent of normal in the week ended Dec. 13.

The total output (including lignite and coal coked) in the week ended Dec. 20 is estimated at 10,431,000 net tons. The average during the four weeks immediately preceding the strike, which may be regarded as normal, was 12,089,000 tons.

Compared with the week before, the output showed an increase of 4,631,000 tons, or 80 per cent. The recovery is the more significant when it is realized that in a single week the bituminous industry climbed from the depression of the strike period to a level of production higher than that of any week from mid-January to mid-August of the past year. Indeed, unless later returns cause a downward revision of the estimates, the curve of 1919 production has again crossed that of 1918.

The recovery was made possible by a general resumption of work in the fields which had been shut down by the strike. The final vote by which the United Mine Workers accepted the President's proposal was taken on Wednesday afternoon, Dec. 10. The following day many men returned to work in the Middle Appalachian region. The movement of resumption resembled a great wave, traveling westward from the Appalachians to the Mississippi.

CENTRAL STATION GIVES ITS EMPLOYEES FREE INSURANCE

Employees with Company Over Six Months Receive Policies for $500 to $1500 as Appreciation of Service and Co-operation

Insurance policies for $500 to $1500 have been presented to its employees by the Merchants Heat & Light Company, Indianapolis, Ind. Employees of six months' service receive a $500 policy and $100 is added for every year above this. The policies automatically increase $100 yearly until a $1500 maximum is reached. A certificate is mailed to the employees with a letter expressing the company's appreciation of co-operation.

This free insurance does not necessitate an examination and does not in any way replace possible payments for injury which would be made under the Workmen's compensation law.

GROUP LIFE INSURANCE FOR GENERAL ELECTRIC EMPLOYEES

Those Employees Having Dependents, Who Have Been in Service One Year or More, Will Receive Policies of $500 to $1,500

The General Electric Company has announced a group life insurance plan for all employees. Every employee of one year or more will have life insurance without cost to himself, regardless of age, sex or physical condition. All of the plants of the company and of its various subsidiary corporations are included in the arrangement under which the free insurance is provided.

Upon the lives of employees who have dependents the insurance is: $500 for one year's service, $750 after two years, $1,000 after three years, $1,250 after four years, $1,500 (maximum) after five years. Upon the lives of employees who die leaving no dependents, the amount insurance is $150 for funeral expenses.

The insurance ceases as to any employee with the termination of his employment, but the insuring company, the Metropolitan Life Insurance Company, agrees that insurance on a standard policy form at regular rates may be secured without physical examination upon application to it by the person whose employment is terminated.

PUBLICITY should be built from the viewpoint of the newspapers to which it goes rather than of the corporation from which it comes. Publicity that is not based on public interest is not worth getting; on the other hand, the publicity that really grips the public's attention because it interests them is beyond price. The publicity man, when he has something to release, should, so to speak, get up from his desk, walk out of the building, shake all atmosphere of his job out of his system and then come back in the attitude of a keen-nosed reporter looking for news. Then he can sit down and write his story with the proper perspective.—*James I. Clarke*, manager service department, National Bank of Commerce, New York.

INDUSTRIAL CONFERENCE PLAN TO SETTLE LABOR DISPUTES

President's Conferees Suggest a National Industrial Tribunal with Regional Boards of Adjustment—Position of Public Utility Employees

A tentative plan for the establishment of a national industrial tribunal has been issued by the Industrial Conference appointed by President Wilson. It provides for a tribunal of nine members, to be appointed by the President, representing equally the public, employees and employers. This tribunal would act as a board of appeal from twelve regional boards of inquiry and adjustment, which would try to settle disputes before production is stopped. Further time is asked by the conference before a solution of railroad and other public utility differences can be proposed, though this part of the question is discussed at length in the report. The conference will reassemble on Jan. 12 to consider criticisms of its plan.

In introducing the details of its plan the conference says in part:

"The right relationship between employer and employee in large industries can only be promoted by the deliberate organization of that relationship. . . . New machinery of democratic representation may be erected to suit the conditions of present industry and restore a measure of personal contact and a sense of responsibility between employer and employee.

"Human fellowship in industry may be either an empty phrase or a living fact. There is no magic formula. It can be a fact only if there is continuous and sincere effort for mutual understanding and an unfailing recognition that there is a community of interest between employer and employee.

RETARDING CONFLICTS

"Pending the growth of better relationships between employers and employees, the practical approach to the problem is to devise a method of preventing or retarding conflicts by providing machinery for the adjustment of differences. The conference believes that it is possible to set up a more effective series of tribunals for the adjustment of disputes than at present exists. To be successful such tribunals must be so organized as to operate promptly as well as impartially.

"There must be full participation by employers and employees. There must be representation of the public to safeguard the public interest. The machinery should not be used to promote unfairly the interests of organizations, either of labor or of capital. The plain fact is that the public has long been uneasy about the power of great employers; it is becoming uneasy about the power of great labor organizations. The community must be assured against domination by either. On the other hand, there must be equal assurance that such machinery will not be used to discriminate against organizations of employees or of employers.

"The plan does not propose to do away with the ultimate right to strike, to discharge, or to maintain the closed or the open shop.

"The plan is national in scope and operation, yet it is decentralized. It is different from anything in operation elsewhere. It is based upon American experience and is designed to meet American conditions."

Provision is made for a National Industrial Tribunal and for industrial regional boards. Panels of employers and employees are to be created and Regional Boards of Adjustment formed to act when disputes arise. If either side to the dispute fails to select a representative a regional board of inquiry shall be formed. During the progress of the inquiry such a board may become a board of adjustment if both sides agree to submit the dispute for adjustment. When a board of adjustment fails to reach a unanimous determination it may by unanimous vote elect an umpire whose decision shall have the same effect as that of a board of adjustment. An agreement by the parties to a dispute or a determination by a regional board of adjustment, an umpire or the National Industrial Tribunal shall have the effect of a trade agreement, which parties to the dispute are bound to carry out.

APPLICATION TO UTILITIES

A statement as to public utility industries is included and is as follows:

"The plan here proposed presents greater difficulties in application to certain public utilities than to competitive industry. The continuous operation of public utilities is vital to public welfare. As the capital invested is employed in public use, so is the labor engaged in public service, and the withdrawal of either, with the result of suspending service, makes the people the real victim. While continuous operation of all utilities is conducive to the general convenience of the people, that of some of them is essential to their very existence. Of the latter class the railways are a conspicuous example and bear the same relation to the body politic as do the arteries to the human body. Suspension produces practical social and economic anarchy and may impose hardship even to the point of starvation upon large sections of the community. The interruption in such essential public utilities is intolerable.

"The conference believes that a plan of tribunals or boards of adjustment and inquiry should be applied to public utilities, but in the adaptation of the plan two problems present themselves: First, governmental regulation of public utilities is now usually confined to rates and services. The conference considers that there must be some merging of responsibility for regulation of rates and services and the settlement of wages and conditions of labor. Such coördination would give greater security to the public, to employee and employer. Second is the problem whether some method can be arrived at that will avert all danger of interruption to service. These matters require further consideration before concrete proposals are put forward."

"The requirement of unanimity of agreement," says the conference, "has by experience in the United States proved remarkably successful and should assure such confidence that neither side can rightfully refuse to submit to adjustment. A precedent condition of such submission is that the interruption of production shall be delayed. The frank meeting of the parties in controversy together with other men skilled in questions at issue always gives promise of settlement."

The conference also made a statement as to government employees. On this subject it says in part:

"The right of government employees to associate for mutual protection, the advancement of their interests, or the presentation of grievances cannot be denied, but no such employees who are connected with the administration of justice or the maintenance of public safety or public order should be permitted to join or retain membership in any organization which authorizes the use of the strike or which is affiliated with any organization which authorizes the strike.

"The conference is not now expressing an opinion upon the propriety of the affiliation of other classes of government employees with organizations which authorize the use of the strike."

INQUIRY INTO GUARANTEES AGAINST DECLINE IN PRICES

Federal Trade Commission, Receiving Complaints on This Practice, Sends Requests for Opinions and Will Hold a Hearing Later

The Federal Trade Commission has sent out several thousand letters asking for opinions in regard to the guarantee-against-price-decline system. Complaints have been made to the commission that this system tends to prevent decrease in the cost of living.

A hearing will be held, probably about the middle of March. The commission's letter says: "To the end that every party at interest may be fully represented, the commission is inviting, generally, producers, manufacturers, merchants (wholesale and retail) and consumers to declare their interest, so that the commission may know what parties should be represented."

PROTEST AGAINST NEW RULES FOR EXTENSIONS

Potomac Electric Power Company of Washington Tells Public Utilities Commission Its Policy In Reaching New Business

Representatives of the Potomac Electric Power Company appeared before the Public Utilities Commission, of Washington, D. C., in protest against a proposed set of rules governing the amounts to be paid by consumers of electricity for extensions.

J. S. Barbour, counsel for the Potomac company, told the commission that the rules would require the company to make untold expenditures in extending service to new homes, without a sufficient guarantee that such customers would use enough current to allow the company a fair return on its investment in making the extensions.

The present policy of the company is to make free extensions where it is satisfied the amount of energy to be used will justify the amount invested in the extension.

FOREIGN TRADE COUNCIL IS TO HOLD CONVENTION

Seventh Annual Conference of this National Organization to be Held in San Francisco on May 12 to 15 and Electrical Industry is Invited

Men of the electrical industry are invited to give thought to the opportunity to acquire trade information offered by the Seventh National Foreign Trade Convention, which will be held in San Francisco, May 12 to 15, 1920.

Announcement is made that at the coming convention special trade advisors will be present from the Far East, Australasia and South America, to be consulted by American business men. In conjunction with the convention, there will be special foreign trade exhibits held under the auspices of the Los Angeles and Seattle Chambers of Commerce in these two Coast cities.

"The bringing of special trade representatives from the foreign nations to this country so that they may be consulted by American business men, is something that should appeal to every manufacturer or merchant and trade organization in the United States," says Secretary O. K. Davis, in commenting upon this feature of the program. "For the purpose of meeting these foreign trade advisors as well as the large number of Americans who are now doing business in foreign countries, who have been invited to attend, the National Foreign Trade Council is taking steps to have the San Francisco Convention one of the largest ever held in this country."

The National Foreign Trade Council, under whose auspices the coming convention will be held, is made up of leaders of American business engaged in foreign trade. The council is headed by James A. Farrell, president, United States Steel Corporation. Among the other active members may be named: A. C. Bedford, chairman of board, Standard Oil Company of New Jersey; Robert Dollar, president, the Robert Dollar Company, San Francisco; Alba B. Johnson, former president of Baldwin Locomotive Works, Philadelphia; Cyrus H. McCormick, president, International Harvester Company, Chicago; William Cooper Proctor, Proctor & Gamble Company, Cincinnati; W. L. Saunders, chairman of board, Ingersoll-Rand Company, New York; John N. Willys, president, Willys-Overland Company, Toledo, Ohio, and Thomas E. Wilson, president, Wilson & Company, Chicago.

OIL AS FUEL DISCUSSED IN PHILADELPHIA MEETING

H. P. Liversidge Points out in Discussion of Papers That Load Factor of 50 Per Cent is Probably the Economical Dividing Line

A joint meeting of the Eastern Pennsylvania Chapter, American Heating and Ventilating Engineers and the Philadelphia Section, American Society of Mechanical Engineers was held in Philadelphia on Dec. 11, 1919, at which the subject "Oil as a Fuel" was discussed from different viewpoints.

Henry Thomas, combustion engineer of the Sun Company, Philadelphia, presented a paper from the producer's point of view, and E. H. Peabody, of the Babcock & Wilcox Company, of New York, from that of the consumer. A brief statement of the origin of petroleum was followed by statistics on the production of oil, its calorific content and its advantages as a fuel.

Mr. Peabody explained the principal methods employed in oil burning in furnaces and emphasized the economic balance between coal and oil, together with the factors which usually govern the use of coal in contrast to oil for power generation purposes.

In the discussion following the papers, the item of load factor of power plants was added to those mentioned in the papers as affecting the use of oil as a fuel. H. P. Liversidge of the Philadelphia Electric Company stated that a load factor of 50 per cent was probably the dividing line, above which coal is more economical and below which oil would show an advantage under the assumption that prices for oil and coal are comparable.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., Utah Section.—Markham Cheever is the new chairman, and Thomas A. Purton the new secretary, of this section.

Oklahoma Utilities Association.—The annual meeting and convention of the Association is to be held in Oklahoma City from Feb. 10 to 13.

Association of Municipal Electrical Utilities of Ontario.—The next semi-annual convention of this association is to be held in Toronto, Canada, on Jan. 15 and 16.

American Electrochemical Society, New York Section.—The section has elected these new officers: W. S. Landis, chairman; W. A. Cowan, vice-chairman; and H. B. Coho, secretary-treasurer.

Electric Club of Chicago.—At a recent meeting of the club Colonel Bion J. Arnold told some phases of his work as a member of the Naval Consulting Board and as an officer of the aircraft production bureau of the army.

I. E. S., Philadelphia Section.—M. Luckiesh, Nela Research Laboratories, Cleveland, Ohio, will deliver an illustrated address on "School Lighting" at the Jan. 16 meeting of this section of the Illuminating Engineering Society.

Kansas State Association of Electrical Contractors and Dealers.—The next semi-annual meeting of the Association will be held in Topeka on April 12 and 13. William L. Goodwin and Samuel Adams Chase are scheduled to be among the speakers.

A. I. E. E., Lynn Section.—Dr. Saul Dushman, Research Department of the General Electric Company, Schenectady, N. Y., spoke on "Structure of the Atom" at the Nov. 5 meeting of the Lynn (Mass.) section of the American Institute of Electrical Engineers.

A. I. E. E., Philadelphia Section.—N. E. Funk spoke on the Chester generating station of the Philadelphia Electric Company and W. F. James reported on the development committee's work at the Nov. 10 meeting held by this section of the American Institute of Electrical Engineers.

A. I. E. E., San Francisco Section.—Under the auspices of this section of the American Institute of Electrical Engineers, Lieut. Colonel F. B. Jewett, chief engineer of the Western Electric Company, delivered an illustrated address on the subject of "Electrical Communication in War Time" in San Francisco on Nov. 24.

A. S. M. E., Connecticut Section.—Harold P. Donle, radio engineer of the Connecticut Telephone & Telegraph Company, lectured on "The Application of the Vacuum Tube to Radio Telegraphy" before the Nov. 21 meeting of the Meriden Branch of the Connecticut Section, American Society of Mechanical Engineers.

High Tension Club.—At the Nov. 18 meeting of the Club held in Keokuk, Iowa, these officers were elected: J. L. S. Scadding, president; G. N. Carlson of the Keokuk Electric Company, first vice-president; P. I. Robinson of the Fort Madison Electric Company, second vice-president; Albion Davis of the Mississippi River Power Company, secretary, and B. H. Moore, treasurer.

District of Columbia Electrical Contractor-Dealer Association. — W. L. Goodwin delivered an address on "Scientific Electrical Merchandising and Electrical Development," Samuel Adams Chase spoke on "Live and Help Live," and C. A. Payne gave a talk on "Patent Rights as Applied to Heating Elements" at a banquet held by the Association in Washington on Nov. 21.

Ontario Association of Electrical Contractors and Dealers.—Among the speakers at the Association's No. 24 meeting were J. M. Wakeman, general manager of the Society for Electrical Development; H. H. Couzens, general manager of the Toronto Hydro-Electric System; C. H. Wilson of the Apex Electric Appliance Company; Kenneth McIntyre, secretary of the association; and George J. Beattie.

Portland Sections of N. E. L. A. & A. I. E. E. Meet Jointly.—On Nov. 18 the Portland sections of the National Electric Light Association and the American Institute of Electrical Engineers held a joint meeting at which Dr. F. B. Jewett, chief engineer of the Western Electric Company, delivered an address entitled "The Development of Communication of Intelligence During the War."

American Institute of Electrical Engineers.—A meeting of the Institute will be held in Chicago on Jan. 9 under the auspices of the lighting and illumination committee. The following papers will be presented: "Series Systems of Distribution for Street Lighting" by W. P. Hurley, "Multiple Systems of Distribution for Street Lighting" by Ward Harrison, and "Mixed Systems of Distribution for Street Lighting" by Charles P. Steinmetz.

American Electrochemical Society.—On April 9, the second day of the spring meeting of the society which is to take place in Boston, Mass., from April 8 to 10, a joint meeting will be held with the American Institute of Electrical Engineers and two symposiums will be presented. One will be on "Electrically Produced Alloys" and the other on "Power for Electrochemical Purposes." Several papers on "Electric Furnaces" and "Electroplating" are being planned for presentation on the first and third days of the meeting.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Electric Franchises in New York City.—A study on this subject, by Leonora Arent, professor of economics in Saint Mary-of-the-Woods College, is published by Columbia University as one of the "Studies in History, Economics and Public Law," edited by the faculty of political science. To ascertain the status of the franchises held by the companies is the purpose of the study. Attention is also devoted to the subjects of franchise by acquiescence and of the duration of grants in which no time limit is expressed.

International Trade Conference.—The foundation of an international organization of business men was laid at the recent Atlantic City meeting of the International Trade Conference. Four commercial missions, one each from Great Britain, France, Italy and Belgium, joined with representatives of the Chamber of Commerce of the United States in planning the organization. A name for the new international association will be chosen later, after a committee representing the several countries concerned has worked out details of organization.

Louisville Company Starts Customer-Ownership Plan.—The customer-ownership plan of distributing electric and gas securities among the citizens served by Byllesby companies has been extended to the Louisville Gas & Electric Company of Kentucky. Within a few days after the announcement of the plan in the newspapers 520 inquiries had been received and nearly 100 residents had become preferred shareholders. The company has opened a new investment department in charge of J. W. Smiley, formerly with the securities department of the Northern States Power Company.

Good Light Reduces Traffic Accidents in Cleveland.—Between 5 p.m. and 9 p.m. there were 25 per cent more traffic accidents in Cleveland during the winter months than in the summer months. This was attributed to poor light and not to slippery streets by Ward Harrison at the thirteenth annual convention of the Illuminating Engineering Society's Convention in Chicago. In support of this claim it was stated that from 9 a.m. to 5 p.m. the number of accidents was higher in the summer months than in the winter months by about 10 per cent. The records also showed that in the best lighted sections of the city all the winter accidents only exceeded the summer figures by 5 per cent.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Coal Clause Upheld.—A complaint alleging the unreasonableness and illegality of a coal clause in the rate schedule of the Penn Central Light & Power Company, brought by the Pennsylvania Glass Sand Company, was dismissed by the Pennsylvania Public Service Commission. The commission stated that under the coal clause the "burden of proof with respect to the reasonableness of the increased rate rested upon complainant, notwithstanding which the respondent offered considerable testimony on this score which was not controverted. . . . The evidence does not disclose that the imposed rate was unjust or unreasonable in amount, and therefore the complaint must be dismissed."

Service Concerns Consumers Primarily.—After a hearing the Illinois Public Utilities Commission has decided a case affecting the Dahlgren Electric Light Company. As between twenty citizens and taxpayers of a village who objected to a compromise agreement between the village board and an electric utility respecting hours of service, declaring such agreement to be unreasonable, and thirty-three taxpayers and consumers of electric current supporting such an agreement, it appeared to the commission that the matter of hours of service would concern primarily the consumers of electric service and that the village board as representatives of the village would, to a great extent, voice the sentiments of the people with respect to such hours of service.

Robbing Peter to Pay Paul.—In authorizing increased street railway fares for the Washington Railway & Electric Company the District of Columbia Public Utilities Commission answered a suggestion that the need for more revenue be met by higher electric rates. It showed the inequity of burdening one service to meet the cost of another. "To equalize the existing disparity in the net earnings of the two principal street railway systems, it has been suggested," says the commission, "that the increased revenues needed by the Washington Railway & Electric Company be provided by increasing the existing rates for electric light and power, thus throwing upon the electric light and power consumers the burden of making good the deficit on street railway operation. This the commission believes to be not only inequitable and unjust, but illegal. In the opinion of the commission, if the problem before it were solved in this manner, an order based thereon could be successfully attacked in the courts by any user of electric light or power. The real question is this: Shall the full cost of furnishing street railway service be paid by the users of that service, or shall a part of it be paid by the users of a totally dissimilar service through increased rates to them, because the owners of the two utilities in question happen to be identical?"

Extensions for Service.—In ordering the Utah Power & Light Company to extend its electric service to the village of Ririe the Idaho Public Utilities Commission said in part: "A utility operating under a certificate of convenience and necessity in a given district does not fulfil its full duty when it merely extends to and absorbs business which has developed to a point which will at once return a satisfactory profit. A utility owes its share of effort to the creation and development of new business. Expenditures made under the order and direction of the commission are of a nature which the commission is bound to observe as being entitled to a fair return, and the adjustment of the rates and classes of service by the commission in the future will be made with this element in view. The former policy of public utilities in anticipating future demands for service by extending and improving their lines to meet such service when it should have developed is no longer either needed or desired. Under the commission's control the necessity for entering and holding territory by occupation is done away with, but this means that a utility will be required to reasonably meet and anticipate a developing demand, and to facilitate its further increase by reasonable extension. Where a public utility has a district apportioned to it under a certificate of public convenience and necessity, the determinative test is not whether a given extension will of itself pay a profitable income, but whether the business in that district, or districts, as a whole, including the contemplated extension pays a sufficient return. The defendant operates as a unit, and serves a wide field of patrons. These services naturally do not all show the same percentage of profit, and this is not required. The commission may order extensions at any time, if necessary, to meet public convenience or necessity, where the return to be expected is reasonably sufficient when the utility's business is considered as a whole, even though the contemplated extension may not, of itself and standing alone, furnish a profitable income. We have no doubt that, in the absence of the commission, a village offering in the neighborhood of $6,000 annual revenue, and which showed a development resulting in a doubling of its electrical demand within a period of twenty months, would be promptly entered by some utility which would desire to have and hold the business which such a community may be reasonably said to offer, both present and future."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

The Word "Employer," in Workmen's Compensation Act.—Claim for injuries received by patrolman of New York City while removing a bulb from an electric fixture in ceiling of police station, work detailed to him by his superior officer, comes within Workmen's Compensation Law, the term "employer" including a municipal corporation, and the term "employee" meaning a person engaged in one of the occupations enumerated in section. (178, N. Y. S., 402.)

Low Uninsulated Wire Over Pathway.—Petition alleging that uninsulated wire was part of a company's line, that immediately beneath it was a pathway used by public, as known to defendant city, or which might have been known by exercise of ordinary care, and which was known to an employee of city, that wire had been uninsulated for several years and was caused to fall within four or five feet of ground by city's blasting, which condition was brought to attention of employee in charge, and defendant's husband was killed by contact with that wire, stated a cause of action against city for negligent homicide. (Higginbotham v. City of Rome, 100 S. E., 720.)

Newly Discovered Cumulative Evidence.—Evidence adduced by affidavits, on a motion for a new trial, in an action against a corporation, for damages for wrongful death alleged to have been occasioned by its negligent use of electricity, as having been first discovered after a trial resulting in a verdict for the defendant, and tending to prove the breaking of one of its high voltage wires, as to which no evidence had been adduced on the trial, and resultant contact of such wire with its service wires, at such a place and in such manner as would have caused the high voltage of the broken wire to enter the building in which the decedent came to his death by means of an electric shock, at or about the time of his death, is not cumulative. Under the operation of the rule *res ipsa loquitur*, the introduction of such evidence would make the defendant company in such case liable, if the break in the wire was the proximate cause of the injury, in the absence of proof by it of proper construction of the wires at the place of the break and due inspection of its lines, wherefore it is of such character as ought to produce a different result upon a new trial, if its effect should not be avoided in some way. (Lindawood versus Potomac Light & Power Company, 100 S E 868.)

Men of the Industry

Changes in Personnel
and Position—
Biographical Notes

J. S. Haas, who has just recently been released from service, has been appointed electrical engineer for the Atlantic City (N. J.) Electric Company's power plant.

Earl S. Hiscox has been appointed superintendent of the Jewett City (Ct.) municipal electric lighting plant, succeeding Edward Rousseau, who has resigned to go into the electrical supply business.

Louis L. Blake has been appointed manager of the Peabody (Kan.) Light, Power & Ice Company. For the past ten years Mr. Blake was superintendent of the Ashland (Ohio Gas & Electric Light Company.

L. H. Newbert, manager of the commercial department of the Pacific Gas & Electric Company, with headquarters in San Francisco, has been appointed by President Ballard of the National Electric Light Association, to head the committee on cooperation for the association during the coming year's activities. Mr. Newbert began his business career with the Pacific Gas & Electric Company, back in 1900, where in the district around Marysville, he proved of unusual ability in making power sales and lighting load sales for his company. Later he was transferred to the San Francisco office, where as head of the sales department of the company, he built up an organization of unusual strength throughout the central district of California. Later the commercial department and the sales department were combined into one department, to be known as the commercial department, and Mr. Newbert was appointed to head this important position, which he has held during the past three years. Since the inception of the California Electrical Cooperative Campaign, Mr. Newbert has been chairman of the advisory committee. Unquestionably a large part of the activities of this committee appointed by Mr. Ballard, will concern itself with recommending the activities of the California Electrical Cooperative Campaign in its application to national problems.

LEE H. NEWBERT

Howard M. Turner, who has been engaged in private practice since his discharge from the U. S. Engineers, has opened a consulting office at 70 State Street, Boston, Massachusetts. Before his entrance into the service Mr. Turner was assistant to the president, and hydraulic engineer, of the Turners Falls (Mass.) Power & Electric Company.

Paul Bailey has been transferred by the American Gas & Electric Company from the Atlantic City Electric Company where he has been electrical engineer for the past two years, to the Ohio Power Company, with headquarters at Fremont.

Edward J. Donnelly, formerly of the Tuxedo Electric Light Company and Southern Dutchess Gas & Electric Company of Beacon, N. Y., has been appointed electric commercial agent for the Queens Borough Gas & Electric Company, Far Rockaway, N. Y.

Daniel C. Jackling, president of the Utah Power & Light Company, Salt Lake City, Utah., and managing director of vast copper mining interests has been awarded the Distinguished Service Medal in recognition of his accomplishments when in charge of the government explosive plants built during the war.

H. J. Littlefield, who has been connected with the Queens Borough Gas & Electric Company, Far Rockaway, for the past thirteen years, more recently as Electric Commercial Agent, has left that organization to organize the United Electric Equipment Company of Rockville Centre, to carry on an electrical merchandising business in the Borough of Queens and the section of Long Island to the East.

Alexander Macomber, who recently became associated with George P. Carver and John West in the new engineering firm of Carver, Macomber & West, Boston, is well known in the central station field. He was graduated from the Massachusetts Institute of Technology in 1907 in the electrical engineering course and for two years was engaged in hydroelectric construction work in northern California, later being employed by D. C. & W. B. Jackson. In 1910 he joined the interests now known as Charles H. Tenney & Company, Boston, as electrical engineer, becoming assistant engineering manager in 1917. During this period he was engaged in varied work associated with upbuilding and operation of the public utilities managed by the Tenney organization, including design, construction, rate, valuation and commission work. The properties under Tenney management grew in number from four to about twenty-five in this time. In May, 1917, Mr. Macomber went to Plattsburg, N. Y., to attend the First Officers' Training Camp, and was soon commissioned captain in the Engineer Corps, being assigned to the development of searchlight problems in connection with mobile warfare. He was promoted to major while on this duty and organized the 56th U. S. Engineers, which was the searchlight regiment of the A. E. F. Major Macomber returned to the United States in May, 1918, and resigned his commission. He is a member of the American Institute of Electrical Engineers, of the Engineers Club of Boston, and of the Alumni Council of the Massachusetts Institute of Technology.

ALEXANDER MACOMBER

Obituary

Richard B. Snyder, sales manager of the Milwaukee (Wis.) Electric Railway & Light Company, died on the morning of Nov. 14 from valvular heart trouble after a severe illness of about five months. Mr. Snyder was born in Baltimore about 40 years ago and went to the Milwaukee Company in 1912.

George B. Diem, superintendent of construction of the Windsor plant of the American Gas & Electric Co., died on Oct. 26. Mr. Diem was born in Switzerland in 1875 and there received his early education. After spending several years with large engineering firms of Europe, he came to this country in 1907 and shortly afterwards became associated with Sargent & Lundy. After spending three years with this concern in its Chicago office, he went to Des Moines, Iowa, as resident engineer for the company, in charge of the erection of a large power plant. He also held the position as resident engineer for this company in Omaha, Kansas City, and Waco, Tex. Upon completion of the work at Waco he became superintendent of construction at the Windsor plant where he remained for the past four years.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—
Notes on Industrial Activities and Business Methods

ELECTRICAL SHEET MILLS BOOKED TO JUNE, 1920

Demand for All Grades of Sheets Is Heavy at Prices Prevailing Since Last March and Many Electrical Manufacturers Will be Short of Stocks

Producers of electrical sheets are sold well through the second quarter of 1920. With one exception the old price of last March prevails, and the amount of this one advance is $6 per ton. During the summer and early fall producers were booking for the end of 1919 and first quarter of 1920, at the price which should then prevail. At that time the steel strike was in the offing with an unknown result. Now it is generally felt that it will not be necessary to exact a premium on sheets because of a higher wage scale, and the former price is in general prevailing as late as first half of 1920 delivery.

The demand for electrical sheets is very heavy, and it is evident that electrical manufacturers throughout the country have full order books. Demands have been received for well over available productive capacity, and consequently some electrical machinery manufacturers are going to go short on sheets. Some prominent producers of electrical apparatus are known to be in the market for additional electrical sheets. There is no reason to believe that these companies did not order sufficient material but rather that allotments to them were not sufficient to cover their excess needs along with the excess needs of virtually all manufacturers using electrical sheets. Sheet production has been higher than normal capacity in certain mills recently, and it is expected that in 1920 more capacity will be added.

This short market is going to work hardship on many manufacturers who failed to take advantage of open books to order according to requirements for the first half of the new year. It is expected that some old customers are going to suffer in this connection as well as new customers. As present unfilled steel orders are greater than at any time this year, the prospect is not too bright for anything but over-capacity orders for 1920.

ELECTRICAL EXPORTS DURING OCTOBER TOTAL $7,280,663

Gain of Over a Million Dollars in Excess of September's Exports Brings Total for Ten Months to $75,719,867

October's electrical exports amounted to $7,280,663, over a million-dollar gain on those of September. The last two months have pulled down the average for the year to date to $7,571,987 per month, so that the total for the year on this basis would be $91,000,000. This, however, would be a 50 per cent increase over the total for 1918, the highest previous year.

Notable gains over September were in exports of carbons, fans, heating and cooking ware, insulated wire, motors, rheostats, telephone material and transformers. This gain over September is encouraging in the face of shipping troubles along the Atlantic Coast during October. Only during one month of this year were exports of heating and cooking ware higher, and the same is true for telephone materials. Exports of motors and rheostats were higher in only two months.

Total exports for the ten months of 1919 amounted to $75,719,867, a gain over the same period of 1918 of 64 per cent. In only the item of carbons was any loss noted, and that exceedingly slight. Several items showed over 100 per cent improvement.

Figures in the accompanying table were compiled by the Bureau of Foreign and Domestic Commerce:

	October		Ten Months Ended October	
	1918	1919	1918	1919
Batteries	276,730	507,704	2,594,954	5,114,513
Carbons	114,991	121,621	1,250,332	1,228,848
Dynamos or generators	254,156	452,946	2,719,085	4,598,879
Fans	15,679	79,406	723,342	1,320,214
Heating and cooking apparatus	86,144	164,114	556,928	1,351,410
Insulated wire and cables	525,031	487,444	4,740,285	7,780,151
Interior wiring supplies, including fixtures	83,656	168,902	1,175,035	1,899,424
Arc lamps	273	2,239	13,737	13,901
Carbon-filament lamps	5,758	6,075	74,218	144,411
Metal filament lamps	191,344	334,835	2,715,756	4,109,046
Magnetos, spark plugs, etc	222,099	222,972	2,170,904	2,564,409
Meters and measuring instruments	83,674	237,077	1,545,994	2,506,697
Motors	1,147,159	1,007,930	6,636,810	8,853,573
Rheostats and controllers	30,281	63,153	197,859	438,269
Switches and accessories	124,720	347,152	1,836,686	3,118,811
Telegraph apparatus, including wireless	19,689	44,566	258,949	751,973
Telephones	148,312	388,428	2,377,119	3,079,565
Transformers	206,575	218,789	2,779,377	3,332,601
All others	1,324,313	2,425,310	14,250,880	23,513,172
Total	4,860,584	7,280,663	48,618,300	75,719.867

GENERAL ELECTRIC COMPANY EXPANDING IN SUPPLY FIELD

Company Has Leased Several Existing Concerns with Excess Capacity To Care for Demands which Are Growing at Rate of $10,000,000

In order to keep pace with the growth in the electrical industry, without in all cases consuming the time required to construct new plants and train new organizations, the General Electric Company has in several instances taken advantage of opportunities to acquire under lease existing supply concerns with excess capacity, with options to purchase at some later date. The company's financial statements of the last ten years show that its sales have grown at the rate of $10,000,000 a year at least. Therefore, if the company is to fulfill the ordinary demands of its customers, factory facilities to provide for such increase must be procured on practically an annual schedule.

In reply to questions asked recently by a representative of the ELECTRICAL WORLD, one of the officials of the General Electric Company said: "The General Electric Company, like all progressive electrical manufacturers, will continue to expand. That is natural and inevitable. Besides, balancing out certain large plants and increasing others, it will probably establish unincorporated units in new locations. In certain cases, however, particularly in the supply field, considerable time will be saved, when our customers are making unusual demands on us, if we can purchase outright or negotiate, at least, for some going business of good reputation and with surplus capacity. Such arrangements may also include the right to purchase the plant at the end of five years or longer. In this way will we be in a position to give service to our customers quickly, without waiting to train an organization and establish volume and economical production.

"That is all there is to the recent acquisitions by the company. They do not, in the amounts involved, constitute a very large proportion of our average annual outlays for new facilities."

In accordance with these plans the company is now negotiating a lease with the D. & W. Fuse Company of Providence, R. I., with provisions for purchase at the end of ten years. The last concern the company leased was that of the rigid conduit business of the American Conduit Manufacturing Company. A few months prior to that the business of the Trumbull Electric Manufacturing Company was taken over under contract.

PRODUCTION OF ELECTRICAL GOODS MUST BE INCREASED

Spring Requirements Will Not Be Met Unless Manufacturers Do Something to Increase Output

With the steadily growing demand for electrical goods, with rapidly lengthening deliveries and stocks on hand getting lower, it becomes more and more apparent that production must be increased, and that quickly, if the spring requirements for electrical goods are to be met quickly and fully. The winter season is generally the low point in the demand for electrical materials of most kinds. To be sure, those electrical equipments that require a long time for fabrication must be ordered during the winter months in order to secure delivery when the project is ready for installation. Generally speaking, however, electrical manufacturers have an opportunity during the winter months to fill out their stock and place themselves in a favorable position to meet the demands opened up by spring building.

Everything next year points to increased requirements for electrical goods. It is evident, however, that unless deliveries turn from a condition of getting worse to one of getting better these requirements will not be met.

Probably the most serious drawback to the production is labor. Labor is requiring shorter hours and on top of it, as a result of its high wages, is losing considerable time. One of the largest electrical manufacturing plants in New England, employing about 10,000 people, reports that about 1,500 are absent every Saturday and that not more than 300 of them have a legitimate excuse. The managers of this plant state that it is the high wages that are causing the men to work only part time.

GOVERNMENT PLAN TO SELL SURPLUS WIRE AND CABLE

Bids for 1,710,000 Feet of Telephone Cable and 854,923 Pounds of Copper Wire Will Be Received Until January 13

The Director of Sales, War Department, following a conference on Dec. 16 with representatives of wire and cable manufacturers, dealers and distributors, announces plans for disposing of the present available supply of copper and wire cable now held as surplus by the War Department. There are approximately 1,710,000 ft. of telephone cable and 854,923 lb. of copper wire to be marketed. Proposals for this supply will be received up until Jan. 13, 1920, at the office of the Director of Sales, Munitions Building, Washington, D. C.

Two plans for disposing of the material were agreed upon as a result of the conference. These were: first, to request proposals for sale outright, the customer to be permitted to submit proposals for all or any part of the mateterial shown on the list; and, second, to ask for proposals for the sale of all of this material on a commission basis. In the proposals to be submitted under the second plan, the bidders will be required to state the amount of commission to be charged, the method of determining minimum prices at which the sale will be made, and to state the minimum prices at which they will purchase the residue of this material at the end of the time specified in the proposal. Furthermore, the Director of Sales will pay particular attention to the ability of prospective contractors or dealers to handle transactions of the magnitude of this sale.

Also the Director of Sales reserves all rights to reject any or all proposals and to continue further negotiations should no satisfactory proposals be received. Under either plan, sales will be made f.o.b. cars, "as is" and "where is."

The greater part of the wire and cable is located in the Philadelphia ordnance district. The remainder is stored at various depots throughout the country. A majority of the material is in excellent condition and packed as originally prepared for overseas shipment.

The approximate quantities and descriptions of the cable and wire are as follows:

1,140,080	ft.	10 pair lead covered telephone cable.
79,200	ft.	10 pair double wrap paper telephone cable.
599,280	ft.	15 pair lead covered telephone cable.
680,800	ft.	25 pair armored, lead telephone cable.
31,320	ft.	25 pair steel armored telephone cable.
100,320	ft.	50 pair lead covered telephone cable.
2,000	ft.	19 g. cable for interior construction.
5,031	lb.	No. 1 triple braid weather proof copper wire.
3,711	lb.	No. 2 triple braid weather proof copper wire.
4,489	lb.	No. 4 triple braid weather proof copper wire.
3,128	lb.	No. 6 triple braid weather proof copper wire.
1,170	lb.	No. 10 triple braid weather proof copper wire.
39	lb.	No. 14 hard drawn tinned copper wire.
26,369,000	ft.	No. 17 twisted pair copper wire.
1,016	lb.	No. 2 rubber covered double braid copper wire.
4,116	lb.	No. 6 rubber covered double braid copper wire.
8,930	lb.	No. 6 rubber covered single braid copper wire.
9,110	lb.	outpost strand, single copper wire.
1,235,695	ft.	bare outpost strand.
35,421	lb.	bronze, tinned .014 in.
87,363	lb.	bronze, tinned .013 in.
6,912	lb.	⅜-in. annealed rods.

PRODUCTION OF ELECTRICAL MACHINERY IS FAR BEHIND

A Few Small Broken Stocks Are Available, but Shipping Dates Are Advanced from One Month to More than a Year

Probably the most important feature of the electrical apparatus marketed today is shipments. While for some types of apparatus shipments are virtually normal, for other types, motors particularly, shipping dates have lengthened tremendously. Shortage in some lines of raw materials has something to do with this condition, but demand is the real factor.

Fractional-horsepower motors a year or so ago could be shipped from stock or at the worst in twelve weeks. Now it is rather common to hear of a manufacturer's production booked up until after January, 1921, more than twelve months. The heaviest demand seems to be for ¼-hp. and ⅛-hp. appliance motors, and on these sizes more than 100 weeks has been given as a shipping date. On the other hand, certain manufacturers could begin deliveries of a portion of an order in twenty to thirty weeks.

Broken stocks exist for motors from 1 hp. to 50 hp. A few of virtually any size in this range can be picked up in some city, but in general it requires from eight weeks to six months to fill a fair-sized order. Normally stocks would be spotty, but shipments would be nearer eight to twelve weeks. For larger motors the volume of orders is not so great, and they can be completed in about the same time, that is eight to twenty-four weeks. Normal shipments would be up to fourteen weeks.

Generators, rotaries and kindred machinery are not coming through in such volume as to lengthen appreciably their ordinary shipping dates. The lowest limit given is twelve weeks, and for larger and more special machines the time of filling an order goes up to ten months.

The exceptionally heavy demand for distribution-type transformers has depleted local and factory stocks to a great extent. These stocks are badly broken but can be transferred to meet a hurry order. It is requiring from six to ten weeks to fill an order which ordinarily would be filled from stock.

Apparatus transformers are up against a stiffer shipping schedule, from six to ten months. The policy of central stations with regard to high-tension customers purchasing their own transformers has resulted in a more diversified distribution of orders among transformer manufacturers. The increasing number of special engineering features which must be worked out to fill these various orders is taxing to a great extent the engineering capacities of the manufacturers and is lengthening shipping dates. Formerly shipments were made in eight to thirteen weeks. At the present time one company is figuring on an equivalent of more than 1,500,000 kw. capacity in special transformers, each one under 200 kw.

House meters used to be carried in stock. Now the demand has taxed manufacturing capacity in spite of recent doubling of that capacity by some producers. A small amount of broken stock exists, but on a large order it takes about three weeks in which to commence shipments. Re-orders are being placed before the original one is completed.

Since summer steam-turbine shipping dates have nearly doubled for one manufacturer. His summer date was rather below normal. However, it is taking from five to seven months to finish turbines in capacities under, say, 1000 kw., and from ten to twelve months for the larger sizes. These dates are little above normal. The absence of capable labor is a contributing factor with one producer. One manufacturer believes his average production is behind about 25 per cent. This would not seem far from a pretty fair estimate of all electrical machinery production.

METAL MARKET SITUATION

Copper Firm After Month of Heavy Sales—Further Advance Brings Lead Price to 7.50 Cents

Copper trading is again active after the Christmas holiday and the market shows a firm tone. Prices rose to 18.75 to 19.00 cents, although some premiums are being offered for future deliveries. Dealers' prices are on a par with those of producers. First quarter deliveries are quoted from 19.25 to 19.75 cents, while second quarter is held at 20.00 to 20.50 cents a pound. Inquiries have been received for second quarter business and already there has been much activity in these long deliveries. The third quarter is receiving attention.

Sales of copper for the month of December have been estimated at nearly 300,000,000 pounds, the biggest month since hostilities ceased. It is also estimated that domestic demand is taking 75 per cent of normal refinery production, whereas in former years it has absorbed from 40 to 60 per cent. Foreign sales, too, have recently increased, particularly to France, Great Britain and Japan.

Lead price was advanced again on Dec. 26 by the American Smelting & Refining Company, this time $7 a ton, bringing the New York price to 7.50 cents a pound. An extreme shortage exists in the market, which the outside interests were taking advantage of with higher prices than 7.50 cents, the most recent report showing payments as high as 8.00 cents.

NEW YORK METAL MARKET PRICES

	Dec 22	Dec 30
Copper:	£ s d	£ s d
London, standard spot	104 0 0	16 15 0
	Cents per Pound	Cents per Pound
Prime Lake	19 00	19 00 to 19.50
Electrolytic	18.50	18 75 to 19.00
Casting	18 25	18 50
Wire base	21 50 to 12 00	21 50 to 22 00
Lead, trust price	7 15	7 50
Antimony	9 62½	9 62½
Nickel, ingot	41 00 to 42.00	41.00 to 42 00
Sheet zinc, f o b smelter	11 50	11 50
Spelter, spot	8 65 to 8 75	9 00 to 9.10
Tin, Chinese *	55.50	59 50
Aluminum, 98 to 99 per cent	32 00 to 33 00	32.00 to 33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	17 00 to 17.50	17.00 to 17 50
Brass, heavy	9 50 to 10 00	9.75 to 10 25
Brass, light	7 75 to 8 00	7.75 to 8 00
Lead, heavy	5 87½ to 6 12½	6 00 to 6 25
Zinc, old scrap	5 00 to 5.25	4 75 to 5 00

THE WEEK
IN TRADE

THE new year opens with the shelves almost bare of electrical goods. Deliveries are long and demand is high. High as it is, however, it is small compared with the call that is expected to come during the second quarter.

Prices are slowly mounting. Advances are reported this week in fir cross arms, bells and buzzers, safety switches, porcelain, pole line hardware and conduits

Inventories are being taken and at the conclusion thereof long delivery purchases can be expected. The tendency to quote prices as of date of shipment is again coming to the front.

NEW YORK

Sales held up well during Christmas week and jobbers' stocks of appliances are so broken as to be of little account as such. Deliveries are still behind but in some schedule material they are picking up. Complaint was heard from one jobber that manufacturers of this material were beginning to dump too much material on him. The answer is undoubtedly that he has tried to protect himself too heavily, and better shipments from manufacturers are giving him more than he can use at this time.

Good supplies of pipe can be found in some places although in general small sizes are scarce. Wire is in sufficient stock, or on the way, to satisfy needs. Lamp stocks are being replenished in better volume. Heater sales are good and shipments are coming through well to keep stocks in fair condition.

Prices have advanced on fir cross-arms, wood and iron box bells and buzzers and on the safety switches of at least one manufacturer.

BELLS AND BUZZERS.—One manufacturer on Dec. 20 advanced the price on iron and wood box bells and buzzers about 15 per cent. An advance of 11 per cent was made by another manufacturer about 6 weeks previously. The demand is steady and shipments good.

CROSS-ARMS.—On Dec. 22, prices advanced on fir cross-arms 20 per cent, New York and New Jersey warehouses. Buying is active and shipments good. Yellow pine advances have been announced, but on Dec. 22 their prices were cancelled, subject to later announcement.

WIRE.—There is a transition going on in prices of rubber-covered wire because of rising cotton prices. Bases are averaging 30 cents. The tendency is to raise the net price of small sizes and lower that of large sizes because cotton is a larger factor in the former and copper in the latter. No. 14 prices are $11.75 to $12.00 in 5000 ft lots.

SOCKETS.—In standard packages, discounts of 20 to 23 per cent prevail, while in 1000 lots discounts as high as 27 per cent can be found. Deliveries of key and keyless are good while those of chain sockets are still poor.

FUSES.—Better sales are reported in renewable fuses, following their recent listing as standard by the Underwriters' Laboratories. To date the products, in whole or in part, of four manufacturers have been listed. Deliveries of renewables are not so good as of non-renewables.

CONDUIT.—Rigid conduit prices of $71 15 are prevailing on ½-in. black in 5000 ft. quantities In general, stocks of small sizes are poor, although in spots they are fair.

FLEXIBLE ARMORED CONDUCTOR—Production of steel strip is still below normal so output of finished conductor is more limited. No. 14 single strip is selling for $86 to $88 per M and double strip for $88 to $90 in 1000-ft. lots.

LAMPS.—Distributers' stocks are building up in better shape, while sales are heavy.

MOTORS.—Good sales are reported in sizes up to 50 hp. Contractor-dealers are paying more attention to motor stocking and are ordering well for spring delivery.

SAFETY SWITCHES.—Price advances of approximately 10 per cent have been announced by one manufacturer as of Dec. 22.

CHICAGO

The Christmas trade among jobbers and dealers was the greatest in their history, some jobbers stating that they have more than doubled their business of last year. In the line of household devices all stocks with the exception of irons were practically exhausted. Christmas-tree lights sold as never before, one jobber stating that whereas he had formerly carried over 4000 or 5000 sets, this year he had completely sold out his reserve, and also large supplies which he had recently received. Porcelain tubes and knobs are very scarce, and one jobber has put in a price increase of about 15 per cent. Practically no deliveries are being made on non-metallic flexible conduit. Building permits in Chicago for the week amounted to $1,300,000. In St. Louis, Mo., the Block Two-Eighty-One Realty Company will erect within the next year a $1,250,000 annex for the Rice-Stix Dry Goods Company. The St. Louis Home & Housing Association which intends to build 1000 homes by the end of 1920, has started work on 175 houses. The American Range & Foundry Company of Minneapolis, Minn., will soon start work on a large plant in East St. Louis. Work has been started on the $2,000,000 Hotel Wolverine in Detroit, Mich. Waukegan, Ill., will shortly have erected 158 bungalows at a total cost of about $500,000.

WIRE.—Prices for rubber covered and waterproof are stiff with a base of 30 cents. Shipments are improving; some jobbers are receiving large quantities of wire, but they relay it on to dealers and contractors as fast as they get it, and consequently are not building up their stocks.

PORCELAIN KNOBS AND TUBES.—It is almost impossible to get deliveries on porcelain, and some manufacturers have called in their price-lists. One jobber has increased his prices about 15 per cent, but most of them are still holding the old price of about $18 per 1000 for knobs and $6.25 per 1000 for tubes.

HOUSEHOLD APPLIANCES.—Sales of appliances of all kinds have broken the record. Some jobbers state that they have done over twice as much business as they did last Christmas. Practically no goods are left on the shelves except a few irons. This is in spite of the fact that some large shipments were received just before Christmas. In St. Louis jobbers helped out the city dealers by selling them merchandise which was ordered by country dealers, but which came in too late to get into the country for the Christmas trade, and on which cancellations are now expected.

CHRISTMAS TREE LIGHTS.—For the first time in history jobbers sold out practically every light they had in their houses. One jobber states that he had formerly always carried over 4000 or 5000 sets until the next year, but this year besides selling out large quantities which had been shipped in to him, he cleaned up his entire reserve. So great was the demand that department and other stores raised their prices 25 per cent during the week before Christmas.

CONDUIT FITTINGS. — Jobbers have advanced their prices on condulets. Old discounts of 20 per cent on one-fifth standard package, and 30 per cent on standard package lots have been lowered to 5 per cent and 15 per cent respectively.

MOTORS.—Three-phase alternating current motor production is twice that of last year, according to one manufacturer. Deliveries are improving to six to twelve weeks, depending upon the size and type when not in stock, and there are a few of some standard sizes in stock. The greatest demand is for motors from 5 hp. to 25 hp. with some calls up to 75 hp. three-phase, but very little call for larger sizes. Sales of fractional horsepower motors are practically all in ⅛ hp. and ¼ hp. single-phase.

SECOND-HAND EQUIPMENT.—There is a good demand for second-hand power-house equipment such as generators, etc., up to about 500 kw. There is little or no call for larger units. The demand for second-hand alternating-current motors is the same as that for the new machines, the greatest in 5 hp. to 25 hp. and ⅛ hp. to ¼ hp. sizes.

BOSTON

The year 1919 closed with a record-breaking volume of trade in electrical New England, both in quantities and money. Expansion of industrial facilities and the building of new mercantile and residential structures continues at a pace which bids fair to exert heavy pressure upon manufacturers and distributers in 1920. In the first eleven months of 1919 New England building operations totalled $209,000,000, or $28.12 per capita. No such total has ever been attained before in this district. Jobbers' stocks are heavily depleted as regards domestic heating appliances and some classes of wiring material, but are beginning to improve in general volume. Orders are being freely placed with the manufacturers for delivery as late as the coming summer. Collections were not up to normal at the close of December, and vigorous efforts were made early this week to round up delinquents. Prices and deliveries are still much unsettled. Rumored advances in the prices of electrical measuring instruments, portable types, and friction tape are being discussed. Condulets are up about 20 per cent compared with early December.

WIRE.—Base prices are 30 cents for rubber-covered, 26 to 28 cents with varied deductions on weatherproof, and 24 to 25 cents for bare. Fair stocks of cable are on hand, but smaller sizes are relatively scarce.

LAMPS.—The demand is vigorous, with a tendency toward longer deliveries.

FLEXIBLE ARMORED CONDUCTOR.—Stocks are very short, with little chance of substantial improvement for four or five months. Prices are chaotic, a recent sale of No. 14 single-strip at $100 per thousand feet reflecting the market scarcity. More common quotations, subject to change, are from $85 to $88.

NON-METALLIC FLEXIBLE CONDUIT.—Bins are almost bare and such material as arrives is immediately absorbed. A rough price Monday was $30 net per thousand feet for $\frac{5}{32}$-in. conduit.

ARMORED FLEXIBLE CONDUIT.—Prices are demoralized on account of the scarcity of this material.

RANGES. — Some sales are reported, notwithstanding last summer and fall's price advances.

PORCELAIN.—All porcelain fittings are very scarce, and orders are taken subject to market price on the day of factory shipment. Nailit knobs are quoted, when available, around $26.40 per thousand f.o.b. Boston, in standard packages, and 3-in. tubes at $7.50 per thousand, standard packages.

CONDUIT.—Deliveries are unsettled and prices irregular. Stocks are low. A tentative quotation of $83.75 per thousand feet on ½-in. black pipe was noted Monday. Buyers are obliged to take chances on price changes when purchasing under present conditions.

PORTABLE LAMPS.—An excellent holiday trade is reported. One jobber sold about 600 portable lamps in two days, just before Christmas. Retail stocks were not exhausted, but were sharply lowered, by the December trade.

WASHERS.—The demand increases and machines are sold virtually before they arrive in the jobber's stock room. Only by herculean efforts can this district avoid a shortage.

CLEANERS.—Trade is brisk, but the supply is more plentiful than in the case of washers.

MOTORS.—Deliveries are rather long, viz., 90 days on single-phase, constant-speed; four to five months on single-phase, variable-speed; twenty weeks on variable-speed, polyphase, and six weeks on constant-speed polyphase motors, taking a few representative quotations. Direct-current motors are a little freer in supply. Prices are firm.

SOCKETS.—While the manufacturers are considerably behind on orders, jobbers report an improvement maintained in supply. Pulls bring 47.5 cents, keys, 27 cents and keyless sockets 25 cents each in case lots.

TAPE.—Boston prices show little change, running around 46 cents per pound for $\frac{3}{4}$-in. black. Complaint is heard that good quality tape is scarce.

DRY CELLS.—Recent price conferences have greatly steadied prices, which quote $32.90 per hundred on No. 6 cells and $33.90 for the ignition type. Good stocks are reported, with healthy demand.

ELECTRIC WELDERS.—A vigorous and growing industrial demand exists.

ATLANTA

With the holiday season over, jobbers report a general slackening in the demand for all lines of electrical material. This condition will continue through the first of the year as the trade is not desirous of placing orders for materials before the inventory period. Building operations have slackened because of the disorganization caused by the holiday season. The annual reports of all jobbers are going to record the greatest year in their history. Bank clearings for Atlanta for the week ending Dec. 18 reached the high water mark of $91,500,000, and for the week ending Dec. 25, $71,700,000, these clearings being from 30 per cent to 50 per cent in excess of the same period last year.

The demand for distribution systems by those towns in the district who have heretofore been without this convenience, is becoming more and more pronounced. Indications are that a great many of these towns will install local plants as soon as they are able to obtain materials.

CONDUIT.—If possible, the conduit situation is becoming worse, the best deliveries at the present time being quoted at nine weeks. Stocks throughout the territory are badly depleted and jobbers announce intentions of placing orders for requirements six months hence.

WIRE.—Despite the continued strong demand, there is a slight improvement in the wire situation in the South. One of the large jobbers reports shipments in transit will help conditions materially and while there is still a shortage of No. 14 rubber-covered, the condition of stocks of large sizes has improved materially. They are quoting factory stock shipments on sizes of 500,000 cir. mills and over. Weatherproof is 29 cents and rubber-covered, 28 cents.

ARMORED CONDUCTOR.—A noticeable slackening in the demand for this article has been registered, but stocks throughout the territory are not improved. Miserably poor shipments, and anticipation of their demands by large users accounts for the slackening in demand. The demand will become brisk again in the early spring.

POLE LINE HARDWARE.—There has been a 10 per cent price advance. Stocks are in fair condition with brisk demand.

PORCELAIN.—As predicted, the porcelain market has shown a price increase of 10 per cent, which new price will control future shipments on all orders in hand. Stocks are in fair condition but shipments are not reliable.

HEATING DEVICES.—Retailers and jobbers report all stocks of heating devices badly depleted, the popular lines being practically exhausted by the holiday trade. There will be no move to re-stock on these lines until later. From announcements just released by manufacturers, prices will be quoted subject to date of shipment only.

CONDULETS.—A price increase of 23½ per cent on this commodity has been announced, despite the fact that there is a good supply in this region. The demand is reported rather dull.

MOTORS.—The demand in sizes up to 100 hp. continues very brisk, and stocks in the territory are spotty. Shipments are poor, averaging 12 weeks. One jobber, however, reports a large shipment promised for early in January. Demand for single-phase motors continues to exceed the supply, but conditions should materially improve in this line within 60 days.

SEATTLE—PORTLAND

Had it not been for delayed shipments from East and consequent shortages, this year's holiday sale in Seattle would have been considerably larger than last. As it was the total business done was nearly as large as last year. The more acute shortages were experienced in percolators, toasters, irons, heating pads and washing machines. Jobbers report retailers purchased in small quantities, but frequently.

Manufacturers in the Portland district report a slowing up in business preceding the holidays, due, partly, to the big storm, earlier in the month. Present indications are that conditions will soon be normal again. Jobbers report the usual seasonal lull in a rather pronounced form. Prices have advanced 15 per cent on all rigid metal and fiber conduit and all condulets. Indications are strong for other rises in copper soon. General retail business has been excellent. Holiday trade, according to all reports, was a record breaker, and had it not been for shortages along certain lines, sales volumes would have been considerably heavier. Principal shortages existed in vacuum cleaners, toasters and electrical tableware. Stocks in small wiring devices and supplies are growing shorter with no immediate prospects of relief. Promises of shipments on orders on eastern factories are dated ahead as far as eight or ten months.

Spokane wholesale houses report business good and retail stores assert holiday sales established new records. Electrical tableware sales particularly showed a considerable increase over last year. Collections are a little slow, particularly from the rural districts. With an unprecedented nationwide demand for lumber, a shortage of freight cars is forcing many lumber mills in Washington and Oregon to close and others to greatly reduced production.

SAN FRANCISCO

Shop keepers and store managers report a record breaking Christmas, a little marred, perhaps, by several untoward strikes. Electrical dealers also participated in this great increase.

VACUUM CLEANERS.—Stocks are arriving regularly, and repeat orders from dealers are very regular, in fact more so than those for any other line of appliances. During the last month or so, there has been an increased demand on lower priced types.

WASHING MACHINES.—During the latter portion of the year the demand has changed so the higher priced machines sell about five times as fast as the lower priced types. Special stores for the demonstration of these better types have been opened up in several cities in the most fashionable districts.

RANGES.—Sales have dropped to a very low figure, not only because of prices, but also because the power companies are not seriously pushing the sale because of lack of facilities. It is difficult to see if this condition will be bettered during 1920.

KNIFE SWITCHES.—The decrease in the number of industrial plant jobs, and the completion of such plants which were underway, will cause a serious falling off in the sale of knife switches, but it is probable that severe inspection by state officials will cause an increased sale in specially protected types.

FIXTURES.—A great many apartment house and dwelling jobs have been practically completed and are now ready for installation of fixtures. There is an increased tendency to simpler forms of lighting units. Big sales are expected for 1920 if prices remain steady.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

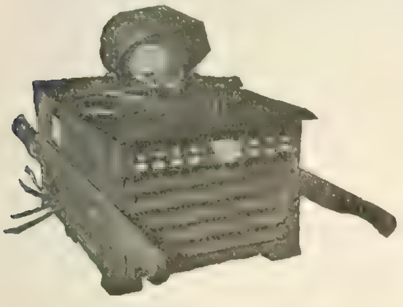
Translucent Glass Lighting Unit

An inclosed translucent glass lighting unit designed to give a soft "velvety" illumination with good distribution and low absorption has been developed by the King Manufacturing Company of St. Joseph, Mo., and is called the "Ve-lu-so." No glare is said to be present when the new unit is used, since the filament of the lamp bulb can not be seen. It has been the aim of the producer to eliminate dust-collecting parts in the unit and to do away with dark ceiling shadows.

GIVES "VELVET" EFFECT WHEN LIGHTED

Improved Electric Arc Welding Machine

A welding machine which is equipped with a manually-operated flux controller for obtaining an arc of any desired length is now being made by the Electric Arc Cutting & Welding Company, 222 Halsey Street, Newark, N. J.



ARC OF VARIABLE LENGTH OBTAINED

The arc length controller, has no moving parts and its handle is removable so that the controller may be set for the desired length of arc and the setting device kept locked up if that is desired.

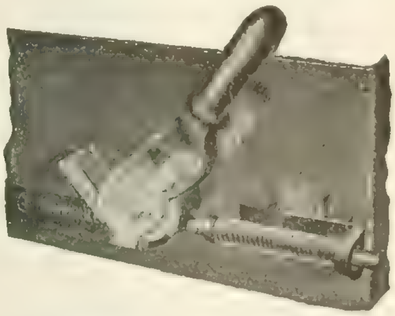
This company has also improved its alternating current arc welding machines by the addition of an appliance which is said to bring the maximum of voltage between the welding leads, or between the handle and work, or across the arc, without external appliances or wires.

Means are now provided on these welding machines for operating an electric automatic chipping hammer which is furnished with the outfits.

In addition these machines now have a rain and dustproof construction, concealed plugs for welding connection and an indicator on the machine to show the length of arc adjustment. A special cable designed for unusually long life is used for the welding leads.

Switches with Quick Make-and-Break Attachment

Fusible and no fuse single throw safety switches equipped with quick make and quick break attachments have been placed on the market by the Trumbull Electric Manufacturing Company of Plainville, Conn., in capacities of from 30 to 600 amp.



COMPRESSION SPRING MAKES SWITCH MOVEMENT QUICK AND POSITIVE

These switches differ from the regular "Safety" switches made by this company in that no matter how the handle is moved from the "off" to the "on" position or vice versa the switch is said to always throw into the full "on" or full "off" position with a quick positive movement. This is aimed to prevent the dangerous and destructive practice of "jogging" or "edging up" the motor.

The quick action of the switch blades is accomplished by means of a compression spring working between the handle and the bearing to which the switch yoke is attached. The position of the handle and the spring is a positive indication of the location of the switch blades. In throwing the switch from "off" to "on" position, the handle's movement is approximately one of 120 deg. The first 80-deg. of movement compresses the spring but does not move the switch blades. At this point the spring lever engages the bearing and continued movement of the handle throws the spring lever over center and the spring continues the movement of the switch into full "on" position with a quick positive throw, regardless of the handle. In opening the switch the action is the same but in the reverse direction.

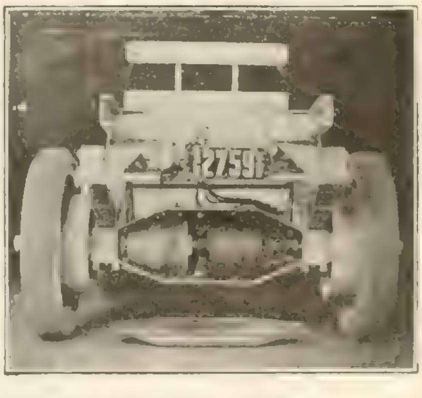
Truck with Motor and Rear Axle Combined

The motor, rear axle and driving gear of the model 2 E electric truck which has recently been developed by the Oneida Motor Truck Comany of Green Bay, Wis., are all in one removable unit.

The single motor is series wound and is mounted on annular ball bearings as part of the rear axle drive unit.

The speed of the new truck is controlled by means of a continuous torque drum-type controller that gives five forward speeds and five reverse speeds. It is mounted under the driver's seat and operated by his left hand, while the reverse pedal is worked by his left foot.

A Sangamo ampere hour meter is used to indicate the state of the battery charge. A safety switch with extra large surfaces and of the double throw type for running and charging positions is located in an accessible asbestos-lined steel box under the driver's seat.



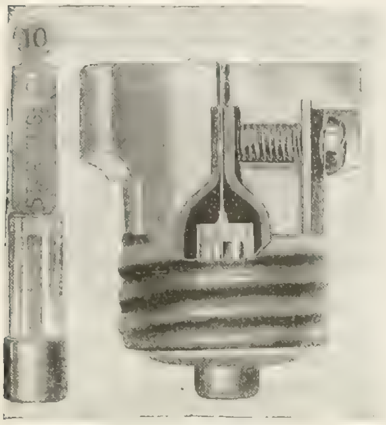
REAR AXLE INCLOSES MOTOR AND DRIVING MECHANISM

The new truck has a capacity of 2 tons and a loading space of nearly 12 ft. behind the driver's seat. Various styles of bodies can be used.

Renewable Fuse Plug

A plug fuse that can be renewed without taking the fuse apart is being marketed by Star Fuse Company, Inc., 290 Church St., New York, N. Y.

An inner cartridge which enters the fuse from the bottom is clamped between two flat pieces of brass at the top of the plug by a screw. The other end terminates in a brass contact cap. A piece of glass tubing protects the delicate part of the fuse element from kinking or bending and holds the melted material of the blown fuse.

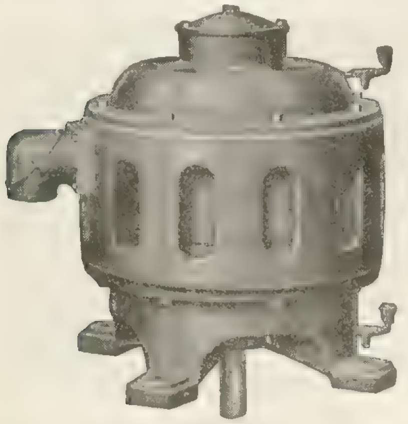

FUSE DOES NOT HAVE TO BE TAKEN APART FOR REFILLING

The fuse element projects slightly outside the plug. The rating is stamped on this projection.

Vertical Induction Motors

Vertical induction motors are now being produced by the U. S. Electrical Manufacturing Company of Los Angeles, Cal., with No. 500 frames and larger; they are known as type "S T U."

The new motors have cast shell type frames designed for rigidity. The bars are brazed to the rings. Fuel bearings of large size and running in oil, are supplied at the top and bottom. The shafts are made of spindle steel. The specially treated form-wound coils and windings are of rectangular wire. Heavy insulation and improved condulets are also features of the new motors, it is said. They are designed to operate without noise or vibration and to have a large overload capacity.


BALL BEARINGS ALLOW USE OF SMALL AIR GAPS

Full Magnet Controller for Elevator Motors

An alternating current full magnet controller for motors in elevator service is now being made by the Warner Elevator Manufacturing Company of Cincinnati, Ohio, and is known as type A. A.

The controller's upper panel carries the main switches, two of them operating for each direction. The master magnet, which is in the center of the lower panel, operates after the main switches have closed and the plunger is raised rapidly. The piston in this plunger gradually drops by gravity and successively cuts in the four accelerating magnets. The master magnet also acts as an interlock to prevent sudden reversals. The main switches have magnetic blow outs and are mechanically interlocked.

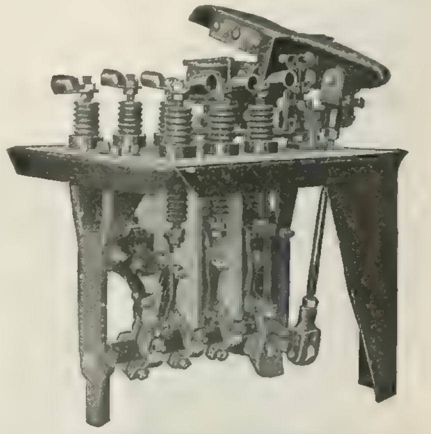
MASTER MAGNET ACTS AS INTERLOCK TO PREVENT SUDDEN REVERSALS

The new controller is for use on motors having wound motors, the rotor resistance being supported on the rear of the board by an angle-iron frame.

Oil-Immersed Switch Operated by Clapper Type Magnet

An oil-immersed magnetic contactor, operated by a clapper type magnet, and designed to have a rigid mechanical structure and reliability in operation has been developed by the Cutler-Hammer Manufacturing Company of Milwaukee, Wis. This contactor has a capacity of 100 amp. at 2200 volts, and is declared to be particularly useful as a main line switch for an automatic 2200 volt motor starter, or for the remote control of a 2200-volt light or power circuit. It is built with three poles, unless used with an auto-transformer starter, in which case five poles are provided.

The frame of the contactor, which is of heavy sheet iron, is arranged for wall or switchboard mounting, and carries two case iron supports with two insulated shafts carrying the contacts.


OIL TANK REMOVED SHOWING CONTACTS AND ARCING SHIELDS

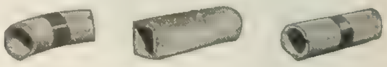
The copper leaf brush contacts have auxiliary arcing contacts. The armature is pivoted to the frame, and is connected by a rod to an arm of the shaft carrying the moving contacts. The attraction of the armature against the face of the magnet rotates the shaft and closes the switch, which is normally held open by the weight of the moving parts.

A sheet metal tank contains the oil for immersing the contacts. The arc is broken at the contacts in a horizontal direction the maker points out. Transit shields are supplied to prevent arcing across adjacent poles.

This new oil-immersed switch may be arranged to have two contactors act as a reversing switch.

Stone Conduit Splits, Elbows and Couplings

Three new forms of "Stone-Duct," a conduit for underground electrical conductors made of magnesium limestone and "Portland" cement, have been produced by the Chicago Stone Conduit Company, 2701 Addison Street, Chicago. One is an 18-in. straight split. The second is a coupling with one square and one round end. The purpose of this piece is to connect new lines of stone conduit, which is round, to old lines of square clay tile. It is stated that cable can be pulled either way through these couplings without stoppage. The third piece is a 45-deg. curve or elbow which is intended to facilitate covering power house and substation cables which curve around pipes or corners. These curved pieces can be cut with a hack saw to any angle, the maker states.


CURVE, COUPLING AND SPLIT OF STONE CONDUIT

Manufacturers' Activities

JEWELL ELECTRICAL INSTRUMENT COMPANY, CHICAGO, ILL., is starting a $50,000 factory.

THE SCHROEDER HEADLIGHT & GENERATOR COMPANY, Evansville, Ind., has changed its name to Sunbeam Electric Manufacturing Company.

TUBULAR WOVEN FABRIC COMPANY, Pawtucket, R. I., proposes the erection of a new two- and four-story plant, which will cost about $200,000 equipped.

METRIC APPLIANCE CORPORATION has been formed to manufacture ammeters, voltmeters and electrical specialties. Executive offices are at 299 Broadway, New York City, and Albert W. Franklin is president.

THE GENERAL ELECTRIC COMPANY has announced that it will erect a new branch factory in Decatur, Ind., the second one in the Central West, the other being at Fort Wayne. The new plant will be a one-story building, 200 x 300 feet, brick and steel. It is planned to have the factory start operations March 1, 1920 and employment will be given to 500 persons.

NORMA COMPANY OF AMERICA, manufacturers of "Norma" precision bearings, on Dec. 10 moved its factory from the Bronx, New York City, to Anable Ave., Long Island City, N. Y., where a modern four-story reinforced concrete building has been acquired. Under the new arrangement a largely increased factory space is secured, making possible the increased output of "Norma" bearings necessitated by the growing demand for these units. The new plant is being rapidly equipped with the special machines needed for precision manufacture, and the full capacity will be available shortly. The executive offices at 1790 Broadway have been consolidated with the factory at the new address.

MIDWEST ENGINE COMPANY, held its annual sales convention in Indianapolis and Anderson, Ind. About forty district representatives were present. In particular the diesel engine, centrifugal pump and steam turbine departments were visited and inspected.

ANNUAL SALES CONVENTION OF MIDWEST ENGINE COMPANY

THE WADSWORTH ELECTRICAL MANUFACTURING COMPANY, COVINGTON, KY., recently suffered a loss by fire of practically all the stock in its factory where the three upper floors of the building were entirely destroyed. However, all the manufacturing machinery located on the first floor was saved. The building is now rapidly being rebuilt and the factory is expected to be again producing enclosed externally-operated switches by the beginning of the new year.

EDISON ELECTRIC APPLIANCE COMPANY, INC., CHICAGO. ILL., announces that its engineering department, after careful investigation and experimentation, is to redesign its old line of furnaces. Some time of course must elapse before the company can obtain the formed bricks and other necessary material. Until such time as the company's proposed line can be made ready for shipment, no literature or prices on the furnaces will be issued and sales will not be pushed. A new bulletin on these devices will be ready for distribution early in 1920.

THE EDWARDS VALVE AND MANUFACTURING COMPANY, East Chicago, Ind., has converted its shop into an electric washing machine factory.

AMERICAN RADIO AND RESEARCH CORPORATION is building a new factory of about 28,000 sq.ft. at Medford Hillside, Mass., for motor manufacture.

BLAW-KNOX COMPANY, PITTSBURGH, PA.,held a convention of its salesmen, engineers and representatives in Pittsburgh, the first week in Dec.

ROME WIRE COMPANY, ROME, N. Y., advises that it is adding a new electric furnace for bronze, a heat treating furnace for annealing, new machinery and enlarging its buildings. The company hopes by spring to be in better shape on shipments.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, EAST PITTSBURGH, PA., has been awarded contracts by the Navy Department for the electrical machinery for three of the new battleships. The price of the three sets was $5,500,000. A duplicate set of the electrical machinery is being built at the New York Navy Yard.

THE WOODROW MANUFACTURING COMPANY, NEWTON, OHIO, has about completed the erection of a new $100,000 factory having 25,000 sq.ft. of floor space for the manufacture of washing machines. The building is of fireproof steel and concrete construction 200 ft. x 46 ft., two stories in the front and three in the rear.

EMERSON ELECTRIC MANUFACTURING COMPANY, ST. LOUIS, MO., is selling one million dollars worth of 7 per cent cumulative preferred stock, the proceeds to be used for the construction of a new factory building immediately adjoining its present St. Louis factory. The company manufactures practically every type of electric motors of two horsepower and smaller.

METHODS OF PACKING DISCUSSED AT CHICAGO.—Reducing the $200,000,000 annual loss from faulty packing, a good share of which is on electrical goods, was the object of a meeting called by the Chicago (Ill.) Association of Commerce, Dec. 4. Standard specifications for boxes and crates, materials and nailing were discussed. Members of the Forest Products Laboratory, American Railway Express and American Railway Association gave valuable information which they have compiled from tests and practice.

NEW SIX LAMP CARTONS ADOPTED. The Edison Lamp Works and the Westinghouse Lamp Company have adopted a new six-lamp carton because, they say, of the increasing tendency of their customers to use various sizes of lamps and the necessity of the agent having a proper package to care for this business. The carton hold six lamps of 50-watts and under, and caters to the common practice of purchasing merchandise in half and dozen lots. Exterior decoration has been reduced to a minimum, thereby eliminating the necessity for wrapping and the expense of material and labor involved. The charge to the agents is three-quarters of a cent each, which the companies claim is less than that of paper and twine. Stocks of the old five-lamp cartons have not been exhausted yet.

PEERLESS INSULATED WIRE COMPANY, 90 West Street, New York City, a Delaware Corporation, has filed notice with the Secretary of State of an increase in capital from $1,000,000 to $4,620,000.

GENERAL ELECTRIC COMPANY has purchased the Symington Company plant in Rochester, N. Y., with the intention of using it to manufacture fractional horsepower motors. About 1000 will be employed at the start.

ROBBINS & MYERS COMPANY'S new plant at Brantford, Canada, is far enough advanced that some production is expected by the end of January, 1920, although several months more will elapse before the plant is producing on any large scale.

FAIRBANKS, MORSE & COMPANY will erect in Chicago, Ill., a building to cost $315,000, three stories, 150 x 300 ft., located at 38th Street and Loomis Place,, in the central manufacturing district. The new structure will be built so as to carry two additional stories if needed.

W. D. WARD has been transferred from the San Francisco office of the Pelton Water Wheel Company to the New York Office as manager of the Atlantic department, which includes the territory east of the Mississippi, Europe and South America. Mr. Ward has been with the Pelton company for twenty-five years, of late as contract and sales engineer. In New York he succeeds F. W. Gay.

THE WAGNER ELECTRIC MANUFACTURING COMPANY has plans drawn for a new $650,000 factory in St. Louis, Mo., for making small motors. Reinforced concrete construction will be used. The main building is to be 400 ft. by 60 ft. and two wings will each be 60 ft. by 60 ft. The whole will have six stories and a basement. Central station power will be used. Bids will be called for early in January. The foundation contract has been let.

ROLLER-SMITH COMPANY, NEW YORK, N. Y., announces that its California representative, the Electric Material Company, 589 Howard St., San Francisco, has opened a Los Angeles office in the Title Insurance Building. The Los Angeles office is in charge of E. H. Bell who has had extensive experience in marketing electrical products. The Electric Material Company handles the Roller-Smith lines of electrical measuring instruments, watt-hour meters and circuit breakers in California, Nevada and parts of Oregon and Idaho.

GRAY & DAVIS MAKING RECORD PRODUCTION.—Gray & Davis, Inc., Cambridge, Mass., report the largest business in the company's history. Over 400 electric starting and lighting systems are being produced daily and by Jan. 1 a further increase of 25 per cent is expected. Plans are being carried forward to produce about 1000 sets a day by next summer. It is announced that the Amesbury (Mass.) factory is now turning out 3000 lamps per day, with prospects of an increase to 4000 lamps by New Year. It is stated that the gross sales of starting and lighting equipment for 1919 will probably total about $5,000,000 and that lamp sales will reach $1,000,000. A 75 per cent increase over these figures is anticipated in 1920. Large orders have been received recently from the Bethlehem, American and Chandler motor interests. The company is developing a new house-lighting system which is expected to be in production in about two months.

HURLEY MACHINE COMPANY PLANS BIG CAPITAL INCREASE.—At a special meeting of the stockholders of the Hurley Machine Company held at the company's offices in Chicago, October 2nd, it was voted to change the capitalization in so far as the common stock was concerned from 15,000 shares of a par value of $100 to 200,000 shares of no par value. This new stock will be exchanged on the basis of seven shares for one of the old common stock. An increase in the membership of the board of directors from five to nine was also authorized. An offering to the common stockholders of record October 15th, of 10,000 shares of the new common stock at $35 per share was also authorized. The proceeds from the sale of this stock are to be used in the extension of the company's present plant facilities. The demand for the company's products, which includes the Thor line of electric washers, ironing machines and vacuum cleaners, has grown very rapidly in the past few years and has necessitated the building of large additions to its present plant. The new board of directors will consist of the following: Edward N. Hurley, chairman. Neil C. Hurley, Samuel Felton, John Burnham, Edward F. Carey, Joseph E. Otis, Silas Strawn, Alva J. Fisher, and Edward N. Hurley, Jr.

Supply Jobbers' Notes

RUMSEY ELECTRIC COMPANY, 1231 ARCH STREET, PHILADELPHIA, PA., **has purchased the 5-story, 25 x 167 ft.** building at 1007 Arch Street. Extensive alterations will be made before occupancy.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY announces that the next annual meeting of the Westinghouse Agent-Jobbers' Association will be held at the Homestead, Hot Springs, Va., during the week of July 26, 1920.

J. F. DAVIS has been appointed sales manager of the Western Electric Company, New England district, with headquarters at 385 Summer Street, Boston, Mass. Mr. Davis is a native of Newport, Ind., and was graduated from Purdue University in 1909, where he took an engineering course. With the exception of two years, his entire business experience has been with the Western Electric Company. He started in the sales organization at Chicago and spent about eight years in that office. For a short time he was in the General Department at 195 Broadway, New York City. He brings to New England the point of view of the Central Western electric supply jobber and is being cordially welcomed to the sales forces of the electrical industry in his new territory.

J. F. DAVIS

Foreign Trade Notes

ELECTRICAL CATALOGS NEEDED IN BELGRADE CONSULATE. — Requests have been received at the Belgrade Consulate for catalogues of recent date of electrical equipment.

ELECTRICAL ENGINEERS LISTED IN COLOMBIA.—The Bureau of Foreign and Domestic Commerce has compiled a list of "Electrical Engineers of Medellin," Colombia, under number 40802 C.

TRADE JOURNALS AND CATALOGUES DESIRED FOR CONSULATE.—American electrical supply manufacturers and firms interested in China as a market are requested by the Vice-Consul at Tsinanfu to send their trade papers and catalogues to his office.

INCREASED USE OF ELECTRIC VEHICLES IN ITALY.—The shortage of gasoline during the war has brought about considerable use of electric vehicles in Milan, more particularly for heavy trucking. There is one electric garage in Milan which operates electric buses and is organizing a corporation with a capital of 3,000,000 lire ($600,000) to manufacture and operate electric vehicles. It is connected with the Società Generale Italiana Accumulatori Elettrici, which will make the batteries. The company would like to form a combination with some American concern manufacturing electric trucks.

LAMPS REQUIRE NO LICENSE FOR CZECHOSLOVAKIA.—The Administrative Board of Import and Export Commission at Prague advises that electric lamp bulbs may be imported into Czechoslovakia without license.

ELECTRIC LAMPS IN SIBERIA.—The Consul at Vladivostok, Siberia, reports 685,000 lbs. of electric lamps in customs warehouses in that city on July 25, 1919. This is an increase of about 50 per cent over the report for June.

IMPORTS INTO AUSTRALIA.—A proclamation has been issued prohibiting the importation without a license into Australia of brass and copper bars, rods, tubes, sheet and wire, zinc, storage batteries and cotton covered electric wire.

IMPORTS OF ELECTRICAL MATERIAL INTO CHINA VIRTUALLY CONSTANT.—In 1917 China imported $4,107,788 of electrical material and fittings, while in 1918 these importations increased only to $4,930,900, according to recent information.

SWISS ELECTRICAL MANUFACTURERS UNDERBID BRITISH ON TURBINES FOR SCOTLAND. — The Corporation of Edinburgh has accepted a tender submitted by Messrs. Brown, Boveri & Company of Baden, Switzerland, amounting to £106,618 for turbo alternators required for the large new power station at Portobello. The lowest British bidder was £174,075. When the tenders were received it was found that the three lowest all came from Switzerland. After the Swiss tender was received the corporation communicated with the three leading British bidders, but these all replied that they could not make any reduction in their prices.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

The purchase of electric welding machinery is desired by a man in Roumania (No. 30,836). Correspondence may be in English.

A firm in Roumania (No. 30,679) desires to purchase asbestos packings, motor machinery and electrical apparatus. Correspondence may be in English.

A trade organization in Greece (No. 31474) desires to purchase and secure an agency for the sale of electrical supplies. Correspondence must be in English.

The purchase is desired by a firm in Switzerland (No. 30,680) of enameled wire, size 0.05 mm. to 0.08 mm. Terms of payment, cash. Correspondence may be in English.

An agency is desired by a man in Italy (No. 30,729) for the sale of electric lamps. Quotations should be given c. i. f. Italian port. Correspondence should be in Italian or French.

A company in Spain (No. 31,399) desires to secure agencies for the sale of cables, wire, switches, portable lamps, insulators, etc. Correspondence should be in Spanish or French.

A busines man in England (No. 31,223) desires to secure an agency or act as sales manager or representative of electrical and mechanical engineering firms. Payment, salary and commission basis.

A firm in South Africa (No. 31,402) desires to get in touch with manufacturers with a view to securing an agency for the sale of electrical motor cars; also of elevators for passenger and freight.

A Chinese resident in the United States, (No. 31,457) desiring to export American goods to China, proposes to open a commission house, and wishes to receive catalogues and price lists of electrical supplies.

The president of an American trading corporation (No. 30,858) is soon to sail for the Balkan countries and desires to secure agencies for the sale of small electric motors, magnetos and armored cables.

Johnson & Phillips, Ltd., London, England, transformer manufacturers, will shortly open an office in Sydney, Australia, under the direction of E. A. Kinsley. Mr. Kinsley is desirious of getting in touch with American firms in regard to supplies of transformer oil. Detailed specifications are requested, and if possible prices per English gallon c. i. f. & e. Sydney. Address Johnson & Phillips, Ltd., Box 740, G. P. O. Sydney, Australia. Specifications are in the hands of the Electrical World.

Trade Publications

CARGO CRANES.—N. B. Payne & Company, 25 Church Street, New York City, have issued bulletin No. 1 on their electric cargo cranes.

SAUSAGE MAKING OUTFITS.—The Brecht Company, 1201 Cass Avenue, St. Louis, Mo. has issued a folder covering its electric driven sausage making outfits.

WASHING MACHINES.—The Laun-Dry-Ette Manufacturing Company, of Cleveland, Ohio is circulating an illustrated folder about its electric washing machine.

VALVE.—The Nordstrom lubricated plug valve is the subject of a number of booklets recently issued by the Merrill Company, 121 Second Street, San Francisco, Calif.

LIGHTNING PROTECTORS.—The Shaw Insulator Company, 7 King Place, Newark, N. J. has issued Bulletin A-16 covering its moulded insulation and lightning protective equipment.

DRILLS AND TAPPERS.—The Barnes Drill Company, 814 Chestnut Street, Rockford, Ill., has issued a circular on its motor-driven self-oiling all-geared 24-inch drill and tapper.

GENERATING SETS.—Direct current generating sets in sizes of 1 to 50 kw. are covered in catalog No. 103 issued by Engberg's Electrical & Mechanical Works of St. Joseph, Michigan.

MOTION PICTURE PROJECTOR.—The Master Machine Tool Company, 2638 Park Avenue, New York City, describes its new "Master" motion picture projector in several recently issued circulars.

LIGHTING FIXTURES.—The Moran & Hastings Manufacturing Company, 16 West Washington Street, Chicago, Ill., is circulating an illustrated folder covering its "Raymo" adjustable lighting fixture.

ENGINE AND RADIATOR HEATERS.—The Majestic Electric Development Company, of Philadelphia and San Francisco, is circulating a folder on its electric engine and radiator heater for use in garages.

New Incorporations

THE PALMYRA (KY.) LIGHT & POWER COMPANY has been incorporated by Lewis A. Kahl, Jesse J. Kahl and W. W Cullins.

THE LOUISVILLE (N. Y.) POWER CORPORATION has been chartered with a capital stock of $20,000 by G. P. Matthews; V. A. Warren and W. F. Wilson of Louisville, N. Y.

THE WINDSOR COUNTY BATTERY COMPANY has been incorporated with a capital stock of $10,000 by D. H. Gray, C. O. Randall of Springfield, Vt., and L. H. Barry of Charleston, N. H.

THE RANWOOD MANUFACTURING CORPORATION of New York City, N. Y., has been incorporated by C. A. Wolf, L. B. Morehouse and M. D. Bird, 80 Fifth Avenue, New York City. The company is capitalized at $200,000 and proposes to do a general electrical and mechanical engineering business.

THE RUBES AUTO ACCESSORIES MANUFACTURING COMPANY of New York, N. Y., has been incorporated by W. G. McIvor, D. A. Posner, 233 Broadway, New York, N. Y., and C. Cobb, Cedarhurst. The company is capitalized at $100,000 and proposes to manufacture auto accessories, electric dynamos, etc.

THE AGENDA NOVELTY MANUFACTURING COMPANY of Brooklyn, N. Y., has been chartered with a capital stock of $25,000 to manufacture electrical and mechanical novelties. The incorporators are: F. E. Bloch, 545 West Eleventh Street; H. J. Lauman, 601 West 112th Street, and D. Goldfoile, 157 East Eighty-ninth Street, New York City.

SERVICE of Syracuse, N. Y., has been incorporated by W. H. Craig, 718 Allen Street; W. N. Henderson, 137 Lexington Avenue, and J. M. Dunne, 704 Midland Avenue, Syracuse, N. Y. The company is capitalized at $75,000 and proposes to manufacture electric apparatus and machinery, auto accessories, etc.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

New England States

CASTLETON, VT.—The Staso Milling Company is planning to enlarge its plant. The proposed extensions will require 1,500 hp. Requests for this power have been made for July 1, 1920. The Rutland (Vt.) Railway, Light & Power Company furnishes the Staso Milling Company with energy to operate its plant.

WINDSOR, VT.—Improvements and extensions are contemplated by the Windsor Electric Light Company early in the spring of 1920. New equipment will be installed, including a 200-hp. twin-runner turbine wheel and possibly a 250-kva., three-phase generator and control switchboard panel for above. Richard P. Osgood, superintendent, will have charge of the work.

MEDFORD, MASS.—The Malden Electric Company has purchased a site on Salem Street on which it proposes to erect a substation and office.

CRANSTON, R. I.—Plans have been prepared by the United Wire & Supply Company of Auburn for the construction of an addition to its local plant, to cost about $100,000.

ESMOND, R. I.—Contract has recently been awarded for the erection of a new mill for the Esmond Mills, to be located at North Providence, to cost about $120,000. Considerable electrical and mechanical equipment, it is understood, will be required.

BRIDGEPORT, CONN.—Arrangements, it is understood, have been completed by the Bryant Electric Company for the construction of a one-story machine shop and automobile service station, to cost about $17,000.

STAMFORD, CONN.—The street lighting committee is considering the installation of a new street lighting system, to cost $47,575 per year. The proposed contract provides for 931 incandescent lamps the same as last year, except that the candle power lamps will be changed from 60 to 100 cp. to cost $23,775; 117 ornamental lamps, $14,700; 74 overhead arc lamps, $6,600. The cost of the installation will be $2,940. The Stamford Gas & Electric Company furnishes the street lighting service.

Middle Atlantic States

CLARENDON, N. Y.—The Western New York Utilities Company of Medina has petitioned the Public Service Commission for approval of a franchise granted by the officials of Clarendon to erect transmission lines and furnish electrical service here.

ENDICOTT, N. Y.—Plans are under consideration by the Endicott-Johnson Corporation for the construction of a new power plant.

HAMDEN, N. Y.—The Hamden Electric Light Company has petitioned the Public Service Commission for permission to construct and operate an electric light and power plant in Hamden. The company will operate in Delaware County.

LONG ISLAND CITY, N. Y.—Arrangements are being made by the Queens Electric Light & Power Company for the erection of a new automobile service plant on Read Street, near Jane Street, to cost about $150,000.

ROCHESTER, N. Y.—S. Henmann contemplates an addition to his plant at 65 Sullivan Street, to cost about $35,000; also the installation of an electric power plant and erection of transmission line, to cost from $12,000 to $15,000.

SCHENECTADY, N. Y.—Plans are being prepared by the General Electric Company for the construction of a new building at its local plant, to cost about $400,000. Harris & Richards, Drexel Building, Philadelphia, Pa., are architects.

BAYONE, N. J.—Arrangements are being made by the board of managers of the Bayone Hospital for the construction of a new power plant and mechanical laundry at the institution. The cost is estimated at about $250,000.

DOVER, N. J.—Arrangements are being made for extensions and improvements to power plant No. 7 at the Picatinny Arsenal, to cost about $25,000. A new machine shop, to cost about $15,000, magazine buildings, shell sectioning, structures and other extensions will also be made.

NEWARK, N. J.—Contracts will soon be awarded by G. C. Higby, architect, 207 Market Street, Newark, for construction of plant for H. Boker & Company, 101 Duane Street, New York, N. Y., on Burnett Avenue, Hilton, a suburb of Newark. The project will include a main building, 135 ft. by 135 ft., three stories, a shop 75 ft. by 135 ft., one story, and a power house, 50 ft. by 80 ft.

PERTH AMBOY, N. J.—Considerable electrical and mechanical equipment will be required in connection with the construction of a new dry dock, mechanical and electrical shops at the plant of the Perth Amboy Dry Dock Company, foot of Broad Street. Lockwood, Greene & Company, 101 Park Avenue, New York, N. Y., are architects and engineers.

SOUTH RIVER, N. J.—Preparations are being made by the Board of Public Works for the installation of two steam turbines in the municipal electric light plant. The cost of the proposed improvements is estimated at about $140,000. E. B. Hedden is superintendent.

TRENTON, N. J.—The Mercer Motors Company is contemplating enlarging its plant. The cost including machinery is estimated at $650,000. E. S. Hare, 245 West 55th Street, New York, N. Y., is president.

TRENTON, N. J.—The Crescent Insulated Wire & Cable Company, Olden & Taylor Streets, is considering extensions to its plant. Negotiations have been completed for additional property on Webster Street, as a site for the proposed building. Arrangements, it is understood, are being made for the installation of oil-burning equipment in its power plant, to replace coal-operated apparatus now in use.

CONNELLSVILLE, PA.—Plans are being prepared by the Yough Electric Company for the construction of a new plant.

FREEBURG, PA.—Plans are under consideration by the Northumberland County Gas & Electric Company of Sunbury for the installation of an electric light and power system in Freeburg.

GETTYSBURG, PA.—The Borough Council has called a special election to submit to the voters the proposal to issue $20,000 in bonds to establish a municipal electric light plant.

HAZELTON, PA.—The Harwood Electric Company has been awarded contract for furnishing electricity for operation of the proposed coal washery at Silver Brook.

PHILADELPHIA, PA.—Plans are under consideration by the Philadelphia & Reading Railroad Company for the reconstruction of its power plant at the Huntington Street Station, recently destroyed by fire. The loss is estimated at about $10,000.

READING, PA.—The Metropolitan Edison Company has closed a contract with the Eastern Pennsylvania Railways Company of Pottsville to supply electricity in the town of Pottsville. The contract calls for a minimum of 2000 kw., which is to be increased to 4500 kw. as needed. To supply this service a high-tension line will be erected from Reading to Hamburg, which is the junction point of the two companies.

WILKES-BARRE, PA.—Plans have been prepared for the construction of an addition to the plant of the Kitsee Battery Company, 62 North Main Street, to cost about $10,000.

WILMINGTON, DEL.—Plans have been filed for an addition to the plant of the Unger Storage Battery Company, Twelfth and Madison Streets.

ANNAPOLIS, MD.—Contract has been awarded by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for a new power plant at the local station to Leavering & Carrigues, 552 Twenty-third Street, New York, N. Y.

JANELEW, W. VA.—The installation of an electric light plant and waterworks system in Janelew is under consideration. Burton M. Davisson is reported interested in the project.

WOODSTOCK, VA.—The Woodstock Electric Light & Power Company is contemplating the installation of two water wheels.

WASHINGTON, D. C.—Bids will be received at the office of the chief engineers, U. S. Army, Washington, D. C., until Jan. 16 for furnishing switchboard feeder panels under advertisement No. 27.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, U. S. Army, Washington, D. C., until Jan. 14, under circular Pr 2,345—1CP, for furnishing six 100-line telephone switchboards.

WASHINGTON, D. C.—Bids will be received at Machinery and Engineering Materials Branch. Regular Supplies Division, Munitions Building, Washington, D. C., until Jan. 7 for furnishing, under circular 136, 1,000 ft. No. 19 lead-covered cable, 150-pair paper insulated.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., some time in the future, under Specification 3,708, for furnishing and installing turbine-driven pumps, feed-water heaters, V-notch meter, filters, forced draft fan and forced draft duct, boiler flues, storage tank, extension to coal conveyor, coal chute, coal gate, coal weigher and piping and appurtenances in the boiler plant at the navy yard, Washington, D. C. A deposit of $20 will be required for plans.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Washington, D. C., until Jan. 6, Schedule 5,296—500 storage batteries. Until Jan. 13, Norfolk, Va., Schedule 5,305—one motor-generator set. Until Jan. 20, Mare Island, Cal., Schedule 5,302—300 gal. insulating varnish. Washington, D. C., Schedule 5,310—single-conductor wire, 112 lb. magnet wire and miscellaneous fixture wire. Application for proposal blanks should designate the schedule desired by number.

North Central States

DETROIT, MICH.—The Clayton & Lambert Manufacturing Company, Beaubien Street, is planning to erect a power plant and a factory along the tracks of the Detroit Terminal Railway, to cost about $500,000.

IRONWOOD, MICH.—At an election to be held in January the proposal to issue $290,000 in bonds for construction of new water works system with pumping plant at Spring Creek, 6 miles north of Ironwood, to replace the present plant at Montreal River, will be submitted to the votors. The plans provide for three electrically and two auxiliary gasoline engine-driven centrifugal pumps.

NORTHVILLE, MICH. — The Detroit Board of Health is planning to build a municipal Tuberculosis Sanitarium in Northville, to include an administration building, infirmary, service building, laundry, ambulance building, nurses' home, laboratory, buildings for employees and power plant. The cost is estimated at about $1,000,000. Stratton & Snyder, Union Trust Building, Detroit, are architects.

CANTON, OHIO.—The Dillon Electric Company contemplates the purchase of a number of machine tools.

CELINA, OHIO—A motor-driven water pump, capacity 400 gal. per minute, remote from power house will be installed in connection with the municipal electric light and water plant. A 400 or 450-hp. boiler is needed for the plant and may be purchased this summer. C. W. Howard is superintendent.

CONNEAUT, OHIO.—Preparations are being made for improvements to the municipal electric light plant, including the installation of a 1000-kw. steam turbine and three switchboard panels and also the construction of 1200 ft. of underground conduit, 4/0. Contract for the work will be let sometime during this month. Benjamin Laubach is superintendent.

EAST LIVERPOOL, OHIO—Plans are being prepared by the Ohio River Power Company for the erection of a transformer station with connecting buildings, to cost about $600,000.

WEST BARBERTON, OHIO—Plans are being prepared by the Portage Rubber Company for the construction of a power plant and office building, to cost $200,000. Bids, it is understood, will soon be asked for the work.

BENTON, KY.—Contracts, it is reported, have been awarded for the installation of an electric light and power plant.

DECATUR, KY.—The General Electric Company of Schenectady is planning to establish a branch plant in Decatur for the manufacture of small motors.

PAINTSVILLE, KY.—A number of improvements are contemplated by the Paintsville Light & Power Company during the early part of the year.

BLOOMINGTON, ILL.—Plans are under consideration to erect cluster lamps on twelve blocks in the city.

LOCKPORT, ILL.—The Trustees of the Sanitary District of Chicago have voted to build a new hydro-electric power plant at Lockport, to cost about $2,000,000. Of this amount $750,000 will be spent this year.

BIG FALLS., WIS.—Preparations are being made by the Big Falls Water Power Company for the construction of a hydroelectric power plant at the Big Falls of the Flambeau River. The plans provide for an ultimate development of 20,000 hp., consisting of four generating units of 5,000 hp. each. Electricity will be transmitted over a double-circuit, three-phase transmission line to Ladysmith (22 miles), Ashland, and will furnish energy to the Ironwood & Bessemer Railway & Light Company, which serves several communities in Wisconsin and in the northern peninsula of Michigan. L. E. Myers is president.

BRUCE, WIS.—Bonds to the amount of $12,000 have been authorized for improvements to the municipal electric light plant.

DARLINGTON, WIS.—The city of Darlington is considering the purchase of the plant of the Darlington Electric Company, to be owned and operated by the municipality.

GRAND RAPIDS, WIS.—The Consolidated Water Power & Paper Company is planning to build a new hydro-electric power plant, increasing its present output by 2500 hp. The company also contemplates the erection of a new sulphite mill, to cost more than $500,000.

MONROE, WIS.—The Monroe Electric Company contemplates an extension to its power plant.

BELVIEW, MINN.—The Northern States Power Company of St. Paul contemplates extending its transmission line from Belview to Sacred Heart. G. O. House, 76 West Third Street, St. Paul, is manager.

CHESTERFIELD, MINN.—The Teal Light & Power Company is contemplating the installation of a duplicate electric generating unit in its plant. D. T. Teal is president and manager.

CLEARBROOK, MINN.—The Clearbrook Electrical Company is planning to build a power house and also to install an ornamental street lighting system.

DULUTH, MINN.—Extensions and improvements involving an expenditure of about $9,000,000, are contemplated by the Minnesota Steel Company to its local plant. The plans provide for the erection of a large wire mill, changes in various mills and additional equipment at the power plant. The construction of 250 additional houses to be erected at Morgan Park. George L. Reis is vice-president.

GOODRIDGE, MINN.—The City Council is considering the purchase of a municipal electric light plant; also the proposal of the Goodridge Milling Company to furnish energy to operate the same.

KELLOGG, MINN.—The Wisconsin-Minnesota Light & Power Company of Red Wing, is planning to extend its electric transmission lines from Wabasha to Kellogg.

SHEVLIN, MINN.—The installation of a municipal electric light plant in Shevlin is under consideration.

KANSAS CITY, MO.—The Kansas City Power & Light Company has petitioned the Public Utilities Commission for permission to issue $9,998,000 in stock and $8,000,000 in bonds. Application has been filed by the Standard Electric Light Company of Kansas City, Kan., for authority to transfer its plant and other property to the Kansas City Power & Light Company. Extensive additions and improvements are contemplated by the Kansas City (Mo.) corporation.

ARTHUR, N. D.—The Farmers Elevator Company is contemplating the purchase of a 20-kw., 110-volt, direct-current generator, 2 miles of No. 8 weatherproof wire, and Duncan Electric meters. J. A. Burgum is secretary and manager.

HETTINGER, N. D.—Extensions and improvements are contemplated by the Hettinger Electric Light & Power Company early in the spring, including the installation of two 72-in. by 18-ft. boilers, one 250-hp. engine, one 150-kva., generator and six 75-kva., 13,200-kva., transformers, and also the erection of 24 miles of transmission lines between Lemmon, S. D., and Hettinger. G. Smith is owner and manager.

BRIDGEWATER, S. D.—The Bridgewater Electric Power Company may possibly purchase high-tension transformers in the spring. G. W. Laing is president.

McINTOSH, S. D.—Bids will be received until Jan. 5 for $25,000 in bonds, the proceeds to be used for the installation of a municipal electric light and power plant.

MILLER, S. D.—At an election to be held on Jan. 6 the proposal to issue $40,000 the proceeds to be used for sinking a 1,100 to 1,200 ft. 8 or 10-in. artesian well, with pumps and pumping equipment, and also an 80 or 100 ft., tower and 80,000-gal. tank. J. C. Bang is manager of the municipal electric light and power plant.

REE HEIGHTS, S. D.—The Council has granted E. L. Hague a franchise to install and operate an electric lighting plant in Ree Heights.

LINCOLN, NEB.—The Omaha, Lincoln & Beatrice Railway Company is planning to extend its car-line from University Place to Haverlock, a distance of 2½ miles, in the near future. Contracts have been awarded for the work. J. M. Bramlette is general manager.

MORRILL, NEB.—Bonds have been authorized for improvements to the municipal electric light and power plant. New equipment, including a new engine will be installed.

SCRIBNER, NEB.—Plans are under consideration by the Scribner Artificial Ice Company to construct electric and ice plants, to cost $40,000 and $25,000 respectively.

ELLSWORTH, KAN.—The Weber Electric Power Company is planning to extend its electric transmission line to five or more small towns to supply electrical service. Benjamin A. Bearnes is superintendent.

HUGOTON, KAN.—Bonds have been authorized for the installation of a municipal electric light plant. The site has not yet been selected or contract awarded for the proposed plant.

HUTCHINSON, KAN.—Plans, it is reported, are being prepared for extensions to the plant of the United Water, Gas & Electric Company to meet the increasing demand for electrical service in surrounding towns.

LANE, KAN.—Bonds to the amount of $15,000 have been voted for the erection of an electric transmission line from Lane to Ossowatomie.

RICHMOND, KAN.—Bonds to the amount of $20,000 have been authorized for the construction of an electric transmission line from Richmond to Ottawa.

Southern States

ASHBORO, N. C.—The Water and Light Department is in the market for the purchase of a 150-hp. boiler, a 250-hp. engine directly connected to a 200-kva. generator. M. M. Rogers of Ashboro is engineer in charge. Leo R. Barker is superintendent.

NEWBERNE, N. C.—Extensions and improvements to the municipal electric light plant are under consideration.

SUMMERVILLE, S. C.—The installation of an electric light, to cost about $40,000, is under consideration by the Commissioners of Public Works.

AMITE, FLA.—The Central Light & Power Company is contemplating improvements to its plant including the installation of additional machinery.

SALLISAW, OKLA.—Improvements to the municipal electric light plant, to cost about $30,000, are under consideration.

CLARENDON, TEX.—The Texas Gas & Electric Company contemplate extensions to its local system.

DONNA, TEX.—The Donna Light & Ice Company is planning extensions to its power plant, including the installation of new machinery. The company has increased its capital stock from $10,000 to $40,000.

FORT WORTH, TEX.—C. O. Thorp of Fort Worth has applied to the state engineer of New Mexico for permission to con struct a reservoir and hydro-electric plant on the Pecos River, about five miles north of the Texas line. The site of the proposed reservoir is near Red Bluff. The cost of the project is estimated at about $600,000.

HOUSTON, TEX.—The question of extending the municipal belt railroad to Morgan's Point, situated on the north side, and converting the system into an electric traction line is under consideration by the Harbor Board and the City Council. The cost of the main line extension to Morgan's Point and Goose Creek is estimated at about $1,000,000.

ROCK SPRINGS, TEX.—The Rock Springs Light Company is contemplating the construction of an electric light and power plant in Rock Springs. V. A. Brown is interested in the project.

Pacific and Mountain States

TACOMA, WASH.—The installation of a 500-kw. automatic switchboard in the municipal street railway substation is under consideration by the city officials. Llewellyn Evans is general superintendent.

BEND, ORE.—Application has been made to the state engineer by the Bend Water, Light & Power Company for 50 sec.-ft. of water from Tumalo Creek. The plans provide for a development of 4225 hp. and for construction of two concrete dams and canal. The cost is estimated at about $229,000.

CALEXICO, CAL.—Bonds to the amount of $11,000 have been voted for the installation of police and fire-alarm systems in Calexico.

FULLERTON, CAL.—Arrangements are being made by the City Council for the installation of a new electric lighting system in sections of Spadra and Commonwealth Avenues and also in the residential districts. Cast-iron standards will be used for the former installation and marbelite standards for the latter.

SAN ANDREAS, CAL.—R. W. Olmstead of Manteca is considering the construction of two dams, 120 and 130 ft., ½-mile tunnel and power plant in San Andreas. The cost of the project is estimated at about $2,000,000.

SAN PEDRO, Cal.—The Van Camp Sea Food Company, Fourteenth Street and Waterfront, contemplates the construction of an ice and cold storage plant and a wharf, 250 ft. long. The cost is estimated at $300,000.

VENTURA, CAL.—The construction of hydro-electric plants and irrigation projects on Sespe and Pivu Rivers is under consideration by the Sespe Light & Power Company, Merchants Trust Building, Los Angeles. The company has been granted a certificate of convenience and necessity by the State Railroad Commission on condition that the company furnishes satisfactory financing plan and sufficient data to enable the commission to determine the feasibility of the project by Mar. 1, 1920. The first unit is to include two reservoirs of 51,000-acre-ft. of power conduit. 3,000-ft. pressure pipe line, 1,000 ft. head and a 10,000-kw. hydro-electric power plant, to be increased to 18,000 kw. when second unit is built; second unit, 100,000 acre-ft. storage reservoirs, 90,000 ft. of conduit, 4,000 ft. pressure pipe line, 2,300 ft. head and an 8,000-kw. plant; third unit additional storage to deliver 100,000 acre-ft per annum for irrigation. About $100,000 has been expended for preliminary surveys. F. Buren is president.

WESTPOINT, CAL.—The Mokelumne River Power & Water Company of San Mateo contemplates the construction of two power plants, one 6,000 hp. and the other 12,750 hp.; two diversion canals, 4½ and 5½ miles long, and reservoirs in south, middle and north forks of Mokelumne River. The cost of the project is estimated at about $1,288,500.

Canada

HALIFAX, N. S.—The Nova Scotia Power Commission has been authorized to proceed with the development of the water powers at St. Margaret Bay to supply electricity in Halifax. The plans for the initial development provide for 7800 hp. at a cost of about $1,000,000. H. K. Smith is chief engineer of the commission.

CHATHAM, ONT.—Extensions are contemplated to the Chatham hydroelectric system, to cost about $90,000. J. G. Jackson of Chatham is engineer.

HAVELOCK, ONT.—Plans are being prepared by the Ontario Hydro-Electric Commission for the installation of hydroelectric power system in Havelock. At an election to be held Jan. 5 the proposal to issue $29,000 for the project will be submitted to the ratepayers. J. W. Bryans is clerk.

IROQUOIS FALLS, ONT.—Large extensions, it is reported, are contemplated by the Abitibi Power & Paper Company to its paper mills and power development, etc., to cost about $3,000,000.

LAKEFIELD, ONT.—At the January election a by-law to authorize the installation of a hydro-electric system in Lakefield will be submitted to the ratepayers. The cost of installing the proposed system, which include the reconstruction of the present distribution system and the purchase of same from the local company, is estimated at about $33,500.

Miscellaneous

WAILUKU, MAUI, H. T.—Extensions and improvements are contemplated by the Island Electric Company, including the installation of a 250-hp. Diesel engine directly connected to a 175-kw. generator and the erection of 20 miles of transmission lines. Jesse C. Blair is manager.

Directory of Electrical Associations

Printed in the First Issue of Each Month

Alabama Light and Traction Association. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

American Association of Engineers. Secretary, C. E. Drayer, Nepecnauk Bldg., 63 East Adams St., Chicago, Ill.

American Electric Railway Association. Secretary, E. B. Burritt, 8 West Fortieth St., New York City.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, Bethlehem, Pa.

American Institute of Consulting Engineers, Inc. Secretary, F. A. Molitor, 35 Nassau St., New York City.

American Institute of Electrical Engineers. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

American Physical Society. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio. nnual Meeting, St. Louis, Mo., Dec. 30-Jan. 2.

American Society for Testing Materials. Sec.-Treas. C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society. Secretary, H. C. Forbes, 29 W. 39th St., N. Y. City.

Arkansas Utilities Association. Secretary, W. J. Tharp, Little Rock, Ark.

Associated Manufacturers of Electrical Supplies. General secretary, C. E. Dustin, 30 East 42d St., New York City.

Association of Edison Illuminating Companies. Secretary, Preston S. Millar, Electrical Testing Laboratories, N. Y. City.

Association of Iron and Steel Electrical Engineers. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

Assiciation of Municipal Electrical Utilities (of Ontario). Secretary, S. R. A. Clement, 190 University Ave., Toronto, Ont., Can.

Association of Railway Electrical Engineers. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago, Ill. Annual Meeting, Chicago, Ill. Oct. 28-31.

British Columbia Association of Electrical Contractors and Dealers. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C. Annual Meeting, Vancouver, B. C. Oct. 19.

Canadian Electrical Association, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St., East, Toronto, Ont.

Colorado Electric Light, Power and Railway Association. Secretary-treasurer, F. O. Safford, Denver Gas & Electric Co., Denver, Col.

Conference Club. Secretary, Sullivan W. Jones, 19 W. 44th Street, New York City.

Commercial Section, N. E. L. A. Secretary. R. H. Tillman, Baltimore.

Eastern New York Section, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

Electric Hoist Manufacturers' Association. Secretary-treasurer, W. C. Briggs, Shepard Electric Crane & Hoist Co., New York.

Electric Furnace Association. Secretary, Dr. C. G. Schluederberg, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Electrical Manufacturers' Club Secretary, F. L. Bishop, Hartford Faience Co.

Electrical Supply Jobbers' Association. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

Electrical Supply Jobbers' Association, Atlantic Division. Secretary, E. Donald Tolles, 52 Broadway, New York City.

Electrical Supply Jobbers' Association, Pacific Coast Division. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

Electrical Trades Association of Canada. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

Electric Power Club. Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

Electric Vehicle Section of the N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York City.

Empire State Gas and Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York City.

Florida Engineering Society. Secretary, J. R. Benton, Gainesville, Fla.

Illinois State Electric Association. Secretary-treasurer, R. V. Prather, Springfield, Ill.

Illuminating Engineering Society. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

Indiana Electric Light Association. Secretary, Thomas Donohue, Lafayette, Ind.

Industrial Electric Heating Association. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

Institute of Radio Engineers. Secretary, Alfred N. Goldsmith, College City of New York, New York. Annual Meeting, New York City, Jan. 7.

International Association of Municipal Electricians. Secretary, C. R. George, Houston, Tex.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria Street, Westminster, London, S. W., England.

Iowa Section, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

Jovian Order. Jupiter (president), Arthur J. Biez, Houston, Tex.

Kansas Public Service Association. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

Michigan Section, N. E. L. A. Secretary, Herbert Silvester, Ann Arbor, Mich.

Minnesota Electrical Association. Secretary and treasurer, Meyer Barnert, St. Paul, Minn.

Mississippi Electric Association. Affiliated with the N. E. L. A. Secretary, E. S. Myers, Vicksburg, Miss.

Missouri Association of Public Utilities. Secretary-treasurer, F. D. Beardslee, 315 N. 12th St., St. Louis, Mo.

National Association of Electrical Contractors and Dealers. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania Tennessee and Wisconsin. Annual convention, Baltimore, Md., Oct. 6.

National Association of Electrical Inspectors. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

National Electric Light Association. Executive Assistant to President, M. H. Aylesworth, 29 W. 39th St., New York. Annual Convention, Pasadena, Cal. May 18-21.

National Electrical Credit Association. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

National Fire Protection Association. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

Nebraska Section, N. E. L. A. Secretary-treasurer, B. H. Conlee, Nebraska Gas & Electric Co., Beatrice, Neb.

New England Electrical Credit Association. Secretary, Alton F. Tupper, 15 State St., Boston, Mass.

New England Section, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

New Mexico Electrical Association. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M. Annual Meeting, Alberquerque, N. M., February.

New York Electrical Credit Association. Secretary, Franz Neilson, 120 Broadway, New York City.

New York Electrical Society. Secretary, George H. Guy, 29 West 39th St., New York City.

Northwest Electric Light and Power Association. Affiliated with N. E. L. A. Secretary, W. E. Herring, 860 Stuart Bldg., Seattle, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

Oklahoma Utilities Association. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City. Annual Meeting, Oklahoma City, Feb. 10-13.

Pacific Coast Section, N. E. L. A. Secretary, A. H. Halloran, Rialto Bldg., San Francisco, Cal. Annual Meeting, Hotel Del Monte, April 7-9.

Pennsylvania Electric Association. State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

Public Service Association of Virginia. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

Public Utilities Association of West Virginia. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

Radio Club of America. Secretary, T. J. Styles, 1112 S. Curtis Ave., Richmond Hill, Queens Borough, N. Y.

Rocky Mountain Association of Municipal Electricians. President, Lawrence Stone, Denver, Col.

Society for Electrical Development, Inc. General manager, J. M. Wakeman, 29 West 39th St., New York City.

Society for the Promotion of Engineering Education. Secretary, Dean F L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

South Dakota Electrical Power Association. Secretary-treasurer, L. V. Schneider, Salem, S. D.

Southeastern Section, N. E. L. A. Secretary-treasurer, Charles A. Collier, Georgia Railway & Power Co., Atlanta, Ga.

Southern California Electrical Contractors and Dealers' Association. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

Southwestern Electrical and Gas Association. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

Southwestern Society of Engineers Secretary, C. E. Barglebaugh, 721 First National Bank Building, El Paso, Tex.

Technical and Hydroelectric Section of the N. E. L. A. Secretary, W. C. Anderson, 29 West 39th St., New York City

Toronto Electrical Contractors' Association. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

Tri-State Water and Light Association. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C.

Vermont Electrical Association. Secretary-treasurer, A. B. Marsden, Rutland, Vt.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill. Annual Meeting, St. Louis, Mo. Jan. 27-29.

Western Society of Engineers, Electrical Section. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill. Annual Meeting, Jan. 28, Chicago, Ill.

Wisconsin Electrical Association. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis. Annual Meeting Milwaukee, Wis. March.

Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 16, 1919)

1,324,792. Apparatus Unit; Wilfred E. Booth, New York, N. Y. App. filed Apr. 17, 1918. Combines resistance and capacity elements.

1,324,793. Automatic Engine Control for Internal-Combustion Power Units; William W. Bucher, Chicago, Ill. App. filed June 2, 1916. Threeway control for isolated electric plants.

1,324,796. Telephone-Exchange System; Louis W. Carroll, Riverside, Ill. App. filed Sept. 14, 1917. Operator's set automatically connected to calling line.

1,324,797. Electrolytic Apparatus; Louis W. Chubb, Edgewood Park, Penn. App. filed Apr. 27, 1917. Collects gases from cells.

1,324,798. Signaling System; Roy D. Conway, Chatham New Jersey. App. filed May 24, 1917. Controlled from a distance over single circuit.

1,324,810. Electric Advertising-Sign; Martin Gold, Chicago, Ill. App. filed Apr. 12, 1917. Shop window display.

1,324,813. Control Apparatus; Arthur J. Hall, Wilkinsburg, Penn. App. filed June 6, 1916. Operation of liquid rheostats.

1,324,814. System of Control; Arthur J. Hall and Laurence M. Perkins, Wilginsburg, Penn. App. filed Aug. 4, 1916. Excitation governed for either accelerating or regenerative action.

1,324,818. Apparatus for Measuring Electrical Resistance; Allen B. Hazard, Berwyn, Ill. App. filed Nov. 23, 1917. Wheatstone bridge circuit.

1,324,819. Control Apparatus; Frederick G. Hickling, Wilkinsburg, Penn. App. filed Dec. 8, 1915. For either direct or alternating current.

1,324,840. Control System; Paul L. Mardis, Wilkinsburg, Penn. App. filed Sept. 21, 1916. Governing apparatus by energy obtained from shunt circuits to resistors connected in series.

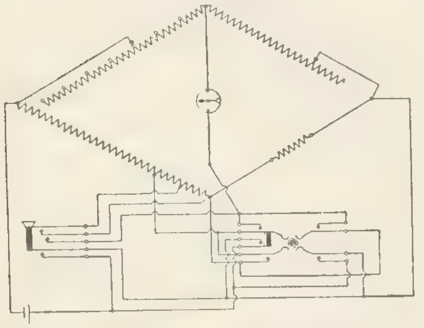
1,324,847. Automatic Switch; Osvald E. Rasmussen, West Hoboken, N. J. App. filed Dec. 1, 1916. Multiple brush type.

1,324,903. Safety-Switch Mechanism; Charles Klink or North Fayette Township, Allegheny County, Penn. App. filed Sept. 10, 1918. Automatic cut out for grounded machine.

1,324,908. Multiple Switch; Hubert F. Krantz, Brooklyn, N. Y. App. filed Mar. 22, 1916. Single exterior operating handle.

1,324,910. Electric Switchboard; Hubert F. Krantz, Brooklyn, N. Y. App. filed Mar. 10, 1916. Single switch element.

1,324,915. Circuit-Closer; Raymond E. McKee, Chicago, Ill. App. filed Nov. 15, 1915. Low tire pressure signal.



1,324,818—Apparatus for Measuring Electrical Resistance

1,324,923. Direction-Signal for Automobiles; John Pfeifer, Springfield, O. App. filed Apr. 12, 1917. Arrow indicates direction.

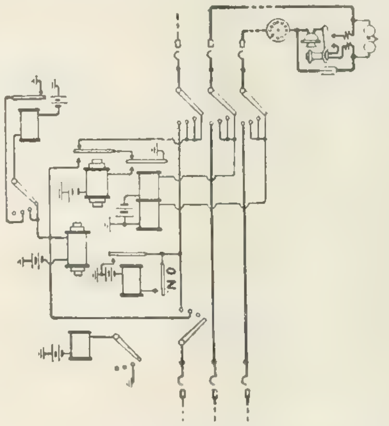
1,324,924. Indicating Device; Edwin Pfister, Cincinnati, O. App. filed Oct. 5, 1915. For street car stops.

1,324,954. Storage-Battery Separator; Campbell C. Carpenter, Niagara Falls, N. Y. App. filed Apr. 12, 1918. Prevents treeing across.

1,324,959. Vibration-Detector; Charles A. Finley, Brooklyn, N. Y. App. filed Feb. 23, 1918. Microphone button attached to ship.

1,324,969. Electrically-Heated Instrument; Frank Huhn, Jay A. Hand, and Jules G. Spiess, Detroit, Mich. App. filed Jan. 25, 1919. Heat conduction a minimum.

1,324,989. Dynamo-Electric Machine; William A. Turbayne, Niagara Falls, N. Y. App. filed May 31, 1916. For starting and lighting systems.



1,324,847—Automatic Switch of Multiple Brush Type

1,324,994. Connector for Electric Wires; Reuben B. Benjamin, Chicago, Ill. App. filed Oct. 25, 1917. For branch circuits.

1,325,005. Driving Mechanism for Valves and Other Devices; Peter P. Dean, New York, N. Y. App. filed Sept. 10, 1917. Electro-mechanical release.

1,325,007. Electrical Connector; H. A. Douglas; App. filed Nov. 21, 1917. Connector and key in cylindrical shell.

1,325,011. Electromagnetic Clutch; Bernard E. Fernow, Jr., Milwaukee, Wisc. App. filed June 5, 1916. Annular type.

1,325,015. Battery-Plate; Roy Benson Hall, Chicago, Ill. App. filed Dec. 16, 1918. Stiffening ribs both vertically and crosswise.

1,325,016. Magneto-Circuit Breaker; William S. Harley, Milwaukee, Wisc. App. filed June 29, 1917. Prevents back flow of current through generator.

1,325,022. Ironing Appliance for Shoe-Treeing Machines; Edwin N. Lightfoot, New York, N. Y. App. filed Mar. 19, 1917. Obviates cord connection.

1,325,052. Panel-Board and Panel-Board Construction; Henry F. Starrett, Chicago, Ill. App. filed May 15, 1918. Provided with wire gutters.

1,325,096. Swivel Attachment-Plug; Otto Kessler, Passaic, N. J. App. filed Dec. 26, 1918. For socket and plug.

1,325,112. Burglar-Alarm Lock; Simpson B. Rodgers, Macon, Ga. App. filed Sept. 27, 1917. Illuminated signal alarm.

1,325,114. Electroconverter - Furnace; Paul Francois Sarron and Jules Simon, Lyon, France. App. filed June 8, 1918. For special steels.

1,325,115. Primary Battery; Charles B. Schoenmehl and Martin L. Martus, Waterbury, Conn. App. filed Mar. 16, 1917. Flat shaped containers form negative element while positive element is oval shaped.

1,325,131. Street and Station Indicator; Charles W. Wright, Topeka, Kans. App. filed Oct. 25, 1915. Interior street car indicator for giving names of streets.

1,325,146. Automobile-Signal; Eugene E. De Ford, Oakland, Calif. App. filed Nov. 30, 1918. Battery operated front and rear signals, each controlled independent of other.

1,325,155. Lamp; Michal Kaczmaryk, Pottsville, Penn. App. filed Aug. 6, 1919. Multiple light for shedding beams outwardly, the light passing upward being partially obstructed.

1,325,160. Circuit-Closing Device for Liquid-Level Gages; Leon G. Le Compte, Shandon, Calif. App. filed Sept. 26, 1917. Separate circuits for two contractors for regestering rise and fall of liquids.

1,325,232. Electric-Motor Casing; Joel R. Cook, Cleveland, O. App. filed Sept. 13 1917. Prevents short circuit by watering casing which allows full ventilation.

1,325,250. Method of Propagating Electric Impulses in Antennae; Otto G. H. E. Kehrhahn, New Rochelle, N. Y. App. filed Oct. 12, 1916. Generators in direct connection with antennae and a continuous source of current.

1,325,254. Projection Light Unit; Joseph W. Legg, Worcester, Mass. App. filed Mar. 31, 1915. Refillable gas-filled projection light unit with relatively small proportion of heat given off at filament.

1,325,257. Ignition-Dynamo; Charles Thomas Mason, Sumter, S. C. App. filed Mar. 15, 1916. Eliminates all moving wire and makes moving parts light and desirable as an oscillator.

1,325,324. Railway Signaling; John S. Holliday, Wilkinsburg, Penn. App. filed May 23, 1916. Regulator comprising a transformer and an impedance coil with core substantially saturated.

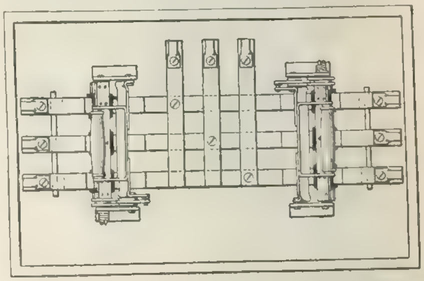
1,325,338. Battery-Seal; Norman D. Sturges, Brooklyn, N. Y. App. filed Apr. 24,1918. Sealed by soldering battery lid and terminal post.

1,325,347. Telephone System; William T. Booth, East Orange, N. J. App. filed July 9, 1917. Electromagnetic means eliminates releasing any calling keys.

1,325,357. System of Electrical Rectification and Distribution; James Knox Elderkin, Jr., Newark, N. J. App. filed Oct. 30, 1916. Rectify alternating current at comparatively high voltages.

1,325,375. Electric Vibrator for Retouching Implements; Waclaw Putbowski, Jersey City, N. J. App. filed May 5, 1919. Noiseless operation.

1,325,481. Street or Station Indicator; Cornelius P. F. McDonnell, Kansas City, Mo. App. filed Sept. 8, 1916. Apron winds up on rollers.



1,324,910—Electric Switchboard for Heavy Power Circuits

1,325,501. Ignition-Timer; Edward B. Jacobson, Pittsfield, Mass. App. filed Feb. 19, 1919. Course traveled by contactor automatically lubricated.

1,325,502. Ignition-Timer; Edward B. Jacobson, Pittsfield, Mass. App. filed Mar. 28, 1919. Self-lubricating contactor avoids gumming.

Electrical World

The consolidation of Electrical World, Electrical Engineer *and* American Electrician

Volume 75 New York, Saturday, January 10, 1920 *Number* 2

Financial Aid Needed

IN THESE piping times of peace, when the purchasing power of the dollar has shrunk immensely and organized labor, restive under the conditions, has demanded and secured added compensation, it is inevitable that somewhere injustice prevails. This is not always due to intentional slight. In fact, it is more often attributable to oversight and lack of appreciation of the true status of affairs. Nevertheless, one very important part of society, comprising professors, schoolmasters, professional engineers and others in non-speculative and non-commercial pursuits, is being slowly ground to dust because of this neglect. Our great educational institutions and engineering societies find themselves unable to function without increased financial support. The government itself is losing from its service large numbers of technically trained men because these men cannot live on the salary the government pays. The same is true in our colleges and universities; professors and instructors are going elsewhere, where higher salaries obtain, in order to survive. Now, these institutions and societies and trained men are vitally essential to the nation and our civilization, and it will be a lasting disgrace if the hampering conditions are permitted to continue. The most thrifty and most self-sacrificing class in the whole country must not be called on to bear huge burdens unaided, and the institutions which represent the real backbone of the intellectual side of the race and make up its moral fiber must be sustained.

Profiteering is no less unjust to the public where capital and labor are agreed upon the division of the spoils than where either interest has the economic jug by the handle. Just wages, fair profits and reasonable prices form an equilateral triangle which cannot be thrown out of shape as long as all the parties in interest give and take in full recognition of one another's rights.

Another Big Western Project

THAT the West, despite tremendous expansion of industry in the last decade, still has vast engineering projects in immediate contemplation is proved by the petition of the Kern Delta Irrigation District, California, for the right to appropriate 2,000 second-feet of the flood waters of the Kern River and its tributaries. The development planned is very extensive, including as it does the construction of a dam to cost $15,000,000 at the junction of the Kern River with its south fork, at Isabella, about sixty miles northeast of Bakersfield, center of California's petroleum industry. A reservoir possibly larger than that behind the Roosevelt Dam, Arizona, will be created as the result of this construction, for it is estimated by the applicants that 1,500,000 acre feet will be impounded. The development of 150,000 hp. is included in the present plans.

Whether the petition of the Kern Delta Irrigation District will be granted depends largely on the results of a survey of water resources of the Kern River system, now being undertaken by W. F. McClure, State Engineer, and Captain Charles H. Lee, president of the State Water Commission. The report will in all likelihood not be presented within less than a year, because of the necessity for intensive study of the conditions over a wide area. Nevertheless much attention is being directed to the proposal in the meantime, due to the magnitude of the project, for if carried through to completion it will take a prominent place among the engineering achievements of the Pacific Coast.

Under government ownership, unprofitable ventures may be carried on indefinitely at the public expense. Deficits come out of the tax levy and fixing responsibility for failure is so difficult that mediocre administration "gets by" in the face of defections that would break a reputation in private industry inside of thirty days.

Einstein's Theory

MUCH attention has been devoted of late in the scientific and technical press to a discussion of Einstein's theory of relativity and its consequences. This subject formed the principal topic of discussion at a meeting in London of the Royal Society, various abstracts concerning which have recently been reported.

The subject of relativity first came into notice some years ago when Michelson and Morley announced the results of a careful series of optical experiments they had made for detecting, if possible, the effect of the earth's tangential motion of rotation in aiding or opposing the transmission of light in the laboratory. The effect of the earth's superficial velocity on the apparent velocity of light in the air could not be detected, although the sensitiveness of the apparatus was amply sufficient for the purpose. In order to account for the absence of the earth's velocity component in the observations, two suggestions were offered, which later crystallized into opposing schools of thought. One was that any bar, rod or prism of substances would be subjected to internal electromagentic stresses when subjected to motion; because, according to the theory of electrons, considered either in a crowd or pair by pair, their mutual attractions are altered by their velocity through the ether. Consequently, a metallic bar set in the direction of the earth's tangential velocity does not have exactly the same length as when it is set perpendicularly thereto. The difference should be extremely small at the greatest value of the earth's rotational surface velocity, and would be undiscoverable by any known laboratory methods; but it has been asserted to be sufficient to account for the non-success of the Michelson-Morley experiments. The other suggestion was the doctrine of relativity, a principle in virtue of which absolute velocities should be incapable of being detected in a universe constructed like ours.

One school of thought thus argued that if the sensitiveness of the Michelson-Morley apparatus were greatly increased, a residual effect of the earth's velocity should be found, in spite of the electronic forces and their effects on the mechanism in masking the phenomenon sought. The other school of thought argued that such a phenomenon could not exist, by reason of the inherent nature of things.

Following up the doctrine of relativity, by a long process of mathematical reasoning Einstein and his followers have been led to enunciate certain remarkable theorems concerning space and time. These theorems are interesting as philosophical speculations. From the standpoint of engineering, they are at present too minute in their effects to have any bearing on practice; although, from the standpoint of philosophy, they are of great importance. More recently, however, certain practical deductions have been stated by the relativists which are quite worthy of examination by astronomers. One is that the perihelion of Mercury's orbit should advance at a small but definitely measurable rate, not yet required by Newtonian principles. A second is that rays of light should bend very slightly in passing through the sun's gravitational field, and third that the red rays of the spectrum should be measurably deflected in such a field. The first two predictions are now stated to have been confirmed reasonably well. The third has not yet been confirmed, although carefully looked for.

The newly awakened interest in the subject has come from the recent confirmation of the second prediction, on the occasion of last May's total solar eclipse. Astronomers appear to be satisfied that such an effect has been discerned. Assuming that both the first and second predictions have been verified, the question arises whether the doctrine of relativity is really fundamental, or whether it is a mere secondary consequence of a yet more fundamental electromagnetic law. We shall probably have to wait for the answer to this question. The mathematical theory is very complicated, and very few persons appear to understand it. Discussion is interfered with, because the doctrine of relativity assumes, in some minds, the nature of a fetish. Nevertheless, if, as is claimed by some, that doctrine denies the existence of a space-filling ether and substitutes an emission theory for the accepted undulatory theory of light, it is worthy of careful examination.

Engineering education deserves the support of industry on many grounds. The highest technical training guarantees a permanent increase in production realized through the acumen of men and women combining theory with practice in ways difficult to those with unbalanced schooling. As the experience of the technical graduate ripens fast under most business régimes an investment in engineering education soon pays for itself and continues thereafter an increasing asset to civilization.

Reorganizing a Distribution System

THE time often comes when, with the growth of a city system of distribution, radical changes become necessary to secure the greatest economy in conductors and the best regulation. Such a crisis has come in the affairs of the Seattle municipal system, and J. D. Ross in the current issue gives an account of the very effective procedure which is being adopted. The present system is supplied partly by a 40-mile (65-km.) transmission line and for the rest by a steam station. The original installation was one of the few plants using two-phase distribution, a condition brought about by an existing two-phase private plant. The lines from the Cedar River hydroelectric plant were duplicate three-phase and star-connected. The new transmission plant is being built on the Skagit River, 100 miles (160 km.) from the city, and the possible final capacity is about 500,000 hp. Over this longer distance it is proposed to transmit at a delivered voltage of 150,000. This transmission is star-delta-connected like the existing one.

An interesting feature of the new hydroelectric station is that the generator, rated at 45,000 kva., is solidly coupled to the transformers through a reactor. All switching will be done on the high-tension side. The voltage control is by an automatic regulator at the station and another acting on the synchronous condensers at the receiving end.

The substations from the new and old plant are half a dozen miles (about 10 km.) apart with the steam plant between them, and at this end of the line begins the new distribution system. The old one is at 2,500 volts, and, because of the rapid growth of the city, it has become burdensome in cost of copper.

The distribution now being installed is at 15,000 volts, star-connected with neutral, giving about 26,000 volts between phase wires. This main distributing network will tie together the two substations and the steam station and will itself feed a working distribution at 2,500 volts, delta-connected for motors, mostly supplied through single-phase feeders for lighting. Seattle being a long and narrow city, the 15,000-volt intermediate distribution is particularly desirable in the matter of regulation. The new arrangement will permit an immense saving in copper and will bring the variations in voltage from no load to full load so low as to be very easily regulated without the present considerable complications in feeder regulators. The new service, too, will be three-phase instead of two-phase, which again saves some copper besides obviating the use for further development of motors which must now be regarded as non-standard, the fact being that two-phase distribution is obsolescent. The 15,000-volt system is of No. 2 wire for mechanical reasons, and this fully meets the requirements of close regulation. It is reckoned that the saving in lost energy by the changes will amount to something like 10 per cent. Ordinarily transmission through an intermediate primary voltage is unnecessary, but as the transmission voltages get higher and higher and the areas served increase the time now and then comes, as it has in this instance, when the wise procedure is to bring the main transmission to one or more substations and then to take advantage of the big step-down transformers with their very high efficiency to feed the intermediate distributing voltage, which can be readily carried over an extent of territory which would be extremely inconvenient to arrange for the high transmission voltage and far too expensive in copper in adhering to the house-to-house primary voltage.

Maximum-Rated Motors

MOTORS, like all other devices made by man, have their limitations—and occasionally break down in service. They may be short-circuited from a failure of internal insulation; their bearings or commutators may become mechanically defective; they may be strained by mechanical overload, or they may be injured by overheating.

Breakdowns in insulation due to purely electrical defects are relatively rare accidents, and the complaints made against motors on this score are comparatively infrequent.

Breakdowns due to purely mechanical defects, such as overloads or weak commutators, are well understood by the average mechanic, who is thus in a position to protect the motor from injury or to repair its defects.

Breakdowns due to thermal overloads are the most troublesome and difficult to deal with, because they are likely to take time to develop. The overheating is apt to be deep-seated and beyond the limit of superficial examination to reveal. The causes are more obscure, are less generally understood and are apt to be cumulative.

The insulating materials in large and expensive dynamo machines are commonly such as can, like mica, stand a relatively high temperature for long periods without injury. On the other hand, the materials that have to be used for insulating the field and armature windings of the smaller dynamo machines, such as constitute the great majority of our industrial motors, are cellulose in one form or another; viz., cotton, paper or fiber. These materials are subject to decomposition and alteration of mechanical and electrical properties, at a temperature near to that of boiling water. If any part or element of the whole winding of a motor reaches the critical temperature, thermolysis there sets in. The damage done depends upon how much the temperature exceeds the critical value and how long it lasts. A sustained temperature, well over the limit, will produce rapid carbonization, with swift loss of mechanical and electrical strength. Moreover, the temperature within the deeper recesses of the windings may be very appreciably hotter than on the exposed external portions. It is essential, therefore, that for long life a motor shall have a temperature at the hottest internal spot less than the critical temperature of chemical decomposition.

In order to make sure that the hottest spot, which is probably deep out of reach, in a motor shall not attain the limiting temperature, the temperature on the accessible surfaces should not be allowed to exceed a certain lower temperature that experience has provisionally assigned and which varies somewhat with the type of motor.

But if the ambient temperature were to rise to 40 deg. C., or if the ventilating ducts in the machine were to become partially clogged in the course of time, or the brushes were to wear badly and set up extra heating, it is evident that the hottest spot would be likely, under the same load, to exceed the decomposition temperature, especially in an old and neglected motor during hot weather. On the other hand, in winter weather, or in a cold climate, or an exposed location, where the ambient temperature never exceeded 20 deg. C., the 50 deg. load and basis of rating might be perfectly safe for the motor.

When motors are carefully installed and are maintained by trained attendants, who understand their business and the thermal inwardness of the motors committed to their charge, risks of overheating may be safely incurred and smaller motors used than in plants where less careful inspection is exercised. In such cases eternal vigilance is the price for a smaller margin in safe temperature.

The article which we print this week on the subject by **A. C. Bunker** is a plea for the motor of greater thermal factor of safety in the average plant. There is much to be said for his side of the case. There is a prudent mean position to be followed. It is just as possible to exaggerate the dangers pointed out in the article as it is to minimize them. It is as bad economically to install unduly large motors with small temperature rises as to install unduly small motors that may burn out from overheating. Unless, however, skilled men are employed to maintain a motor installation, it is reasonable to have a good margin of thermal safety.

Regulation of utilities must be reasonably restrained if the incentive to build up a prosperous and expanding public service is to be retained. Shylocks do not make for progress in the public utility field.

Teachings of Experience

THE results of a short circuit on a 900-volt, 25-cycle underground transmission line on the system of the Commonwealth Edison Company, Chicago, which are described elsewhere in this issue, have emphasized the value of some of the engineering features of modern central stations. There was nothing unusual about the initial trouble, but it occurred in such close proximity to a generating station that the effect was quite far-reaching. The resultant explosion in the manhole was very severe, but it failed to damage or displace any of the seventeen other cables which were there. These cables were adequately protected by their fireproofing. The older ones were covered with split tile, and the last cables installed were cemented in accordance with present practice.

In the substations and generating stations the advantage of supplying the safety devices with energy from a small storage battery having no other duty was well demonstrated. The value of the protection afforded the system by reserve batteries was also proved in spite of the fact that these batteries were naturally of insufficient capacity to carry the entire load at full pressure for such an extended period. This is an expensive but very desirable form of service insurance.

The value of proper fusing in an Edison three-wire distributing system was amply demonstrated in this accident. When the two direct-current subtations were shut down it was only the fuses in the system that saved large sections of the underground cable from being destroyed by the heavy drafts of current from more distant substations which attempted to supply service to the affected area. Had the downtown district been supplied by a smaller number of larger substations the effect of the disturbance on the underground system would undoubtedly have been more severe. The area covered is less than a square mile and is supplied by nine substations rated at from 3,000 kw. to 9,500 kw. each. While this disturbance on a large generating system brings out no fundamentally new features, it demonstrated that a system of 500,000 kw. capacity or more can be kept under control when, as in this case, the skillful developments of the engineers of the industry are embodied in its design.

Application of Vectors to Wiring Diagrams

Relay and Metering Schemes Are Worked Out by Means of Vector Diagrams—A Systematic Method of Notation and Analysis Is Offered for the Solution of Such Problems

BY LEWIS A. TERVEN
Westinghouse Electric & Manufacturing Company

IT IS doubtful whether vectors are used to better advantage in any other field than in their application to wiring diagrams. Several specific problems are taken up in this article in order to make it possible for the reader to apply the method at will. In the matter of notation the double subscript scheme appears to be the best available and has been adopted in the present paper.

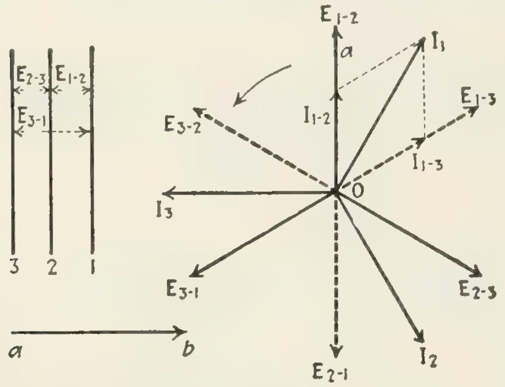


FIG. 1—GENERAL VECTOR RELATIONS IN A THREE-PHASE CIRCUIT

A vector represents by its length and direction the qualities of intensity and relative phase of the electrical quantity represented.

In the examples of diagrams shown, the vectors are read in the direction of the arrow; thus, in Fig. 1, the vector is called V_{a-b}, where V represents an arbitrary quantity or vector. Reading opposite V_{b-a} would mean $- V_{a-b}$. Counter-clockwise rotation of vectors is assumed, and, unless specifically marked, phases 1, 2 and 3 occur in order reading down on horizontal buses and from right to left on vertical buses. Vectors are assumed as to general length and direction with reference to average values and position and not as due to instantaneous values. In other words, a positive direction of flow of power through the circuit is taken and vectors are drawn to correspond.

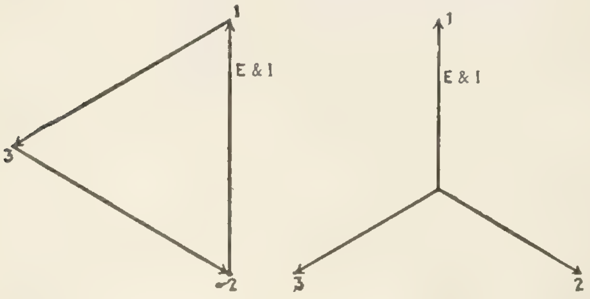


FIG. 2—VECTOR DIAGRAMS FOR INTERNAL RELATIONS IN STAR-CONNECTED AND DELTA-CONNECTED GENERATORS

Since three-phase distribution of power is the rule, and as any other system can be interpreted from the principles applying to the three-phase system, the latter is selected here for applications. In Fig. 1 *oa* represents the voltage from line 1 to line 2, and may be called E_{1-2}; E_{2-3} lags behind E_{1-2} by 120 deg., and E_{3-1} lags behind E_{2-3} by 120 deg. Voltages E_{2-1}, E_{3-2} and E_{1-3} can be obtained by simply reversing E_{1-2}, E_{2-3} and E_{3-1}, as indicated by dotted lines. The current (I_1) in line 1 consists of a current caused by the voltage E_{1-2} from wire 1 to wire 2, and a current due to potential E_{3-1}, which will flow from wire 3 to wire 1. The current in line 1 due to E_{1-2} may be considered as positive since the sign of the sub I is +, and in order to add to I_{3-1} the latter must be reversed to the position shown dotted I_{1-3}. The vector sum of current in phase with E_{1-2} and E_{1-3} gives I, which represents in value and direction the current in line 1. In a similar way, the currents in lines 2 and 3 are found, and they are indicated in Fig. 1 as I_2 and I_3. The vector relations thus deduced correspond to unity power factor, and with the vectors so drawn it may be said that the current in a wire lags 30 deg. behind the voltage between that wire and the next wire reading counter-clockwise.

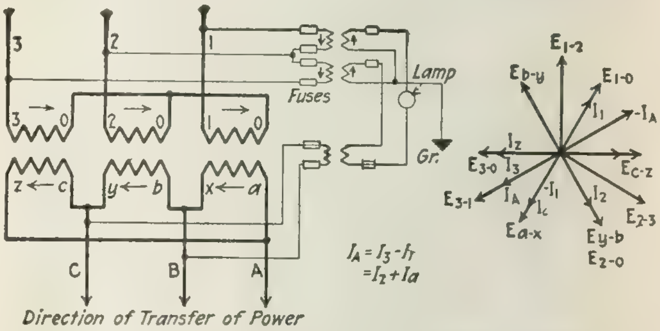


FIG. 3—STUDY OF STAR-DELTA CONNECTED SYSTEM

In case of a delta-connected generator the internal-vector diagram of both voltage and current is shown in Fig. 2a; for a three-phase star-connected generator the internal vectors are represented in Fig. 2b. The external conditions in both can be represented by Fig. 1 as before.

As so many different methods of connecting transformers are in practice, vector representation of the current and voltage relations is more complicated than in the case of generators. With delta-delta or star-star-connected transformers the phase relations in the primary will differ by 180 deg. from corresponding relations in the secondary. For delta-star or star-delta transformation, the line current of the primary will be 30 deg. displayed from the line current of the secondary. This condition is shown on Fig. 3. This case is worked out rather fully since it is a representative problem.

The phase relations in the primary are shown by vectors E_{1-2}, E_{2-3} and E_{3-1} for voltage and I_1, I_2 and I_3 for current. The current I_1 is in phase with the voltage E_{1-0} at unity power factor, and I_2 and I_3 can be shown to agree in phase with E_{2-0} and E_{3-0}, voltages which produce the currents concerned.

Considering the internal relations of each transformer, E_{x-a} must be 180 deg. out from E_{1-0}, due to the fact that one is the induced and the other is the impressed voltage of the transformer. In a similar manner E_{y-b} and E_{z-c} are 180 deg. out of phase with E_{2-0} and E_{3-0} respectively. But it must be borne in mind that the primary of the transformer functions as a motor, while the secondary acts as a generator. Hence voltage E_{x-a} is in phase with E_{1-0} as far as the external circuit is concerned, because if a circuit should be established between wires x and a the current would flow from x to a exactly in phase with the current flowing from 1 to 0 in the primary.

The current in wire A is the vector sum of the currents I_z and I_a. This resultant vector is found as indicated in Fig. 3. and is 30 deg. ahead of the current in wire 3 or I_3, or voltage E_{3-0}.

A simple solution for determining the secondary currents results from neglecting the interposition of each transformer, one by one, because single-phase transformers do not affect the direction of flow of current from primary to secondary. Thus, if current I_3 should jump the gap from 3 to z its direction from z to A would be just the same as the direction of the current which results when considering the presence of the transformer. Similarly I_2 would flow from 2 to y and on into wire C. From this method I_a results from $+ I_3 - I_1$, which gives the same position as before.

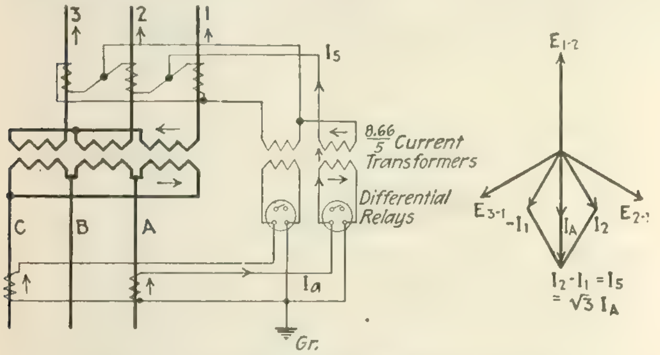


FIG. 4—CONNECTING DIFFERENTIIAL RELAYS

I_a in this particular arrangement is really 180 + 30, or 210 deg., behind I_1, or $- I_1$ is 30 deg. ahead of $- I_A$. If the primary diagram had been drawn with wires 1, 2 and 3 entering the primary coils on the right of the individual coils, then I_A would equal $I_1 - I_3$ and be located 30 deg. behind I_1.

As long as the neutral of the high-tension star is available and voltage transformers are connected between line wires and the neutral, no difference of phase will result relative to the voltage between line wires in the secondary. Thus E_{1-0} corresponds to E_{x-a}, E_{2-0} to E_{y-b} and E_{3-a} to E_{z-c}. But frequently the potential transformers are connected between 1 and 2 and between 2 and 3, giving E_{1-2} and E_{2-3}. From the vector diagram (Fig. 3) it is seen that E_{1-2} is 30 deg. ahead of E_{1-0} or E_{x-a}. If it is desired to synchronize between the high-tension and low-tension sides of the transformer, as occurs when generators are feeding the low-tension side and the high-tension side is connected to an incoming power system, voltages from the secondaries of the potential transformers must be selected which are in either phase or 180 deg. apart. Again referring to diagram Fig. 3, it is seen that E_{y-b} (= E_{C-B}) will correspond to E_{2-0} (= $E_{2-3} - E_{1-2}$) in phase, but since the resultant is 8.66 times the value of E_{1-2}, E_{3-2} or E_{y-b}, potential transformers must be selected of the proper ratio to produce 100 volts in the secondary system of the voltage transformers. (It is usual practice to choose potential transformers with appropriate ratio to give 100 volts, nominal voltage, in the secondary.) All of the above difficulties in synchronizing may be avoided by the use of a synchroscope instead of lamps, in which case the pointer of the synchroscope is shifted to the zero position when primary and secondary are in synchronism. Afterward the instrument will always indicate synchronism at the correct location of the pointer of the meter.

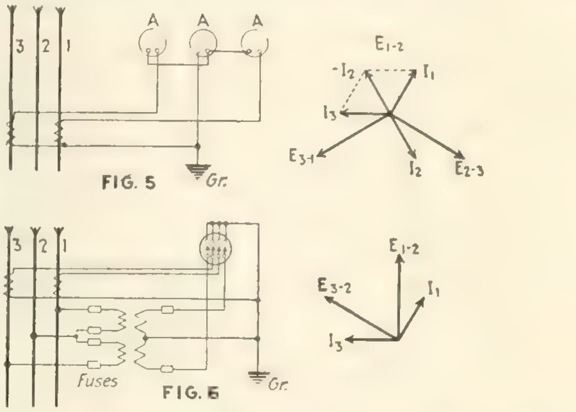


FIG. 5

FIG. 6

FIGS. 5 AND 6—CURRENTS DERIVED FROM OPEN-DELTA CONNECTION; COMMON ARRANGEMENT FOR POLYPHASE WATTMETER

A similar problem arises when it is desired to protect the power transformers shown in Fig. 3 through the use of differential relays. Fig. 4 shows such a scheme and the vectors illustrating the application. From the vector diagram it is seen that the current in line A and hence in secondary of current transformer in line A is that arising from vector summation of $- I_1 + I_2$. In order to obtain a current from the primary side of the power transformer which will be in phase with I_A or I_a, it is necessary to compound $I_2 - I_1$. Hence the current transformers in the primary are connected delta, and current I_5 represents $I_1 - I_2$ and corresponds to I_a in connection with the differential relay. This means that the current I_a would flow through the current transformers on lines 1, 2 and 3 in preference to taking the path through the relay, since the instrument possesses a high reactance. In a similar way, current I_5 flows through the current transformer on wire A. Expressed differently, current I_a is a continuation of current I_5, and so long as they are of equal magnitude no current will flow through

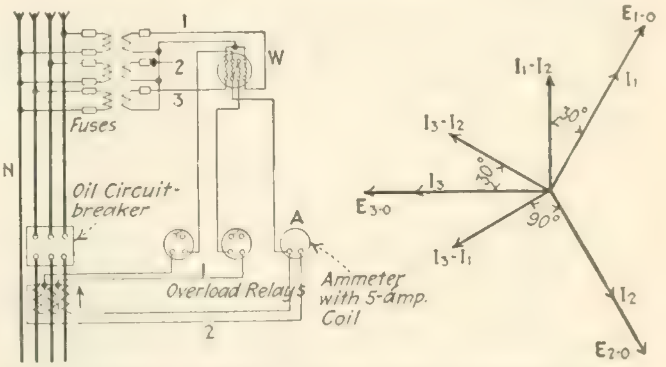


FIG. 7—FINDING CURRENT AND VOLTAGES FOR COMBINED RELAY AND WATTMETER SCHEME

the differential relay. It usually happens that the current transformers are manufactured for a 5-amp. secondary rating, and as I_c would correspond to $\sqrt{3} \times 5$, or 8.66 amp., a current transformer with a ratio of 8.66 to 5 would have to be used between the relays and the current transformers in the primary wires. Special current transformers can be installed on wires *A* and *C*, which will give a normal secondary current of 8.66 amp., thus avoiding the extra 8.66/5-amp. current transformers; but it frequently happens that the special current transformers do not lend themselves to use with meters, and the latter are frequently installed on the same set of current transformers.

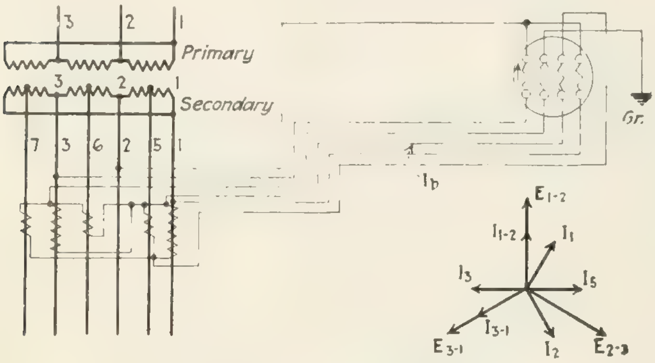


FIG. 8—THIS CIRCUIT OFFERS SEVERAL SOLUTIONS IN POWER MEASUREMENT

Solving Meter-Connection Problems

The widest application of vectors to diagram work comes in the selection of the proper phase conditions to indicate the correct values of electrical quantities of a circuit. Problems involving combinations of voltage and current are numerous, and a few illustrations follow.

One of the most simple vector combinations permits the use of only two current transformers to measure the current in any leg of a three-phase system. This is shown in Fig. 5. Note that $I_1 + I_3 = -I_2$, or $-I_1 = I_2 + I_3$.

The expression for power in a three-phase circuit is $\sqrt{3}EI \cos\phi = 1.73\, EI \cos\phi$. A commonly used vector combination to measure three-phase power is shown in Fig. 6. Two potential and two current transformers are connected to a polyphase wattmeter, the latter consisting essentially of two independent parts, a right half and a left half. In each part a current is multiplied by a voltage and the wattmeter reads the sum of the power indicated by the two halves.

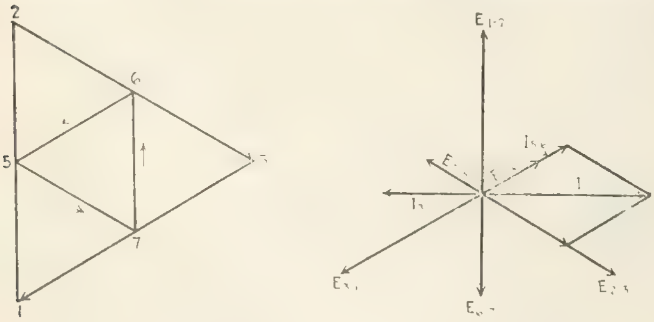
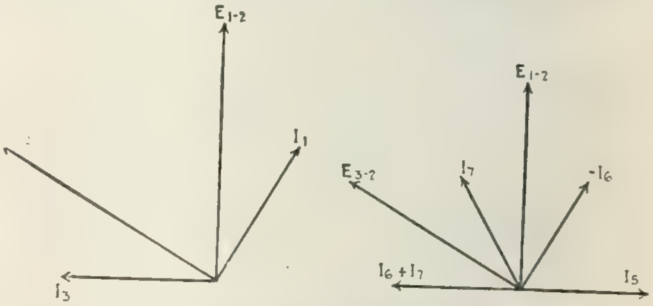


FIG. 9—SIMPLIFICATION OF RELATIONS SHOWN IN FIG. 8

The power indicated in Fig. 6, eliminating power factor, is $(I_1 \times E_1 \times \cos 30 \text{ deg.}) + (I_3 \times E_3 \times \cos 30 \text{ deg.}) = 0.866\, IE + 0.866\, IE = 1.73\, EI$, the condition to be met for measuring power in a three-phase circuit.

The current and potential transformers used for power indications may be used for other instruments, meters, or even for relays. Under such limitations considerable ingenuity must be exercised to obtain proper vectorial relations in the different apparatus. In Fig 7 a portion of a wiring diagram and the vector relations existing at the wattmeter are shown.

As the currents in the lines are in phase with their respective voltages to the neutral, no 30-deg. relation between current and voltage can be obtained without compounding. This may be done as in this typical case, the right side of the meter using E_{1-0} and $I_1 - I_2$, and the left side using E_{3-0} and $I_3 - I_2$ [$= -(I_2 - I_3)$], because it is not possible to use $-I_2$ twice and it has already been used once on the right-hand side of the meter. (The reverse of I_2 to $-I_2$ is accomplished by entering the meter from the top or reverse direction as shown.) The unused vectors will then be $I_3 - I_1$ and E_{2-0}, and since they are 90 deg. out of phase, no power will be derived from them, but the first four vectors named will correctly indicate the power in the three-phase, four-wire circuit. The currents $I_1 - I_2$ and $I_3 - I_2$ represent the vector summations of I_1 and I_2 reversed, and I_3 with I_2 reversed. Hence these currents are 1.73 times the value of I_1, I_2 or I_3, assuming balanced currents flowing in the circuit. This condition must be taken care of by calibration of the meter.



FIGS. 10 AND 11 — VECTOR RELATIONS FOR MEASUREMENT OF POWER AT 220 VOLTS (10) AND 110 VOLTS (11); CONNECTIONS AS IN FIG. 8

Only two relays are shown, but good protection of the circuit is afforded because the current in one relay is due to I_1 and I_2 and that in the other is due to I_2 and I_3. A third relay could be inserted in the third leg of the delta between the ammeter and the wattmeter. The ammeter is connected with only one current transformer in order to use a 5-amp. full-scale instrument.

An Unusual Condition

In Fig. 8 a rather odd condition for power measurement is represented. From the secondary of a three-phase delta-connected power transformer wires 1 to 7 are run, and of these lines Nos. 1, 2 and 3 compose a three-phase, 220-volt circuit, while Nos. 5, 6 and 7 form the neutrals to the three-wire systems 1-5-2, 2-6-3 and 3-7-1. It is desired to connect a single polyphase wattmeter which will indicate the power under all conditions of power consumption, whether the lines be balanced or not. As the voltage coils of the wattmeter must be connected to one or the other values of voltage, the current transformers in the 110-volt lines must be of one-half the ratio of those in the 220-volt lines. Potential coils of 220 volts are chosen with standard 5-amp. current transformers in the 220-volt wires, which will correspond to 2.5-amp. current transformer secondaries in the 110-volt lines.

To solve the problem connections are first made for 220-volt, three-phase power; then connections are added for 110-volt, three-phase power; afterward checks are taken for three-wire load, balanced or unbalanced. Vector relations between the current in the 220-volt delta and the 110-volt neutrals must first be deduced. This may be done in several ways, one of which is shown in Fig. 8, where the current in the neutral wire I_5 is considered as being due to the currents which return on I_1 and I_2. This brings I_5 in phase with $-I_3$, I_6 in phase with $-I_1$, and I_7 in phase with $-I_2$. Another view of I_5 results from considering it as the outgoing current from a corner of an imaginary 110-volt delta, as shown in Fig. 9. Here E_{5-6}, E_{6-7} and E_{7-5} are shown in correct rotation to close open V connections 5-2-6, 6-3-7 and 7-1-5 respectively. I_5 is the resultant of I_{5-7} in phase with E_{5-7} and $-I_{6-5}$ in phase with $-E_{6-5}$. As before, I_5 comes out as $-I_3$ in phase.

The vector relations obtaining in the 220-volt power measurement are given in Fig. 10. Although current I_b, consisting of $I_1 - I_3$, arrives at the wattmeter terminals, only current I_1 goes through the wattmeter coil since the other end of the coil is connected to $-I_1$, and a bridge connection is provided between the bottom of the right-hand meter-current coil and the top of the left-hand meter-current coil, which conducts $-I_3$ to the top of the left-hand coil, which is the place where it should go.

For 110-volt, three-phase power two current transformers would be sufficient, one being in line 7 and one in line 6. The right-hand side of the meter would be fed by $-I_6$ and the left-hand side by $I_7 + I_6$, $-I_6$ being in phase with I_1 and $I_7 + I_6$ with I_3. However, three current transformers are essential, because otherwise power could be drawn from line 2 to line 5 without any power indication in the meter. Fig. 11 shows the vectors as selected, $I_7 + I_6$ being used in phase with I_3 and $I_5 + I_7 = -I_6$ being used in phase with I_1.

CHECKING METER ACCURACY

A check on the accuracy of the meter for different conditions may be had by assuming all possible current combinations one by one. For three-wire power 1-5-2, if balanced, all power will be shown by the right-hand side of the meter as $E_{1-2} \times I_1$. If unbalanced, the current in I_5, being then in phase with I_1, will add or subtract arithmetically from I_1 according to whether the greater load be from line 1 to 5 or from line 5 to 2.

THE CHARACTERISTICS OF ELECTRIC STEEL CASTINGS

Steel of Any Given Chemical Composition Produced in Electric Furnace Will Be Better than That Produced by Other Methods

Physical characteristics of electric steel castings show that much better results can be obtained by the electric process than by the use of any other method. The heat can be controlled so accurately that almost any desired chemical composition can be obtained. This fact is shown by the accompanying analysis and physical characteristics of both acid and basic steel of one manufacturer. Furthermore, such results were consistently obtained in every heat of electric steel. Low phosphorus and sulphur with a high ratio of elastic limit to ultimate strength has been obtained by another manufacturer of electric steel, the results in detail being shown in Table II.

The actual comparisons of open-hearth and electric steel castings which follow show very clearly the value of the latter:

COMPARISON OF OPEN-HEARTH AND ELECTRIC STEEL CASTINGS

	Open-Hearth	Electric
Elastic limit (lb. per sq. in.)	35,000	45,000
Ultimate strength (lb. per sq. in.)	70,000	80,000
Elongation (per cent)	15	30
Reduction in area (per cent)	50	45

This steel is of the following composition: C, 0.25; Si, 0.20; Mn, 0.55; S, 0.01; P, 0.01. It is used for marine construction such as propeller shafts. The electric steel is tough and very resistive to vibrating and alternating shocks and stresses.

Results of comparative tests of electric and open-hearth steel for forged armature shafts and electric railway axles are given in Table IV. The castings were heated to 1450-1460 deg. Fahr. (790 deg. C.), held at that temperature for one hour, quenched in 65 deg. oil, and then drawn at 1185-1200 deg. Fahr. (645 deg. C.) for one hour and cooled slowly in the furnace. The open-hearth steel was also heat-treated after it had been forged.

Excellent results were obtained by electric steel makers in munition work. In Table II are shown the characteristics of low-nickel-chrome gun-steel forgings for the navy. After forging they were quenched at 1400 deg. Fahr. (875 deg. C.) and drawn back at 1200 deg. Fahr. (650 deg. C.).

The figures reproduced in this article were collected by the Electric Furnace Association in an endeavor to assemble accurate data.

TABLES I TO III—CHEMICAL COMPOSITION AND PHYSICAL CHARACTERISTICS OF ELECTRIC STEEL CASTINGS

		Analysis							Physical			
		Cr.	Ni.	C.	Si	S	P	Mn	Tensile Strength, Lbs per Sq. In	Elastic Limit, Lb per Sq. In.	Reduction in Area, per Cent	Elongation in 2 In., per Cent
Table 1	Basic			0.19	0.23	0.025	0.044	0.74	66,750	42,500	51.7	35.0
	Basic			0.23	0.20	0.021	0.040	0.64	76,000	45,000	45.8	30.0
	Acid			0.19	0.27	0.043	0.036	0.52	62,400	36,500	50.0	32.0
	Acid			0.24	0.33	0.050	0.056	0.70	69,000	37,800	44.0	28.0
Table 2				0.80	0.40	0.027	0.020	0.62	113,250	62,250	20.2	15.0
				0.40	0.50	0.020	0.011	0.52	97,300	49,230	29.4	20.5
				0.23	0.35	0.024	0.018	0.55	70,000	27,500	52.0	33.5
				0.18	0.40	0.022	0.016	0.70	62,500	39,000	55.5	34.2
Table 3		0.34	2.25	0.35	0.11	0.023	0.029	0.56	102,000	65,000	52.5	31.0
		0.40	3.40	0.35	0.19	0.025	0.010	0.57	105,850	74,000	54.1	22.5
		0.45	2.91	0.39	0.11	0.026	0.023	0.54	102,125	60,000	51.8	22.0

TABLE IV—COMPARISON OF PHYSICAL CHARACTERISTICS OF STEEL MADE BY OPEN-HEARTH AND ELECTRIC FURNACE PROCESSES

	Armatures		Axles	
Properties	Open-Hearth	Electric	Basic Open Hearth	Basic Electric
Ultimate strength, lb. per sq.in	91,200	107,700	89,100	105,140
Elastic limit, lb. per sq.in	46,000	69,950	41,060	61,850
Elongation (per cent)	22.2	23.5	21.5	22.0
Reduction of area (per cent)	44.8	50.0	31.74	52.37
Elastic torsion, lb. per sq.in	16,750	33,700	16,750	33,700
Shearing strength, lb. per sq.in.	62,400	76,000		......

New Distribution System for City of Seattle

On Account of Scattered Loads, Feeders from Substations Will Operate at 15,000 Volts to Neutral—This Requires Only Small Conductors, Gives Excellent Voltage Regulation and Small Energy Loss on the Lines

BY J. D. ROSS
Superintendent of Lighting, Seattle, Wash.

BY THE adoption of a system of feeders from substation to distribution centers, operating at 15,000 volts to neutral (25,980 volts between phases) the city of Seattle expects to dispense with feeder regulators and to replace many miles of 350,000-circ.mil cables by No. 2 wires, saving over 50 per cent of the 2500-volt copper now in use. The No. 2 wire is adopted to insure mechanical strength, and about 10 per cent of the energy now delivered to the distribution system will be saved by an enormous reduction in line losses.

Seattle owns its own light and power system and is also served by a private company under Stone & Webster control. The city plants serve 60,000 customers besides city institutions and street lighting, and the company serves 30,000 within the city limits. Seattle since the war is generally credited with more than 400,000 people. The company, being first in the field, has established its service in the business section, leaving the outlying districts for competition with the city. At the time the city entered the field in 1904, the company operated a two-phase system and the city followed suit in order that power apparatus might be used on either system.

GENERATING SYSTEM

The city distribution system is supplied partly by its Cedar River hydroelectric plant, 40 miles (64 km.) distant, through two three-phase, 60,000-volt, star-connected lines. This plant, with additions now under way, will be equipped to generate 20,000 kw. A steam plant in the city now furnishes 20,000 kw., and another unit is being added, making a total of 35,000 kw. in steam power.

A new hydroelectric plant of 36,000 kw. as a first unit on the Skagit River has been financed and work is under way. This site is 100 miles (160 km.) from Seattle and will admit of the installation of 500,000 hp. On this account transmission will be at 160,000 volts or higher, delivering 150,000 volts at Seattle. Since during the fifteen years of its life the Seattle system has not lost a single main-station transformer, and since the insulation of to-day is still more dependable, and since very large low-voltage switches and busbars give more trouble than they prevent, the 45,000-kva. generators will be coupled solidly to the transformers through a reactor and all switching will be done on the high-tension side. The station will then become simplicity simplified, reliability will be greater, and the work and troubles of operation will be reduced. The system will be controlled by the proper "T.A." regulator acting on the station voltage and by another acting on synchronous condensers in Seattle to control the power factor.

The Skagit substation will be in the north end of the city, while the Cedar River substation is in the south end about 6½ miles (10.4 km.) distant. Between the two lies the steam plant. All will be interconnected by an intermediate voltage of 15,000 star-connected. The regulation will therefore be well attended to and a uniform voltage supplied at the steam plant and both substations, the condition requisite for good regulation on the distribution system which they supply.

DISTRIBUTION PROBLEM A DIFFICULT ONE

On account of the fact that two competing distribution systems are maintained over a city 20 miles (32 km.) long and about 2½ miles (4.0 km.) wide, every effort must be made to decrease the expense of distributing energy. The city serves all residence customers at the same rate, 5½ cents for the first 45 kw.-hr. and 2 cents for all in excess of this amount. If energy is supplied to the substation busbar at a cost of ½ cent, it is evident that the only opportunity for appreciably cutting the cost to the consumer lies in reducing distribution expense.

Although the two-phase system has no superior from an operating standpoint, the city is changing its distribution system to three-phase. There is a saving of one wire in each power circuit and two-phase machinery is becoming increasingly hard to obtain. Standardization and price tend to make two-phase systems obsolete and Seattle must now make the change.

The choice of an intermediate voltage through the city is the foundation for the radical change in Seattle's system. The very best voltage is the highest that can be used economically, provided that it is as safe to life and property and as easily operated. The writer installed a 15,000-volt, two-phase system in Seattle ten years ago. The center of each phase was grounded and a fifth wire was used as a ground. Customers were served along the waterfront and in suburbs with 7500-volt pole transformers, while 15,000-volt transformers were put under cover, as they were not then made for outdoor work. Substations were connected by the same system. The system worked splendidly, and 15,000 kw. is now so distributed. Service was vastly cheaper. For safety to life and property no wire smaller than No. 2 was used, so the drop in voltage was small, and better results in regulation were often obtained than on the regular 2500-volt feeders with induction regulators. The system was extended to the suburbs. In one case a small suburb, South Park, 7 miles (11 km.) from the substation was supplied from a 50-kw. transformer with good regulation. For years only one No. 2 wire was used to connect this suburb, the other transformer terminal being grounded.

A good-sized steel mill on tidewater was connected two-phase over two wires, the common return being a ground in the salt water. The service was much better than that on expensive 2500-volt feeders, and losses were less. It is natural, then, that the city should go a step further and change all feeders to this system, abolishing the 2500-volt feeders. It is also a natural step now to choose a three-phase star-connected system with 15,000 volts from phase wire to neutral. Considering the first essential, safety to life, the neutral will be grounded at many points so that there can be no greater voltage to earth than 15,000, as in a 15,000-volt delta system. The lines will be placed on the top of the pole and will always be cut out before work is done on them. They are therefore as safe as any 15,000-volt system delta-connected and safer to linemen than any 2500-volt system which is frequently repaired with the line alive.

A second requisite, best regulation, is met in a manner almost ideal; for while the voltage in relation to all other wires is 15,000, the transmission voltage is 25,980. The same copper will therefore transmit three times as much as on 15,000 volts, or 108 times as much as can be carried at 2500 volts on ordinary feeders using induction regulators. Since, to insure mechanical strength, no wire smaller than No. 2 will be used, it is obvious that there will be almost negligible loss on suburban circuits. In the case of No. 2 feeders, the same mechanical strength, if desired, may be had at a less cost by substituting a steel-cored aluminum cable, the equivalent of a No. 3 copper line. This is ample in most residence work.

Another requirement, low cost, is met in a way that needs no comment. All suburban feeders, branches and secondaries will be of No. 2 wire or smaller. Lowest maintenance and simplicity of operation are also taken care of better than under the existing system.

Finally, concerning power losses, there is no doubt that about 10 per cent of all power now distributed at 2500 volts in Seattle will be saved. Not only is there this great saving in energy but there is a very great saving in copper and automatic regulators.

Thomas insulators rated at 35,000 volts are being used for the three phases in three colors, mahogany, yellow and blue, while the neutral, where carried, will be on a 15,000-volt insulator such as is used at present, though theoretically it does not require insulation.

FEWER SUBSTATIONS AND NO VOLTAGE REGULATORS

No transformer either feeding or being fed from this voltage will be star-connected on the other side, so that there is no objectionable star-to-star connection in the entire system. The 15,000-volt star system will now replace the customary 2200-volt or 2500-volt feeders and most of the distribution network of large circuits. The automatic induction regulators will become unnecessary in probably every case. The customary suburban substations will also be rendered unnecessary. Instead of a few large centers of distribution from expensive substations we have many small centers containing only transformers with disconnecting switches or fuse switches. Often these centers are on poles much like the pole transformers on a 2500-volt network. The heavy feeder equipped with its induction regulator now gives place to a high-voltage feeder with practically no loss to compensate for and therefore no need for a regulator. For best regulation the 2500-volt feeder is usually run to a center from which branch lines radiate, some of them doubling back toward the power house; but this is not so in the case of the high-voltage feeder, which may be tapped all along its route, and all centers tapped will have no appreciable difference in regulation. Again, this fact now makes it possible to use small networks around each center so that it is not necessary for residence purposes to have long branches. For this reason no 2500-volt primary and no secondary need be larger than No. 2, while it is doubtful if any larger than No. 4 will be needed. No copper larger than No. 2 is needed for the feeders, so that in all the city distribution there will be no larger copper than this needed except for local power secondaries and tie lines across the city between main step-down stations. About $100,000 in copper and induction regulators will be salvaged from the present distribution system, and all future distribution will be vastly cheaper and simpler; average regulation will be better, operation will be simpler, the main substation will be simpler, and life and property will be as safe or safer. No higher voltage will be introduced in the city than is now used as far as the public property and other property are concerned.

A fair estimate of the voltage regulation over the new system at full load will be as follows:

	Per Cent
Main transformer, 25,980 volts or 15,000 volts; 2500 volts at each distributing center	2.00
2500-vole network	1.50
2500, 250 and 125-volt transformers..............	2.00
Secondaries and services	1.50
Total drop, no load to full load, beyond residence distributing centers	6.82

This average over all suburban work will not be disturbed by any large suburban power loads as these will be fed directly from the high-voltage feeder without appreciable effect. The voltage regulation of the entire system will depend on the automatic regulators at the hydroelectric and steam stations to regulate voltage and the regulators used on synchronous condensers at the substations to control power factor. Since the drop in feeders from the substations to distribution centers is almost negligible, it is easy to produce the uniform voltage desired at all distribution centers and to have practically perfect control at these points. From these points to the customers' lamps, as stated above, we must meet a voltage drop of 6.82 per cent, and this is the only drop that cannot be easily and completely compensated. An analysis of loads on existing feeders shows that residence loads of different districts do not vary so widely as might be supposed, although in the Seattle circuits, as in most cities, energy for small power demands and business lighting is carried on the same wires as that for residence lighting and cooking. Since the peaks occur about the same time, a great part of the 6.82 per cent drop can be compensated for by regulating the system voltage. This is further made much easier by the fact that the power factor on residence circuits drops to 50 per cent on light load and rises to nearly 100 per cent on full load.

NATURE OF DISTRIBUTING CENTERS

A distributing center ordinarily becomes nothing more than a transformer on one or more poles. The transformer may operate between phases at 25,980 volts or from phase to neutral at 15,000 volts as desired. Stations of each kind will no doubt be used. In general, such a station will be put on a small residence lot bought for the purpose, instead of on the street. Where the district warrants the change a small room may be built to house the transformer. The architecture of this cell may be made as good as or better than the surroundings, and the small grounds may be made to add to its appearance. The location sought would be the center of load.

Distributing centers may be laid out having one square mile or less in the better districts, and they may be greater in scattered sections. As a rule the smaller the area the better the regulation, the smaller the copper used and the smaller the area and the fewer the people in darkness during any local accident of short circuit. The largest 2500-volt wires and secondaries will be No. 4 and No. 6, with possibly an occasional No. 2. The 2500-volt branches may be connected at the distribution center through disconnecting switches, or if desired they may be connected through fuses and the various branches may be kept separate and not tied into a network as the shortness of the lines eliminates much of the necessity for and advantages of a network. Such a system of separate mains connected through fused switches has the effect of localizing trouble to a degree several times that reached with the usual system. On a test conducted on a branch of a circuit serving 871 customers there were thirty-five transformers with a total rating of 275 kw. The maximum demand of the year was 232 kw. The branch carried 804 residences and apartments, fifty-four small business lighting meters and nine small power loads, besides eight water heaters and twelve domestic-service installations in the residences. The yearly load factor was 25.3 per cent. The street frontage of lots in this district aggregated 70,700 ft. (21,210 m.), and the average frontage per lot was 81.4 ft. (24 m.). The average watts per foot was 3.3. The ratio of secondary bus to street frontage was 61 per cent, making the average watts demand per foot of secondary mains 5.4 watts. The percentage of the district built up was 67.5, so that if fully built up the load to be expected would be 4.9 watts per front foot.

This district is an average one, but, of course, every other district will vary from it and will vary from year to year. The demand will never be less. In this test residence lighting was found to be little more than half the total energy. The day is therefore gone when greater economy in lighting can lessen demand, since small power and electric cooking are increasing and will form the bulk of a greatly increased suburban load.

It will be noted that phase relation is chosen throughout to give best regulation as well as lowest price. The Skagit system will have its step-up transformers star-connected, 160,000 volts, at the power house. At the substation, however, the step-down transformers will be connected in delta, this being thought preferable when the secondary or intermediate voltage is star-connected; *i.e.*, 15,000 volts between phase and neutral. This star system is used alike for interconnecting stations and for feeders. The Cedar River system is also star-connected, 60,000 volts, at the station feeding substation transformers, delta-connected on the high side.

The star-connected feeder system steps down at the distributing centers to short mains at 2500 volts. Where these are three-phase for power purposes the 2500-volt side will be delta-connected. A star 2500-volt system could have no advantages in cost as the runs are short and mostly single-phase. The secondaries are supplied by the regular 2500/250-volt and 125-volt transformers.

Supplying Domestic Service

The low rates given by the city have produced a wonderful effect and the success of electric cooking is now largely a matter of education. This being so, the question of distribution at first seems appalling when we consider the feeder wires required, but the system just outlined meets the difficulty. The only wires requiring a considerable increase in size are the short 2500-volt mains and secondaries. Here, too, we have a choice between larger mains and closer spacing of transformers or subdivision of the network. At present no transformers are spaced further apart than five spans. The low power loss and close regulation to distribution centers and the fact that for mechanical reasons no feeders smaller than No. 2 are used makes domestic service a very desirable load and one not to be feared.

Saving in Residence Current

Besides the saving in copper there is a much more important saving in energy. The Seattle system employs large-sized wire but for years its losses in kilowatt-hours from substation to meters ran between a minimum of 20.6 per cent and a maximum of 22.2 per cent, and this in spite of the fact that 15,000 kw. is distributed on 15,000-volt feeders. The average cost in 1918 of residence energy at the meter was 4.45771 cents, while the selling price averaged 5.20194 cents.

A considerable saving in copper and a 10 per cent saving in energy will combine to make a great reduction in cost. All energy so saved is reclaimed after all fixed charges and operating costs have been paid, and it may be considered as carrying only the costs of extra services and meters with part of its pro rata on the 2500-volt system and secondaries.

Without going into detail, aside from the interest and depreciation on these costs, each kilowatt-hour so saved, at the 1918 selling price of 5.2 cents and at an annual load factor of 25.3 per cent, would be worth $115.24 per kilowatt-year net. The profit on each kilowatt-year sold would be $16.48, so that, aside from the saving in copper and regulators, if 10 per cent of the distributed energy is reclaimed the profit per kilowatt sold at the customer's meter will jump to $29.28.

A 15,000-volt star system gives 25,980 volts between phases. It is the general opinion of cable manufacturers that about 25,000 volts on duplex or triplex cables is the highest limit to which we can with safety go. The writer believes that the future will bring a greater preference for single cables in separate sheaths, and in this case such cables would be insulated for only 15,000 volts. The same is true for submarine cables. In residence districts there is no danger of overloading feeders. Duplicate feeders or sections in important districts are less expensive as cables are small.

Summary

In the new system there will be no feeder regulators. Those now in use will be removed.

The 350,000-circ.mil. 2500-volt feeders, consisting of thousands of pounds of copper, will be taken down. Instead the new feeders will be all of No. 2 copper on the top position of the pole. No. 2 is chosen for mechanical strength.

There will be fewer feeders, so that much space will be saved both in the main substations and on distribution poles.

The residence feeders will supply transformers giving 2500 volts for distributing, except where power jobs are supplied directly along the line at lower voltages. The network will be of No. 4 or No. 6 2500-volt wires, feeding the ordinary pole or underground transformers supplying secondary mains of No. 4 and No. 6 wires and supplying service at 250 volts and 125 volts.

A loop system between substations, or a system of cross-connections between feeders, may be used at least on important feeders, and sectionalizing switches can be used to cut any section dead for repair without stopping service. The 2500-volt network of the different centers will not be connected but will be entirely separate to minimize the area affected by a short circuit or an open circuit. Life and property are safeguarded as well as or better than before. There will be a flat voltage throughout the length and breadth of the city at every center, no matter how remote. As a final result average regulation will be vastly better. Simplicity of construction will guarantee greater continuity of service.

Saving in material will be very great. Besides the saving in feeder wire, many of the heavier feeder branches will be removed. In Seattle this will save over 50 per cent of the 2500-volt copper now in use. It will also save the cost of regulators and reduce the size of main substations. There will be a great saving of energy—in fact, 10 per cent of all distributed, the cost of which has been paid by the other 90 per cent. There is no danger of overloading a feeder of No. 2 wire, so that electric cooking and suburban power business, large or small, may be taken in remote suburbs as willingly as if close in and will become a good paying load.

The system lends itself readily to underground work for either power or residence service.

The main argument for the system is that for ten years in Seattle it has demonstrated its great worth from all points of view, and at the present time several thousand kilowatts are being rapidly transferred from the 2500-volt system. The writer is now surprised that he and his associates were too conservative to see the importance of this system before.

The writer is indebted to his engineer of inside construction, W. J. McKeen, and his engineer of outside construction, Glen Smith, for their ideas and help in the design of this system.

Electric Heat Treating of Forgings

Operating Results from 900-Kw. Two-Unit Automatic Pusher-Type Electric Hardening and Drawing Furnace—Practically All "Rejects" Eliminated Except Those Due to Variations in the Metals

ELECTRIC heat-treating furnaces are in growing demand where quantity production of a uniform quality is required. One of these furnaces was installed by the Ingalls-Shepard Forging Company, Harvey, Ill., and was used during the war to treat forged aëroplane and tractor cranks which were being manufactured for the government. However, the advantageous use of electric heat treating is not limited to war work. The foolproof qualities of the apparatus make the electric furnace a potent factor in maintaining the quality of the forgings during peace times especially when labor is scarce and inefficient. With the electric furnace a much higher percentage pass the Brinell test than is the case when the pieces are treated in fuel-fired furnaces, and it is the commercial inequality of the steel rather than any fault of the furnace that is responsible for a great majority of the "rejects" that still have to be sent back.

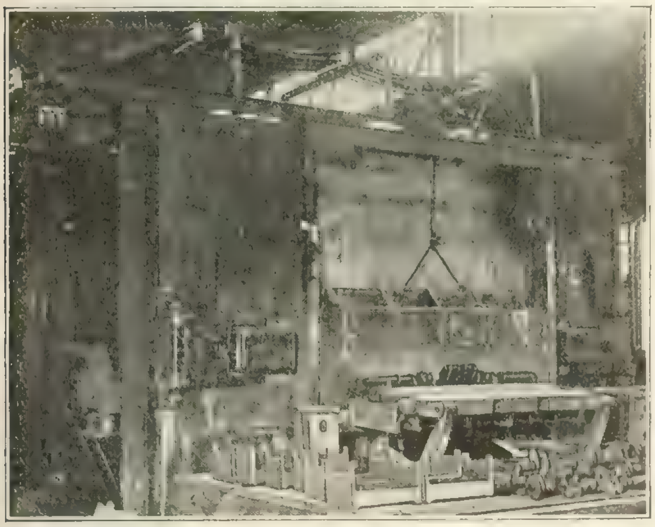


FIG. 1—HEATING SECTION OF FURNACE
This shows the receiving end, the crankshafts to be heat-treated, the supports for the furnace leads and the electrical connections to the side of the furnace.

The furnace being discussed is a Bailey stationary resistance reverberatory type of electric furnace manufactured by the Electric Furnace Company, Alliance, Ohio, and designed to treat 72 tons every twenty-four hours. The unit is built in two similar sections, each containing a hearth 20 ft. by 7 ft. (6 m. by 2 m.). The pieces to be heat-treated are first placed in the heating section, which is heated to a temperature of about 1450 to 1550 deg. Fahr. (790 to 840 deg. C.). Then the pieces, which happen to be cranks in this case, are quenched in water and passed into the second section, where the temper is drawn with a temperature of about 1050 deg. Fahr. (565 deg. C.). The cranks are placed in front of the door of the furnace by hand, but all the

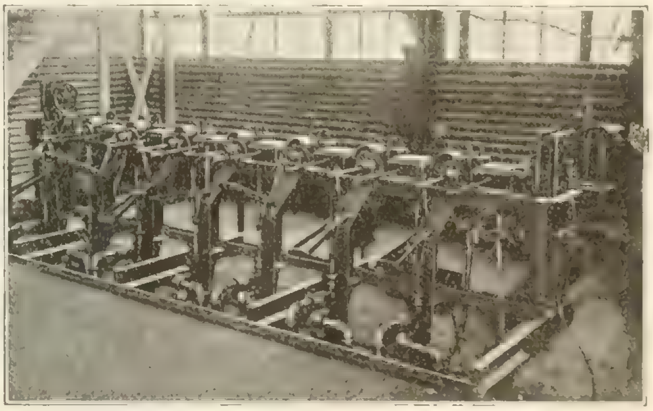


FIG. 2—DRAWING SECTION OF FURNACE
This shows the discharging end, the motor-operated hydraulic control equipment and the motor-driven plunger and centrifugal pumps.

mechanical operations in connection with feeding the pieces through the furnace are carried on continuously by the aid of motor-driven auxiliaries. The heat to the furnace is controlled by manually operated oil switches which connect the heating elements of the furnace sections to different taps on the transformer windings.

Energy is supplied to the furnace from three 300-kva. single-phase transformers. One transformer is connected to each of the two heating troughs in the heating section of the furnace. The two heating troughs in the drawing section of the furnace are connected in parallel to the other transformer. This method of connection balances the load on the three phases, as may be seen diagrammatically in Fig. 4. The same illustration also shows the connections to the transformer tap. The connections between the transformer taps and the oil switches are at the top of the transformer room.

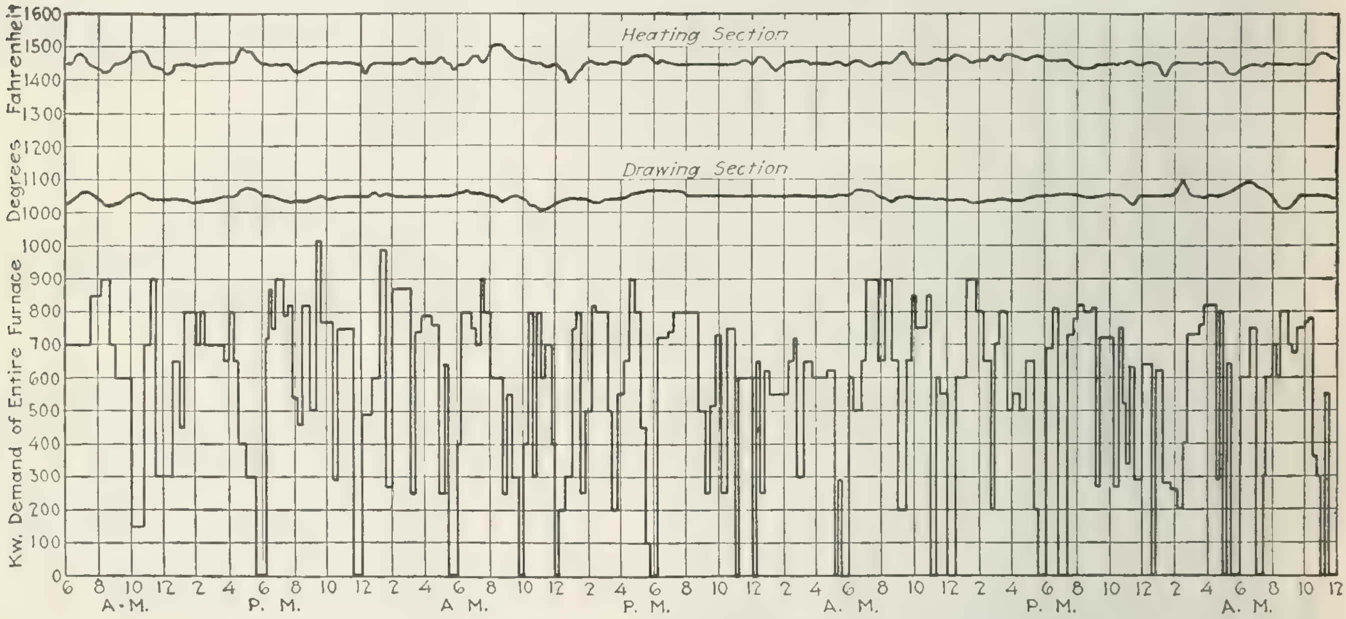


FIG. 3—LOAD AND TEMPERATURE CURVES FOR THREE AND A QUARTER DAYS

No regular records have been kept of the energy consumption nor of the tonnage output of the furnace, but tests were made for three or four days and the curves obtained then are shown in Fig. 3. During that time about 215 kw.-hr. was consumed per ton of metal treated. However, nearly half of the metal was in the cradles which supported the cranks. Consequently the energy consumption was about 400 kw.-hr. per ton of net output. The load factor for the three and one-quarter days averages 54 per cent with a maximum demand of about 1015 kw.

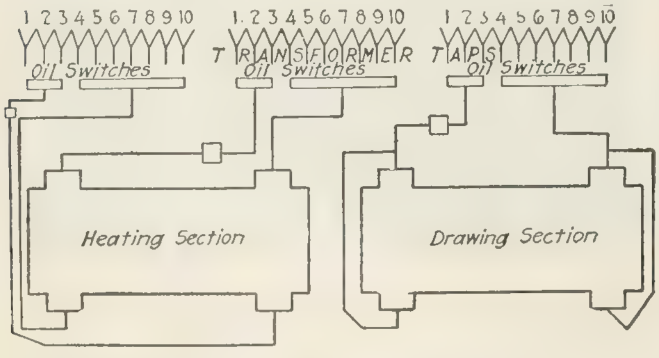


FIG. 4—METHOD OF BALANCING THE TWO SECTIONS OF FURNACE ON THREE SINGLE-PHASE TRANSFORMERS

BURNING LOW-GRADE COALS OF MONTANA AND WYOMING

Tests on Fuels That Have Heretofore Given Operating Men Much Difficulty Show that Proper Furnace Design Will Solve Problem

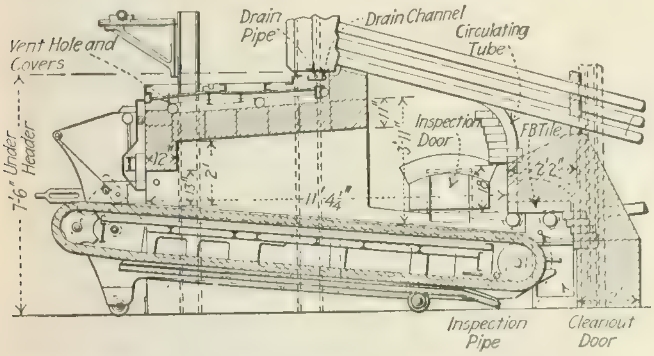
BY E. H. BULL, EAST CHICAGO, IND.

EVER since the commercial development of coal mining in the Red Lodge district of Montana and the Sheridan district of Wyoming thirty-five years ago there have been constant attempts to burn the fuels, but the best results obtained fell far short both from an efficiency and a capacity standpoint. On the average 60 per cent over-all efficiency and 140 per cent of builder's rating were obtained for periods of over two hours' duration. Nearly all the early attempts to burn this grade of fuel failed because of (1) the problem of ash discharge (these coals are classed as high-ash coals), and (2) the problem of igniting the coal promptly and in sufficient quantities. Recently these problems were solved by using a chain grate with a long arch having a steep pitch, the stoker providing a satisfactory fuel bed and the arch the concentration of heat necessary at the stoker gate.

The coals mined in the Red Lodge district have a black color and much luster. They are about as bright as some of the bituminous coals of Pennsylvania, but in contrast to most sub-bituminous coals do not lose this luster when exposed to the air for a short time. However, Red Lodge coals do not stock very well and for this reason must be classed as sub-bituminous, even though in heat value they approach some of the bituminous coals of the Mississippi valley. The ash in these coals is largely due to dirt, which occurs as partings, too thin to be separated in mining. The sulphur content is low. In general, the structure of the coal is such that it can be broken into marketable sizes with only a small percentage of fine coal and slack remaining as residue.

Bear Creek coal from the Red Lodge district has this average analysis, expressed in percentage: Moisture, 15.48; volatile matter, 35.46; fixed carbon, 34.80; ash, 14.26. The B.t.u. as fired is 9354.

Bear Creek coal ingnites freely in furnace having a long sloping arch. Such a furnace is represented in the accompanying illustration; the ratio of active grate area to boiler heating surface is 1 to 37.4. As the boiler was set and in service several years before the stokers were purchased, the distance from the floor line to the bottom of the front boiler header is not so great as modern practice dictates. The high moisture content of the fuel, the thin fuel bed and high chain speed require the greatest possible concentration of heat at the stoker gate. In addition the fuel requires slight moistening. When burning there is a large amount of very light particles of carbon which leave the grate. These ignite and give off an intense white flame. In the particular design shown herewith the furnace volume was relatively small and these particles were carried over into the combustion chamber or stack.



PROPORTIONS OF FURNACE THAT BURNS MONTANA AND WYOMING COALS SATISFACTORILY

For minimum combustible in the ash the coal should be of a uniform size, about ¾ in. (19 mm.) screening, and without an excessive amount of fine coal. Coal having 40 per cent ¾-in. (19-mm.) screenings, 20 per cent ½-in. (13-mm.) and the rest all passing ¼-in. (6-mm.) screen will give the best results. On the tests quoted the coal size was not all that could be desired, owing to there being insufficient fine coal, as already mentioned.

The intense igniting effect of the furnace shown is best illustrated by the statement that a 2¾-in. (69-mm.) to 3-in. (75-mm.) fuel-bed thickness was found advantageous and chain speeds approaching 12 in. (30 cm.) per minute were used.

Results of two tests with this furnace and Bear Creek coal, one at a medium and one at high rating, follow:

	A	B
Per cent combustible in the ash	20.27	18.31
Draft in furnace, in inches	0.18	0.22
Flue-gas temperature, in deg. Fahr.	505	613
CO_2 at uptake, in per cent	12.5	12.97
Coal burned per square foot of active heating surface, in pounds	28	38
Per cent builder's rating developed	158	209
Combined efficiency, in per cent	75.8	75.6
Duration of test, in hours	8	8

Another prominent coal from this district is Red Lodge. In general it is very similar to Bear Creek coal, having an average analysis, expressed in percentage, as follows: Moisture, 15.27; volatile matter, 41.24; fixed carbon, 30.91; ash, 12.85; sulphur, 1.31. The B. t. u. as fired is 9553. Owing probably to its slightly higher volatile content, it ignites a little more freely than Bear Creek coal. It burns to a very clean white ash.

Results of tests using Red Lodge coal in a furnace similar to that shown in Fig. 1 show the following:

	A	B
Per cent combustible in the ash	20.71	19.10
Draft in furnace, in inches	0.17	0.17
Flue-gas temperature, in deg. Fahr.	531	528
CO_2 at uptake, in per cent	12	12.75
Coal burned per square foot of active heating surface, in pounds	31	30.5
Per cent builder's rating developed	178	182
Combined efficiency, in per cent	73.1	77.8
Duration of test, in hours	8	8

Southeast of the Red Lodge district in Montana, just across the Wyoming state line, is the so-called Sheridan coal field. The various coal beds of this field are very similar. All of them are distinctly black and have a shiny luster when fresh. Exposed to dry air, the blackness is intensified by a partial loss of the luster. At the same time it undergoes a rapid change by the loss of its free moisture, which causes it to crack. Though weakened by this shrinkage, the coal will not crumble for an indefinite period if properly protected from the weather. When it is subjected to alternate wetting and drying, however, it breaks into small lumps and is finally reduced to dust.

Though the coals of the Tongue River group of the Sheridan field contain a comparatively high percentage of moisture and disintegrate on exposure like the lignites, they do not show a woody structure. On the other hand, some of the coals from the other groups of the Sheridan field do show this woody structure. Their main difference from the Tongue River group is a slightly higher moisture content. An average analysis of the Sheridan district coals shows the following percentages: Moisture, 20.52; volatile matter, 31.23; fixed carbon, 30.00; ash, 9.25. The B.t.u. as fired is 9096.

Sheridan coal ignites freely when used in a furnace having a proper igniting effect. To secure the best results, it must be burned with a thicker fuel bed and slower chain speed than is desirable for the coals of the Red Lodge district.

Referring again to the accompanying illustration, results of tests with this furnace and Sheridan coal follow:

	A	B
Draft in furnace, in inches	0.196	0.16
Flue-gas temperature, in deg. Fahr.	552	
CO_2 at uptake, in per cent	12.6	11.8
Pounds coal burned per square foot active grate surface	35	30
Per cent builder's rating	195	152
Combined efficiency, in per cent	78.1	76
Duration of test, in hours	8	24

It may be of especial interest to notice that the test at 152 per cent was conducted under normal operating conditions, no provision being made for maintaining a steady load.

The tests here reported are selected from a series. While results obtained are unusually good, they represent no extraordinary efforts with these furnaces. They can, therefore, safely be taken as indicative of the possibilities in using these fuels. With respect to capacity, it may be said that 209 per cent rating represents the maximum secured. Undoubtedly the furnace volume was the limiting feature, as the ignition showed no signs of failure.

Experience with these lower-grade coals clearly establishes the fact that a chain-grate stoker can be used in their firing to solve the ash-discharge problem.

Moreover, the successful employment of chain grates necessitates a long and steeply pitched flat arch to provide quick ignition, as well as a large grate surface, if good overloads are to be secured.

Making Proper Rates for Electric Welding

Question of Central-Station Rates Is of Vast Importance to the Welding Industry—All Factors Should Be Considered Fairly and a Far-Reaching Co-operative Policy Adopted

BY S. I. OESTERREICHER
Member American Institute of Electrical Engineers

WITH the exceedingly interesting and timely comments of C. I. Crippen about making rates for electric welding,* a subject of vast importance to the electric welding industry has been touched upon. The uncertainty which seems to exist upon this subject among central-station interests is no doubt due to the indifference of the welding industry, which during a long period in the past did not assist those affected by the rates as much as its unquestionable duty would have suggested.

While welding installations of only comparatively small sizes had to be considered—say from 25 to 100 kva.—no great harm was done by such tactics to either interest. However, with the installation of large equipments and the operation of large unit welding machines, central stations suddenly experienced disturbances upon their lines and in their stations, which were anticipated but partly and were blamed entirely upon the welding equipment. Thus, to protect themselves, central-station interests launched into a partially retroactive policy, greatly to the detriment of the welding industry as a whole.

Since welding installations of several thousand kva. capacity are not unusual any more, it is proper that all points of doubt should be considered as broadly and fairly as possible, and a far-reaching co-operative policy inaugurated. The revenue from such large installations may easily reach several thousand dollars a month. It is therefore obvious that, from a purely commercial standpoint, a welding load is a very desirable constant source of income to the central station.

Looking at the reverse side, it should be recalled that central-station engineers, on account of past sad experiences, had jumped to the following conclusions:

1. That a welding installation is a very unreliable metering proposition.
2. That it has a poor load factor.
3. It has a constantly fluctuating load varying between extreme limits, and
4. It has a bad power factor.

To aggravate matters all around, usually old or unsuited generators and transformers were installed. These were cross-connected haphazard to carelessly selected nearby pole lines, and then, if trouble developed, all the blame was laid on the welding installation.

During the war the welding industry received a large impetus. For the tremendous advantages which electric welding offered, all the blunders of the past were instantly forgiven. If in the near future the mutual advantages gained recently are lost, the central stations will lose just as much as the welding industry.

To both interests the first important point of the controversy is, no doubt, the metering. The time-honored opinion on one side that, due to the short period involved, an integrating wattmeter does not respond quickly enough, is contradicted by the claim on the other side that the deceleration of the meter disk compensates for the lagging acceleration. As far as the writer is aware, not the slightest positive proof has been offered to support either contention. Considering for instance a 200-volt, 300-amp., single-phase, two-wire wattmeter, whose disk at full load makes 25 r.p.m., and assuming the total energy consumption to be integrated within 0.2 second, it will be found that to register correctly the meter disk has to travel about 0.08 of a revolution. It is scarcely possible that by merely looking upon a meter disk any one could guess within 100 per cent the actual travel during such a short time interval. A stop watch will scarcely be of any assistance; neither will a cycle recorder with an ammeter and voltmeter check be of any value, since no instrument is of such absolute dead beat as to come to rest from no load to full load within 0.2 second. Such methods therefore are of no value in ascertaining the behavior of a wattmeter under sudden intermittent heavy loads.

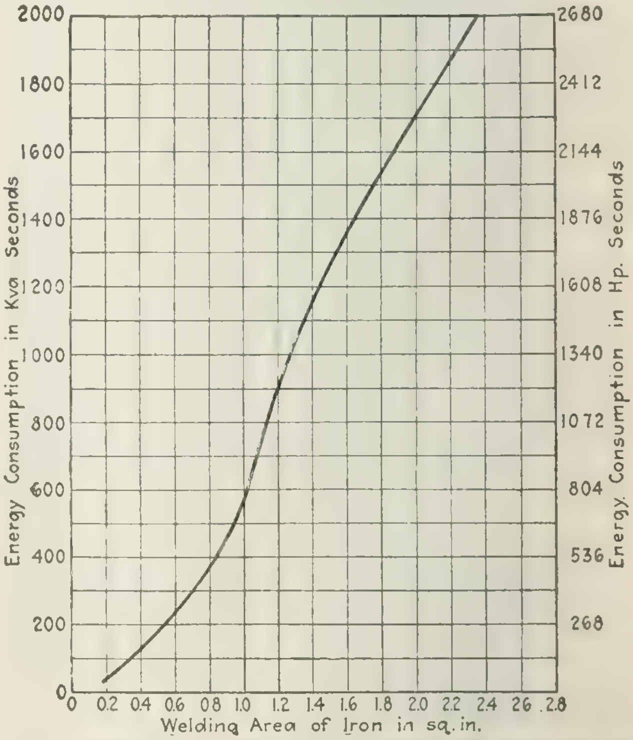


FIG. 1—ENERGY CONSUMPTION OF RESISTANCE WELDING FOR COMMERCIAL GRADES OF SHEET IRON

The next step of the metering proposition was to take the rated energy consumption of the welding machine as given by the manufacturer, assume a certain load factor, calculate from these data the energy consumption, correct for the power factor and check the answer periodically on the meter dial. The result obtained on the meter was usually a constantly varying, lower energy consumption than calculated, and no doubt this was the cause of the great distrust of the meter. This method is worse than no check at all, and it is so for the following reasons:

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*See ELECTRICAL WORLD of May 31, 1919, page 1173.

1. The energy consumption at a welder depends upon the welding area of the metal, but is not a proportionate variable. That is, all other factors being the same, two square inches of a certain weld do not consume twice as much energy as one square inch does. Fig. 1 shows this fact plainly. It is also of common knowledge that on a spot welder the area of the weld varies from weld to weld just as much as the electrode contact area does. Assuming an electrode at the start as $\frac{3}{16}$ in. diameter at the tip, after about 200 welds it might be anything from $\frac{1}{4}$ in. to $\frac{5}{16}$ in. diameter, thus gradually increasing its contact area anywhere from 75 per cent to 175 per cent.

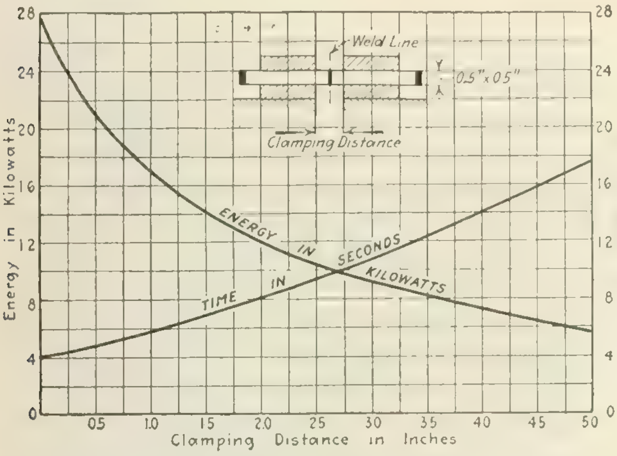


FIG. 2—EFFECT OF CLAMPING DISTANCE BETWEEN ELECTRODES UPON TIME AND ENERGY DEMAND. AREA, 0.25 SQ.IN.

2. On butt welders the energy consumption does not depend upon the size of the weld alone, but also upon the clamping distances. Fig. 2 gives some information about the influence of variable clamping distances upon the energy consumption of welding machines. On a butt welder, the clamping distances increase with the gradual wear of the electrode; thus the above spot welder conditions are duplicated on butt welders also.

3. If no compensation is made to vary the impressed emf. of the welder—and this is never done—then the time must vary from weld to weld according to the condition of the electrode. If the time is changing constantly, the assumed load factor changes correspondingly; thus there are three constantly changing factors in the estimated energy consumptions, beyond any reasonable approximation of the actual facts.

A more reliable method would be a periodic oscillograph test, but this method is rather complicated and expensive and could be done only by large central stations which have both the equipment and the trained personnel for such work.

Such tests, once they are made for certain types of welders and work, will give excellent data from which to check the actual behavior of the standard type of wattmeter. If such comparisons are made, it will be found that the integrated energy consumption of the wattmeter will be larger than the oscillograph test indicates. It is not intended to claim that the wattmeter registers "fast." Laboratory tests are usually made by skilled men, who before the test carefully ascertained all important factors entering into the test, as area of weld, condition of electrodes, welder, emf., cleanliness of material, etc., whereas under normal operating conditions almost no attention is paid by the operator to these considerations. In fact, if the operator works on a piecework or bonus basis, he will conceal as much as possible all discrepancies which have a tendency even temporarily to curtail his earnings. The result of his policy has a very important effect upon the wattmeter.

Summing up the metering proposition and speaking from experience on large welding installations with capacities over 250,000 sq.in. of welding per month, where ten to fifteen butt welding machines are constantly thrown on or off the supply circuit, it is safe to claim that in such installations the standard alternating-current integrating wattmeter is on the job.

THE LOAD FACTOR

The present-day tendency in resistance welding practice is to perform the weld as quickly as possible without injury to the metal, but fast enough to prevent imperfection at the weld. Having in mind large welders with 5 to 15 sq.in. weld capacities, this tendency will give a unit load factor not much over 10 per cent per welder. From the central-station viewpoint, this factor is certainly very low and undesirable.

However, two important circumstances alter the condition considerably. The first point is that in large installations one large welder will not suffice to do all the required work, therefore several will have to be installed. Owing to the big energy demands these large welders never operate simultaneously. While one welds the next is cleaned, the third is prepared, the fourth is waiting for the signal to weld, etc.; thus the load factor of the installation as a whole is considerably over 10 per cent and nearer to 20 per cent. Another natural circumstance of large installations is the fact that not all work requires large welders. There are usually ten to fifteen smaller welders installed, of which 30 per cent might work intermittently with the larger welders. Thus it will be seen that the load factor is bad only in small installations connected to small central stations, while large installations, which necessarily must receive their supply of energy from comparatively larger central plants, have rather a good aggregate load factor, reaching well up to 25 to 30 per cent.

Another point for consideration is the fact that, owing to its temperature, a large work cannot be handled immediately after welding. The work must cool off before additional operations can be performed upon it. The cooling takes some time. In several instances it was found desirable to shift the working hours of the welding crew several hours ahead or behind the working hours of the rest of a factory, for the sole reason that there should be on hand sufficient cool welded work for the successive manufacturing steps. If this time-shifting is selected to coincide with the low-point period of the load factor of a central station, then there results an actual all-around improvement. For this the welding installation should be entitled to a certain proportionate consideration.

MAXIMUM DEMAND

Owing to the instantaneous severity of a welding load, demand upon a supply station seems to be of considerable importance. However, the shifting of a load factor toward an off-load period, as described, will certainly take the severest effects off the system. Under such conditions regulation of the supply system suffers only in small plants, and only in places where lighting and power loads are fed from the same mains.

But large welding installations are usually direct-connected through transformer banks to the station buses, where the fluctuating character of the welding load will be almost negligible and certainly will not affect the regulation of a system in a degree commensurate with the size of the connected welding installation. Of course in all these discussions it is assumed that the station apparatus, transformers and supply feeders are properly selected, with equipment properly calculated to fit the particular welding load. In the past this has not always been the case, and this is one of the causes of so many different maximum demand charges.

The ratio which the maximum demand should bear to the connected load will always remain a local issue between producer and consumer. The ratio should, however, be made to depend on the average kilovolt-ampere energy demand of all the welders (and not on their rated capacities as given by the manufacturer) and of the rated capacity of the primary supply installation. If the welding customer bears a part of the installation charges caused by larger transformers and larger supply mains, he should benefit by the resultant mutual advantages. However, no demand charge should be based upon a mixed welding and motor load supplied from a common primary installation. The importance of this claim will be more evident if it is stated that by separating a certain mixed welding and motor circuit, and by installing an additional 100-kw. equipment, the maximum-demand charge in a single supply circuit in one month was reduced over $200.

To be sure that no more disturbing overloads are thrown upon the line than have been contracted for, overload relays, time clocks and maximum-demand indicators will be found sufficiently reliable for all honest purposes on both sides of the controversy.

Proper grouping of the single-phase welding loads upon a three-phase supply system will give perfect satisfaction in almost all installations but those of small size.

Power Factor

So much has been said and so much worry caused about the poor power factor of a welding installation that it is now universally accepted that the power factor is bad, and nothing further is done about it. The outstanding feature about this condition is that the central stations, in a most unfortunate moment, decided to "penalize" the power factor. It is not the charge for the condition, but the adoption of the word for the charge, which makes the customer balk and is the cause of no end of distrust toward the welding machine. The word "penalty" conveys to the lay mind the impression that a poor power factor exists only with welding installations, and naturally the conclusions are not flattering for the welding equipment.

No attempt is made here to describe the well-known methods of improving the power factor of a welding installation with synchronous apparatus. The adoption of such methods is more of a commercial than an engineering problem. Upon investigation it will be found that, with few exceptions, it is cheaper to pay for the poor power factor than to invest in additional apparatus. However, the average power plant usually has, besides a welding installation, a number of other consumers, the effects of whose poor power factor are felt in considerable measure at the generators. If all such sources are investigated and segregated upon one common bus, together with a welding load, it might be found that either a synchronous or static apparatus would more than pay for itself, if installed at the proper place.

If this fact is explained to a welding customer, there can be no doubt that he will be only too eager to bear a certain proportion of the investment for a special apparatus and thus secure for himself a better rate for the consumed energy. With proper co-operation between the central station and the welding customer on all these points of mutual interest, much misunderstanding and distrust could be eliminated, benefiting all parties concerned in the welding industry.

UNDERGROUND CABLE TROUBLE CAUSES UNUSUAL DISTURBANCE

Short Circuit Close to Busbars Causes Two Large Generating Stations to Fall Out of Step and to Trip Out Substation Rotaries

A rather unusual disturbance occurred recently on the 9000-volt, 25-cycle transmission system of the Commonwealth Edison Company, Chicago, from which some interesting and valuable observations have been made. The trouble started with a cable breakdown about 200 ft. (60 m.) from its oil switch at the Fisk Street generating station. The proximity of the short circuit to the station bus caused such a heavy flow of current into the fault that a large momentary drop in voltage resulted. Because of this the groups of affected turbo-generators, with a capacity in operation of 65,000 kw. at Fisk Street and 50,000 kw. in the Northwest station, lost their loads of synchronous converters, speeded up and dropped out of synchronism with each other. All efforts to restore normal voltage were nullified for a few minutes by a flow of wattless current in the tie line between the two stations. These various complications were not immediately made clear to the load dispatcher's office because of the vast number of telephone calls which were necessary to take care of the situation in the affected substations. Consequently the restoration of the generating stations to normal was somewhat delayed. In order to re-establish synchronism the tie line between the affected and the normal sections of the generating stations was opened up and the machines then picked up load.

A number of minor difficulties were experienced in some of the synchronous converter substations, and in one instance a 1000-kw. machine was seriously damaged. This was due to the failure of its protective devices to function completely. Meanwhile the unequal supply of energy from the various substations to the underground direct-current system caused the blowing of many fuses in this network, and in two instances manhole fires resulted.

About one hour and forty minutes after the "blow-out," when the restoration of service was well under way and pressure was again up to normal in most parts of the system, a second short circuit occurred in a section of the Fisk Street switch house which had not been affected by the earlier trouble. The disturbance from this second short circuit was much more limited than in the earlier case, but, coming right on top of the first, it resulted in the blowing of more fuses in the downtown district. However, the newspaper presses, the theaters and other important customers had full energy when needed and the entire system was practically normal early in the evening.

Maximum-Rated or 50-Degree Motor

Argument for the Continued Use of a Motor with Good Factor of Safety—It Is Held that the Slight Saving in First Cost of a 50-Degree Motor Is Overbalanced by Greater Maintenance Expense

BY A. C. BUNKER
Chief Engineer Crocker-Wheeler Company

DURING the last few years there has been an increasing agitation on the part of some motor manufacturers to introduce a new type of motor ostensibly in the interest of the motor-buying public and to have in its favor general economic considerations. The maximum-rated or 50-deg.-rise standard is to be applied to commercial motors which have their electric circuits (armature, fields, etc., or rotor, stator, etc., as the case may be) insulated with cotton, silk, paper or similar materials, treated or impregnated with varnishes, gums or other insulating compounds similar to those used at the present time on the 40-deg. standard machine.

Some years ago the American Institute of Electrical Engineers established a maximum limit of temperature beyond which insulation must not be used, but this does not justify manufacturers in subjecting insulation to this upper limit as a normal condition. It is just as necessary in electrical apparatus to provide a margin or factor of safety, in order to meet the wide variations in service conditions, as it is to allow a factor of safety in the building of a bridge or anything else.

In every branch of engineering a reasonable factor of safety has always been considered essential, and indeed, the chief duty of the engineer is to make sure that proper precautions are taken, not only for ordinary conditions but for contingencies that are practically sure to arise sooner or later in actual service. Electrical machinery is not essentially different from other kinds of machinery and should not be designed with zero factor of safety nor made the only exception to a heretofore universal and unquestioned rule. Experience is always proving that defects may exist, accidents may occur, emergencies may arise, conditions may change, demands may increase, and various other things may happen. These are too numerous and difficult to foresee always or to provide for except by relying upon our good and tried old friend "safety factor."

The very expression "maximum-rated" clearly discloses the absence of any factor of safety. Probably for that reason the camouflaged designation "continuous-rated" is often used. It is certainly no more continuous than the 40-deg. standard with its overload capacity. Hence it is also called "single-rated" in order to get away from the self-indictment of maximum-rated. This is merely evasion. Evidently advocates of the maximum-rated standard either forget or were not closely enough in touch with the art twenty years ago to remember that some manufacturers then made maximum-rated machines and that until the standard of rating was changed makers and users lived through expensive troubles, one cause being the roasting out of coils if operating conditions were not good.

Standards were later changed to provide machines having more margin in capacity and to conform in general to 40-deg. temperature rise. (Some manufacturers even went further and produced machines on a 35-deg. rise temperature basis.) This departure from the maximum-rated standard resulted in machines which gave and are giving general satisfaction to users.

One of the arguments for the 50-deg. motor is that standardization, lower overhead charges, simplified factory methods and interchangeability can be more easily accomplished by departing from present standards and adopting this new maximum-rated standard. It is also claimed that the present 40-deg. standard is the result of individualistic effort, although no logical explanation has ever appeared which would indicate how either a 40-deg. or a 50-deg. standard has any relation to, or is in any way an evolution from, either an individualistic or a collective effort. It is quite certain that manufacturers can apply their collective efforts to a 40-deg. standard with much less disturbance and expense both to themselves and to the public than they could to a new standard.

TEMPERATURE LIMITS AS DEFINED BY A. I. E. E.

The user of a motor should acquaint himself with just what the A. I. E. E. Rules say in regard to this temperature rating. The A. I. E. E. Rules, revised 1918, page 35, paragraph 375, sixth line, under the subject of "Temperature Limits," say: "Whatever be the ambient temperature at the time of test, the rise of temperature must never exceed the limits in column two of the table." The table referred to is that given on page 36 and shows that the temperature rise (maximum) should never exceed 65 deg. C. This allows for limiting observable temperature rise of 50 deg. and 15 deg. for hot-spot correction. So that should the ambient temperature be say 10 deg. C., then the highest hot-spot temperature should not exceed 75 deg. C., or the observable temperature should not exceed 60 deg. C. It is necessary therefore for the user of the maximum-rated motor to be very careful on this point. When this necessity for precaution becomes more generally known it will probably cause a reaction.

Of course, in recent years improvements have been made in motor design and construction; but so far as insulating material is concerned, we could get just as good cotton, paper, varnish and gums twenty or more years ago as we can to-day, and coils for commercial motors are not made much, if any, better now than they were then. Such changes as have been made have been along the lines of getting more out of material than heretofore, reducing to some extent and under some circumstances the excess or hot-spot temperatures; but little, if anything, has been done to permit fabric or varnishes to stand up under higher temperatures.

Advances have been made in the application of motors, but even so, some large users are to-day deliberately ordering 40-deg. motors which are larger than called for by the connected load so as to provide a still larger factor of safety and thus insure in case of accident that any breakage of shafts or pinions will be external to the motors. Some motor buyers are actually specifying 35-deg. temperature rise on what would be called commercial motors.

The Power Club, the membership of which is made up from representatives of all motor manufacturers, is not unanimous as to the advisability of adopting the maximum-rated or 50-deg. rise standard, and after long discussion on the subject a compromise was arrived at allowing two standards, so that we are worse off than we were with the old 40-deg. standard. Moreover, the Power Club in its publication says (5303):

"2. Machines having 40 deg. rating are designed for all classes of service, including those in which an overload capacity of 25 per cent for two hours is desired.

"3. Machines having 50 deg. rating are designed for conditions in which the load requirements are *accurately* known and under which the machine *will not be* subjected to loads in excess of its rating." (Italics are the author's.)

If the manufacturers of motors cannot arrive at a unanimous agreement on this subject, and in order to keep the peace consent to two standards, and if they deem it necessary to print the above explanation, is it not reasonable to expect that there is much doubt as to the desirability of this new rating?

The advocates of the maximum rated or 50-deg. standard are largely confined to the manufacturers because buyers generally, especially if they know anything about motors, want a motor to use, and do not intentionally buy repair bills, loss of output and trouble with their own customers when they buy motors. In buying motors, as in everything else, some users are too prone to save on first cost, especially if they have the support of plausible arguments.

Specific Arguments for 50-Deg. Motor Answered

Motor users should consider some of the arguments of the maximum-rated advocates because these arguments at least indicate the points upon which there is a difference of opinion. The following are a few of these arguments noted in the Electrical World, May 12, 1919, and elsewhere:

(1) The large number of well-trained men now engaged in the application of motors and the unusual desire to do things better to-day than yesterday mean that the motors must now be selected with a greater degree of accuracy than was considered essential in the early days.

This means that in order to prevent having trouble with this new type of motor a well-trained man must be employed or consulted, and a greater degree of accuracy is necessary in determining what the actual load will be than heretofore. In other words, if you must do something and then do not do it, a penalty follows.

If a factory or plant is of such size that growth or other conditions require several motors to be kept in a storehouse, and if these are the maximum-rated or 50-deg. motors, then before one of these spare motors can be used an expert must carefully investigate the load which it is to carry. If the location is dusty, if the ventilation is not good, or if the motor is to carry 10 per cent, 15 per cent or 25 per cent overload for an hour or so, or if the voltage or frequency is low at times, or if the voltage is high at times, then this motor will not do according to the quoted statements. It is then necessary to run the risk of burning up another motor, or procure a larger motor or at approximately the same price a 40-deg. standard motor. Experience has taught that if this is done in the first place expense and delay are saved.

(2) It is better to have a motor underloaded than so heavily loaded that it cannot operate successfully.

Why then a maximum-rated motor? The argument in favor of the 40-deg. standard has always been that there should be a margin between the nominal rating of the motor and its ability to carry overload, and this leeway in actual service has been none too great.

(3) Ample margin must be allowed between the requirements of the driven machine and the maximum torque developed by the motor.

It is a physical fact that a 40-deg. motor has a greater capacity for torque relative to its rating than a 50-deg. motor would have, both motors being commercial motors and designed for these respective temperatures.

(4) It might appear that a motor which has a temperature rise of 40 deg. will have a longer life than one designed for 50 deg. As previously pointed out, this is not true.

In certain picked cases this may be true, but this statement is fallacious for motors in general service.

(5) Compare the factor of safety of a motor rated in the old way with that of a motor rated in the new. Was the purchaser any better off?

This statement is decidedly illogical. A 40-deg. motor can be selected with just as much intelligence as a 50-deg. motor can be, and the inherent margin of the 40-deg. motor would still be available for the exigencies of service conditions.

(6) This new and simplified method of rating places on the purchaser the burden of determining the appropriate margin to be provided.

This statement shows that the motor user is made responsible for every step in selecting and using the motor he is to buy, and if later anything goes wrong with the motor, one or another of several limitations which might or might not have been exceeded are excuses which prevent the user from getting any redress. In the event of trouble the evidence will in many cases be destroyed, or hard or expensive to obtain, so that the only thing left for the user to do is to pay for repairs or replacements.

(7) Let it be universally understood that the 40-deg. rating is 83⅓ per cent of the name-plate rating of a continuous-rated motor; another method of obtaining the 40-deg. rating from a continuous-rated motor is to de-rate to the next even rating.

If a 50-deg. shunt motor is carrying full load and is new and clean, the temperature rise of the shunt fields being 50 deg., a 16⅔ per cent reduction of its load will not lower the shunt-field temperature to 40 deg.

(8) Under the continuous-rating system the purchaser will know exactly what he is getting and pay for that only.

It is little consolation to know that a motor has to be hedged about by every safeguard, the particular application passed on by well-trained men; that it will not stand any overload except momentarily and that by no possibility must the motor be subjected to unfavorable conditions.

(9) It should be realized when applying these motors that it is particularly unwise to assume that because a 10-h.p. motor when 25 per cent overloaded for two hours (40-deg. motor) did the work, a motor of the same continuous capacity will do the same work.

This is a definite condemnation of the 50-deg. motor by a 50-deg. advocate. If a 40-deg. motor were carrying its overload capacity at times, the 50-deg. substitute of the same nominal rating would come to grief.

Another reason (No. 10) advanced for the maximum-rated or 50-deg. standard is that "From an economic standpoint we should save all material possible." If it is necessary to select a larger motor to be as safe as this type of motor will permit, and as this next larger size weighs and costs practically the same as the standard 40-deg. motor, is there then any economic saving?

No damage to fabric insulation will result if it is subjected to the upper limit of temperature as given by the A. I. E. E., provided that this limit is not exceeded. It is, however, quite another matter when this insulation is put in a motor and subjected to service conditions. Assume that the 50-deg. motor will meet its temperature guarantees when it is new and clean and on the test floor, but what happens after the motor has been in service several weeks? Even in a relatively clean place the radiating surfaces will be covered with dust.

What is going to happen when these 50-deg. motors have the air-ventilating ducts even partially clogged up? Is it customary or practicable to clean out ventilating ducts of 40-deg. motors? Does a user want a motor in which these ducts must regularly be cleaned out? What happens if one of these motors is installed close to the power house or source of supply where the voltage supply may be 10 per cent above normal?

TEMPERATURE MAY RISE OWING TO HIGH VOLTAGE

Increase in temperature rise is very nearly proportional to the increase in voltage. Under some applications it is more. It is not uncommon to find circuits having a voltage variation due to line drop as much as 10 per cent, so that if one of these maximum-rated motors were to be installed near the source of supply or center of distribution its temperature would no longer be 50 deg. but something higher. A direct-current motor, for instance, operating a fan or pump and subjected to an increase in voltage will have its temperature rise increased, owing both to the increased load and to the increased field temperature. Sometimes these motors are required to operate under low voltage, say only 10 per cent reduction. It is certain for a given load that the armature, in case of a direct-current machine, would be required to carry heavier currents.

On a cold Monday morning, after a factory or plant has been shut down over Sunday, a motor is required to carry from 15 to 30 per cent more load for an hour or more until the shaft, bearings, etc., get warmed up and better lubricated. Maximum-rated motors, not having any overload capacity, are not suitable for these conditions.

Many times it is very desirable to put on a little extra load, perhaps temporarily, but often as a regular condition. Many times this happens without the knowledge of any one qualified to determine motor capacities.

In a large number of cases it is not possible to control all of these conditions all of the time, and if motors are used which have no overload capacity, it is inevitable that sooner or later they will be subjected to overloads or the equivalent in the different conditions of operation.

POWER MUST BE SUFFICIENT TO INSURE PRODUCTION

The experience of motor users is continually showing that the loss in output from a motor being down represents far more than the difference in price between a maximum-rated and a 40-deg. machine. In these times, when production is more vital than ever before, motors should have enough capacity and margin so that when they are put in service they can be forgotten and trusted to pay their own way in the plant.

In looking over literature published by the suppliers of this maximum-rated motor it is noted that they are designated under different headings, namely, maximum-rated, 50-deg. rise, single-rated and continuous-rated. These terms refer to the same motor. One supplier states that these motors have no sustained overload capacity and care must be exercised in analyzing the conditions of load to which they are applied, and it is further mentioned that a ¾-hp. rating under the double system of ratings heretofore prevailing (meaning 40-deg. rise standard) may have been successfully used for driving a machine which required ¾ hp. normally but at times had as much as 1 hp. With a continuous rating ¾-hp. is obviously not adapted to meet this condition. A 1-hp. continuous-rated motor should be used.

Another supplier states that 50-deg. motors continuously rated are guaranteed to operate at a temperature rise of 50 deg. for full-load continuous service without overload temperature guarantee. They should only be specified for conditions for which the load requirements are actually known and under which the motor will not be subjected to loads in excess of its rating. Other examples of caution in the use of these motors are given. There must be some reason for all this caution and explanation regarding 50-deg. motors, and it is not clear why a buyer should pay more per pound for material in a 50-deg. motor than in a 40-deg. motor.

The maximum-rated motor has been on the market a relatively short time, but enough experience has been gained to justfy the caution that is required in its selection. It is not difficult to find users who are going back to the 40-deg. standard motors and refusing to reconsider the 50-deg. standard motor.

Is there any real justification for the needless risk in using one of these motors, or any logic in buying the next larger size 50-deg. motor, in order to be somewhere nearly as safe as with a 40-deg. motor, especially when the two motors cost approximately the same? Is it not far safer to continue with the 40-deg. standard that has been tested and found satisfactory through long years of operating experience?

IT HAS been said that the reconstruction period through which we are now passing is even more trying than the five years of actual world warfare. The effects of the war are being felt now from both economic and psychological standpoints. Economically the operation of the law of supply and demand would work out the situation, were it not that this law is obstructed by certain unpatriotic action familiarly known as profiteering. Psychologically, the public mind is still affected by five years of anxiety, and it is but natural for it under these circumstances to react to all kinds of extremes. It seems to me that the need of the time is for us all to go forward with courage in the regular pursuit of our business, laying stress upon the necessity for more production, more economic saving and more conservation.—*R. H. Ballard.*

Readers' Views and Comments

Possibilities of Standard Transformers for Rural Lines

To the Editor of the ELECTRICAL WORLD:

SIR: It is not economical to purchase 6600-volt transformers which are only insulated to withstand a test of 14,200 volts (A. I. E. E. standard) when for about 5 per cent more money a transformer can be purchased which will withstand the manufacturers' standard test of 26,000 volts. This is the opinion of a large manufacturer of transformers, and it applies particularly to the small transformers installed on rural lines. The manufacturer has also pointed out that with the proper transformer taps it is possible for utilities greatly to increase the capacity of their rural lines without having to buy new transformers for the higher voltage. It is not feasible to do this, however, with transformers which are only insulated for a 14,200-volt test, even if they are rated at values large enough for the customers' requirements.

There appears to have been a tendency to underestimate a farmer's transformer requirements. Manufacturers were originally asked to produce 2-kva. transformers of the 13,200-volt class; then the demand increased to 3 kva., and now the greatest call is for 5-kva. transformers. The smallest 6600-volt transformer made by this particular manufacturer is rated at 1.5 kva. Smaller transformers of this voltage class could be supplied, but, judging by past experience, the requirements of most rural consumers soon exceed the safe carrying capacity of such a small transformer.

Chicago, Ill. S. N. CLARK.

Consideration of Efficiency in Purchasing Motors

To the Editor of the ELECTRICAL WORLD:

SIR: In the mind of the average purchaser of an electric motor the most important consideration is generally that of price. The efficiency of the motor is not usually taken into consideration at all and in most instances is not even mentioned. In fact, the question of efficiency is so seldom discussed that the average purchaser has a very vague conception of what motor efficiencies should be. But were the purchaser to concern himself seriously with this question he would find that it is often of as much importance as the question of first cost.

Motor design has in general been pretty well worked out and basic patents have expired, so that it is fairly safe to say that no one manufacturer possesses any great advantage over the others in the way of increasing the efficiency of his product. The result is that the efficiencies of standard makes of motors run pretty well together.

But manufacturing costs may be cheapened at the expense of efficiency, and if a purchaser considers first cost only he may in a few years pay out the equivalent of the first cost of the motor in excess power bills. Assume, for example, a 10-hp. motor operated ten hours per day with energy at 5 cents a kilowatt-hour. With 300 days' operation per year each point in efficiency makes a difference of about $10.50 annually. But as the ordinary motor user would not be likely to detect a deficiency of 10 per cent below the average, after having installed the motor, it behooves him to know what he is buying.

In addition to protecting one from the manufacturer who might build to cater to the first-cost man, a familiarity with motor efficiencies will in numerous instances help in selecting the proper motor for the service. At times a close consideration of efficiencies may show it advisable to do what would otherwise seem absurd.

If changes in factory were to permanently reduce the load on a 5-hp., 60-cycle, three-phase motor to 1½ hp., offhand judgment would probably decide in favor of the 5-hp. motor. However, efficiency tables at hand give the smaller motor at full load an efficiency of 80 per cent and the larger one at one-fourth load an efficiency of 71 per cent. On the basis of 300 days a year, ten hours a day and 5 cents a kilowatt-hour, there is a difference of approximately $24 per year in the power bill in favor of the 1½-hp. motor. In other words, the smaller motor would pay for itself in three or four years.

Again, various types of alternating-current motors have different efficiencies. In general the squirrel-cage motor is highest. The wound rotor of the slip-ring motor, the brushes and the external circuit introduce resistance losses which in general lower the efficiency of this type of motor a few points. Likewise the winding and mechanism of the single-phase motor tend to reduce its efficiency. A study of the efficiency tables of these types may result in a decision to go to a considerable expense to insure the installing of the proper motor.

Practical considerations compel manufacturers to depart somewhat from the most efficient designs of motors. There is, of course, one frame size. one size of lamination, slot, wire, etc., best suited to build each rating of motor. But the number of ratings is so great, as may be conceived by considering the different horsepowers, speeds, frequencies and phases of alternating-current motors in commercial use, that it is practically impossible to provide each rating with its theoretically correct frame and stamping. Consequently one size of these parts must be used for several ratings. But as there is one rating best suited to the frame there may be one rating with highest efficiency. As a consequence efficiency tables show quite a little variation for different sizes and also for the different speeds of the same horsepower. For instance, the tables of one manufacturer show a squirrel-cage motor of 10 hp., 1800 r.p.m., to have an efficiency of 86, while the 1200-r.p.m. motor of the same horsepower is credited with 89 per cent. Similar unexpected and irregular variations appear here and there throughout the tables.

The point at hand is that this 3 per cent gain is of value. However, unless efficiency is given consideration in the selection and purchase of motors, it and similar gains may be replaced by losses so obscured that they may never be realized and will therefore in the end prove extremely expensive to the purchaser of the machine.

Albion, Ill. ALBERT MCCALL.

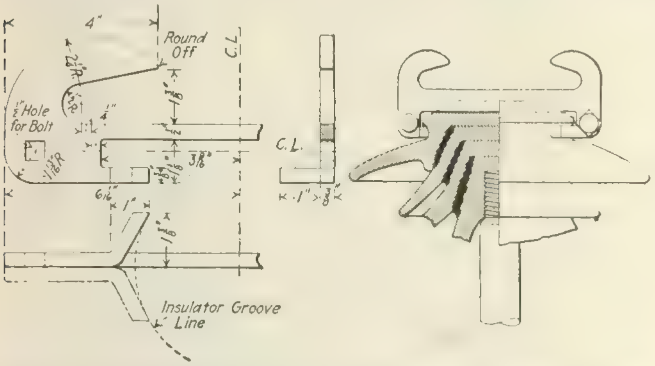
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and
Maintenance of Equipment for Economical Generation
and Distribution of Electrical Energy

SIMPLE LIFTING TOOL FOR HIGH-TENSION LINES

Consists of a Clamp Fastened to a Pin Insulator Screwed on End of Insulating Rod—Can Be Used to Hold "Hot" Line to One Side

For changing insulators on "hot" high-tension lines a simple lifting tool has been developed which can be used to pick up the wire on an overhead line and hold it to one side while the insulator is being replaced. The clamp is of cast phosphor bronze, the mixture recommended consisting of 10 lb. (4.5 kg.) of copper to 1 lb. (450 g.) of phosphor tin. Two castings, shown in the accompanying sketch, are required in order that the device may be fastened into the clamping groove of the insulator. With this arrangement the device is sufficiently strong for employment under maximum service conditions.



METAL JAW CLAMPED TO PIN INSULATOR FOR HOLDING "LIVE" WIRES AT DISTANCE WHILE RENEWING INSULATORS

The dimensions given in the sketch are to fit Ohio Brass Company's insulator No. 10,748, but with proper modifications a clamp of this type could also be used on other insulators.

H. E. WEIGHTMAN,
Engineering Service Company, Chief Engineer.
Chicago, Ill.

INSUFFICIENT INSULATION CAUSE POLE-TOP BURNS

Excessive Leakage of Current Shown by Charred Paths Visible on Cross-Arms Near Steel Pins—Pins Tied Together Electrically

On the 224-mile (360-km.), 60,000-volt line of the Southern Sierras Power Company some trouble had been experienced in the burning of wooden pole tops. The poles are of Oregon pine 35 ft., 40 ft. and 50 ft. (10 m., 12 m. and 15 m.) in height and are placed 260 ft. (80 m.) apart. The conductors are arranged in an equilateral triangle with 72-in. (1.8-m.) spacing. Side pins are of 2-in. (5-cm.) tapered iron pipe with lead threads, and the top pin straddles the top of the pole.

The burning of the pole tops usually started at the point where the cross-arm through-bolt passed through the arm and pole. The fine charred paths visible on the surface of the arm near the iron pins showed that there was excessive leakage of current.

To overcome this leakage of current, the three pins were bonded by means of No. 9 galvanized-iron wire. This wire was electrically connected to the pins by making a loop on the ½-in. (13-mm.) bolts that hold the pin to the pole or in the cross-arm. In order to protect the man who bonded the pins, the wires were stapled to the arm and to the pole before they were connected to the pins. A crew of two linemen and one groundman bonded this line while it was in operation. Since that time there has been no pole-top burning due to leakage of current.

Riverside, Cal. R. H. HALPFNNY.

BOSTON EDISON STOKER AND CONTROL EQUIPMENT

Sectionalized Mechanism Is Employed for Motor-Driven Coal Feed—Indicating Instruments Facilitate Service

The stoker drive and boiler-plant equipment at the L Street generating station extension of the Edison Electric Illuminating Company of Boston, Mass., are of interest as an illustration of the importance of flexible means of operation under modern conditions of energy production. The boilers recently installed (Fig. 1) are of 1232-hp. rating and of the cross-drum type. Each has a total heating surface of 12,322 sq.ft. (1110 sq.m.) and is equipped with double-tube super-heaters having 3174 sq.ft. (286 sq.m.) of heating surface. The boilers, which are of the B. & W. type, are equipped with

FIG. 1—DRAFT GAGE, TACHOMETER AND STOKER CONTROL LEVERS, WITH PRESSURE PIPING BEHIND INSTRUMENTS

Westinghouse thirteen-retort underfeed stokers (Fig. 2), the total grate area per boiler being 207 sq.ft. (18.7 sq.m.).

The stokers are installed under the mud drums, and each stoker is sectionalized into four parts with separate drive and draft regulations. The four driving motors are Westinghouse direct-current interpole motors, type S. K., 110-volt, with continuous rating of 5 hp., 550 volts, 8.3 amp., 450 to 975 revolutions. The drive is obtained through sprocket and chain and clutch to double-worm gears.

Fig. 1 shows the other end of the same installation. The meters and controls are on the fronts of the boilers. For each of the four separately controlled sections there is a precision gage indicating the draft under the fire and a tachometer indicating the rate at which coal is being supplied by the stoker. At the middle of the boiler two draft gages are mounted, one indicating the draft over the fire and the other draft at the uptake.

A Bailey boiler meter is also mounted at this point which records on one chart the steam flow, air flow and the flue temperature. Back of the meters may be seen the pressure piping to the various meters.

Directly under the four sets of section meters are four levers which operate through chains to the rheostat controls of the stoker motors. These boilers are equipped with clinker grinders which are flanked with adjustable aprons for dumping. The aprons for each section are operated independently by the wheels shown at the base of the boilers along the floor.

At the side of the boiler not shown in the cut is a lever for throwing the clinker grinder in and out of gear. Four other levers at the sides of the boiler operate dampers to each section under the fire.

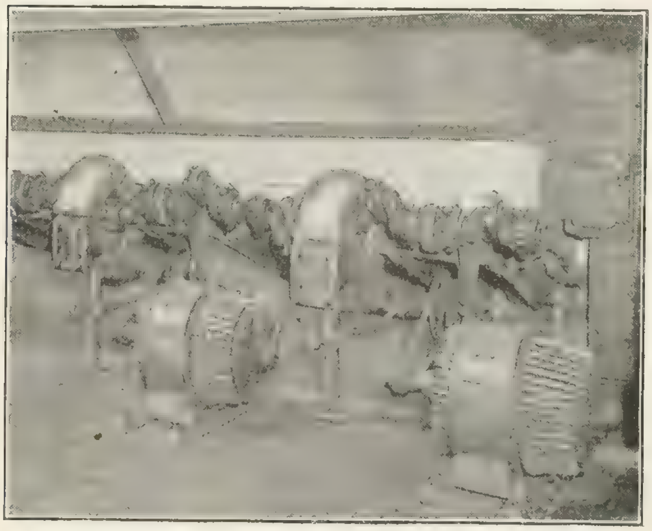


FIG. 2—VIEW SHOWING ONE-HALF OF THE STOKER DRIVE FOR ONE BOILER UNIT

The boilers are operated with a standard relationship between air flow and steam flow and with minimum flue temperature. These indications are given by the Bailey boiler meter. The policy of operating the furnaces by means of these observations has proved very satisfactory. George R. Davison,

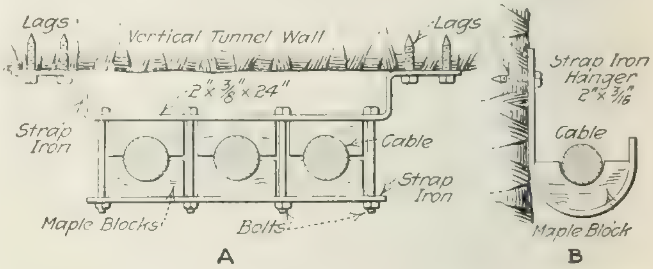
Superintendent Technical Division, Generating Department, Edison Electric Illuminating Company of Boston.

SUPPORTS FOR VERTICAL AND HORIZONTAL CABLES

Maple Blocks Next to Lead Sheath Prevent Abrasion —Vertical Cables Supported Every 4 Ft., Horizontal Ones Every 5 Ft.

Two types of cable supports used by the Cleveland (Ohio) Electric Illuminating Company are shown in the illustration—one for three vertical cables and the other for single horizontal cable. Both are adapted to No. 4/0 lead-covered 11,000-volt cable.

The main vertical support used for the power cables consists of a 2-in. (50-mm.) by $\frac{3}{8}$-in. (9.6-mm.) by 24-in. (60-cm.) piece of strap iron bent as shown and fastened to the wall with lag screws. The maple blocks are paraffined and bored to the exact diameter of the cable, which is $2\frac{5}{8}$ in. (65 mm.) in diameter. When these blocks are sawed through the center line of the hole the diameter of the opening is reduced so that they will grip the cable. A piece of strap iron held in place by bolts over the faces of the blocks clamps the blocks over the cable. These wall hangers are placed at 4-ft. (1.2-m.) intervals.



FIGS. 1 AND 2—GANG-TYPE CLAMP FOR SUPPORTING THREE VERTICAL CABLES AND STRAP HANGER FOR HORIZONTAL RUN

For supporting the horizontal runs in tunnels a simple hanger (*B* in figure) was designed. This consists of a piece of wrought-iron strap 2 in. by $\frac{3}{16}$ in. (50 mm. by 4.7 mm.) bent into a hook shape and drilled at one end to take a lag screw. A semi-circular maple block rests on this hanger and is bored to fit the periphery of the cable. The blocks are prevented from working out of the hook by the cement fireproofing which covers the full length of the cable. The hangers on the horizontal runs are placed on 5-ft. (1.5-m.) centers.

DATA ON PAPER-INSULATED LEAD-JACKETED CABLES

Working Pressure and Tests of Y-Connected Neutral-Grounded Circuits—Preferable to Open-Delta-Connected Circuits

Although impregnated paper, used for insulating high-tension cables, has the tendency to absorb moisture and requires a waterproof outer jacket and the careful sealing of ends, it is probably the most widely used and generally the best available for this service. It will stand higher operating temperatures with a lower rate of deterioration than rubber or varnished cambric and has high dielectric strength.

The accompanying table presented by Wallace S. Clark of the General Electric Company before the convention of the New England Section of the National Electric Light Association indicates the range of conductor cross-section obtainable in paper-insulated cable if the overall diameter is limited to 3 in. (7.5 cm.) and the smallest cable is limited by allowing a tension of about 90 volts per mile at the surface of the conductor.

Some companies have changed from this type of circuit to an open-delta, but this method is not so economical. The advantages of the star-connected system over the open-delta circuits are that it has a higher kilowatt capacity in a given duct and a minimum cable cost for a given kilowatt capacity. If a three-conductor No. 4/0 15,000-volt cable with 6/32-in. by 6/32-in. (4.8-mm. by 4.8-mm.) paper insulation cost $1 per foot, a three-conductor No. 4/0 15,000-volt cable with 6/32-in. by 3/32-in. (4.8-mm. by 2.4-mm.) paper insulation would cost $0.90, which indicates quite a saving if the "Y" connection is used. A comparison of change of voltage and connections shows that a three-conductor, 500,000-circ. mil., 15,000-volt, delta-connected, 325-amp., 9400-kva. cable would have a loss of about 8 watts per duct foot and would cost $1 per foot, whereas a three-conductor 350,000-circ.-mil., 25,000-volt, star-connected, 250-amp., 11,000-kva. cable would have a loss of only 7 watts per duct foot and would cost only $0.88. Therefore the star-connected grounded system would have an increased capacity of 30 per cent, a decreased investment of 12 per cent and a decreased transmission loss amounting to 12½ per cent.

THREE-PHASE PAPER-INSULATED LEAD-JACKETED CABLES

For Y-Connected Neutral-Grounded Circuits

Working Pressure, R.M.S. Volts	Insulation On		Minimum, Cable	Maximum Cable	Five-Minute Test Voltage	
	Each, (In.)	Belt, (In.)			Between Conductors	To Earth
30,000	[illegible]	$\frac{11}{64}$	3/0	3/0	75,000	45,000
25,000	$\frac{9}{32}$	$\frac{9}{64}$	1/0	250,000 circ. mil.	62,500	37,500
15,999	$\frac{11}{64}$	$5\frac{8}{64}$	2	650,000 circ. mil.	37,500	22,500
10,000	$\frac{4}{32}$	$\frac{2}{32}$	7	750,000 circ. mil.	25,000	15,000

LIMITATION TO OUTPUT REMOVED BY MODIFYING RHEOSTATS

Expedient Adopted at Holtwood (Pa.) Station for the Purpose of Facilitating Maximum Use of High Water Flow

On account of the large reactive loads thrown on the Holtwood plant of the Pennsylvania Water & Power Company during the high-flow season, the generators are subjected to electrical loads heavier than their rating. This overload and the high bus voltage at which the plant must operate demanded a heavier field current than the rheostats were designed to carry. Very simple changes in the rheostats permitted them to be used for this sustained load.

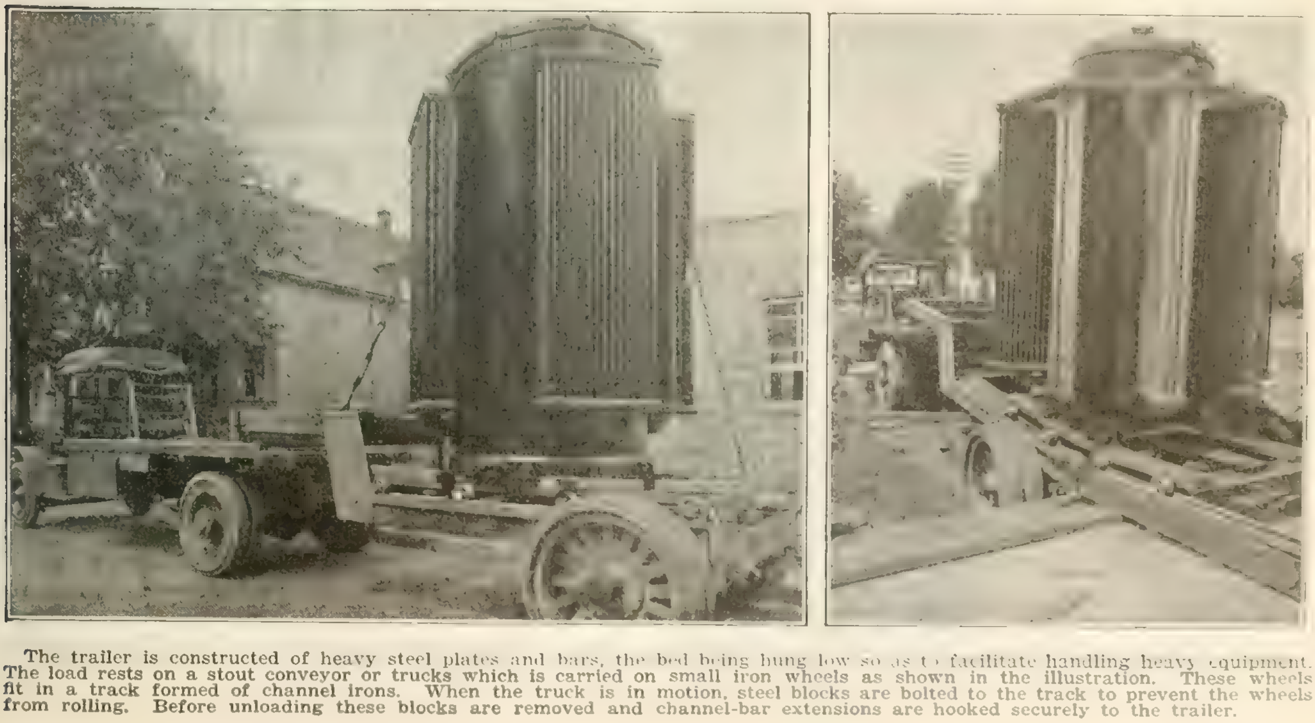
In the original rheostats, which had three sets of elements, the section which was in constant use was below the other two. This arrangement caused the top layers to be heated unnecessarily by the hot air arising from the bottom layer. In addition, the wiring ran above and between the grids and was subjected to more heat than the insulation could withstand. Copper washers used to compensate for the space occupied by the terminal rods oxidized to such an extent that they frequently fell apart and caused short circuits.

In order to keep the generators in service while the rating of the rheostats was increased, a spare field rheostat was constructed with improvements over the original type. All copper washers in the rheostats were replaced with iron washers and the grids were placed in two layers with the section in constant use at the top. The terminals were so arranged that all wiring would be placed on the outside of the rheostat, thus protecting it from heat.

The new spare rheostat was built from standard grids taken from discarded transformer neutral grounding stacks. This necessitated the purchase of only a circuit breaker.

Baltimore, Md. N. B. HIGGINS.

Trailer Used by Detroit Company Transporting a 2000-Kw. Transformer



The trailer is constructed of heavy steel plates and bars, the bed being hung low so as to facilitate handling heavy equipment. The load rests on a stout conveyor or trucks which is carried on small iron wheels as shown in the illustration. These wheels fit in a track formed of channel irons. When the truck is in motion, steel blocks are bolted to the track to prevent the wheels from rolling. Before unloading these blocks are removed and channel-bar extensions are hooked securely to the trailer.

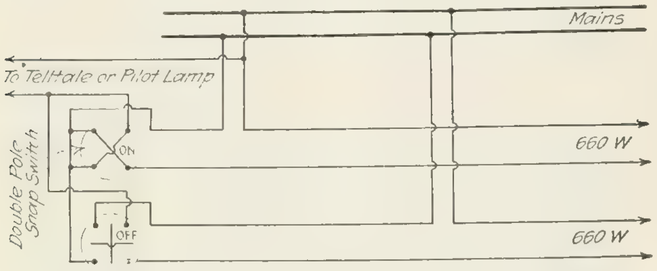
INDUSTRIAL APPLICATIONS

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

PILOT LAMP INDICATES STATE OF PLANT CIRCUITS

Can Be Placed in Any Location, Independent of Lighting System, to Tell When Circuits Are Turned Off

It frequently happens that several lamp circuits have to be controlled from separate points. As a result some of the lamps may be left lighted unintentionally. Where this would be objectionable the pilot lamp scheme used at the Lane Manufacturing Company's plant in Montpelier, Vt., may be used to advantage to indicate when all the lamps are not extinguished. Its system involves the use of relatively little wire and double-pole snap switches. The factory circuits are connected to one-half of the contacts of these double-pole switches and the other contacts of the switches are connected in multiple and are inserted in series with the pilot lamps. Thus when any circuit is "on" the pilot lamp will also be "on"; if the circuits are all dead, the non-lighting of the pilot lamp will indicate this condition. Two lamps can be inserted in the pilot lamp circuit if desired, so that there is little likelihood that both will be burned out at the same time. If one is burned out, the other will assure the indication of the condition of the circuit.



METHOD OF CONNECTING CIRCUITS AND SWITCHES FOR PILOT-LAMP SYSTEM

Montpelier, Vt. **Clayton J. DeMerritt.**

GALVANIZED-IRON COVERS FOR PROTECTING MOTORS

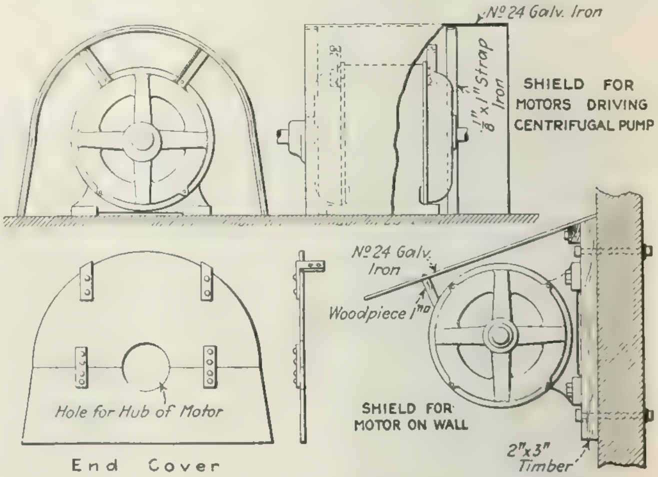
Three Types Used in Paper Mill Prevent Water from Getting Into Motor Windings with Subsequent Failures

In the pulp and paper industry many motors must be placed in wet and damp positions, as under tanks to drive centrifugal pumps, because the pumps are more efficient when the material to be pumped flows into the tanks by gravity. Sometimes, however, these overflow and drench the motor with water or liquor, which grounds the motor and causes insulation breakdown. Protection for such motors was afforded where the writer is engaged by placing galvanized-iron covers over the motors. Care had to be taken, however, to leave an air space of at least 8 in. (20 cm.) between the top of the motor and the cover for ventilation.

One type of cover was made as follows: Two pieces of ⅛-in. by 1-in. (3.2-mm. by 2.5-cm.) strap iron, which form the contour of the shield, were placed the length of the motor apart and riveted to the No. 24 galvanized iron sheet. The shield was attached to four angle-iron pieces which are arranged and fastened as shown. To prevent the priming liquid from injuring the motor an end covering was fastened to the top shield on the side nearest the pump by means of angle-iron pieces and stove bolts. The opposite end of the motor was left open, but the hood extends beyond the motor's end about 8 in. (20 cm.). Leaving the front open provides adequate ventilation for the motor.

To protect motors from occasional splashes of water and from heavy dust a self-supporting hood was used in some cases, but this rests on the floor and is not supported by the motor. Three pieces of ¼-in. by 1-in. (6-mm. by 2.5-cm.) strap iron were used here to stiffen the hood, the third strap being placed in the center of the sheet iron. The shield is then simply placed over the motor to be protected so that there is about 6 in. (15 cm.) clearance above the motor to provide ventilation.

The shield shown in Fig. 2 is used to protect motors that are mounted on the wall. It consists of a sheet of No. 24 galvanized iron large enough to cover the motor. A piece of wood 2 in. by 3 in. (5 cm. by 7.5 cm.) fastened to the covering is nailed to the wooden frame above the motor. To prevent the hood from touching the motor a piece of wood 1 in. by 1 in. (2.5 cm. by 2.5 cm.) is nailed to the center of the hood so it will rest on the motor. This hood extends at least 1 ft. (30 cm.) on each side of the motor to cover the pulley and prevent it from throwing water into the motor.



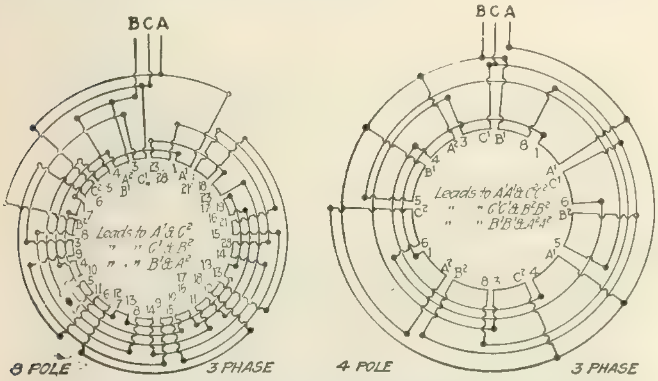
FIGS. 1 AND 2—HOODS FOR PROTECTING MOTORS DRIVING CENTRIFUGAL PUMPS AND FOR SHIELDING WALL MOTORS

Aroostook Pulp and Paper Mill. **W. B. Smith.**
Van Buren, Me.

CHANGING THE SPEED OF AN INDUCTION MOTOR

When Speed Had to Be Doubled It Was Found Desirable Also to Double Rating, as Mechanical Qualities Were Adequate.

Instead of purchasing a new motor of increased speed when the speed of a certain machine was to be doubled, an industrial concern decided to rewind the original motor to fit the new operating requirements. The motor was a 5-hp., 440-volt, three-phase, 60-cycle, 900-r.p.m. synchronous speed), eight-pole squirrel-cage induction motor, and it was rewound for 440-volt, three-phase, 60-cycle, 1800-r.p.m. (synchronous speed) with four poles. The change was made as follows:



FIGS. 1 AND 2—STATOR WINDING OF SQUIRREL-CAGE INDUCTION MOTOR BEFORE AND AFTER SPEED WAS DOUBLED

The eight-pole winding consisted of forty-eight coils (two-layer winding) of thirty-two turns of one No. 16 (0.0508 in.) double-cotton-covered wire per coil, connected series-delta (Fig. 1). There were sixteen groups with two coils in series per group, and the pitch of the coil was one and seven, which is full pitch, or 100 per cent chord factor for eight poles.

As the required speed (1800 r.p.m.) was double the original speed, the rating of the motor was increased to 10 hp. in order to retain the same torque. The rotor, bearings, shaft, etc., were found of adequate size to stand the added mechanical strains due to the higher speed, and, being found satisfactory, the winding was developed.

If the motor is considered as a generator, with the speed doubled it would develop twice the voltage, and therefore, if the motor was rewound with the same number of turns and connected series-delta, it would require a line voltage of 880 for the 1800 r.p.m.

As the machine was to be rewound for 440 volts, the number of turns could be reduced one-half and the area of copper increased in the same proportion and the winding connected series-delta. However, this would make a stiff coil, which would be difficult to handle. As the full pitch of the four-pole winding should be 48 divided by 4 or 1, and 13, the coil ends would project beyond the iron further than the eight-pole coil ends did, because the pitch of the new coil is longer. Developing a coil for the 1 and 13 throw, it was found that the coil ends extended out so far as to interfere with the end brackets, and the pitch was therefore decreased one slot at a time, until a throw was obtained that would leave at least ½ in. (13 mm.) clearance between the end brackets and the coil ends on each side of the machine. The correct pitch was found to be 1 and 10. Now, as decreasing the pitch or chording would have the same effect as reducing the number of turns in the coil, in the proportion of 1—the sine of one-half the electrical angle included between both sides of the coil—the angle for the 1 and 10 pitch would be 135 deg. The sine of one-half this angle is 0.92388, and the active turns will be decreased 1 — 0.92388 = 0.07612, or 7.612 per cent. This decrease would cause the motor to act as if overloaded 7.612 per cent. Now, as the motor was for continuance duty and as there was ample room in the slots for the needed turns, it was thought advisable to increase the turns 7.612 per cent. The new coil would then have thirty-two times 1.07612 = 34.43584, or thirty-four turns of one No. 16 0.0508-in. double cotton-covered wire per coil. The stator was then rewound with forty-eight coils of thirty-four turns each with a pitch of 1 and 10, connected parallel-delta (Fig. 2). There were twelve groups of four coils in series per group. The rotor bars were then welded to the end rings, and the end rings were turned down to increase the resistance, as welding a rotor tends to decrease its resistance.

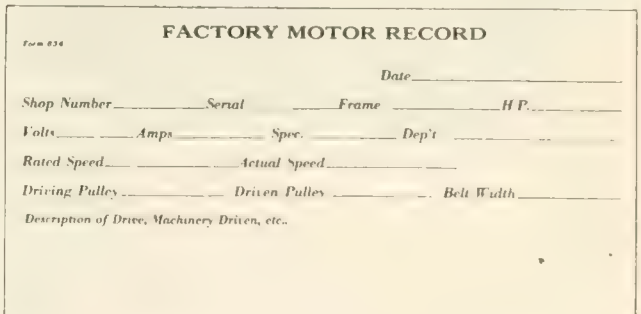
The motor was assembled, given a load test, and was found satisfactory in every respect.

New York, N. Y. C. A. JOHNSON.

TEST RESULTS TABULATED ON FACTORY MOTOR CARD

Comparison of Records Bearing Motor Ratings and Characteristics Allows a Complete Analysis of Power Conditions in Plant

When making a complete power survey of the installed motors in its plant, the Robbins & Myers Company recorded the results of the test on 5-in. by 8-in. (12.5-cm. by 20-cm.) filing cards. These cards are provided with spaces for shop serial and frame number, the name-plate data, the department, data on driving and driven pulleys, size of belt, machinery driven, and the load readings of the motors. In addition to this information there is a space for the specifications which are necessary in order to permit a complete analysis of the motors. Of course it would be impossible for every plant to have performance curves of all its motors, but in this case it is possible because practically all motors are manufactured in the plant. There is therefore available a complete file of these curves and with the data gathered from the test each motor's performance can be analyzed. This analysis allows the determination of whether or not it is economical, to make changes and what changes are necessary. Motors are provided that will operate at



Form 834

FACTORY MOTOR RECORD

Date ________

Shop Number ______ Serial ______ Frame ______ H P. ______

Volts ______ Amps ______ Spec. ______ Dep't ______

Rated Speed ______ Actual Speed ______

Driving Pulley ______ Driven Pulley ______ Belt Width ______

Description of Drive, Machinery Driven, etc..

Load ______ K.W. Amps ______ P.F. ______ Volts ______ H P ______

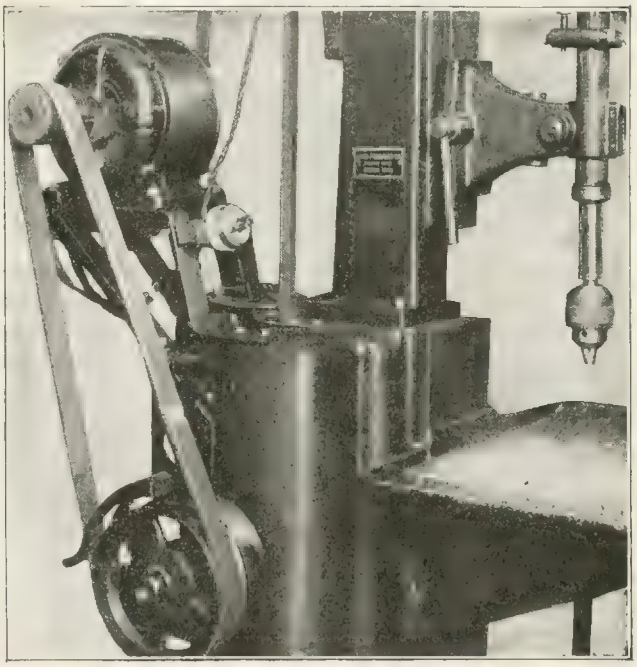
FACTORY MOTOR CARD SHOWS RESULTS OF MOTOR TESTS the highest efficiency and power factor on the determined load, but often it is necessary to take future extensions into account.

R. F. McNett,
Springfield, Ohio, Supervisor of Power.

HOME-MADE MOUNTING FOR DIRECT-BELTED MOTOR

Space Limitations Prohibit Direct-Connection Drive—Switch Mounted on Floor or Wall Within Easy Reach of Operator

To drive a 12-in. (30-cm.) Allen vertical drill at the factory of the Rawson Electrical Instrument Company, Cambridge, Mass., it was necessary to mount a ½-hp., 110-volt Westinghouse single-phase induction motor upon the machine frame. Space limitations made the installation difficult, but it was effected satisfactorily through the use of 1½-in. by $\frac{3}{16}$-in. (4-cm. by 5-mm.) iron straps bent to hold the motor about 12 in. (30 cm.) above the working plane and thus provide for satisfactory direct belting. Diagonal bracing below the skeleton bracket thus formed for the motor stiffens the frame. The motor-control switch is conveniently mounted on a 1-in. by ¼-in. (2.5-cm. by 6-mm.) supporting strap within easy reach of the operator at the drill.



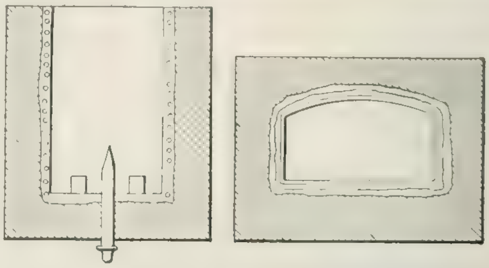
MOTOR MOUNTED ON MACHINE FRAME ABOVE DRIVEN PULLEY

ADVANTAGES OF CYLINDRICAL HEAT-TREATING FURNACE

Discussion of Its Merits as Compared with Those of the Other Wire-Wound Furnace, Namely the Hearth-Muffle Type

There are two general types of wire-wound electric heat-treating furnaces which are used to quite a large extent for relatively small work. One type may be called the cylindrical or "pot" type and the other the ordinary hearth-muffle type. In the ordinary hearth-muffle furnaces the work usually rests on the hearth, while in the cylindrical furnaces the work is usually suspended on jigs or by wires. When the product being treated requires the utmost care as to rate of heating and uniformity of temperature, the cylindrical type of electric furnace has an advantage over the ordinary hearth-muffle furnace in the method of placing the work in the furnace, according to A. F. MacFarland, of the U. S. Ball-Bearing Company.

The work in the hearth-muffle furnace resting on the hearth receives heat from the walls of the muffle by radiation and by conduction through the atmosphere of the furnace. Another advantage is the facility for handling material in the cylindrical furnaces on jigs. Of course there are special cases where the hearth-muffle type of furnace may have an advantage over other types, and the above statements apply in general only.



FIGS. 1 AND 2—CYLINDRICAL AND HEARTH-MUFFLE TYPE ELECTRIC HEAT-TREATING FURNACES

COST COMPARISONS FOR MOTION-PICTURE PROJECTION

Energy and Maintenance Costs for an Installation of Gas-Filled Tungsten and Arc Lamps Are Tabulated, Showing Total Saving

The economy for motion-picture projection of gas-filled tungsten lamps over arc lamps is clearly shown in the accompanying table compiled by George G. Cousins of the Hydro-Electric Power Commission laboratories. In addition to the economical advantage of incandescent lamps, further considerations are responsible for their selection. Among these are the elimination of light fluctuation and eye fatigue, reduction of wear on machine due to absence of carbon ash, less heat in the operating booth and simpler control. Although high screen brightness is not obtainable by the use of incandescent lamps, it is thought that some values of screen brightness now used are higher than necessary.

COMPARISON OF COSTS OF ARC AND MAZDA LAMP PROJECTION

Type of arc.	Type of arc control.	Renewal cost of carbons per 10-hr. period.	Renewal cost of Mazda lamps at $6 ea. giving 100 hrs. life.	Additional cost of Mazda renewals over carbon renewals per 10-hr. period.	Cost of energy per 10-hr. period for arc at 6c. per k.w.-h.	Cost of energy per 10-hr. period for Mazda lamp.	Saving in cost of energy for 10-hr. period for Mazda over arc.	Total saving per 10-hr. period over arc with Mazda at 100 hrs. life.
35-50 amp. a. c. or d. c.	Rheostat	$0.30	$0.60	$0.30	$2.76	$0.51	$2.25	$1.95
35-50 amp a. c.	Compensator	0.03	0.60	0.30	1.42	0.51	0.91	0.61
35-50 amp. d. c.	Motor-generator	0.30	0.06	0.30	1.29	0.51	0.78	0.48
60-75 amp. a.c. or d c	Compensator	0.39	0.60	0.21	2.24	0.51	1.73	1.41
60-75 amp. d. c.	Motor-generator	0.37	0.60	0.23	2.04	0.51	1.53	1.30

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics.
Including Methods of Increasing the Use of Electric
Light, Power and Heat

EMPLOYMENT OF OIL AS FUEL FOR CENTRAL STATIONS

Difficulties of Transportation, General Points of Advantage, Importance of Facilities for Storage and Cost Are Factors in Every Application

The remarkable increase in oil production was recently demonstrated in papers by Henry Thomas and E. H. Peabody, before the American Heating and Ventilating Society and the American Society of Mechanical Engineers, by a comparison of the oil production in 1859 of about 2000 barrels per annum in the United States with that of the world production in 1918 of about 500 millions of barrels per annum. The world production in 1918 was distributed with about 355 million barrels in the United States, about 63 million barrels in Mexico, about 40 million barrels in Russia and the remainder scattered. These figures show the Mexican production to be about 15 per cent of the world production.

Of the total of 355 million barrels of oil produced in the United States per annum it is estimated that from 75 to 150 million barrels are used annually for fuel purposes. As far as the Eastern States are concerned, the Mexican oil fields must be depended upon for the oil supply for fuel uses. It is interesting to note that other oil fields not yet developed in Mexico promise to yield an output of oil as great as the present Mexican supply.

The greatest difficulty at this time in the use of oil as a fuel lies in the transportation problem. With an estimated coal shortage in 1919 of say 100 million tons, there is little need for further reason why the oil supply does not meet the demand. The fact that about 100 million gallons of gasoline are required per annum for automobiles is an evidence of the magnitude of the demands upon the oil industry at the present time.

Among the principal advantages of oil for power plant boilers there may be mentioned the following: Higher efficiency for boiler and furnace; flexible control at light loads; high average boiler capacity; low cost of banking fires; elimination of labor difficulties; repairs less costly; low cost of handling fuel; uniform grade of fuel; general cleanliness and quick starting of fires.

The facilities for oil storage are obviously one of the very important items to receive consideration in the oil-burning plant. Where these facilities amount to say ten to twenty thousand gallons, horizontal storage tanks are often used, but for larger storage facilities vertical tanks are preferable. While the idea is often advanced that many small hand-fired power plants could be given a higher efficiency by changing over to oil burning, it should always be remembered that oil by its very nature is a zone proposition.

The viewpoints of producer and consumer of oil are apparently very similar, but while almost any one can consume or burn oil, the refinements in most cases require expert assistance, and while the consumer of oil usually appreciates the advantages outlined above for oil, two points always must be faced, namely, can oil be secured in sufficient quantity, and how much will oil cost as a fuel in comparison with coal? Practically every case is a special problem of its own, and it is very difficult to give general rules which will cover all cases. Each problem should be worked out on a basis of the cost of oil and coal together with the numerous other economic items which enter into the solution.

WISCONSIN CONFERENCE ON AGRICULTURAL SERVICE

Analysis of Present Practices with Enumeration of Advantages and Disadvantages of Different Plans of Handling Business

By C. D. LeCheverell
Secretary Railroad Commission of Wisconsin

Utilities and others interested in rural electric service recently held a conference with the Railroad Commission of Wisconsin to discuss questions of rural extensions and use of electricity by the farmers which have come to the fore very rapidly in the last two years, due, no doubt, to the unprecedented prosperity of the agricultural districts. This demand for service came at a time when all utilities were suffering from the financial stringency and were practically unable to secure capital to make needed extensions. It was recognized and was admitted by all utility operators that the most satisfactory method of extending this service would be to have the work done at the expense of the utility. Practical considerations at the present time make this out of the question. Two methods have been followed in Wisconsin. The utility has made the extension where the cost of it has been borne by the farmers to be served. The result of this method has been that the farmers, say, on a line extending east from the utility would receive service at an initial expense of $250 each, while the farmers residing, say, west of the utility would be obliged to pay $350 to $400 each, due to the fact that their district was more sparsely settled than the district the other side of town. Another serious objection has been that there would be twelve possible customers on the proposed line, nine of whom would contribute to the cost of its building. The other three farmers, although refusing to contribute to the initial cost of the line, would demand in many cases and would be able to force the utility to give them service since the utility is a public service corporation and has facilities for serving such farmers, its lines passing alongside their farms.

In selling energy to rural customers, if the expense of constructing the line has been borne by such customers, the utility has usually put into effect the urban rate modified in some instances by a higher minimum monthly charge.

The other method which has been followed to considerable extent in Wisconsin has been for the farmers in a certain district wishing to receive electrical service to incorporate as a distributing company, the prospective consumers taking stock enough to cover the cost of building the proposed line. This distributing utility purchases its energy at a wholesale rate at the city limits, and in turn bills it to its customers at a higher rate—a higher rate planned to include the ordinary distribution and operating expenses of the farmers' utility. This has resulted in farmers usually paying a higher rate than was charged by the local utility in the city and has also been open to the objection that certain farmers would refuse to become stockholders and yet demand and be entitled to receive service from the company.

The utility operators who were present at the conference were quite unanimous in their opinion that the present rates for rural electric service in effect are unremunerative and in fact throw a burden upon the urban consumers of making up the deficit arising from the operation of the rural business. The representatives of the farmers and consumers who were present and the representatives of the farmers' distributing companies who were present agreed that the rates for rural business ought to be compensatory, and that no burden should be thrown on the urban customers by reason of rural service. The rural companies that have been formed aim in their rates to cover merely operation and provide no return on the investment. It was pointed out that if the rate were made sufficiently high to cover a return on the investment, they would then be able to sell their stock on an investment basis and could offer service on an equal basis to all prospective customers who apply, whether stockholders or not. One suggestion was made that in both cases the utility should establish a consumer charge which should be equal to the interest charge upon the investment per consumer, and that, where the consumer was a stockholder, or where the consumer had contributed his proportion of the expense of constructing the line, this consumer charge should be waived. It was claimed that this would place the non-stockholder and the farmer who refused to contribute to the cost of building the line on the same basis with stockholders and those who did contribute.

All of these plans have ignored those elements of the excess cost of rural service over urban service such as increased depreciation per customer, increased maintenance per customer, increased line losses due to the fact that there are fewer customers per mile of line, increased transformer loss due to fewer customers per transformer and the increased maintenance expense.

It was agreed when the meeting adjourned that those present should formulate their experience and views and submit them to the commission, who would then make a study of the matter presented and, if feasible, have printed in pamphlet form a summary of this information together with such recommendations or proposals as the commission might deem advisable. In calling this conference it was not the commission's idea that it would be able to put into effect any hard and fast rule governing rural extensions. It was thought, however, that principles might be laid down.

ELECTRIC REFRIGERATORS ARE REVENUE PRODUCERS

This Profitable Field for Residential Lines Should Be Developed—Figures on Monthly Revenues from Installations

That the domestic electrically operated refrigerator is a most profitable producer of revenue is the opinion of sales managers of four power companies in cities in Ohio who were interviewed on this subject. Some of the managers state that this device has no equal as a revenue producer on residential lines and that the field has immeasurable possibilities. The following table shows the approximate revenues which these machines are producing as far as data are available:

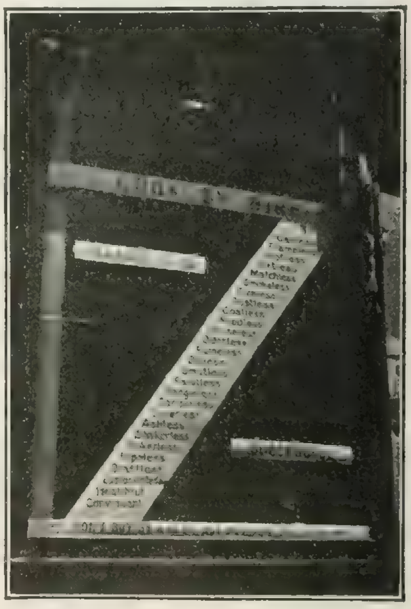
Demand Each	Kilowatt Hours per Month	Monthly Revenue
400 watts	100 to 125	$5.00 to $6.25
	50 to 60	2.50 to 3.00
	75 to 90	3.75 to 4.50
	60	3.00

These figures are not higher than the amount the average family pays for ice. Besides, the companies state that the dry, even temperature prevents food molding and spoiling. One company states that in one of these refrigerators food was kept five and six days without spoiling and milk was kept sixteen days.

All companies emphasized the importance of proper installation and the use of a good ice box in order to keep down excessive costs to the consumer. Besides this only an occasional oiling and adjustment by a service man were deemed advisable.

The companies interviewed were: Toledo Railways & Light Company, Lorain County Electric Company, Elyria; Trumbull Public Service Company, Warren, and Alliance Gas & Power Company.

Effective Central-Station Range Advertisement Used by Maine Company



The Central Maine Power Company recently "ran" an unusually effective electric range window advertisement, illustrated herewith, in which no less than twenty-seven advantages of electric cooking were featured on a diagonal poster connecting a "Cook by wire" invitation with the admonition "Don't buy by and by, but buy and buy now." The display attracted widespread local attention.

POLITIC WAY OF INTRODUCING AUTOMATIC RATE ADJUSTMENTS

Discount Given to Power Customers Who Sign Rider Which Varies Rate Schedule with Changes in the Company's Cost of Coal and Labor

On the theory that it is better public policy to say "Will you?" than "You must," one of the large central stations in the Middle West gives a discount of 0.25 cent per kilowatt-hour to all power customers who sign its standard rider providing for automatic adjustment of the rate schedules. This method has proved so successful that practically all the company's power customers who require 50 kw. or more have agreed to pay rates which shall be automatically adjusted to compensate for changes in the cost of supplying the service. These adjustments in the power rate schedules are made on the following basis:

"When the cost of heat units in the coal delivered into the company's bunkers is greater or less than 14.5 cents per 1,000,000 B.t.u. (252,000 cal.) the rate charged for electric energy shall be increased or decreased at the rate of 0.045 cent per kilowatt-hour for each increase or decrease of one cent or major fraction thereof above or below 14.5 cents per 1,000,000 B.t.u. (252,000 cal.).

"When the equivalent hourly wage of all employees (excluding department heads and officers) is greater or less than 58 cents the rate charged for electric energy shall be increased or decreased at the rate of 0.012 cent per kilowatt-hour for each increase or decrease of one cent or major fraction thereof in the equivalent hourly wage."

The company makes provision for obtaining all necessary tests and records each month. The unit cost of heat units and the equivalent hourly wage obtained from these records constitutes the basis for adjusting charges for energy on bills rendered during the thirty-day period beginning with the tenth day of the succeeding month. This allows ten days after the end of any thirty-day period for compiling the records.

VALUE OF PROMPT-PAYMENT DISCOUNTS IS QUESTIONED

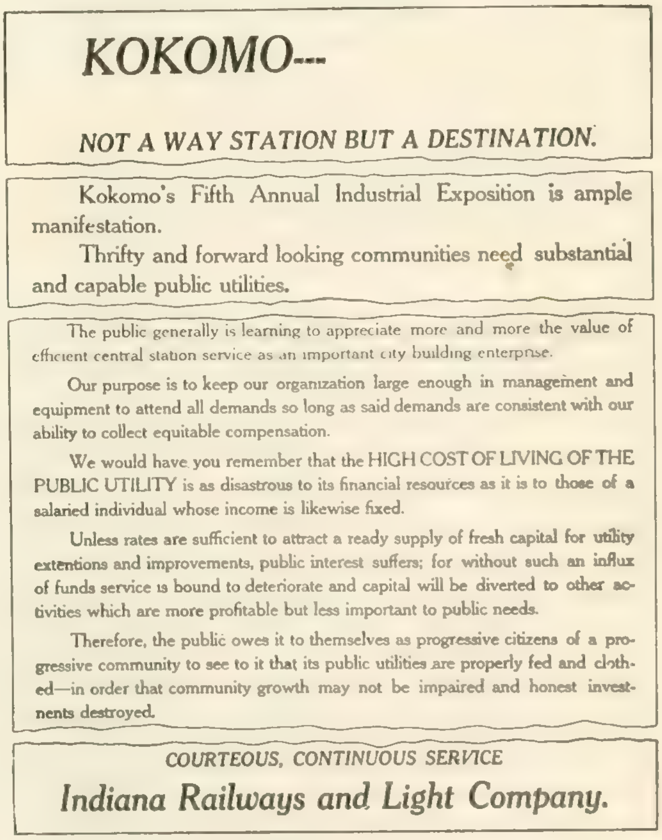
Relations with Large Power Customers Disturbed by Existence of Net and Gross Charges—A Comment from New England

The time-honored practice of billing electrical energy at a certain net rate provided payment is made within a stated period after the statement is presented has been in vogue among central stations so long that it has become an institution. A recent experience of a New England company with this arrangement, however, has convinced the management that the establishment of a standard rate per kilowatt-hour payable within thirty days is preferable to the discount plan. The use of the net rate worked out well enough when dealing with residential lighting customers and small power users, but in two late cases its application has created serious annoyance in dealing with large industrial customers.

One of these customers purchases energy amounting to $3,000 per month and ordinarily makes payment within the time limit necessary to secure the 10 per cent discount. Recently the time expired without payment, owing to illness in the customer's clerical force. The office system should have taken care of the matter automatically, and it was obviously no fault of the central station that the bill was delayed in payment. Nevertheless, the industrial plant was obliged to pay $300 more for energy in the month in question than would have been the case had the usual prompt payment of the central station bill occurred, and the bill was finally settled only after considerable discussion had taken place, in which the central station manager stated that if he rebated the excess above the net he would become liable to the public utilities commission for practicing discrimination.

In the other case, a valued power customer refused to pay the gross rate although the time limit on the discount had expired, and at last accounts the central station had no recourse except to notify the customer that unless full settlement were made service would have to be cut off. In discussing these cases with a representative of the ELECTRICAL WORLD, the manager stated that he was convinced that the friction arising from the existence of the discount between the central station and the large customers made it expedient to eliminate the gross rate, and he proposed at an early date to establish net rates applicable to the various classes of customers and subject to thirty-day payment.

Diplomatic Forecast of Probable Rate Change



KOKOMO---

NOT A WAY STATION BUT A DESTINATION.

Kokomo's Fifth Annual Industrial Exposition is ample manifestation.

Thrifty and forward looking communities need substantial and capable public utilities.

The public generally is learning to appreciate more and more the value of efficient central station service as an important city building enterprise.

Our purpose is to keep our organization large enough in management and equipment to attend all demands so long as said demands are consistent with our ability to collect equitable compensation.

We would have you remember that the HIGH COST OF LIVING OF THE PUBLIC UTILITY is as disastrous to its financial resources as it is to those of a salaried individual whose income is likewise fixed.

Unless rates are sufficient to attract a ready supply of fresh capital for utility extentions and improvements, public interest suffers; for without such an influx of funds service is bound to deteriorate and capital will be diverted to other activities which are more profitable but less important to public needs.

Therefore, the public owes it to themselves as progressive citizens of a progressive community to see to it that its public utilities are properly fed and clothed—in order that community growth may not be impaired and honest investments destroyed.

COURTEOUS, CONTINUOUS SERVICE

Indiana Railways and Light Company.

The advertisement which is reproduced with this article was used recently in special local editions of Kokomo, (Ind.) papers issued in connection with the city's industrial exposition week. It aimed to accomplish a twofold purpose. It expressed the Indiana Railway & Light Company's good faith and public spirit toward its community, and it intimated rather pointedly yet tactfully that the general public utility situation demanding higher rates might soon find application in Kokomo.

DIGEST OF ELECTRICAL LITERATURE

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Interchangeability of Squirrel-Cage Rotors.—B. B. RAMEY.—In case of injury to the rotor or squirrel-cage induction motor it often happens that a star rotor of the particular motor in trouble is not available. The writer shows that in such emergencies it is sometimes possible to use rotors of other ratings that may be on hand provided they fit mechanically.—*Electric Journal,* November, 1919.

Wide-Range Speed Regulation of Direct-Current Motors.—G. BARRUSTA.—It is often desirable, for instance in paper mills, to cover a very large range of speed by continuous regulation on the driving motor, such that the torque decreases as the speed goes up. A range of at most one to four can be had by adjusting the motor field at constant voltage. Speed regulation may also be obtained at a constant motor excitation by employing a separately excited generator to supply the motor voltage, the adjustment being made in the generator field. In the first case the motor runs with poor commutation at high speeds, in the other case the generator commutation will be difficult at low motor speed. The author proposes to combine the two methods, using motor field regulation at lower speeds and generator field regulation at higher speed. The question of efficiency is considered, it being shown that while armature copper loss should be kept low, high maximum values of magnetic induction are permissible.—*L'Industrie Electrique,* Sept. 10, 1919.

Iron-Sickness in Transformers and Generators.—M. VIDMAR.—The author draws attention to the disastrous effects that may arise from iron filings when, through carelessness in construction, they exist in cavities in the iron cores of electrical machinery. In large units considerable voltages (of the order of a few tenths of a volt) may occur between neighboring plates or other parts. If iron filings, or chains of filings, bridge across such places, very high local temperatures may obtain through development of Joulean heat—0.2 volt would suffice to heat an iron particle to 1000 deg. C. inside a fraction of a second. A burn may result where the insulation between laminae is destroyed. The local losses then increase, and break-down follows in severe cases. In investigating certain cases of transformer burn-outs, the author found in the cores big lumps of solidified iron filings, forming welds across bundles of plates. This leads to the conclusion that iron-sickness was the cause of these premature break-downs. The accumulation of material around the burn, and the welding of the plates, may go on for weeks, and results in a steady increase of the no-load losses, manifested by a slow rise in oil temperature. As preventive means there are suggested subdivision of the core by heavy pressboard insulations for every thirtieth plate, and use of paper with projecting edges.—*Elektrotechnik und Maschinenbau,* Jan. 5 and 12, 1919.

Lamps and Lighting

Factory Lighting a Central-Station Problem.—O. R. HOGUE and J. J. KIRK.—Analyzing the data collected by the Commonwealth Edison Company during the past year, a marked tendency is shown toward higher intensities of artificial lighting. It is said that the average intensities in the larger new installations during the past year have been more than double those five years ago. Very little local lighting is used and that only when necessary. It is also shown that during the winter months which have the greatest amount of darkness the average watts per unit installed are higher than during the other months of the year. The figures in the table show the advantage obtained by increasing from the ordinary low standard to a moderate intensity and also the still further advantage of increasing to a real production intensity. It seems certain that in promoting productive intensities there appears the greatest possibility of service to industry, and wide adoption of such intensities is only a matter of getting the truth before the responsible executives.—Paper read before Illuminating Engineering Society, Oct. 23, 1919.

OLD INSTALLATION

Class of Business	Equipment	Watts per Sq.Ft.	Foot-candles
Iron-pulley-finishing shop...	Drop cords, 60-watt lamps, bare or tin shaded.........	0.27	0.2
Soft-metal-bearing machine shop	25 100-B deep-bowl reflectors.	1.00	4.6
Heavy-steel machine shop...	13 100-watt C, 23-in. eye-shield units..............	0.60	3.0
Carburetor assembling shop.	84 40-watt B, two 100-watt C, 14 40-watt drops..........	1.00	2.1

NEW INSTALLATION

Equipment	Watts per Sq.Ft.	Foot-Candles	Average Increase in per Cent Production	Total Cost in per Cent of Payrol
200-watt C reflectocap units..........	1.90	4.8	20	5.5
25 200-watt C deep-bowl reflectors....	2.00	12.7	15	...
13 300-watt C in same units	1.70	11.7	10	1.2
19 300-watt C, 10 200-watt C eye-shield units...........................	1.90	12.5	12	0.9

Photometry of Searchlights.—The nearest point to a searchlight at which the photometric law holds depends on the size of the source of light, the focal length and the diameter of the mirror. This limiting distance can be calculated or determined by experiment, but it is not correct to assume that it is 500 times the focal length, as is often done. Besides measuring the maximum intensity of the beam, the distribution of the light within the beam should be determined by rotating the searchlight so that the beam passes across the photometer head, particular care being taken that the exact center of the beam passes the photometer. The absorption of light in fairly clear air is about 10 per cent for 1 km. distance and 20 per cent in air of poor transparency. The effect of absorption may be eliminated from the test by taking photometric measurements at two different points sufficiently far apart, but this may lead to great errors in the case of unsteady searchlights. It is preferable to take the two observations simultaneously with two photometers at points subtending a small angle at the searchlight and at equal heights above the ground.—*Technical Review*, Oct. 14. (Abstracted from *Electrotechnische Zeitschrift*, July 31, 1919.)

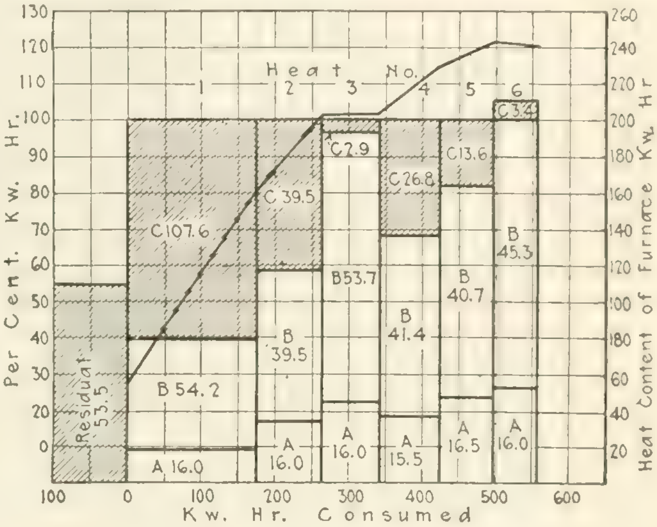
Generation, Transmission and Distribution

The Blomquist Steam Generator.—A steam boiler, or high-speed steam generator, of a radically new type, has been put in operation in a Gothenburg mill. The boiler consists of 11 pressed steel cylinders of 305 mm. (12 in.) diameter and 2.5 m. (8 ft.) heated length, which are rotated at the rate of 375 r.p.m. Due to centrifugal action the water will cover the entire inner surface of the tubes, keeping the temperature of the steel below 300 deg. C. The tubes are supported in ball bearings, feed-water being injected at one end and steam taken out at the other, through steam-tight boxes. The generator produces 6000 kg. (13,000 lb.) steam per hour, at 50 atm. (740 lb. per sq.in.). The heated surface is 27 sq.m. (290 sq.ft.), which corresponds to a normal vaporization of not less than 220 kg. steam per sq.m. (45 lb. per sq.ft.) per hour. This steam generator may be used to increase the pressure in existing plants, where high-pressure turbines can be employed to utilize the increase in boiler capacity thereby obtained.—*Elektroteknisk Tidsshrift*, June 20, 1919.

Installations, Systems and Appliances

Developments in Lifting Magnet Practice.—F. N. PICKETT.—The lifting magnet has proved to be one of the most efficient devices in the saving of time and labor where iron is handled in large quantities. In the present article the use of this implement is described in various applications, including the handling of pig iron, steel rails and plate. Interesting problems arise in adapting the lifting magnet to these various purposes, and these are dealt with in the article.—London *Electrician*, Sept. 26, 1919.

Commercial Testing of Metallurgical Electric Furnaces.—H. M. ST. JOHN.—The electric furnace test proper naturally resolves itself into three parts—the preliminary test, the intensive test and the operating test. These must sometimes be supplemented by various special tests to determine some one factor which cannot readily be studied under ordinary operating conditions. The preliminary test covers the period from the time current is first turned on until the furnace is operating smoothly under regular plant conditions. This period will ordinarily include from one to two weeks, although it may be much more prolonged. The object of the intensive test is to determine the best possible performance of which the furnace is capable under the stipulated manufacturing conditions. A careful determination is made of all the factors which enter into the reliability and economy of furnace operation. When the intensive test has been completed, unless the furnace has already exhibited defects so serious as to make its further use undesirable, it should be put to work as a regular part of the plant equipment and operated steadily in a routine manner for at least a month. The figure shows a diagram of one day's operation, in which the percentage of total energy input, as utilized and dissipated in various ways, is plotted against the total input expressed in kilowatt-hours. *A* represents the heat absorbed by the metal, calculated as 160 kw.-hr. per ton of brass at 1090 deg. C. (1994 deg. Fahr.); *B* the various heat losses from the furnace during operation, and *C* the heat absorbed by the furnace structure as its temperature rises. In each of the rectangles shown in the diagram the altitude indicates the percentage of heat input disposed of in the manner indicated, while its area is proportional to the heat input in kilowatt-hours. In rectangles marked *A* the altitude represents also the thermal efficiency of the furnace during each heat. The shaded areas indicate that heat energy stored in the walls of the furnace, that marked "residual" being the initial stored heat with which the furnace started the day. The figures show the numerical values of each area in kilowatt-hours. The broken-line curve indicates the rate at which heat is being stored by the furnace, or—what is virtually the same thing—the rate of temperature rise.—*Chemical and Metallurgical Engineering*, Sept. 15, 1919.



HEAT BALANCE OF A RESISTANCE FURNACE

The Elimination of Dust from Gases by Electricity.—The latest improvements in this process provide for the filtration of the gases in a powerful electric field. Very high-tension electricity is needed, so the alternating current generated at 110 volts and 25 periods is transformed up to 50,000 volts. This high-tension current is then rectified by "kenotrons," which are a sort of valve with very low vacuum and incandescent cathode described later. The actual dust filters are composed of metal tubes of ordinary commercial sizes, inside which thread-shaped electrodes are maintained at high tension. The tubes may be placed either vertically or horizontally, and the arrangements differ according to the precise purpose in view. The particles of talc, cement, stone dust and metallic oxides can all be deposited. The dust of pyrites is deposited at a temperature of about 400 deg. C., and also the vesicles of the sulphuric acid to form the concentrated liquid. The "kenotrons" are static apparatus which resemble X-ray tubes in appearance, and they effect the same result as the rotary rectifiers generally employed. The volume of rectified current through the kenetrons increases rapidly with the temperature of the heated electrode and remains constant so long as the temperature of the latter is constant.—*Technical Review*, Oct. 28. (Abstracted from *La Technique Moderne*, August, 1919.)

Electrophysics and Magnetism

Voltage Surges in Coils.—W. ROGOWSKI.—In an extensive series of articles on the theory of propagation of electromagnetic waves in coils and the related practical questions of over-voltages in transformers and the protective action of choking coils, the author makes an attempt to predict theoretically the wave form of the voltage surge that penetrates into the winding, when an emf. is suddenly applied at the two ends of the coil. A solution is approached step-wise by considering first a coil of one turn, which is compared to a short-circuited line, then a coil of two turns, treated as a superposition of two lines with certain short circuits between them. The static and magnetic interactions between the two lines thus are taken into account, assuming symmetrical distribution of potential to ground, and by means of difference equations the reasoning is extended to the case of the coil with three turns. Finally the same analysis is applied to a flat coil with many windings. If the turns are widely spread, an overvoltage is to be expected, which for any number of turns is equal to the impressed emf. For a coil of two turns the overvoltage is independent of the spacing, for many turns it decreases rapidly when the pitch is decreased. In one of the papers (Jan. 26) a comparison is made between the author's method of attacking the problem and that of Rüdenberg, Wegner, Böhm and Lenz. It is pointed out that under the influence of alternating emfs. overvoltages may occur (1) by "voltage resonance," giving high voltage to the ground, and (2) by "current resonance," giving steep gradient, *i.e.*, high voltage between turns.—*Archiv für Elektrotechnik*, 1917-18, Jan. 8 and 26, and Feb. 17, 1919.

Electrochemistry and Batteries

Effect of Amalgamation Upon the Single Potential of Aluminum.—LOUIS KAHLENBERG and JOHN A. MONTGOMERY.—Measuring the single potential of aluminum in a one-third molar solution of aluminum chloride at room temperature by means of the calomel electrode, the writers obtained much higher values with amalgamated than with unamalgamated aluminum, owing to the removal of the coat of resistant oxide by the mercury. They showed also that the measurements were actually the single potentials of the aluminum and not those of an aluminum amalgam.—*Proceedings A. E. S.*, Sept. 23, 1919.

A New Lead Accumulator Theory.—CH. FÉRY.—Years of experimental research have led the author to the conclusion that the current theory of the phenomena of charge and discharge can no longer be upheld. Instead of the classical double sulphatation formula the following equation is given:

$$Pb_2 + H_2SO_4 + Pb_2O_5 = Pb_2SO_4 + H_2O + 2PbO_2.$$

Thus during the normal functioning of the cell no lead sulphate is ever formed. Instead a sulphate of univalent lead is supposed to form on the negative plates during discharge. This is an unstable salt of black color. In presence of sulphuric acid it easily changes into the ordinary white sulphate, which explains the turning white of the negatives through sulphatation when a battery is allowed to stand discharged. The action of the cell during discharge is compared to that of a primary battery, the polarization, by formation of hydrogen on the negatives, being prevented by the presence of lead pentoxide, which easily reduces to PbO_2, and thus acts as a strong oxidizing agent. The hypothetical subsulphate as well as the pentoxide are relatively good conductors, and the results of the author's quantitative work seem well to justify the assumption of their existence.—*Bulletin de la Société Française des Electriciens*, February, 1919.

Units, Measurements and Instruments

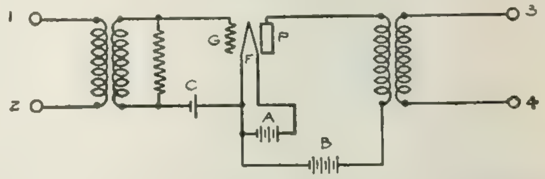
An Electric Distance Pressure Gage.—OTTO HAUSER.—On the pointer shaft of an ordinary manometer a small commutator is placed, so that it turns between two brushes. The commutator is so arranged that the resistance between the brushes will vary when the manometer deflects. This is utilized to actuate a pointer instrument, placed at some distance, *i.e.*, on a control panel, and built according to the ohmmeter principle, with two crossed coils, elliptic iron core, and without directive springs. A dry-cell battery of 3 to 6 volts supplies the control current. Graphically recording instruments are described, which are capable of tracing the pressure curves for up to 5 manometers on the same diagram, in rectangular co-ordinates and uniform scales.—*Helios*, Jan. 26, 1919.

A New Alternate-Current Potentiometer for Measurements on Telephone Circuits.—P. O. PEDERSEN.—A brief description of a new form of alternating-current potentiometer suitable for measurements of telephone circuits.—London *Electrician*, Nov. 7, 1919.

Telegraphy, Telephony and Signals

Localization of Breaks or Faults in Submarine Cables.—J. F. LLOYD.—The writer explains inaccuracies in measurements required for locating faults and gives the calculations for making the necessary corrections.—London *Electrician*, Oct. 31, 1919.

Telephone Repeaters.—BANCROFT GHERARDI and FRANK B. JEWETT.—In this paper the authors have endeavored to set forth briefly the history of the research and development work which has led up to the final production of successful telephone repeaters. The various forms of amplifiers which have been suggested are described and their possibilities and limitations pointed out. The essential properties of repeater networks, together with the necessary line conditions for successful repeater operation, are described and illustrated. Tandem operation of repeaters is discussed, as is also the use of repeaters in four-wire circuits.—*Proceedings A. I. E. E.*, November, 1919.



EARLY APPLICATION OF THE VACUUM TUBE TO TELEPHONE REPEATING SYSTEMS

Inter-Imperial Communication Through Cable Wireless and Air.—CHARLES BRIGHT.—The writer points out the dependence of the British Empire upon communication between the United Kingdom and the Dominions. He gives reasons for his belief that these systems should be under the control of the government as a matter of national defense. The author gives a table showing the principal British cable routes, approximate distances from London and the tariff rates.—London *Electrician*, Oct. 24, 1919.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

News in Brief

Summary of Important Happenings in the Industry During the Week

One of the factors in the situation which attract attention is the still close tendency of money. Securities which find a ready sale under present conditions are those having speculative possibilities. These are snapped up quickly and they absorb free capital to the detriment of securities which offer merely a fixed rate of return. Utilities may be forced by this situation to try to market more of their securities directly instead of through banking houses. If they can do this at less cost than the commission charged by bankers, there will be a net saving.

On Jan. 1 Stone & Webster, Boston, admitted as partners Frederick P. Royce, George O. Muhlfeld, Henry B. Sawyer, Frederick S. Pratt, Harry H. Hunt and Howard L. Rogers.

The Empire State Gas & Electric Association announces a contest, open to employees of member companies, for statements on "Our Obligations to the Public." Two prizes, $15 and $10, will be paid.

Complete organization of the Radio Corporation of America has been effected. Owen D. Young, vice-president of the General Electric Company, is chairman of the board and the new company. Edward J. Nally, formerly vice-president and general manager of the Marconi Wireless Telegraph Company of America, is president. The General Electric Company has a large interest in the new company, which will develop commercial radio business between this country and South America and Europe.

Nicholas Stahl, general engineer Narragansett Electric Lighting Company, Providence, R. I., says that many engineers and superintendents of other central stations are traveling to Providence to see what is being done in the installation of oil-burning apparatus, now in operation.

On application of the General Electric Company, Howard C. Foss, district manager of Stone & Webster, has been appointed receiver of the Savannah (Ga.) Electric Company. The proceedings were in the United States District Court. The company operates the electric railway in Savannah. It also furnishes electric service, competing with another central-station company in the city.

A report on a recommended uniform registration law to regulate the practice of professional engineering, architecture and land surveying has been made to the Engineering Council by a committee of fifteen engineers representing the member societies.

Geological Survey statistics show a total output of 458,000,000 tons of bituminous coal in 1919, the smallest since 1915.

Action has been taken by the California Railroad Commission on security issues affecting two companies. The San Joaquin Light & Power Corporation may sell at 94½ plus accrued interest $494,000 of the issue of $1,250,000 bonds authorized on Aug. 20. The Pacific Gas & Electric Company is given until June 30, 1920, to dispose of the balance of the preferred stock issued as authorized June 30, 1919.

The San Francisco Electrical Development League has plans under way to give a farewell luncheon on Jan. 12 to R. H. Ballard, president of the National Electric Light Association, and John A. Britton, chairman of the public policy committee, before their departure for the East to confer on the program for the national convention at Pasadena in May.

The universal adoption of the metric system of weighing and measuring was advocated by speakers at the annual convention of the American Association for the Advancement of Science in St. Louis.

The California Railroad Commission has authorized the Sierra & San Francisco Power Company to add a surcharge of 2½ mills per kilowatt-hour to the rate charged for energy sold to the Coast Counties Gas & Electric Company.

A four-week campaign of stock selling to customers of the Public Service Company of Northern Illinois, Chicago, has resulted in sales of about $1,000,000 of 6 per cent preferred stock to about 5000 customers. This sale is still continuing, the company's employees acting as its selling agents.

The new year opens on the Pacific Coast with a general tone of optimism in all lines of industry. Christmas holiday trade electrically exceeded all previous estimates. Portland central stations report appliance sales in excess of 30 per cent of estimated volume In Los Angeles one dealer has just received a solid trainload of twenty-five cars of electric washing machines. The new year witnesses unusually heavy enrollment in universities of the West. The University of California passes Columbia and becomes the largest in America, with 9,685 students as against 8,204 in Columbia. Enrollment in the engineering courses is greatest among students pursuing electrical engineering, with 697 students enrolled. Vast new agricultural acreages are under way for the new year, requiring greater extensions of electrical services, electric pumps and appliances for the farm

Building holding over the old year and that anticipated for 1920, and expectations of extensions to central-station lines in certain sections, are causing buying far into the new year.

Virtually all the non-ferrous metals are higher than a week ago. Copper shows little advance, but its wire base at the mill is higher by ¾ cent and copper-wire rod is 1 cent higher Zinc and lead sheets are higher by ½ cent and 1½ cents respectively

From virtually all over the country, but particularly the East, reports show an absence of the usual midwinter lull in electrical supply buying. Inventory has interfered little with business. Stocks are badly broken in such lines as some schedule materials, loom, flexible armored conductor and conduit, boxes, low-voltage porcelain, lamp and heater cords and tableware. Pipe stocks are spotty and wire is generally available.

Price advances over the last week of December and the first week of January have been applied to flexible armored conductor and conduit, friction tape, heating appliances, lamp cords and magnet wire, single-phase motors, knife switches, porcelain tubes, some time switches and unit lighting fixtures. Further motor and pipe advances are predicted.

Among the larger projects contemplated throughout the country is the construction of a large power plant at Amoskeag Falls by the Amoskeag Manufacturing Company of Manchester, N. H., to cost about $500,000.

Plans have been approved by the City Council for providing funds to complete the construction of the Los Angeles (Cal.) municipal power plant No. 2 in the San Francisquito Canyon by May 1.

F. M. FEIKER VICE-PRESIDENT OF McGRAW-HILL COMPANY

Former Editor of "Electrical World" Becomes Chairman of the Board of Editors of the Largest Technical Publishing House in the World

Frederick M. Feiker, editorial director of the ELECTRICAL WORLD, *Electrical Merchandising* and *Ingeniería Internacional*, has been elected vice-president of the McGraw-Hill Company and chairman of the board of editors.

A little over four years ago Mr. Feiker joined the McGraw organization as editor of the ELECTRICAL WORLD, coming from Chicago, where for three years he had been chairman of the editorial board of all the publications of the A. W. Shaw Company, among them being the magazines *System* and *Factory*.

FREDERICK M. FEIKER

The new vice-president of the McGraw-Hill Company was born at Northampton, Mass., in 1881, and in 1904 was graduated from the Worcester (Mass.) Polytechnic Institute in electrical engineering. After special research work in the field of high-tension transmission with Prof. H. B. Smith, he served from 1906 to 1907 as technical journalist with the General Electric Company. While in that work, which brought him intimately in touch with the trade and business publications of the country, he conceived the idea of a management paper devoted to all phases of manufacturing. His forward thinking in this connection resulted in his going to Chicago in 1907 as a member of the staff of *System*. Shortly afterward this idea of his became concrete in *Factory*, a magazine of management, of which he became managing editor. In 1912 he became chairman of the board of editors of all the A. W. Shaw publications.

With his early training in electrical engineering and his later experience in the field of selling and production economics as a background, Mr. Feiker, on returning to the electrical field in 1915 as editor of the ELECTRICAL WORLD, quickly sensed the pressing character of the commercial problems to be solved by the electrical industry and with characteristic vision and insight at once pointed out that the greatest development of the manufacturing and central-station groups could come only with the establishment of sound business principles and harmonious relations in the trade and distributing branches. With the assistance of William H. Onken, Jr., then managing editor and now editor of the ELECTRICAL WORLD, whose knowledge of the industry knew no bounds, and O. H. Caldwell, now editor of *Electrical Merchandising*, but at that time a member of the ELECTRICAL WORLD staff, Mr. Feiker developed what he called a "functional" paper on selling that would supplement and extend the service of the ELECTRICAL WORLD to the industry. The rapid growth of that paper, *Electrical Merchandising*, is testimony to the editorial and publishing genius of the recently elected vice-president of the largest technical publishing house in the world.

Mr. Feiker is a constructive thinker, with a resourcefulness of common-sense ideas that amazes even his associates who know him best. He has never been content in his editorial work to be a looker on but has gone down into the industry and there rubbed elbows with other leaders on committees in various electrical associations. No small share of the constructive thinking of the electric vehicle section of the National Electric Light Association in the past four years has been his. He is this year chairman of the New York Section of the Illuminating Engineering Society. He is also a member of the other principal engineering societes.

Mr. Feiker is a man of simple tastes and with a sympathetic nature that has endeared him to those who have been associated with him on the ELECTRICAL WORLD.

REPORT ON PRODUCTION OF BITUMINOUS COAL

Statistics of United States Geological Survey Show a Total Output for 1919 of 458,000,000 Tons, Smallest Since 1915

The report of the United States Geological Survey on bituminous coal production, issued on Jan. 3, shows an output of 8,621,000 tons of soft coal during Christmas week. This brought the total production from the beginning of the year to Dec. 27 up to the figure of 451,618,000 tons. With three working days remaining, this suggests a total bituminous output for the year 1919 of 458,000,000 tons. This is the smallest in any year since 1915. Compared with the 579,386,000 tons of the record year, 1918, it is a decrease of more than 121,000,000 tons.

The average for the week—85.5 per cent of normal—is not, however, a true measure of the extent to which operations have been resumed in the union districts, for neither the day before Christmas nor the day after count as full working days. A better measure is found in the fact that on Monday, Dec. 22, the output was 103 per cent of normal, or in the fact that compared with production at Christmas time of last year the week shows an increase of over 2,000,000 tons.

OIL-BURNING APPARATUS IN USE AT PROVIDENCE

Initial Installation of Narragansett Electric Lighting Company Is Now in Operation and Attracts Much Interest

Oil-burning apparatus, installed recently under two of the boilers at the South Street station of the Narragansett Electric Lighting Company, Providence, R. I., is now in use.

Nicholas Stahl, general engineer of the company, made the following statement regarding the beginning of the experiment with oil:

> Some time ago the Narragansett Electric Lighting Company decided to make a thorough investigation of the possibilities of using oil as a fuel. We knew that stations on the Pacific Coast were equipped to burn oil exclusively, but there were none in the East, north of Florida, that made use of oil as regular fuel. The boilers, which were started this morning, will run regularly on oil, although it would be possible at any time to change back to coal at very short notice. We have constructed a service tank, holding 210,000 gallons, which will provide sufficient storage for the two boilers now in operation. The results secured will determine whether the oil-burning equipment will be extended, and at that time a large storage tank will be constructed.
>
> Many engineers and superintendents of other central stations have been to Providence to examine what has been done, and it is evident that there is a very great interest among electric light companies in the pioneer step which the Narragansett company has taken.

WATER-POWER BILL IS NOW BEFORE THE SENATE

Senator Nelson of Minnesota Says Water-Power Construction Has Been at a Standstill for Ten Years

With the water-power bill the unfinished business in the Senate and with debate on it under actual headway, the chances seem favorable for fairly prompt disposal of the measure. Senator Lenroot of Wisconsin, who is leading the opposition, has made clear his position, and apparently the differences between his views and those of other members of the Senate are capable of reconciliation.

Senator Walsh of Montana, who is regarded as one of the authorities in the Senate on water-power matters, deprecated the action of the committee in injecting again into the debate the controversy as to the length of the license.

Senator Smoot entertains opposite views. "I think if the pending amendment is not agreed to," he said, "the provisions of the bill will be such that it will be very difficult indeed to get any financial assistance in the United States to install power plants under it. So far as the provisions of the bill are concerned, there are other things in it that I do not like at all, as to which I am willing to yield my judgment in order to get some kind of a workable bill so that every power site in the United States upon the public lands may be developed. There is no need of framing the bill in such a manner that it will be impossible to secure the necessary money to develop the power plants."

Senator Nelson of Minnesota made the chief plea in favor of the bill. He pointed out that water-power construction has been at a standstill in the country for ten years. He reviewed the various delays and the differences of opinion between the Senate and the House which have worked to delay the measure. He told how finally the conferees at the last session of Congress had agreed at the eleventh hour, but in the jam of legislation at the end of the session the Senate was unable to agree to the conference report and the measure died with the Congress. The present bill, he declared, is practically the same bill that was agreed on in that conference. The amendments which were made by the Senate committee he characterized as in no way changing the general purport of the bill agreed upon in conference.

NEW MEMBERS OF FIRM NOW IN STONE & WEBSTER

Frederick P. Royce, George O. Muhlfeld, Henry B. Sawyer, Frederick S. Pratt, Harry H. Hunt and H. L. Rogers Become Partners

Stone & Webster, Boston, announced Jan. 1 that Frederick P. Royce, George O. Muhlfeld, Henry B. Sawyer, Frederick S. Pratt, Harry H. Hunt and Howard L. Rogers had been made partners in the firm. All have been leading members of the organization for years and have had important parts in its activities.

Mr. Royce is a graduate of the Massachusetts Institute of Technology, class of 1890, and for many years has been occupied in the development, financing and management of public utilities. For some time before becoming associated with Stone & Webster he was active in the executive affairs of Charles H. Tenney & Company, Boston, and lately has been in charge of the investigation by Stone & Webster of the Interborough and Brooklyn Rapid Transit companies.

Mr. Muhlfeld was educated at Purdue and Cornell universities, and, after several years of responsible direction of hydroelectric construction for Stone & Webster in the West, was appointed construction manager of the organization. He is at present general director of the division of engineering and construction, with headquarters in the New York office.

Mr. Sawyer has for many years served as treasurer of the public utilities operated by Stone & Webster. He is prominent in philanthropic work in Boston and is a trustee of the Boston Symphony Orchestra. At present he is heading a party of engineers and investigators for Stone & Webster on a trip to Japan, where a 30,000-kw. hydroelectric plant is to be built by the firm, with other important contracts pending.

Mr. Pratt has been employed by Stone & Webster since his graduation from Harvard College in 1894. He has directed various industrial chemical enterprises under Stone & Webster management and of recent years has had charge of a group of Stone & Webster properties in the Northwest, the most important being the Puget Sound Traction, Light & Power Company of Seattle, Wash. Mr. Hunt was graduated from the Massachusetts Institute of Technology in 1889, and for many years has been active in public utility management, looking particularly after various Southern properties of Stone & Webster. Mr. Rogers, a graduate of the Massachusetts Institute of Technology in 1893, has been continuously in the engineering and construction division of Stone & Webster since that time. He is now in charge of the home office of this division at Boston.

Semi-Annual Index for Volume LXXIV

The semi-annual index of the ELECTRICAL WORLD for the issues from July to December, 1919, inclusive, is printed as a supplement with this number. Any readers desiring to bind the numbers for this volume in two parts because of the difference in page size between the papers printed in New York (covering July, August and September) and those printed in Buffalo under strike conditions (covering October, November and December) will, on application, be supplied with a second copy of the index which can be trimmed to the smaller size of page.

WORK OF THE SIGNAL CORPS DURING THE MONTHS OF WAR

The Report of General Squier, Chief Signal Officer of the Army, Gives Credit to Manufacturers for Development Efforts

In last week's issue of the ELECTRICAL WORLD, page 35, extracts were printed from the annual report of Major General George O. Squier, chief signal officer of the army. These are now supplemented by additional excerpts.

In a chapter on "Engineering and Research in America" General Squier gives much information:

> Major C. E. Mendenhall and Lieut. John T. Tate, with the assistance of the General Electric Company, perfected a trench-signaling lamp which after test at the front was ordered sent to France in considerable quantities. Major R. W. Wood developed a telescopic signaling device, using a 6-volt, 2 amp. lamp. This lamp was tested at the front and favorably passed upon by the American Expeditionary Forces. It has made possible light signaling in broad daylight over a distance of 18 miles (28.8 km.). Major Wood also developed a secret daylight signaling lamp which has a range of 5 miles (8 km.). This also was ready for shipment abroad at the time of the signing of the armistice. Secret signaling at night, with the aid of the ultra-violet light, was perfected by the Science and Research Division, working in collaboration with Norman Marshall. With simple signaling telescopes of the sort mentioned above, using only a 6-volt, 2-amp. lamp, secret signals have easily been sent 6 miles (9.6 km.). Major Wood also developed new means of adapting this method to the problems of signaling to airplanes and secret signaling between convoys and obtained thereby a device which will be of much use in peace as well as in war.

The report says that in general it is not believed that there is any telephone or telegraph system so far devised that will prevent a line from being actually tapped and all signals sent over it obtained without the knowledge of the sending or receiving station.

General Squier says that the remarkable development and improvement of military radio equipment which has taken place under the direction of the Signal Corps during the last eighteen months will undoubtedly materially change the system of army communication. A typical example of this development is the airplane radio telephone.

In carrying out the program for development of radio apparatus the Signal Corps called upon a great many industrial engineering organizations and individual engineers for assistance in solving the problems incident to this work. General Squier says:

> It is impossible to print a complete list of the companies and individuals that contributed effectively to this work, but the contributions which have been made by certain companies have been so noteworthy as to justify mention in this article. Because of its unusually large engineering organization and its familiarity with so many of the fundamental problems which were involved in the development of radio apparatus for the Signal Corps, the Western Electric Company has contributed much more largely to this program than any other organization. However, the contributions which have been made to the development work by the Westinghouse Electric & Manufacturing Company, the General Electric Company, the International Radio Company, the General Radio Company, the De Forest Telephone & Telegraph Company, the National Electric Supply Company and the Marconi Wireless Telegraph Company have been of incalculable value to the Signal Corps during this emergency. It is particularly worthy of comment that all of these companies, and, in fact, any others with which the Signal Corps worked on the development of radio apparatus, evinced the most whole-hearted co-operation, with the sole purpose of assisting in every way to further the effectiveness of the American army.

The opinion is also expressed that the art of radio communication in general will be benefited enormously by the revolutionary improvements that have been effected in certain of the parts of radio apparatus, notably the vacuum tube. On the subject of the development of vacuum tubes the report says in part:

MAJOR-GEN. GEORGE O. SQUIER

> To make such a device, with its complicated yet accurately constructed metallic system within a practically perfect vacuum, is no small problem even when made in the laboratory on the individual unit basis by a skilled operator who appreciates the delicacy of the job. To turn out tubes by the thousands by factory methods involves almost infinitely greater difficulties. How well certain companies, in collaboration with the Signal Corps, have succeeded in solving these difficulties is indicated by the fact that recently the total rate of production in the United States of high-quality standardized tubes was considerably in excess of 1,000,000 a year.
>
> Varied as are the applications at present, the uses, actual and potential, growing out of war-development work have proved that the art of vacuum-tube engineering and the application of its products to radio engineering, telephone and telegraph engineering, and particularly to electrical engineering in general, are still in their early infancy. That vacuum tubes in various forms and sizes will, within a few years, become widely used in every field of electrical development and application is not to be denied.

The Chief Signal Officer considers that the work of standardization and quality production of vacuum tubes, accomplished during the last eighteen months, under the pressure of military necessity, represents an advance in the art of electrical engineering which will prove of inestimable industrial and scientific value to this country and to the engineering world at large.

Promoting Lighting Development in England

THE ELECTRICAL
DEVELOPMENT ASSOCIATION,

84, Kingsway, W.C.2.

Telephone. Holborn 253.

LIGHTING SEASON—1919-1920.

Artificial Lighting has been restricted for five years.

Economy and increased production are the needs of the day,

In the coming six months, work and recreation will be carried out to a great extent by artificial light.

Good Lighting increases output, saves strain, adds to comfort, reduces accident and waste.

Electric Lighting saves fuel, preserves health and injures nothing.

Platitudes! Exactly; but most of the troubles of this life arise from neglect of the obvious.

Are all the people in your district using electricity for Lighting? Are those who do use it provided with the best lamps and with the latest fittings? Has anyone advised them or overhauled their installations since 1913?

The modern electric lamp fitted in the modern way gives satisfaction to everyone, in appearance, utility and cost **—a bright and silent canvasser for a great Public Service.**

This is the call of England's Electrical Development Association to stimulate after-the-war interest in electric lighting.

ENGINEERING COUNCIL ACTS ON REGISTRATION OF ENGINEERS

Committee Representing the Various National Societies Makes Report with Draft of Recommended Uniform Registration Law

Because of widespread and persistent interest in the subject of licensing or registering engineers, architects and surveyors, the Engineering Council, at its meeting of Oct. 25, 1919, authorized the creation of a committee to make a thorough study and submit a report. Fifteen engineers from all parts of the country and of long experience in the various branches of the profession of engineering were appointed members of this committee, as follows: T. L. Condron, chairman; Francis C. Shenehon, Farley Gannett, John H. Dunlap, Arthur M. Greene, Jr., Caleb M. Saville, James H. Herron, John Klorer, A. Lincoln Fellows, C. H. Snyder, Amos Slater, Bion J. Arnold, John W. Alvord, J. W. Woermann and A. M. Schoen.

After much hard work, extending through fourteen months, the committee has presented a report to the Engineering Council. This is accompanied by a "recommended uniform registration law, to regulate the practice of professional engineering, architecture and land surveying." The council voted to receive this report and to give it immediately, together with the proposed law, as wide publicity as could be secured with the aid of the engineering and architectural societies and the technical journals, in order that the members of these professions might be informed and discussion elicited to guide the council in the consideration of this important matter at its meeting in February, 1920.

The Engineering Council has as yet taken no action upon the merits of the question of the advisability of legislation providing for the registering or licensing of practitioners of the professions named.

ORGANIZATION OF RADIO CORPORATION OF AMERICA

Owen D. Young Is Chairman of the Board and Edward J. Nally the President—General Electric Company Has Large Interest

Organization of the Radio Corporation of America, in which the General Electric Company owns a large interest, has been completed. Owen D. Young, vice-president of the General Electric Company, will be chairman of the board of the new company. Edward J. Nally, formerly vice-president and general manager of the Marconi Wireless Telegraph Company of America, is president.

The other officials are: Charles J. Ross, secretary and controller; George S. De Sousa, treasurer; Lewis MacConnach, assistant secretary; Marion H. Payne, assistant treasurer; John W. Griggs, general counsel.

Following are the directors: Gordon Abbott, chairman of Old Colony Trust Company, Boston; Albert G. Davis, vice-president General Electric Company; John W. Griggs, formerly Attorney General United States and ex-Governor of New Jersey; Edward W. Harden, of James B. Colgate & Company; Edward J. Nally; Edwin W. Rice, Jr., president General Electric Company; James R. Sheffield, of Sheffield & Betts; Owen D. Young, vice-president General Electric Company.

It is stated that arrangements have been made with Marconi's Wireless Telegraph Company, Ltd., of England, for the formation of a South American company, to be managed by the company of this country. A majority of the stock in various companies which are to construct stations in South America will be owned by the Radio Corporation of America.

President Nally states that the corporation will compete directly with the cable companies on overseas business as soon as its property is returned by the federal government. It will reach Europe as well as South America.

The official announcement says in part:

> Under new conditions of financial strength and in possession of the engineering resources of the General Electric Company, with a departmental staff of exceptional experience and ability, the company expects to attain the great objective for which it has always aimed, namely, a world-wide system of commercial wireless communication.
>
> In accordance with what is understood to be the wishes of the United States government, effective means have been taken to see to it that the actual control of the Radio Corporation shall at all times remain in the hands of loyal American citizens or corporations.
>
> In fact, it was at the instigation of our government, which desired that the former American company be entirely divorced from its parent company in England, that the Radio Corporation was formed. Owing to the greatly increased use of wireless by the United States government during the war the government has come to regard the subject of wireless as one of very vital importance to this country, especially from a military standpoint, and consequently looked with grave concern upon the participation on the part of a foreign corporation in American wireless affairs. These objections have now been eliminated.

Wireless apparatus developed recently by the General Electric Company, including the Alexanderson high-frequency alternator, is acquired by the new company.

PROGRESS OF THE N. E. L. A. OVERHEAD SYSTEMS COMMITTEE

Reports Submitted at the Denver Meeting Show that Much Interesting Information Can Be Collected Regarding New Methods

A report of the recent Denver meeting of the overhead systems committee of the National Electric Light Association has been made available. The meeting was held in the offices of the Denver Gas & Electric Company

Those in attendance were as follows: Markham Cheever, Salt Lake City; R. L. Baker, New York City; Thomas Sproule, Philadelphia; W. T. Oviatt, Providence, R. I.; W. T. Morrison, New York; L M Klauber, San Diego, Cal.; R. E. Cunningham, Los Angeles, Cal.; W. G. Kelley, Chicago; R A Hammack Denver, Col.; H. H. Kerr, Denver, Col.; John B Fisken, Spokane, Wash; H. R. Wakeman, Portland, Ore.; A. E. Silver, New York; J. E. Woodbridge, San Francisco, Cal.; W. K. Vanderpoel, Newark, N J

Reports of the various sub-committees were submitted, and it was found that there had been a very gratifying response to the questionnaires issued by the sub-committees. From the data in hand it was indicated that much interesting information can be collected regarding new construction and maintenance methods and devices. The greatest interest is being displayed in the question of insular maintenance, so that more information can be collected regarding their operating performance and the necessary remedies can be worked out to eliminate the causes of insulator failures. It was felt at the meeting that a special study should be made of the causes of failures of suspension insulators and that such research should be continued until this part of the outside plant equipment can be depended upon to give continuous and satisfactory results. There were interesting discussions and developments regarding many construction and maintenance details.

MERCHANDISING AND LIGHTING SCHEDULES OF THE N. E. L. A.

Division on Co-ordinate Advertising and Sales Campaigns of the Commercial Section Issues Its Outline for Special Drives

The Commercial Section of the National Electric Light Association, under the direction of its division on co-ordinate advertising and sales campaigns, is about to put into effect the plan which it submitted to the 1919 convention at Atlantic City.

This plan provides for the issue of monthly reminders by the section, calling attention to the merchandising schedule under which it is expected that special drives will be made on certain devices each month in the year. These reminders will be sent to the central stations six or eight weeks in advance of each monthly special sale or drive, and it is proposed to list on these monthly reminders the manufacturing companies which are prepared to supply advertising matter on the appliances or devices appearing on this schedule.

The purpose of having these reminders reach members six or eight weeks in advance is that they shall be enabled to obtain such advertising matter as may be available from manufacturers and to enable them further to supplement such free matter with any other forms of advertising which they may desire. At the same time, special articles will appear in the N. E. L. A. Bulletins, and all manufacturers are asked to co-ordinate their advertising with the schedules as far as possible when making up their advance plans for publicity.

The division on co-ordinate advertising and sales campaigns comprises: E B. Atchley, F. R Davis, Willard Hall R. C. Jones, J. S Kennedy, H. H. Koelbel, J. C. McQuiston, W. R. Roberts, M. Wakeman and Henry Harris, chairman.

The two schedules follow:

Merchandising Schedule.—January, clearance sale; February, heating pads; March, vacuum cleaners; April, sewing machine and sewing-machine motors; May, grills; June, flatirons; July, fans; August, clearance sales; September washing machines; October, radiant heaters; November toasters, December electrical Christmas gifts.

Lighting Schedule.—January better lighting; February, outdoor lighting (tennis courts playgrounds, etc.); March stores and windows; April residence; May electrical advertising (signs outline lighting, display lighting etc.); June, public buildings; July, industrial; August stores and windows, September electrical advertising (signs, outline lighting, display lighting, etc.); October residence; November, better lighting (with emphasis on office buildings); December, industrial

MEETINGS OF N. E. L. A. COMMERCIAL SECTION

Many Committees Get Together This Week to Make Plans for Reports to be Presented at the Pasadena Convention

A number of meetings of committees of the Commercial Section of the National Electric Light Association were held on Monday, Tuesday, Wednesday and Thursday of this week. With the exception of the meeting of the Power Sales Bureau, which was held at the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company, all of the meetings were held at association headquarters in New York.

The meetings were very well attended. Arrangements were made to develop reports for presentation at the Pasadena convention. In a majority of cases, it is announced, manuscripts of these reports will be made available around Feb. 1, so that advance copies may be available to facilitate discussion.

The schedule of meetings follows:

Monday, Jan 5—Commercial service and relations with customers' committee. R F Bonsall, chairman; standardization and testing division (merchandise sales bureau), Oliver R. Hogue, chairman; merchandise sales bureau, E. A. Edkins, chairman; lighting sales bureau, Clarence L. Law, chairman; co-ordinate advertising and sales campaigns division (advertising and publicity service bureau), Henry Harris, chairman; compensation of salesmen committee, Adolph Hertz, chairman; newspaper advertising campaigns division (advertising and publicity service bureau), Mathias Turner, chairman; publications division (advertising and publicity service bureau), Cyril Nast, chairman; adequate service outlet division (advertising and publicity service bureau), P L Thomson, chairman.

Monday, Jan 5.—Commercial service and relations with Oliver R Hogue, chairman; merchandise sales bureau, E A

Tuesday, Jan 6 – Advertising and publicity service bureau L. D. Gibbs, chairman; "Electrical Salesman's Handbook" committee, I. Lundgaard, chairman; power sales bureau, R. H Knowlton, chairman; wiring committee, R. S Hale, chairman.

Wednesday, Jan. 7.—Executive committee commercial section, John G. Learned, chairman.

Thursday, Jan. 8 — Committee on education, Fred R. Jenkins, chairman.

GOVERNOR AND COMMISSION AT ODDS IN NEW JERSEY

Commission Points Out Tendency to Demand that It Grant Whatever the People Demand, Without Regard to Rights of Utilities

A charge of willful neglect of duty made against the Board of Public Utility Commissioners of New Jersey by the City Commission of Montclair has been dismissed by Governor Runyon. The Governor declared that he found no intentional wrongdoing in the approval of the zone fare system of the Public Service Railway Company, but that the commission had lost public confidence and that he would remove some members if he could do so.

The statement of Governor Runyon said in part:

> As to the judgment of the board in establishing the rates which resulted in the bringing of these charges I have nothing to say, as possible errors of judgment do not enter into the controversy.
>
> But it is clear to me that the Board of Public Utility Commissioners has long since lost the confidence of the public, and the public confidence once having departed, the board's usefulness is also gone. In the present case, and with the importance and far-reaching effects of this board's decisions, suspicion and mistrust loom large and become epidemic. This is peculiarly unfortunate in this day of ever-rising prices.
>
> For some members of the board I have great respect. I believe thoroughly in their honesty and know them to be possessed of large ability. But, unfortunately, certain members of the board have proved themselves out of place. I will grant that they are honest and sincere, but their unfitness is so marked that every member of the board, able and incompetent alike, has been made to suffer. And with the present membership of the board maintained without a break, conditions will not improve. I am, therefore, free to say that if the absolute power of removal were mine I should exercise that power at least to the extent of removing from said board those whom I considered unfit, replacing them with men whose honesty would be coupled with notable ability, to the end that the public should know that their interests were in fair and competent hands.
>
> The Legislature has the power to protect the public interest by abolishing the existing commission and creating a new one. While I voted in the Senate for the bill which added two members to the original board of three members, I did so in the belief that the public interest and volume of business demanded such additional members. I no longer believe that to be the case, but am convinced that three members are amply sufficient for the proper transaction of the business of the board.

Commenting on the criticism of Governor Runyon, the board issued a statement in which it said:

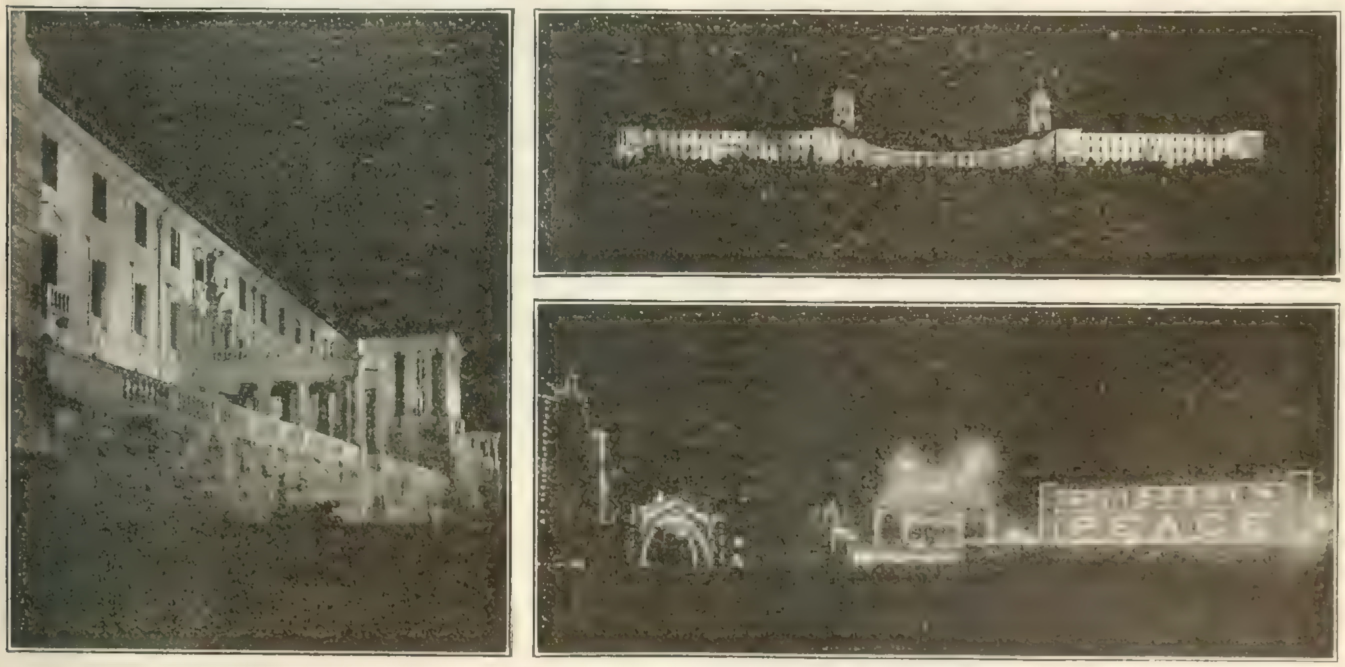
> The board is gratified that the complaint of Montclair was legally and judicially disposed of by the acting Governor. It is to be regretted, however, that he should have so unfairly abused the power of his office by indulgence in an unjust criticism of the personnel of the board, using the proceedings before him as an excuse for so doing. His action rather lends credence to much of the criticism which has been leveled at him during the whole proceeding.

In its annual report, just issued, the board asks the Legislature to investigate its administration, and particularly its authorization of rate increases.

The report charges that there has been a tendency to demand that the commission grant whatever the people demand, without giving the rights of public utility companies any consideration. It continues:

> Such a contention can lead only to disaster. Its primary effect would be widespread ruin of public utility enterprises. After this would come demoralization of service.
>
> Though the allowances of increased fares may result in misunderstanding and false charges of favoritism to corporate enterprises, the public officials upon whom the law imposes the duty of increasing rates when existing rates are insufficient must perform this duty, disagreeable as it may be. It seems to us that in much of the recent discussion of the public utilities question this fact is not appreciated.

Celebrating Peace Electrically in South Africa



During a recent peace celebration in Pretoria, the capital of South Africa, the administration buildings were illuminated by floodlights, as shown in two of the illustrations. Church Square was also specially illuminated for the occasion. The illumination received so much favorable comment that it was suggested that it be retained permanently.

PRIZE CONTEST ON "OUR OBLIGATIONS TO THE PUBLIC"

Empire State Gas & Electric Association to Give Two Cash Prizes for Best Statements on This Topic

A prize contest for statements on the obligations of gas or electric companies and their officers and employees to the public that they serve is announced by the Empire State Gas & Electric Association. A first prize of $15 and a second prize of $10 will be paid.

The contest is open to any employee of a member company. Statements must be of not more than 300 words and must be received in the association office not later than Jan. 20. M. H. Aylesworth, executive assistant to the president of the National Electric Light Association, will be judge.

FOUR TYPES OF LIGHTING MAINTENANCE DISCUSSED

Commercial Maintenance, Central-Station Maintenance, Street-Lighting Maintenance and Boulevard Lighting Maintenance Form Topic

At a recent meeting of the Chicago Section, Illuminating Engineering Society, J. L. Stair, National X-Ray Reflector Company; F. A. Kaup, supervisor of service and repair department, Commonwealth Edison Company; Henry Nixon, deputy commissioner of gas and electricity, city of Chicago, and C. H. Shepherd, electrical engineer, Lincoln Park Commissioners, discussed the maintenance of the various types of lighting equipment under their direction.

Mr. Stair recited the experience of a commercial cleaning company which had been in the window-cleaning business and had gone into the fixture-cleaning business. This company, with the co-operation of the National X-Ray Reflector Company, has been able to build up quite a profitable business, which will perhaps be extended to other cities in the near future. The prices under which it has been operating have been low, owing to the fact that it can employ the same class of labor ordinarily used in cleaning show windows. Its average charge has been 21 cents per unit, but the prices have varied from 13 cents per unit to 38 cents per unit, depending upon the conditions. This price includes one cleaning per fixture per month and also includes incidental breakage which occurs during cleaning.

Mr. Kaup recited the experience of the Commonwealth Edison Company in conducting its lighting unit maintenance service on 50,000 commercial units, 3100 electric signs and a number of arc lamps. This company makes a charge of 35 cents per unit for this service.

Mr. Nixon reviewed the experience of the city of Chicago in maintaining about 50,000 street lamps which it operates. On this work it has been necessary to use high-priced experienced electrical labor and to pay the union scale. This naturally resulted in higher costs. It has been found that a man with a machine can patrol 1100 lamps of the type on high standards and the man without a machine can patrol 550 lamps. Of the lamps on the 10.5-ft. standards 1500 can be patrolled by one man. This is handled by men in machines exclusively. The cost of patrolling, renewing and cleaning the 100-cp. lamps is $2.84 per unit. This is divided into $1.80 for patrolling and renewing and $1.04 for cleaning. The cost for the 600-cp. lamps is $5.70 for patrolling, renewing and cleaning, of which $3.60 is for patrolling and renewing and $2.10 is for cleaning. Fifty lamps per day is considered a day's cleaning work for one man. This is usually handled by placing a man in a district and making him responsible for the district. The gang system of cleaning has been tried out and it appears to be better, although experience with it is limited to date. The city is now getting 2200 hours' average light out of its incandescent lamps and has discontinued its former exact method of checking lamp life. The life of a special lamp which the city is using will run to 3000 hours' average burning.

Some startling costs taken from the beautiful ornamental system in Lincoln Park and on Chicago's north side boulevards were given by Mr. Shepherd. The 20-in. alabaster globes which the Lincoln Park Commission now uses on top of its high concrete standards cost something over $16 each. In the fiscal year of 1919 there were 171 breakages, this amounting to 10 per cent of the cost of maintenance of the system. Mr. Shepherd discussed special troubles which occur on lamps located near the lake, where insects proved an unusual nuisance. He also pointed out that it had been necessary to adopt the use of railway-type incandescent lamps in "islands of safety" because of the vibration caused by motor buses operating on the boulevards. He stated that lamps of different manufacture give different life records, but the average life record as shown by lamps on the Lincoln Park street-lighting system was about 2800 hours. The present cost of operating this system is about 60 per cent of the cost of operating the arc-lamp system which it replaced. Cleaning occurs about once every two weeks.

In the discussion E. D. Tillson of the Commonwealth Edison Company described and demonstrated a self-cleaning fixture which the company is now recommending for foundries, cement mills and other applications where dust prevails. A. L. Ahrenberg of the Central Electric Company demonstrated an industrial type fixture in which the lamp is totally inclosed in a dust-proof glass inclosure. He stated that tests on this unit showed that the lamp operated at a temperature which was lower at the leading-in wires with the lamp totally inclosed than it would be if the inclosure had a hole at the bottom and one at the top for ventilation. When the holes were in the inclosure the "chimney effect" caused an increase in lamp temperature at the leading-in wires.

By-Product Service of the Electric Fan

SLICING CUCUMBERS

We don't guarantee success, and would like to know what luck others have before we try it on ours.—*The Exciter, House Organ of the Central Maine Power Company.*

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., Philadelphia Section.—"Electrical Construction Problems" will be discussed by this section of the American Institute of Electrical Engineers at its Jan. 12 meeting.

A. I. E. E., Boston Section.—"Storage Batteries—Their Many Applications and Methods of Operation" was the subject of a talk given by J. Lester Woodbridge, chief engineer Electric Storage Battery Company, Philadelphia, at the Nov. 12 meeting held by this section of the Institute.

Massachusetts Association of Electrical Contractors and Dealers.—Frank S. Price, president Pettingell-Andrews Company, Boston, will address the Boston district of the association at the Boston City Club Jan. 15 at 1 p.m. upon the relation between the jobber and the contractor. A question period will follow the usual luncheon and address.

Massachusetts State Association of Electrical Contractors and Dealers, Boston, District.—The Nov. 20 meeting of the Boston District of the association was addressed by Francis A. Williams, clerk of the State Board of Examiners of Electricians, who read a paper on the workings of the license law passed in Massachusetts in 1915.

Peoria Electrical Men Form Club.—The Peoria (Ill.) Electric Club has been organized by Peoria men interested in the electrical merchandising, contracting and lighting business. R. S. Wallace, manager of the Central Illinois Light Company, addressed the club at its first meeting, and it is planned to have other meetings during the year.

The Southeastern Section, N. E. L. A.—A meeting of the executive committee, Southeastern Section, was recently held in Atlanta at which appointments were made of chairmen of the various standing committees for the coming year. President Tillery announced that the second meeting of the executive committee would be called either in the middle of January or the early part of February, to take up matters of importance to the section.

New Officers and Directors of the Engineers' Club of San Francisco.—Ely C. Hutchinson, manager of the engineering and sales department, Pelton Water Wheel Company, San Francisco, is the new president of the club; J. E. Woodbridge is first vice-president, Edwin Duryea, Jr., second vice-president, Charles C. Hardy treasurer, and Allen G. Jones secretary. The newly elected directors are Bruce Lloyd, Charles E. Townsend, A. E. Chandler, B. P. Legare, Abbot A. Hanks, E. O. Shreve, A. H. Halloran and W. G. Vincent, Jr.

A. I. E. E., Denver Section.—A. L. Powell, illuminating engineer Edison Lamp Works of the General Electric Company, Harrison, N. J., addressed this section of the American Institute of Electrical Engineers on "Late Developments in Industrial, Store and Residence Lighting" at its Nov. 22 meeting.

Boston Edison Section, N. E. L. A.—At the annual meeting of the section on Nov. 17 the following officers were elected: President, J. C. Norcross; first vice-president, J. C. Redmond; second vice-president, J. J. Buckley; secretary, W. S. Holway; treasurer, W. L. Frisbie; executive committee, G. H. White, W. E. Gould, T. E. Penard, S. C. Clough.

Jewett Addresses Engineers of Spokane.—Under the auspices of the local section of the American Institute of Electrical Engineers, Dr. Frank B. Jewett, chief engineer Western Electric Company, spoke to the Associated Engineers of Spokane, Wash., on Nov. 14, his topic being "Some War-Time Developments in Electrical Communication and Allied Fields."

A. I. E. E., Panama Section.—On Nov. 3 this section of the American Institute of Electrical Engineers inspected the United States naval submarine base at Coco Solo, Canal Zone. Lieut. A. L. Vaughn, engineer officer, and W. L. Hersh, electrical engineer of the Panama Canal, who designed the submarine storage-battery-charging station, delivered talks during the day.

Joint Meeting, A. I. E. E., St. Louis Section, and Associated Engineering Societies of St. Louis.—Otto B. Blackwell, transmission and protection engineer, American Telephone & Telegraph Company, addressed the Nov. 19 joint meeting of the St. Louis Section, American Institute of Electrical Engineers, and the Associated Engineering Societies of St. Louis on the subject of "The Telephone Transmission Circuit."

American Physical Society.—A symposium of papers on the electron tube was given at the meeting of the society held in Chicago on Nov. 28 and 29. The papers included "Phenomena in Pure Tungsten Filament Electron Tubes," by Irving Langmuir, General Electric Company; "Phenomena in Oxide-Coated Filament Electron Tubes," by H. B. Arnold, Western Electric Company; "The Relations of the Constants of an Electron Tube to Its Physical Dimensions," by L. A. Hazeltine, Stevens Institute of Technology; "Theory of Action of Electron Tubes as Amplifiers," by John M. Miller, Bureau of Standards; "Theory of Action of Electron Tubes as Generators," by John H. Morecroft, Columbia University; "High-Power Transmission Sets," by W. C. White, General Electric Company; "Telephone Sets," by O. B. Blackwell, American Telephone & Telegraph Company, and a paper by E. H. Armstrong, major, U. S. A.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Power Surcharge.—In a case affecting the Empire District Electric Company the Missouri Public Service Commission substituted a surcharge for thirteen months of 5 mills per kilowatt-hour for a proposed surcharge of 6 mills on rates to power consumers in order that some emergency relief from increased operating expenses may be afforded an electric utility not seeking a return based on the full value of its property.

Depreciation Charge.—In granting the petition of the Big Springs Electric Company for authority to discontinue a flat charge the Utah Public Utilities Commission found that the earnings of the company had been sufficient to pay as much as 10 per cent on the investment. It appeared that the company was not setting aside any amount for depreciation. The commission held that at least 3 per cent should be set aside from earnings as a depreciation fund. The meter system was authorized.

Vaule of Plant.—In a rate case involving the Mercersburg, Lehmasters & Markes Electric Company the Pennsylvania Public Service Commission says: "It is proper to recognize that where a judicious investment has been made in the utilization of an existing property to greater or less extent, a value may be created greater than the actual investment made, which should be recognized by the commission in its conclusion. The exercise of good judgment and forethought, as well as the taking advantage of a situation, may, and often does, result in the creation of values which, in connection with the investment itself, should be considered in arriving at a fair value."

Minimum Charge.—The Public Service Commission of Pennsylvania refused to permit the Panther Valley Electric Company to increase its minimum charge when it could not show that the increase was actually necessary in order to be in a position to serve its customers or to pay its operating expenses and yield a fair return on its investment. The commission held that a minimum charge should always be considered in connection with the other elements of the rate schedule. Where the existing schedule afforded sufficient revenue it should not be altered by the addition of a minimum charge unless the rate schedule be lowered in such an amount that the revenue derived from this service would be decreased in about the same amount that the revenue derived from the minimum charge would be increased.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Rates Increased on the Minidoka Project.—An increase in rates has been announced by the government in electric service for Rupert, Idaho. Light and power rates are to be increased approximately 20 per cent and heating rates from $1.25 to $2 per kilowatt. The government has also ordered the segregation of the heating system from the lighting and power circuits.

Electric Vehicles of Baking Companies. — A list of twenty-five baking companies which use electric vehicles has been compiled by A. Jackson Marshall, secretary Electric Vehicle Section, National Electric Light Association. It is headed by the Ward Baking Company, with a total of 400 vehicles at its branches in eight cities. The twenty-five concerns have approximately 1200 electric delivery wagons in service at the present time.

City Saves $15,000 Through Central-Station Service. — Two years ago the City Council of Grand Forks, N. D., signed a contract with the Red River Power Company (Northern States Power Company) for electric energy for operation of its water-pumping supply system and street-lighting system. At a recent meeting of the City Council a report showed that in the twenty-three months of the contract the city had saved $14,846 compared with the cost of operating its own plant.

Standardization of Army Electrical Equipment.—Every article used by the military establishment from a scratch pad to a tractor is in process of standardization. As some 300,000 different articles are used by the army, the magnitude of the task is obvious. Considerable progress has been made in the standardization of electrical equipment. This part of the work is perhaps further advanced than any other owing to the exigencies of the war period. Early in the war the lack of standardization in electrical equipment made it necessary for the engineers with the American Expeditionary Forces to cable lengthy specifications for articles needed. These orders were often rendered unintelligible in transmission, and, worse still, greatly taxed the capacity of the transatlantic cables to carry such a volume of matter. A single uniform catalog was hastily produced from which orders were made in the future by mere reference to numbers. Now all the electrical equipment needed by the nine supply branches of the army has been catloged.

Electric Steel Production.—According to statistics compiled by the Electric Furnace Association, in total tonnage production of ordinary steel castings the electric furnace has already passed the crucible and in 1918 it was approaching the converter casting output. In making this comparison it should be borne in mind that the same class of castings is not made in these two processes. In 1918 production of electric steel castings was nearly five times that of 1915.

H. M. Byllesby & Company Acquire Investment Banking Business.—The investment banking business of R. S. Moore & Company has been acquired by H. M. Byllesby & Company. R. S. Moore has been elected a vice-president of H. M. Byllesby & Company and will have under his charge the management of the investment banking business in the New England States, with offices at 30 State Street, Boston, and 10 Weybosset Street, Providence.

New Hydroelectric Installation for Madagascar. — According to Consul James G. Carter, Tananarive, Madagascar, the installation of an electric light system for Tamatave, the principal port of Madagascar, is under consideration by the authorities there, and the project has the approval of the Governor-General. Waterfalls capable of developing 3000 hp. are available 10 to 15 miles west of the city, and part of the utilization of this power will probably be taken up with the electrification of the railway at that point and with electrometallurgical and electrochemical industries.

Great Growth of Two Ohio Companies.—Rapid growth has taken place in the business of the Trumbull Public Service Company, of Warren, Ohio, and the Massillon (Ohio) Electric & Gas Company, two subsidiaries of the Cities Service Company. The Trumbull company had a switchboard output of 5,693,426 kw.-hr. of energy in 1912, while the maximum demand in the twelve months ending Dec. 31, 1912, was but 1550 kw. For the first nine months of 1919 the Trumbull company had a switchboard output of 51,957,357 kw.-hr. of energy, with a maximum demand in these nine months of 21,000 kw. It is estimated by the management that the total switchboard output in 1919 will exceed 72,000,000 kw.-hr., with a maximum demand of 22,500 kw. At Massillon the property which is now the Massillon Electric & Gas Company had an output for the twelve months of 1912 of 1,898,374 kw.-hr. at the switchboard, with the maximum demand in the twelve months of but 764 kw. For the first nine months of 1919 the Massillon Electric & Gas Company had actual deliveries at the switchboard of 24,333,967 kw.-hr., with a maximum demand in the nine months of 9400 kw. The management estimates that the switchboard delivery of electric energy for 1919 will be in excess of 39,000,000 kw.-hr. and maximum demand 9700 kw.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Proximate Contributing Cause of Death.—Parents may recover from a power company for death of their son through electric shock, even though the company's negligence was not the sole cause of the death, provided it contributed proximately thereto. (Kribs vs. Jefferson City Light, Heat & Power Company, 215 S. W. 762.)

Assumption of Risk by Repairman.—In an action for injuries to a street railroad's repairman, who, on assurance of his foreman that it was safe, mounted a ladder resting against a trolley wire and cut a guide wire, the question whether the employee assumed the risk of a fall the Court of Appeals of Kentucky held to be for the jury. (215 S. W. 944.)

Disobedience Does Not Relieve Employer of Liability. — Where a lineman was doing his work on top of a tower carrying an electric transmission line, his contributory negligence in failing to observe a direction not to go near certain live wires did not relieve his employer from liability to make compensation for his death. (Mississippi River Power Company vs. Industrial Commission, 124 N. E. 552.)

Subrogation of Rights Against Negligent Third Person.—In an action by a workmen's compensation insurer to recover indemnity paid by it, under a policy issued to a telephone company, on account of the death of the latter's employee, brought against the power company whose negligence caused the death, the insurer's rights to recover were the same as the rights of the deceased. (Fidelity & Casualty Company vs. Cedar Valley Electric Company, 174 N. W. 709.)

Maintaining High-Tension Wire Over Telegraph Wire.—An electric company which, after the erection of a telegraph company's line, erects and maintains over and across the line of telegraph wires, or in close proximity thereto, a high-tension wire which carries a dangerous current of electricity is bound to exercise ordinary diligence in the erection and maintenance of its poles and wires so as to permit an employee of the telegraph company who ascends a pole of his company in the discharge of his regular duties to perform his work in reasonable safety; and an employee of the telegraph company, while in the exercise of ordinary care for his own protection, has the right to assume that such high-tension wires are properly placed and insulated. (Columbus Power Company versus Puckett, 100 S. E. 800.)

Men of the Industry

Changes in Personnel
and Position—
Biographical Notes

H. S. Brooks, who for a number of years has held the position of general construction superintendent for the American Telephone & Telegraph Company, has been appointed assistant vice-president of that company.

L. L. Ferree, superintendent of the Harrisburg (Pa.) Light & Power Company, has been made manager of the Salem (Ohio) Lighting Company. Mr. Ferree has been connected with the electrical companies of Harrisburg for sixteen years, originally being associated with the Paxtang company and going over to the Harrisburg Light & Power when that company was absorbed.

Col. W. E. Greenlaw of Eastport, Me., has been nominated to be a member of the Public Utilities Commission of Maine for a seven-year term to fill the vacancy caused by the resignation of Hon. W. B. Skelton of Lewiston. Col. Greenlaw has been mayor and postmaster of Eastport, is a former adjutant-general of Maine, and during the world war served as quartermaster of the Twenty-Sixth Division. He is at present commander of the American Legion in Maine.

Frank A. Coffin, formerly assistant sales manager of the Milwaukee (Wis.) Electric Railway & Light Company, was appointed sales manager of the company as of Dec. 1, 1919. Mr. Coffin is an engineer, and his entire experience has been in the central-station field. From 1902 to 1905 he worked in the operating department of the Commonwealth Edison Company, after which he went to the University of Illinois, graduating in 1909 with the degree of B.S. in electrical engineering. He went back to the Commonwealth Edison Company for about three years, one of which was spent on construction work at the Fisk Street and Quarry Street stations, and two years were spent in the engineering department on station and substation design. In January, 1912, Mr. Coffin joined the engineering department of the Milwaukee company, where he was employed for about a year on power-plant design. He was then transferred to the sales department in an engineering capacity, and on Jan. 1, 1917, was made assistant sales manager.

F. A. COFFIN

Charles F. Wallace, who recently returned to Stone & Webster after a term of service in the shipbuilding industry during the war, has left Boston on a business trip to Japan, where he will investigate various hydroelectric matters on behalf of the firm.

Charles P. Bruch, until recently vice-president and director of the Postal Telegraph Company, has just been placed in charge of the interests in a large part of South America of the Marconi Wireless Telegraph Company of America and is sailing immediately for Buenos Ayres. Himself the son of a distinguished telegraph manager, Mr. Bruch has been all his life in telegraphic operation and administration, and served in the great War as a major in the signal section of the Officers' Reserve Corps, U. S. Army, also as a member of the committee on telegraphs and telephones of the Council of National Defense. Mr. Bruch is also past-president of the Magnetic Club of New York and the Ohio Society of New York, and is now the president of the Society of the United States Military Telegraph Corps. He has also been active and prominent in the affairs of various telegraphic organizations, notably the old-time Telegraphers' and Historical Society, New York Telegraphers' Aid Society, the Society of the U. S. Military Telegraph Corps, the Telegraph and Telephone Life Insurance Association, etc.

General E. J. Spencer, manager of the recently organized St. Louis Electrical Board of Trade, is a West Point graduate (1882), who, after leaving the army in 1892, returned to the service twice during national emergencies. In 1898 he was commissioned lieutenent colonel of the Third United States Volunteer Engineers for service in the Spanish-American war, and in 1917 he was commissioned colonel of engineers in the national army. He organized three regiments of engineers, the last of which, known as the Thirty-second Engineers (railway and bridge), he took over to France. Over there he was appointed first chief of staff of Base No. 2. In addition to his army service General Spencer did some important research work for what was then the Thomson-Houston Electric Company, after which he undertook considerable high-tension underground work for light and power companies in the Central West. From 1904 to the time he entered the national army General Spencer had been practicing as a consulting engineer in St. Louis. He was colonel of the first regiment of infantry, National Guard of Missouri, and wears the uniform of that rank in the photograph, though he was promoted to brigadier general in 1913.

BRIG.-GEN. E. J. SPENCER

Obituary

Frederick A. Brainerd, secretary and vice-president of the Ingersoll-Rand Company, died on Jan. 18 in his home in Mount Vernon, N. Y., aged fifty-eight.

Henry Wilson Hodge, noted engineer, ex-New York Public Service Commissioner and lieutenant-colonel on the staff of General Pershing in France, where he was in charge of building military highways and railroads during the war, died suddenly from heart disease on Dec. 22 in his home in New York City in the fifty-fifth year of his age.

Albert Schmid, for many years associated with the Westinghouse interests as electrician and mechanical engineer, died at New York, Dec. 31. Mr. Schmid was born in Switzerland in 1858 and came to the United States in 1882 at the instance of the late George Westinghouse and was associated with the Westinghouse interests until his death. When the Westinghouse Electric Company was organized in 1885, Mr. Schmid was made its chief engineer and later, through several promotions, became general superintendent. He was recognized among all engineers as having a peculiar facility for combining beauty of design, simplicity and mechanical efficiency. The general lines of contour of the early designs of electric motors and generators produced by Mr. Schmid prevail to a large extent in the apparatus being built to-day. When the European Westinghouse electric companies were organized Mr. Westinghouse designated Mr. Schmid for important work in connection therewith, and thereafter he continued to occupy important executive positions in a number of the European Westinghouse companies.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—
Notes on Industrial Activities and Business Methods

METER DEMAND UNFILLED EVEN WITH INCREASED PRODUCTION

Makers Can Begin Shipments of Watt-Hour Meters in Three Weeks on Orders Which Would Normally Come from Stock

Meter production is far behind the demand in spite of recent increases in productive capacity. One prominent manufacturer of watt-hour meters increased his capacity approximately 100 per cent in the early fall and hoped to be able to accumulate stocks by the end of October. He still can't begin shipment on a fair-sized order inside of three weeks. Other manufacturers, too, have increased their capacities in varying amounts, up to 100 per cent, and the demand is still unsatisfied.

It is becoming more usual now for central stations to order meters before shipments on a previous order have been completed. This overlapping of orders is a new turn in the market and shows the difficulty of accurately judging future needs and carrying anything like a fair utility stock. Heavier ordering is reported from all sections of the country because of the big volume of new houses and of newly wired old houses. One central station in the East has set approximately 6,000 meters in the last six weeks.

The smaller stations are getting nearly as big relative increases. Former orders of 100 meters at a time are being doubled. Central stations have been able to use fewer of their summer home meters for other installations this fall because more summer homes are being occupied all the year round. In the Manhattan district of New York City office building owners are requiring tenants to meter their lighting current as lighting agreements run out.

The increasing demand for 10-amp. meters is noticeable, both for new installations and for replacing 5-amp. sizes. The answer to this is found in the more general use of energy-consuming household devices and better lighting.

SHOULD PORCELAIN PACKING CHARGES BE PASSED ON?

Southern Jobbers Show Great Diversity of Opinion Concerning the Advisability of Taking a Step of This Description

Southern jobbers are discussing the advisability of passing packing charges on porcelain on to the consumer as a separate item of cost. There seems to be a considerable diversity of opinion as to the wisdom of taking such a step. Some of the jobbers who are very much opposed to such action point out that this item of cost is already added into the charges and that the consumer eventually pays the charge without being made aware of the fact. Furthermore, to add packing charges to a bill for material, especially if the consumer thinks the packing charges so added are excessive, might have a tendency to create friction between the consumer and the jobber. Incidentally such a step would offer an opportunity to unscrupulous jobbers to hold out, directly or indirectly, a cut in price by offering to absorb packing charges, especially in the face of keen competition.

On the other hand, the advocates of separate packing charges claim that the item of packing is a variable cost and therefore should be charged as a separate item in order to prevent confusion in figuring the charge on the commodity itself. They claim that it is not fair to spread the packing charge over the entire allotment of porcelain they receive, thus penalizing the large user for more than his proportionate share of the packing charges of the shipment.

It is virtually impossible to make a statement regarding the cost of such packing charges, as it varies widely, dependent upon the class of material packed, the availability of boxes, excelsior and labor, etc., and the methods and distance of transportation. It can only be arrived at by averaging the cost over a long period of time for entire shipments. A report from the South states that most jobbers have no accurate idea of what these packing charges are and consequently are adding arbitrary amounts to take care of this item.

TREND OF PRICES AFFECTED BY POLICY OF RESERVE BANK

First Increase in Discount Rate Took Money from Stock Market—Further Increases May Seriously Affect Business

A forecast of business conditions and the trend of prices during the next twelve months will depend largely upon the banking policy to be pursued by the Federal Reserve Board. Many bankers and business men believe that the extensive speculation which has been carried on this year in both stocks and commodities, and the resulting currency inflation and high prices, is largely due to the low discount rate which was maintained for as many months by the board of the Federal Reserve Bank. The board has now begun to act. It might be well for business men in the electrical industry to watch the policy and actions of the board closely and to pay some attention to the published reports from the national banks of Europe.

The board gave a warning against speculation last summer, and the prices of stocks dropped appreciably. This was only temporarily, however, and in a short time speculation was greater than ever not only in stocks but in many commodities. No action was taken until the second week in November, when the discount rate at the Federal Reserve Bank in New York was raised one-quarter of one per cent. This did not mean much in itself, but it was one step further than the warning which had been given in the summer, and the fear of what might be done caused a crash on the stock exchange.

The troubles of the stock exchange did not affect the electrical business, but if the second warning of the banks is not heeded, and more drastic action has to be taken to curb speculation not only on the stock exchange but in commodities, then business in general may be expected to feel the results. Many bankers believe that the Federal Reserve Board at Washington intends not only to restrict speculation, but also to bring about general deflation in currency and lower prices by raising the discount rates of the twelve federal reserve banks to whatever extent may be necessary. This is really raising the price of money, which means that electrical as well as other producers and consumers will not be able to borrow so much. This will result in a reduced volume of buying and lower prices would be expected to follow.

Particularly will higher money be felt in new building and in development work. In both of these the electrical manufacturer and jobber is vitally interested. Any drawback to construction work will be felt at once in the electrical industry. Besides there is every reason to believe that the country is on the verge of an internal development of water-power resources. The extent to which electrical materials will be needed is apparent. More expensive money, however, will by no means be conducive to the most extensive development.

BRASS MARKET NOW IN A FLOURISHING CONDITION

Electrical Manufactures Absorbing Large Output—Prices Lower than Last Summer—Labor More Stable and Deliveries Fair

The influence of the cost of copper upon the price of brass is well illustrated by the course of the latter since midsummer, when advances in the cost of labor in the Naugatuck Valley of Connecticut failed to produce any considerable change in quotations to electrical manufacturers compared with the increases which accompanied the upward movement in copper. In a review of the conditions prevailing in the brass market published in the ELECTRICAL WORLD Aug. 30, 1919, page 493, it was pointed out that labor cost was a much less important factor in the price of brass than material cost. The following comparison of base prices of brass ard brass products bears out this contention:

	Aug., 1919	Dec., 1919
Sheet metal:		
High brass	27¼	24¼
Low brass	30½	26¼
Wire:		
High brass	27¼	24¼
Low brass	30½	26¼
Commercial bronze	33½	28
Rods:		
High brass	26¾	22¾
Low brass	31¼	27
Commercial bronze	33½	29
Brazed tubes:		
Brass	39	36
Copper and commercial bronze	44½	40¾
Copper:		
Sheets	33½	28½
In rolls	31¼	26¼
Drawn-copper shapes	30¾	25¾
Copper wire, bare, f. o. b. mill	26¾	22

These prices include delivery from the mills up to fifty cents per 100 lb. freight rates. They show that the reduction in the price of copper which has taken place since summer has been directly reflected in lower quotations by the brass manufacturers, while the wage scales established in the Naugatuck Valley remain generally the same. Throughout the electrical industry there is a widespread opinion that copper is not likely to go lower in price for some time, and if advances occur at a rate which indicates a rising market, there will doubtless be a flood of new orders which will overtax the facilities of the brass mills and seriously extend deliveries.

At the present, however, the needs of electrical manufacturers appear to be well cared for; *i.e.*, in the case of those who have pursued a far-sighted policy with regard to orders. The brass mills carry few stocks of material suited to electrical manufacturing requirements. Regular trade is cared for first, and it seems fair to say that recent severe shortages in sockets, for example, were not due to any large extent to brass shortage. The failure of jobbers last spring to realize that a large increase in business was almost upon them had much to do with the scarcities noted from time to time in these columns and still not wholly overcome, to put it mildly.

The brass mills are running about ten hours per day now and in some cases at night. Raw copper is plentiful, and the base price in the ingot of about 19¼ cents at this writing may be contrasted with 24 cents last summer. Labor is not up to normal efficiency as yet. One of the larger mills is working about 50 per cent of its departments at night and has a total of 66,000,000 lb. of brass in process in its establishments. There is a very heavy demand for sheet copper for washing machines, and in some cases deliveries cannot be promised to new customers until next summer or early fall. Commutator copper for small motors is also in great demand, but this business does not appear to be affecting the supply of brass to manufacturers of sockets and switches. Europe has not as yet begun to purchase copper on a large scale from this country and cannot afford to do so at the current low rates of exchange.

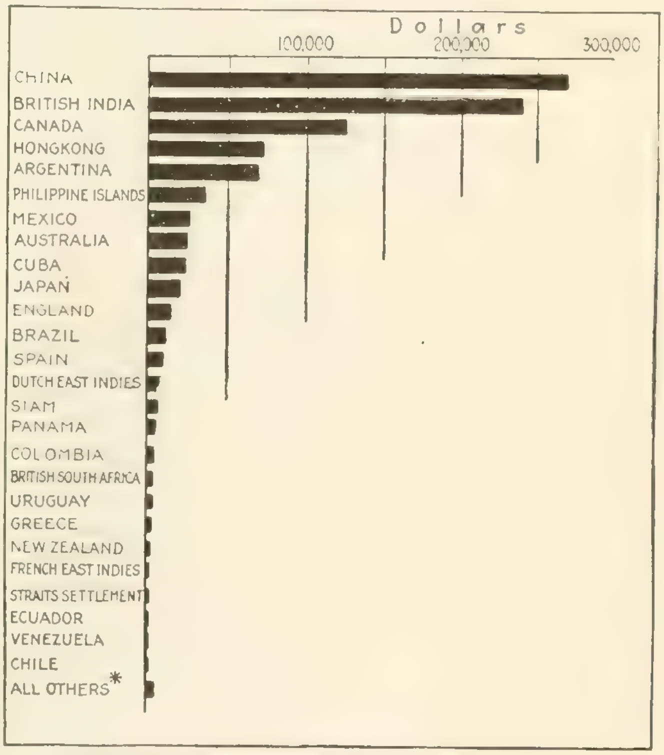
Among the different brass mills deliveries vary considerably, but in general seamless tubing is quoted around thirty-five days; sheet metal, forty-five days; brass wire, thirty to fifty days; copper wire, thirty to forty days; screw shells and socket shells, sixty days. Price guarantees are being given for the first quarter of 1920. In sum, there appears no reason for disquiet as to the supply of brass unless a heavy increase in demand should suddenly arise. Considering scarcities in many other fields, the brass market is more favorably situated than is supposed to be the case, but there seems little prospect of lower prices or quicker deliveries for months to come.

ELECTRIC FAN EXPORTS IN FIRST HALF OF YEAR

China Principal Market, Followed Closely by British India—Average Value $19, with Range Between $6 and $42

During the first six months of the current year exports of American-made electric fans amounted to $995,838. More than 50,000 fans were exported in that period, having an average value of $19.

British India, which usually is the best customer of American fan manufacturers, gave way during the first half of 1919 to China. Cuba, which is ordinarily among the first five, dropped to ninth place.



ELECTRIC FAN EXPORTS DURING FIRST SIX MONTHS OF 1919

South America, which prior to the war purchased large numbers of fans, is still absorbing a much smaller volume of imports, Argentina leading as usual.

A considerable range of values is noticed, from as low as $6 per fan for Italy to as high as $42 per fan for Siam. The two principal markets, China and British India, both averaged $24 per fan. Canada's average was low with $12. The same figure held for Argentina. The accompanying table gives a detailed summary of electric fan exports during the first half of the year. A graphical presentation is also given:

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*All others include Belgium, France, Iceland, Italy, Bermuda, British Honduras, Honduras, Salvador, Newfoundland, Labrador, Barbados, Jamaica, Trinidad and Tobago, other British West Indies, Danish West Indies, French West Indies, Haiti, Peru French Asia, British West Africa, French Africa and Italian Africa

	Jan.	Feb.	Mar.	Apr.	May	June	Total
Greece	2,590	..	250	......	......	747	3,587
Spain	4,503	...	......	......	2,395	3,495	10,393
England	14,765	. .	......	......	.	.	14,765
Canada	4,212	4,332	37,000	11,824	14,532	54,324	126.224
Panama	2,101	716	176	144	1,788		4,925
Mexico	1,665	2,407	1,661	2,701	10.500	6,001	24.935
Cuba	94	13,231	1,342	150	4,663	3,236	22.716
Dominican Republic	8,464	12,326	26,894	7,377	750	13,914	69,725
Brazil	754	4,200	3,510	714	1,240		10,41
Chile	......	429	.		470	565	1,464
Colombia	1,639	243	903	247	965	56	4,053
Ecuador	307	1,051	.	371	..	....	1,729
Uruguay	.....	....	944	2,750	..	.	3,694
Venezuela	1,400	205	18	.	.....	....	1.623
China	14,007	10,041	107,115	16,824	109,768	12,818	270.578
British India	73,385	35,286	43,470	43,674	23,024	20,243	239.582
Straits Settlement	200	450	131	50	525	846	2,202
Dutch East Indies	..	236	8,892	118	64	415	9,725
French East Indies	286	1,367	...	.....	342	548	2,543
Hong Kong	31,093	10,472	25,598	......	4,175	2,328	73.666
Japan	2,221	121	2,813	80	12,326	2,790	20,351
Siam	4,446	1,280	..	....	......	......	5,726
Australia	3,892	5,300	4,826	7,928	1,153	700	23,799
New Zealand	1,132	1,339	...	135	......	......	2,606
Philippine Islands	17,493	507	3,840	92	11,759	931	34,622
British South Africa	512	435	....	......	1,659	1,101	3,707
All others	130	400	142	422	1,357	3,471	5,922
Total	176,526	121,003	269,934	96,433	201,125	130,817	995,838

METAL MARKET SITUATION

Copper, Lead, Spelter, Zinc, Sheet, Antimony, Nickel and Tin Show Price Advances

Virtually all metals show an increase in price during the past week. The London copper market is £4 higher, but domestic producers are not permitting their prices to follow to such an extent. The domestic electrolytic market is ¼ cent higher than a week ago, quotations standing at 19 to 19.25 cents, although 19.50 cents has been found.

Copper-wire base has advanced from 21.50 to 22.25 cents a pound and copper-wire rods from 20.25 to 21.25 cents. Scrap copper is ¾ cent higher, as are the brass scraps.

Lead continues higher to 8 cents, although the outside market has received as high as 8.75 cents New York for January shipment, with more bids at a like figure. The supply shows little improvement. Sheet is 1.50 cents higher.

Spelter is ½ cent higher, sheet zinc is up a like amount, while the old scraps are up ½ cent.

An advance of 1 cent per pound has been placed on ingot nickel by the International Nickel Company. Straits tin is 4 cents higher to 59.50 cents a pound, and antimony is ¼ cent higher to 9.87½ cents, while aluminum is ½ cent lower.

NEW YORK METAL MARKET PRICES

	Dec 30	Jan. 6
Copper:	£ s d	£ s d
London, standard spot	116 15 0	120 0 0
	Cents per Pound	Cents per Pound
Prime Lake	19.00 to 19.50	19 00 to 20 00
Electrolytic	18 75 to 19 00	19 00 to 19 25
Casting	18 50	19 00 to 19.25
Wire base	21.50 to 22.00	2 25
Lead, trust price	7 50	8 00
Antimony	9 62½	9 87½
Nickel, ingot	41.00 to 42 00	42 00 to 43 00
Sheet zinc, f.o.b. smelter	11 50	12 00
Spelter, spot	9.00 to 9.10	9.50 to 9.60
Tin,	59.50	63.25
Aluminum, 98 to 99 per cent	32.00 to 33 00	31 50 to 32 50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	17 00 to 17 50	17 75 to 18 25
Brass, heavy	9 75 to 10 25	10 50 to 11 00
Brass, light	7 75 to 8 00	8 50 to 8 75
Lead, heavy	6 00 to 6 25	6 75 to 7 00
Zinc, old scrap	4 75 to 5.00	5 00 to 5.25

THE WEEK

IN TRADE

From virtually all over the country, but particularly the East, reports show an absence of the usual midwinter lull in electrical supply buying. Inventory has interfered little with business. Stocks are badly broken in such lines as some schedule materials, loom, flexible armored conductor and conduit, boxes, low-voltage porcelain, lamp and heater cords and tableware. Pipe stocks are spotty and wire is generally available.

Price advances over the last week of December and the first week of January have been applied to flexible armored conductor and conduit, friction tape, heating appliances, lamp cords and magnet wire, single-phase motors, knife switches, porcelain tubes, some time switches and unit lighting fixtures. Further motor and pipe advances are predicted.

The outlook for 1920 is particularly good in view of building held over from 1919 and anticipated in 1920 and the amount of central-station extension predicted in some sections. Ordering far in advance shows the faith in the new year.

In the Far West business is rather dull and the rainfall light, the latter being a determining factor in next season's crops.

Building plans projected in the past week show interest in several large lofts and office buildings and a large apartment house on Manhattan Island. In addition over $7,000,000 has been appropriated for schools in New York City and over $14,000,000 for fourteen new municipal piers on Staten Island.

NEW YORK

From reports of several jobbers in the district, the usual midwinter slump in buying of electrical supplies is not going to be experienced this season. Manufacturers of many lines are not able to supply sufficient material to meet more than daily needs of the trade, and these needs are not dropping off.

A few jobbers who have completed their inventory report bigger stocks than they had a year ago, because they now have lines which did not exist at that time on account of war curtailment. Stocks are more diversified now, although badly broken in some schedule materials, flexible armored conductor, flexible non-metallic conduit, low-voltage porcelain, certain outlet boxes, lamp and heater cords and heating ware. Pipe is not in good shape in smaller sizes, but rubber-covered wire is sufficient for the time being, with mill shipments about thirty days. Air-heater stocks are good here and bad there, according to the manufacturer concerned.

During the last week of the year, and in some cases the last day, several price changes became effective. Flexible armored conductor and conduit advanced in price, ordinary friction tape went up, at least one manufacturer of heating appliances published an advance, and lamp cords and magnet wire increased. Some single-phase motor manufacturers advanced 10 per cent as late as Jan. 5. Rubber-covered wire base is averaging lower.

FLEXIBLE ARMORED CONDUCTOR.—The last of December prices advanced on sizes other than No. 14 about 10 per cent, while No. 14, two-wire, has been reported up about 7 per cent. Supply of steel strip is short, and little relief is expected in the near future. Jobbers cannot stock. They are quoting $86 to $90 on 1000-ft. lots, but a price as high as $110 has been heard.

FLEXIBLE METALLIC CONDUIT.—On 1-in. sizes and larger a change in discount and an advance in list of $1 per 100 ft. caused an advance in price of about 15 per cent the last of December. For smaller sizes a change in discount raised the price 10 to 12 per cent.

RIGID CONDUIT.—Stocks are low, and jobbers are selling ½-in. black in 5,000-ft. lots for $70 to $78.

TAPE.—An advance of 5 cents a pound on ¾-in. ordinary black friction tape was effective the last of December, bringing jobbers' prices around 40 and 45 cents.

HEATING WARE.—Effective Jan. 1, prices on table heating ware were advanced on the "Universal" line on an average about 20 per cent. Orders booked for the first half of 1920 are extremely heavy on all lines.

AIR HEATERS.—Sales have been heavy, and jobbers' stocks are extremely spotty, depending upon the manufacturer concerned.

LAMP CORDS.—The market is short and shipments are quoted around twelve to sixteen weeks. The last of December prices advanced about 10 per cent at the mills. Producers quote on silk cords when the silk is available for insulation.

MAGNET WIRE.—A 5 per cent advance was effective the last of December. Large sizes are more available than sizes around 20 and higher. Shipments are around ten weeks on these small sizes.

RUBBER-COVERED WIRE.—In 1000-ft. lots No. 14 sells for $12.50 to $13.25, while in 5,000-ft. lots the price ranges from $11.25 to $11.75. Stocks are fair. Latest reports show lower bases as follows: Four producers on 30 cents, two on 28 cents, one on 27 cents, two on 26 cents and one on 23 cents, averaging just under 28 cents.

MOTORS.—On Jan. 5 Century single-phase and polyphase motors advanced 10 per cent, while Wagner single-phase and Crocker-Wheeler fractional single-phase advanced a like amount in the last part of December.

CHICAGO

Electrical jobbers and dealers are very enthusiastic about their outlook for 1920 business. Jobbers are in general extending their forces, putting on new salesmen, and several new jobbing houses and many new retail dealers started business on the first of the year. The volume of service now demanded from electric companies has increased to such an extent that it is very difficult for the present generating stations and transmission lines to take care of it. This means a large amount of construction during 1920, some of which is already started. Chicago building permits for the week amounted to only $1,540,000. The Home and Housing Association, St. Louis, Mo., expects to have a fund of $2,000,000 available this spring for constructing homes. The aim is to have 1,000 new homes built by the end of 1920. There is a marked scarcity in Chicago of loom, armored conductor and porcelain fittings. Manufacturers of these materials are adopting more generally the price at delivery method of selling.

WIRE.—Prices have remained firm at about a 30-cent base for rubber-covered. The low cost of copper has been offset by the higher cost of labor and especially of cotton. This has caused manufacturers to change their base sizes in weatherproof wire to include from No. 0 to No. 0000, instead of No. 4 to No. 0000. The base price on weatherproof remains at about 30 cents, but this change has raised the price of wire smaller than No. 0 1½ cents to 2 cents per pound.

FLEXIBLE ARMORED CONDUCTOR.—Armored conductor is very scarce and prices are stiff. Some jobbers who lowered their price about three or four months ago have now put them up, and the average price for No. 14 two-wire per 1,000 ft. is $87.50 in 5,000-ft. lots.

NON-METALLIC FLEXIBLE CONDUIT.—This material is almost impossible to get from the factory, and no definite date of delivery is promised. Prices are stiff and net $28 to $30 per 1,000 ft. for 7/32-in. loom in lots from 1,000 ft. to 5,000 ft.

KNIFE SWITCHES.—Prices have advanced 10 to 15 per cent. Stocks are low, particularly in the smaller sizes. The net price on a 30-amp., three-pole, 250-volt fusible switch is $2 in fifty-dollar lots.

TIME SWITCHES.—Some manufacturers have increased their prices about 10 per cent. Delivery is very slow.

LIGHTING FIXTURES.—Manufacturers of ornamental lighting fixtures have in general raised prices during the last month or two. On Jan. 1 the Brascolite prices advanced 10 per cent.

CROSS-ARMS.—Cross-arms are very hard to get, and some of the makers prefer to turn out other lines of lumber products because of a greater profit. There has recently been a price increase of about 20 per cent put into effect on some cross-arms. A four-pin, 5-ft. cross-arm is now quoted at $86.50 net per 1,000 f.o.b. Chicago.

BOSTON

Business tends to increase with the turn of the year. Several price advances are noted, including a 10 per cent increase on Century motors effective Jan. 5 and corresponding readjustments in Wagner and Crocker-Wheeler motor prices within the past week or so. Armored flexible conductor is quoted higher; electric coal leaders advanced from 5 to 10 per cent Jan. 1, and snap switches, porcelain tubes and friction tape are stiffer. Stocks are spotty and especially low in socket devices. Collections are a little improved. Deliveries are somewhat better on flexible armored conductor and pull sockets. Central station business is increasing very rapidly, one central New England company adding about 1,500 hp. in motor load during December. Generating plant expansion will be a feature of 1920 on some of the important medium-sized New England systems. Electrical contractors are very busy, both industrial and residential work occupying their forces.

MOTORS.—A general advance in price is looked for, but two of the largest producers have not changed their quotations to conform to the above increases of 10 per cent. Stocks are very hard hit, especially in single-phase motors; two representative deliveries quoted are twenty and twenty-six weeks.

ARMORED FLEXIBLE CONDUCTOR.—Single-strip No. 14 is bringing $88.50 to $90 with healthy demand and scanty but gradually improving stocks.

WIRE.—Base prices rule around 24.5 cents on bare, 26 to 28 cents on weatherproof and 30 cents on rubber-covered. Smaller sizes are low in stock, but current demands are being fairly well met through incoming shipments. Prices on No. 14 rubber-covered range from $11.50 per 1000 ft. in 5,000-ft. lots to $16 in less than coil lots.

SOCKETS.—Prices are steady, with better supply reported in pulls.

RIGID CONDUIT.—Higher prices are expected, but these have not shown up notwithstanding the difficulties of securing satisfactory delivery on smaller sizes of black pipe. Box covers are hard to get, and fitting stocks are hard hit. Rigid black pipe, ½-in. size, is quoted at $83.75 per 1,000 ft. for less than 2,500-lb. lots.

TUBES.—A price advance from $7.50 to $8.50 per 1,000 in barrel lots is noted, with scarcity in supply. Porcelain is very hard to get at present.

NON-METALLIC FLEXIBLE CONDUIT.—This material brings about $30 per 1,000 ft. in the 7/32-in. size, when it can be had. The market is pretty well oversold.

METALLIC FLEXIBLE CONDUIT.—Prices are firm, double-strip ranging from list plus 15 per cent to list minus 10 per cent and single-strip from list plus 10 per cent to list minus 15 per cent, according to quantities. A severe shortage is being faced.

SNAP SWITCHES.—Discounts are being cut from the former 20 per cent basis to 17 and 15 per cent, standard packages. The incoming supply is fairly good, but stocks are not equal to the demand, by and large.

TAPE.—Prices are somewhat stiffer, and the demand has fallen off in consequence. An advance of 5 cents per pound occurred Jan. 1. Tape in 100 lb. lots, ¾-in. black, quotes around 52 cents per pound, while 1,000-lb. lots, on a yearly contract bring around 46 cents.

WATT-HOUR METERS.—Some central stations are buying for June delivery. Prices are steady, but the supply is being absorbed so fast that stocks are virtually cleaned out. A fair average delivery is given as from thirty to forty days.

APPLIANCES.—Jobbers will not be supplied to any extent until the middle of February, it is said. Business continues very active. A good supply of 660-watt radiators is reported in jobbing circles, and flat-irons are not all cleaned out. Hollow ware in general, however, is low in stock.

ATLANTA

Dec. 31 closed the greatest year that Southern jobbers have ever known. The new year finds optimism the rule, and everything indicates that the year 1920, the early part at least, will be equally good or even better. Indications in the section point to a big building year, the 1919 permits for Atlanta totaling 3,022 permits, valued at $10,442,000. Many of these permits were taken out in the last few days of 1919, throwing actual building operations into 1920. Clearings for Atlanta show a gain of $1,000,000,000 over 1918, December alone showing a gain of $100,000,000 over the same month last year.

The new year ushers in a number of new price advances on electrical commodities, the principal ones of which are as follows: Wire, 5 per cent; cross-arms, pine and fir, 20 per cent; friction tape, 10 cents per pound; flexible steel conductor and armored lamp cord, 5 per cent.

The slackening in jobbers' orders due to the inventory period has passed, and jobbers report the receipt of numbers of large orders for January shipments.

RIGID CONDUIT.—Conditions remain unchanged, stocks continuing very low, owing to slow shipments.

WIRE.—Jobbers report a brisk demand for future shipments on rubber-covered, while the demand for weatherproof continues to exceed the supply in almost all the popular sizes. Stocks of rubber-covered are fair. Jobbers are quoting prices on rubber-covered, 28 cents base; weatherproof, 29 cents base, plus 5 per cent.

LAMPS—Jobbers report that the last few months have seen the greatest demands for lamps yet recorded. This is accounted for by the large amount of building and the general demand for more and better light. The tendency of textile mills to improve their illumination has caused a brisk demand for the large-size lamps in from 150-watt to 250-watt sizes. All stocks and shipments throughout the territory are reported good.

FLASHLIGHTS.—The heavy Christmas demand has badly depleted local holdings, and orders are being placed very generally for replenishment of stocks. This is particularly true of flashlight cases.

FLEXIBLE ARMORED CONDUCTOR.—The shortage continues, owing to poor shipments. There are very little stocks of moment in the territory, with no prospects of immediate improvement. Jobbers' prices are quoted as follows: Two-wire, 1,000 ft. to 2,500 ft., No. 14, single-strip, $99 per 1,000 ft.; $3 more is now being asked for double-strip.

FLEXIBLE NON-METALLIC CONDUIT.—Inability to supply the demand is reported by all jobbers, such shipments as are coming in being diverted to fill back orders. Prices are: ¼-in., $3.60 per 100 ft. in lots of 1,000 ft. to 2,500 ft.; $\frac{7}{32}$-in., $3.30 per 100 ft., same quantity.

CROSS-ARMS.—A price advance is registered effective Jan. 1: Washington fir, two-pin, 3-ft., less than 1,000 lineal ft., 67 cents; four-pin, 5-ft., less than 1,000 lineal ft., $1.06. Pine, two-pin, 3-ft., less than 1,000 lineal ft., 51 cents; four-pin, 5-ft., less than 1,000 lineal ft., 85 cents.

FRICTION TAPE.—This is another item registering a sharp advance on the first of the year, jobbers quoting weatherproof friction tape at 80 cents per pound in lots of 25 lb. to 100 lb., while splicing compound is quoted at 73 cents. A brisk demand is noticed in both articles, especially the weatherproof. Stocks are in fair condition.

FLEXIBLE CONDUIT.—Price has advanced 5 per cent. The new price for ½-in., in lots over 1,000 ft., is $10.29 per 100 ft.

LAMP CORD.—The steel-armored variety is quoted at an advance of 5 per cent.

SEATTLE—PORTLAND

The usual and anticipated lull in electrical jobbing and retail business succeeding heavy holiday sales finds both jobbers and retailers taking inventory and getting ready for early spring business. During the past week sales dropped to practically nothing. Building was at a standstill, shipyards and allied industrial plants, logging camps and lumber mills were closed. Indications, however, point to an immediate resumption in building on a larger scale than that of the past few months, and as soon as prevalent car shortage is overcome mills and camps will resume on a larger scale than ever before.

Steel-ship building in the Puget Sound district for the time being seems doomed. It is believed, however, that spring will bring a resumption. Unless new contracts are signed steel-ship building in Seattle will be completely finished before April 1.

Seattle's espenditure on building and construction work during 1919 exceeded that of the previous year by approximately $5,000,000, the year's figure being $15,615,000. Out of this sum $5,920,000 was spent for residences.

The Spokane territory reports that more than $3,000,000 of building has been mapped out already for completion in Spokane during 1920. The largest projected building is a one-million-dollar flour mill.

FIXTURES.—The volume of sales, which has been heavy in the Seattle district for several months past, has shown during the last two weeks a perceptible decrease. This let-up is giving both jobbers and fixture houses an opportunity to build up their stocks, which were almost depleted in certain types. At present shipments are slow. The rural demand is keeping up well considering seasonal conditions.

WASHING MACHINES.—Sales since the holiday trade have shown a marked decrease, but dealers are filling back orders from several shipments which recently arrived. Stocks are low at present but additional shipments are already en route for stock replenishment.

SAN FRANCISCO

The rainfall, so important here, has been disappointingly slow, and the amount of frozen storage available for next year will be low for the fourth year in succession. On top of this heavy frosts will seriously influence the crop and orchard production for 1920.

POLES.—Jobbers and pole firms are accumulating stocks in expectation of a year of power extensions. Local stocks were seriously strained a few days ago as the result of an almost unprecedented windstorm in the latter part of November, which, it is estimated, toppled over about 1,000 poles along the lines of various power companies in the affected area.

SCHEDULE MATERIAL.—A remarkably brisk business was done during the latter half of 1919, principally in standard lines for rush construction on apartment houses and private dwellings. Particularly in demand is a new socket attachment, like a current tap except that it provides for the insertion of a plug, and porcelain box covers to replace the exceedingly scarce steel covers. There is an increasing call for sign receptacles. Local stocks are fair. An order for 5,000 lock sockets is reported from a San Diego shipyard.

LAMP CORD.—The new regulation making the use of $\frac{1}{64}$-in. insulation cord illegal became effective Jan. 1, and jobbers have been paring down their stocks until generally they are in a very satisfactory state, although this process has been considerably assisted by slow deliveries from the factory anyway. Fair strike of $\frac{1}{32}$-in. cords are on hand.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

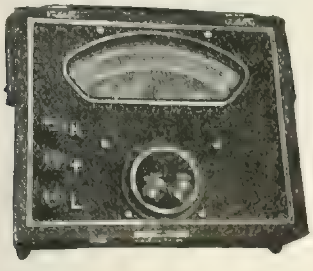
Electric Auto-Engine Heater for Garage Use

To keep automobile engines warm during normal winter weather while the car stands in the garage the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has brought out a 100-watt lamp-socket electric heater, complete with flexible cord and screw plug. It is hung by a hook on the engine, keeping both carburetor and engine warm. The heating unit of the new heater is entirely protected by a perforated sheet-metal guard.

HAS NO DELICATE PARTS TO GET OUT OF ORDER

Single-Pivot Measuring Instruments

In order to reduce friction to a minimum, only one pivot is used in the "Monopivot" galvanometers, microammeters, millivoltmeters and milliammeters which have been brought out by Herman H. Sticht & Company, 15 Park Row, New York City. This pivot is at the center of the coil, and the movement is balanced so that the center of gravity of the whole moving system is at the point of the pivot. The jewel bearing is in the center of the spherical iron armature core.

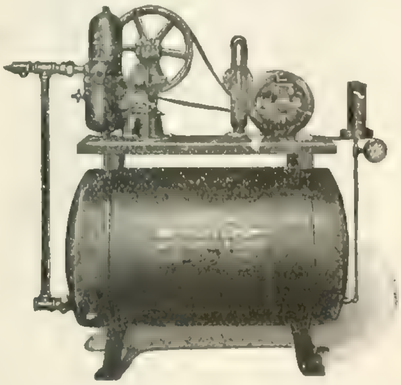


SINGLE PIVOT REDUCES FRICTION

All these instruments are equipped with zero adjusters. They are made up in two portable models and two models for wall mounting. The portable instruments, models C and D, are contained in quartered-oak cases with bayoneted hinged covers. The coils are inclosed in dust-and-fume-proof metal compartments. The wall-type instruments, models E and F, are furnished with brackets and are adjustable to any angle in the horizontal plane.

Motor-Driven Water Supply System

A new motor-driven water system, known as the "Hi-Speed Outfit," has been announced by the Goulds Manufacturing Company of Seneca Falls, N. Y., and consists of a Fig. 1695, 1¼-in. by 1⅛-in. (31.8-mm. by 28.6-mm.) plunger-type pump fitted with an air cock, connected by a round belt to a ¼-hp. electric motor, wound for 110-volt or 220-volt alternating current, 110-volt or 220-volt direct current, or for 32-volt direct current. The outfit is mounted on a galvanized welded steel tank with an approximate capacity of 30 gal. (113 l.). The capacity of the outfit, which is automatic in operation, is intended to be 180 gal. (681 l.) of water an hour at 43 lb. pressure on the tank.

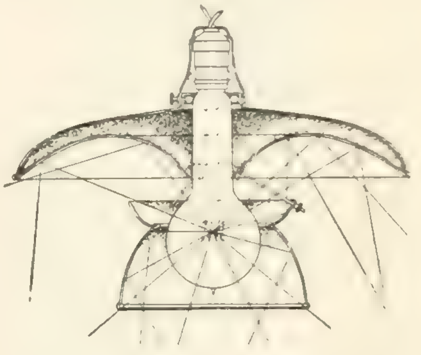


FLOATING-TYPE BELT IDLER FASTENED DIRECTLY ON WOOD BASE

Glareless Metal Lighting Unit for Commercial Use

An all-steel commercial lighting unit designed to combine the vertical and horizontal lighting features of both the deep and shallow-bowl type reflectors, without cross-reflection, deep shadows or glare, has been announced by the Art Metal Manufacturing Company, East Sixty-first Street and Curtis Avenue, Cleveland, Ohio, and is known as the "Amco Super-Light."

Like the industrial lighting fixture made by this company, the new unit consists essentially of two reflectors. A gas-filled lamp is used. The open-bottom construction is used to prevent the collection of dust and dirt, and so the lamp can be replaced without taking the unit apart. To eliminate discoloration, chipping and cracking the new commercial unit has a porcelain enamel finish throughout. Attached to the upper and lower reflector as well as the canopy are chrome-gold-decorated bands.



LIGHT DISTRIBUTION, SHOWING USE OF TWO REFLECTORS

One size of the new lighting unit is available for 150-watt and 200-watt lamps in both ceiling-attachment and chain-suspension styles.

Mica-Top Fuse Plug

The K-E mica-top fuse plug made by the Kirkman Engineering Corporation, 237 Lafayette Street, New York City, formerly had its fusible element exposed on the side of the plug, in order to hold the screw shell. It has now been improved, the maker says, by the provision of a solder slot in the well of the porcelain, which not only conceals the fuse element but prevents the screw shell from turning.

SCREW SHELL PREVENTED FROM TURNING

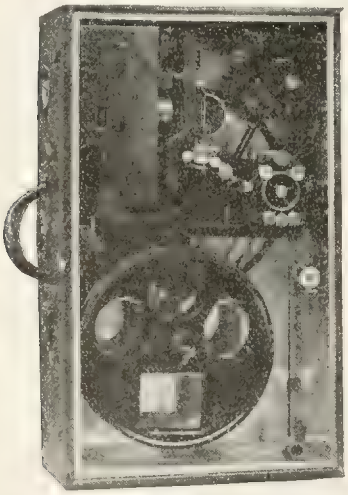
Safety Guards for the High-Tension Line Workers

To keep a man working on "hot" high-voltage lines within certain bounds of safety the Bush Electric Company, 6654 Broadway, Cleveland, Ohio, has developed its safety guards. These are made of selected wood, which is submitted to a drying and impregnating process said to make it capable of withstanding 5000 volts to an inch. This affords protection to the worker should he, in setting or removing the guard, accidentally allow it to strike the live line.

PREVENT CONTACT WITH LIVE LINE

Portable Standard-Film Motion Picture Machine

A portable motor-driven motion picture projector contained in a suitcase and using standard-width film has been brought out by the Graphoscope Development Company, 50 East Forty-second Street, New York City, and is known as the "Portmanto" model. One feature of the new machine pointed out by the maker is that it employs a lateral projection which removes the rays of light and heat from the head and allows both reels of film to be placed in one metal magazine below any possible source of fire and projected by a set of fire rollers.


FIREPROOF FILM MAGAZINE SUPPORTS MOTOR, MECHANISM AND LAMP

The light source employed by the projector is a 350-watt incandescent lamp, and a $\frac{1}{16}$ hp. electric motor is the driving mechanism.

Full Magnet-Type, D. C. Controller for Elevator Service

For use with electric elevator motors the Warner Elevator Manufacturing Company of Cincinnati, Ohio, has brought out its type BA full-magnet direct-current controller.

The main switches are located on the controller's lower panel, while the accelerating and high-speed magnets are on the upper panel. Three of the magnets on the lower panel operate for each direction and the direction magnets are mechanically interlocked. With the new controller the field circuit is never opened until after the motor has been disconnected from the line. The accelerating magnets are operated successively by B. E. M. F. The contacts are of the rolling butt type, except the control and high-speed contacts, which are of silver.

FIELD CIRCUIT NOT OPENED UNTIL MOTOR IS DISCONNECTED FROM LINE

Miniature Electrical Measuring Instruments

With an over-all diameter of $2\frac{9}{16}$ in. (40 mm.) and a weight of but 4 oz. (0.11 kg.), miniature voltmeters and ammeters have been developed by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., for use on small panels where economy of space is necessary. The new type of instrument is especially intended for measuring small direct currents, such as the filament and plate currents of radio-communication sets, or those in connection with farm-lighting and other small charging and lighting sets, or in use with dental and electro-medical work.

To support the cylindrical core and movable element between the pole pieces of the magnet, use is made of two simple bronze alloy punchings securely fastened to either side of the pole pieces. Insulation of the small aluminum frame which carries the coil of the movable element is by oxidation. Moreover, the base of the pivot support is elongated and clinched around either side of the aluminum frame of the movable coil.

By combining the new millivoltmeter with a non-inductive heater and thermocouple it is said to be made suitable for the measurement of high-frequency alternating currents such as are encountered in radio work. The same instrument can also be operated on alternating-current circuits of commercial frequency, it is stated, provided that they are not subjected to overloads.

FLUSH-TYPE DIRECT-CURRENT VOLTMETER

These instruments can be furnished for mounting with the face flush with the panel, or for projection. They are arranged for rear connection. The standard finish is white dial, nickel bezel ring and black marine case, but black dial instruments can also be obtained.

Protective Combinations for Farm Service

To meet the requirements of farm service from transmission and distribution lines, as well as other moderate capacity installations, Schweitzer & Conrad, Inc., of 4435 Ravenswood Avenue, Chicago, have placed on the market their type XW protective combinations. These are furnished for voltages up to 25,000 and consist of an adjustable horn-gap arrester, disconnecting switch, choke coil and fuse mounting. The arrester is furnished with a resistance in the ground circuit. The resistance unit is inclosed in a "Bakelite" tube provided with ferrules at both ends which fit in bronze clips so that replacements can be made if necessary without tools. When preferred, the arrester can be furnished with a fuse instead of a resistance unit in the ground circuit. The series fuse will fit in the clips provided for the resistance unit. The disconnecting switch is provided with combination blade guides and spring lock to prevent the switch from opening because of vibration. The long-turn choke coil is stated to be of liberal carrying capacity, while the fuse is held at an angle of 45 deg., so that it can be easily removed or replaced. Standard "S. & C." fuses are regularly furnished.

One feature of these combinations is the use of corrugated insulators for outdoor service. The arrangement of these special insulators is such that their corrugations which support the live parts are in all cases vertical. The corrugations of the insulator supporting the grounded horn and resistance are horizontal, because such parts are normally grounded.

The protective combinations rated at 7500 volts are mounted on one cross-arm, while those rated at 15,000 volts and 25,000 volts are installed on two cross-arms. In all cases only two bolts are necessary to fasten the equipment to the cross-arms.

Electric Phonograph With Suspended Motor

In order to eliminate undesirable vibration a suspended electric motor is used in the "Kurtzmann-Unique" phonograph now being manufactured by Louis S. Kurtzmann of 630 Main Street, Buffalo, N. Y. This motor is of the universal type and is designed to be noiseless. On the phonograph is an electric stop which automatically stops the motor when the end of the record is reached. Mounted on the top of the phonograph there is also an electric lamp to aid in operating the machine when the light of the room is not sufficient.

Electrically Operated Washing Machine

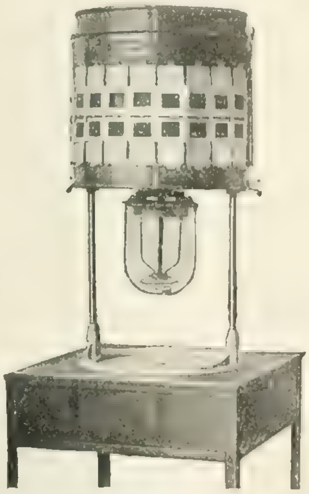
A washing machine driven by an electric motor and designed to combine the advantages of both cylinder and oscillating type machines has been placed on the market by the Albaugh Dover Company of Chicago and is known as the "Butterfly." Efforts have been made to simplfy the mechanism and reduce the number of parts.

CLOTHES ARE IN TURN LIFTED, SOUSED AND FLUSHED

Electric Arc Color-Testing Instrument

In the "Fade-ometer" an electrical color-testing instrument manufactured by the Atlas Electric Devices Company, 126 South Clinton Street, Chicago, the fading effect of sunlight is standardized and reproduced for testing the permanency of colors in textiles, wall papers, coloring materials, etc. The new device consists of an arc using special electrodes and incased in two telescopic sheet-steel cylinders, the whole being mounted on a stand. The instrument, which may be used on either direct or alternating current, is said to consume about 2800 watts and the life of the electrodes is said to be about twenty hours.

Automatic mechanism is provided to maintain the arc constant during the full life of the electrodes, the regular test period for samples being considered twenty hours. Provision is made for testing forty samples at once. Part of each sample is covered and part is exposed to the light so that comparisons can be made between the tested and untested portions of the samples which are under inspection.



COLOR-TESTING INSTRUMENT WITH SAMPLE HOLDING SECTION RAISED

Coated Welding Electrode

A new-type coated electrode has been brought out by the Electric Arc Cutting and Welding Company, 222 Halsey Street, Newark, N. J., which states that it is not a completely inert covered electrode holding the arc within a sleeve and covering the deposited metal with slag, but an electrode which has chemicals in its coating to attack the oxygen and hydrogen of the air with a greater chemical affinity than steel at the welding temperature, so that the steel is saved from the weakening influences of these two elements both by the action of the chemicals and the enveloping of the arc in the outwardly moving gases of the oxygen and nitrogen combined.

Moreover, as a result of this gasifying action, it is said that no brushing, chipping or cleaning is necessary with the new electrode since the successive layers which are added show no inclusion of dross.

Electric Compound-Melting Pot

An electrically heated melting pot for melting battery compound and other compositions of a like nature in garages, repair shops and other businesses, which includes the manufacturing and repair of electric batteries, has been recently developed by the General Electric Company of Schenectady, N. Y.

The new pot has a 4-qt. (3.7-l.) capacity, is portable and has a bail to facilitate handling. Around the top of the pot is a flange which extends over the inside to prevent boiling over. The inner edge of this flange also acts as a lip for scraping the compound from the ladle. The heat is generated by a three-heat cartridge type unit which is inserted in a slot at the bottom of the pot and is regulated by a three-point plug switch. A uniform, well-distributed heat is said to be assured, and there is no danger of fire from overheating or of cooling from insufficient heat during the temporary absence of the operator.

NOTES ON RECENT APPLIANCES

Inclosed Commercial Lighting Units

The Reflectolyte Company, 910 Pine Street, St. Louis, Mo., is making its "Supreme Reflectolytes" in 75-watt to 500-watt sizes and in styles to harmonize with decorative schemes of various descriptions.

Linen Shades for Individual Lamp Bulbs

J. A. Whaley & Company, 118 Fifth Avenue, New York City, are making "Kno-Glair" pleated linen electric light shades which have recently been approved by the Underwriters' Laboratorires.

Motor-Generator Set for Meter Testing

Roth Brothers & Company, 1400 West Adams Street, Chicago, have placed on the market a three-unit motor-generator set for use in meter-testing laboratories and for other alternating-current testing.

Portable Radiant Electric Heater

The No. 7 radiant electric heater made by the Majestic Electric Development Company of 656 Howard Street, San Francisco, and 1205 Allegheny Avenue, Philadelphia, now has an improved easily removable wire guard and a locking swivel permitting the reflector to direct the heat in any direction.

Manufacturers' Activities

MANNING, BOWMAN & COMPANY will enlarge its nickel and silver plant at Meriden, Conn.

THE SPRAGUE ELECTRIC WORKS of the General Electric Company, Bloomfield, N. J., has broken ground for the construction of a new two-story addition to its plant, estimated to cost about $40,000.

THE BRYANT ELECTRIC COMPANY, Bridgeport, Conn., has completed plans for the construction of a new four-story addition to its plant, for increased capacity. The structure will be about 60 ft. by 218 ft. and is estimated to cost $120,000.

LYNTON T. BLOCK & COMPANY, operating the Utilities Indemnity & Fire Exchanges and the Employers' Indemnity Corporation, has moved to new quarters on the second floor of the Chamber of Commerce Building, Broadway and Locust Street, St. Louis, Mo.

THE WHEELER GREEN ELECTRIC COMPANY, Rochester, N. Y., manufacturer of electric motors, etc., has completed arrangements for the erection of a new addition to its plant, about 40 ft. by 40 ft., for increased capacity. The structure is estimated to cost about $19,000.

THE APPLETON ELECTRIC COMPANY, Chicago, is erecting a new plant which will give it double the present space and will result in increased production. The building is to be a four-story and basement structure and will cover an area of over 45,000 sq.ft. It will provide 140,000 sq.ft. of floor space, and the entire plant is to be equipped with additional new machinery. The building of this large plant at Pauling and Wellington Streets is indicative of the company's optimistic view of the future.

APPLETON ELECTRIC COMPANY'S NEW PLANT

THE CURTIS & MYERS ELECTRIC COMPANY, electrical contracting engineers, announces the opening of its new store at 192 Pipestone Street, Benton Harbor, Mich., with a complete line of motor and factory apparatus, electrical eppliances, fixtures and housewiring materials. Messrs. Curtis and Myers were formerly with the Benton Harbor-St. Joe Railway & Light Company.

THE BLACK & DECKER MANUFACTURING COMPANY has opened an additional office on the Pacific Coast, at 201 Maynard Building, Seattle, Wash. This office is in charge of A. E. Nordwall, who will have charge of the distribution of Black & Decker products in the State of Washington, working under the direction of the main Pacific Coast office in San Francisco.

LINK-BELT COMPANY, CHICAGO, ILL., announces an addition to its Belmont foundry at Indianapolis, Ind. The extension virtually consists of completing two new furnace buildings, but for the present installing only one furnace of 15-ton capacity instead of 10-ton, the capacity of the present furnaces. The company is also purchasing the necessary machinery, such as rolling mills, sand blast and other foundry equipment needed to take of the additional capacity. The building will be about 70 ft. wide by 400 ft., and when finished will complete the foundry as originally laid out. These additions are being made to give better service.

SANFORD, RILEY STOKER COMPANY is to build a factoy of initial working area of 30,000 sq.ft. at Worcester, Mass.

THE STANLEY INSULATING COMPANY, Greenfield, Mass., has prepared plans for the construction of a new addition to its plant, for increased capacity. The structure is estimated to cost $30,000.

THE CHICAGO ELECTRIC MANUFACTURING COMPANY is erecting a new $75,000 two-story factory covering 100 ft. x 135 ft. of ground on the site of the old offices at the corner of Twenty-eighth and Halstead Streets, Chicago, Ill.

THE GOULDS MANUFACTURING COMPANY, Seneca Falls, N. Y., manufacturer of pumping machinery, has completed negotiations for the acquirement of the seven-story building, about 25 ft. by 152 ft., now occupied by the company, at 19 Park Place, and extending through to 16 Murray Street, New York City.

THE ELECTRIC SALES & ENGINEERING COMPANY has been organized at 813 Prospect Avenue, Cleveland, Ohio, to handle electrical equipment and supply engineering service. Robert P. Burrows, formerly in charge of the commercial section, engineering department, of the National Lamp Works of the General Electric Company, is sales engineer and will be in charge of all commercial activities of the company.

TOWLE & CALHOUN is the name of the company recently formed in Grand Rapids, Mich., by Joseph H. Towle and T. A. Calhoun to distribute the Willys farm light throughout western Michigan. Mr. Towle was formerly with the Railway Improvement Company, New York City, the People's Railway Company, Dayton, Ohio, and the Springfield (Ohio) Railway Company.

F. S. MONTGOMERY, for the past six years advertising manager of the National Metal Molding Company, Pittsburgh, Pa., and prior to that for several years district manager in charge of the Atlanta office of the same company, tendered his resignation which took effect Dec. 31, since which date he has been associated with the Ivan B. Nordhem Company, outdoor advertising, 8 West Fortieth Street, New York City. Mr. Montgomery's successor has not been announced.

NEW X-RAY SELLING PLAN — The National X-Ray Reflector Company, Chicago, put into effect on the first of the year, a revised plan for distributing X-ray reflectors. Previously the manufacturers had filled all orders direct when placed direct, whether from jobber, central station, isolated plant or consumer, on a trade protection differential. Now, however, the company states, all products in the direct-lighting group both for commercial and industrial work will be handled solely through X-ray electrical supply jobbers, except in New York and Chicago where large local X-ray sales organizations exist. The products that are used for indirect lighting, being largely in the nature of a "chandelier" line, will continue to be marketed through "chandelier" outlets, distinctly and positively separated from the direct-lighting line and at one price to any legitimate member of the electrical trade.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY will make an addition to its East Springfield factory at an estimated cutlay of $150,000.

THE KITSEE BATTERY COMPANY, 62 North Main Street, Wilkes-Barre, Pa., has had plans prepared for the construction of a new one-story addition to its plant.

THE GENERAL ELECTRIC COMPANY has awarded contract for the construction of a new four-story addition to its plant on Boyd Street, Newark, N. J., about 60 ft. by 80 ft., which will cost $66,000.

THE VICTORY BATTERY COMPANY, 30 West Houston Street, New York City, has filed notice with the Secretary of State of an increase in its capitalization from $20,000 to $30,000 to provide for general business expansion.

THE ARROW ELECTRIC COMPANY, Hartford, Conn., has arranged for the purchase of property extending from Hawthorn Street to the New Haven Railroad, adjoining its present works. It is understood that the site will be used for future expansion.

THE WILSON-MAEULEN COMPANY, 781 East 142d Street, New York City, manufacturer of pyrometers and other kindred equipment, has filed plans and awarded contract for the erection of the proposed new three-story plant at St. Mary's Street and Concord Avenue, for increased capacity.

THE H. W. JOHNS-MANVILLE COMPANY announces the removal of its Des Moines offices to more modern quarters at 213 Ninth Street on Jan. 2. W. B. Roberts, Des Moines manager, says that the new location will give him better facilities than ever for serving Iowa with asbestos and magnesia, electrical and automotive equipment and allied Johns-Manville products.

THE AMERICAN LAVA COMPANY, Chattanooga, Tenn., manufacturer of electrical insulation and specialties, announces through Paul J. Kruesi, president, that Capt. John Kruesi, formerly of the Detroit Edison Company, has returned from France and will have general management of the Lava company. He is also connected with the Southern Ferro Alloys Company, electric furnace manufacturer of steel alloys, and the Chattanooga Electro Metals Company, Chattanooga, Tenn.

Supply Jobbers' Notes

JOHN E. COUSINS, for the past twenty-five years with the Pettingell-Andrews Company, Boston, Mass., has been appointed assistant general manager of the company. Mr. Cousins is widely known throughout the New England electrical trade, and in his new work he will have direct charge of the physical stock and equipment of the organization.

THE CENTRAL ELECTRIC COMPANY, 320 South Wells Street, Chicago, jobber and wholesaler, has opened a new retail store, the Central Electric Shop, 302 West Jackson Boulevard. It has a showroom for displaying decorative lamps and household appliances and fixtures. Contractors' material will still be handled by the company's other store. Herbert Hazletine will be the manager directly in charge under H. D. Olsen, retail manager of the parent company.

THE WESTERN ELECTRIC COMPANY'S Atlanta office announces the closing of a lease for additional quarters required to handle its growing business in this district. The new building, which will be located in the uptown business section, will contain approximately 50,000 square feet of floor space and will be five stories in height. The first three floors will be used for the warehousing of electrical supplies, while the two top floors will be devoted to office use. The company expects to get into the new quarters about June 1, 1920.

SOUTHERN TIER ELECTRICAL SUPPLY COMPANY recently opened an electrical supply jobbing and retail house at 173 Washington Street, Binghamton, N. Y. Edwin C. Wehle is president and Albert H. Hyle is secretary and treasurer. The former was a salesman and the later assistant treasurer of the Mohawk Electrical Supply Company of Syracuse, N. Y. The capitalization is $35,000. About 13,000 sq. ft. of floor space is occupied for warehouse, offices and store. As soon as the lease expires ,the company announces, it will discontinue its retail sales, which embrace only 16 per cent of its business, and sell at wholesale only, carrying out its belief as to the function of the electrical jobber.

Foreign Trade Notes

ELECTRICAL SUPPLIES FOR CZECHO-SLOVAKIA.—According to a British trade representative at Prague, electric lamps, generators, transformer parts and watt-hour meters are urgently required in Czecho-Slovakia. Among the articles for which import licenses are granted are electric bulbs, copper and vulcanite goods.

SPANISH REGULATION IN REGARD TO ELECTRICAL INSTALLATIONS.—From Trade Commissioner P. S. Smith the Bureau of Foreign and Domestic Commerce has received two copies of a pamphlet (No. 40.823) containing a set of rules and regulations in regard to electrical installations, provisionally approved and recommended by the Permanent Spanish Electrical Committee for immediate application, subpect to such modifications as may be dictated by further study and practice. These regulations apply only to those electrical installations the operation of which may affect the safety of the public and persons obliged to work in close contact with live currents.

SOUTH AMERICAN INDUSTRIAL INVESTIGATION—P. S. Smith, trade commissioner of the Bureau of Foreign and Domestic Commerce, will sail for South America the latter part of January to study the South American markets for industrial supplies. Mr. Smith during the past year has conducted investigations of the electrical goods markets in Spain and South American countries. Before leaving this country Mr. Smith will confer with manufacturers of electrical appliances and machinery accessories with the idea of co-operating with them. He was scheduled to meet manufacturers in Boston Jan. 8, 9 and 10, and he will meet manufacturers in Philadelphia Jan. 15 and 16, and in New York from Jan. 19 to the date of sailing. Mr. Smith will sail for Buenos Aires on the Vestris the latter part of this month or the early part of February.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A civil engineer in Sweden (No. 31,592) desires to secure an agency for the sale of electrical apparatus.

A business man in Canada (No. 31,563) desires to act as manufacturers' agent for the sale in Canada of electrical specialties.

An electrical engineer in Spain (No. 31,583) desires to secure an agency for the sale in southern Spain of electrical goods, appliances and machinery.

A purchasing agent of firms in France (No. 31,561) desires to get in touch with manufacturers of electric lamps, electrical accessories for house lighting, etc.

The General Import Agency, El. Moustacas & Company, Eski Voevoda, No. 98, Galata, Constantinople, Turkey, is interested in the importation of electrical articles.

A firm of importers in the Netherlands (No. 31,590) desires to purchase or secure an agency for the sale of automobile accessories, especially electric light apparatus, combined or not combined with electric starter.

A firm of importers and general commission merchants in India (No. 31,542) desires to represent manufacturers of electrical fittings and accessories, generators and motors.

A representative of American exporters (No. 31,593) established in Denmark, desires to take over the agency of several additional lines of electrical equipment for sale in the Scandinavian countries. Finland, Poland, Letland, Esthonia and Russia.

I. S. Poulsen, member of the Norwegian industrial import house of Bergsvik & Poulsen, is in the United States for a short time to secure agencies in Norway for different kinds of American electrical products, especially alternators, direct-current generators, motors, transformers, electrical supplies, electrical cable, all sizes of rubber-covered wire, bare wire and copper bars. While he is in the United States Mr. Poulsen may be reached by mail at 214 North Seventh Street, Newark, N. J.

Trade Publications

REFLECTORS.—Harvey Hubbell, Inc., of Bridgeport, Conn. is circulating a mailing folder on industrial lighting reflectors.

GLASSWARE.—The Macbeth-Evans Glass Company, Pittsburgh, Pa., has issued an illustrated folder on its "Alba" light, No. 5350.

CURRENT TAP.—Harvey Hubbell, Inc. of Bridgeport, Conn. has prepared circular No. 185 about the No. 6700 "Hubbell" current tap.

STEEL PIN.—The new "Pierce Presteel" pin is the subject of a folder being circulated by Hubbard and Company of Pittsburgh, Pa.

OIL ENGINES.—The Allis-Chalmers Manufacturing Company of Milwaukee, Wis., has issued bulletin 1532-A on Diesel type oil engines.

SHOPS.—Westinghouse, Church, Kerr & Company, 37 Wall Street, New York City, has issued a folder showing some of the shops it has built.

PYROMETERS.—The Cleveland Instrument Company of Cleveland, Ohio has published bulletin No. 40 covering its resistance pyrometers.

HYDRAULIC TURBINES.—Booklet "B" has been issued by the Trump Manufacturing Company, of Springfield, Ohio, and covers its hydraulic turbines.

PLUGS.—An illustrated folder has been issued by the Cutler-Hammer Manufacturing Company of Milwaukee, Wis. on its new swivel attachment plug.

MOTORS.—Bulletin No. 105 is being circulated by the U. S. Electrical Manufacturing Company, Los Angeles, Cal., to tell about its electric motors.

REFLECTORS.—Bulletin Nos. 16-14 on reflectors for industrial lighting, standard dome type, has been isued by Harvey Hubbell, Inc., of Bridgeport, Conn.

TRANSFORMERS.—The Packard Electric Company, of Warren, Ohio, has issued bulletin No. 200, dated October 1919, about its distribution transformers.

ELECTROMETER.—The Pyrolectric Instrument Company, 636 East State Street, Trenton, N. J., describes its "Quadrant Electrometer" in bulletin No. 8.

TESTING DEVICES.—The Western Electro-Mechanical Company of Oakland Cal., has issued a booklet describing its load and meter testing equipment.

BALL BEARINGS.—The Gurney Ball Bearing Company of Jamestown, N Y., has issued an engineering bulletin giving uses of ball bearing in machine design.

LIGHTING PLANTS.—The Julius Andrae & Company, of Milwaukee, Wis., have issued catalog No. 10 covering lighting plants and house-wiring acceessories.

FIRE ALARMS.—The Interstate Machine Products Company of Rochester, N. Y., has issued bulletin No. 500, describing its "Sterling" electric siren fire alarm, Model M.

TRANSFORMERS.—Bulletin No. 202 on series regulating transformers for series street lighting is being distributed by the Packard Electric Company, Warren, Ohio.

DRILL PRESS.—The High Speed Hammer Company of Rochester, N. Y. has issued a folder on its high speed, ball bearing, motor-driven, bench drlil press.

LAMP GUARDS.—Various types of lamp guards are illustrated and described in a mailing folder now being circulated by Harvey-Hubbell, Inc., of Bridgeport, Conn.

METERS.—The Rawson Electrical Instrument Company, of Cambridge, Mass., describes its type 501 portable single pivot meters in bulletin No. 1 recently published.

BAFFLES.—One-piece permanent baffles for water-tube boilers are covered in a folder which has been published by the Betson Plastic Fire Brick Company of Rome, N. Y.

HOME LIGHTING PLANTS. The new "Jasco" country home lighting plant is described in a new booklet issued by the Julius Andrae & Sons Company, of Milwaukee, Wis.

NITRATE PLANT NO. 1.—The J. G. White Engineering Corporation, 43 Exchange Place, New York City, has issued a booklet telling about the construction of Nitrate No. 1.

CRANES.—The Wellman-Seaver-Morgan Company of Cleveland, Ohio, has issued bulletin No. 38 entitled "Mechanical Handling of Cargoes."

STOKERS.—"Coal" is the title of a thirty-one-page booklet which the Under-Feed Stoker Company of America, Book Building, Detroit, Mich., has issued. This contains much interesting information regarding coal from various geographical sections of the country.

GATE VALVES.—"Electrical Operation of Gate Valves" is the title of a booklet being distributed by the Cutler-Hammer Manufacturing Company of Milwaukee, Wis., and New York City, and contains an address given by Peter Payne Dean before the Metropolitian Section of the American Society of Mechanical Engineers.

New Incorporations

THE KING ELECTRIC MANUFACTURING COMPANY of Tonawanda, N. Y., has been incorporated by L. Smith, B. Kibler and V. F. King. The company is capitalized at $25,000 and proposes to manufacture electrical equipment.

THE OAK RIDGE (IND.) ELECTRIC COMPANY has been incorporated with a capital stock of $3,000 by M. D. Johnson, Iva S. Johnson and Oscar Moffit. The company proposes to supply electricity for lamps, heaters and motors in Oak Ridge.

THE PORTVILLE (N. Y.) UTILITY COMPANY has been incorporated by G. L. Verguson, M. J. McCary and E. C. Nagel of Portville, N. Y. The company is capitalized at $50,000 and proposes to generate and distribute electricity for lamps, heaters and motors.

THE STANDER-LINDENBAUM COMPANY of New York, N. Y., has been incorporated with a capital stock of $20,000 to manufacture and deal in gas and electric fixtures. The incorporators are: P. Lindenbaum, B. and E. Stander, 819 Hunts Point Avenue, Bronx, New York City.

THE PEOPLE'S LIGHT & POWER COMPANY of Woodstock, Me., has been organized with a capital stock of $10,000 to supply electricity for lighting the towns of Woodstock and Greenwood. Mark C. Allen is president; Thomas W. Gordon, treasurer, and Ned I. Swan, clerk, all of Woodstock.

THE ENDURANCE BATTERY CORPORATION of New York, N. Y., has been incorporated with a capital stock of $25,000 by J. H. Sweiback, 1239 Simpson Street; R. Guinzburg, Flushing, and A. G. Meinecke, 3920 Broadway, New York City. The company proposes to manufacture storage batteries.

THE HADGES & McLAIN COMPANY of New York, N. Y., has been incorporated with a capital stock of $100,000 by E. Hadges, H. E. McLain and W. Loomer, 652 Amsterdam Avenue, New York City. The company is capitalized at $100,000 and proposes to manufacture supplies and electrical devices.

THE ELGIN MANUFACTURING & PLATING COMPANY, 3 Lexington Street, Baltimore, Md., has been incorporated with a capital stock of $100,000 by Edward W. Haydon, Albert A. Ross and E. K. Ross. The company proposes to manufacture electric flashlights, carbide lamps and novelties and to do electroplating.

THE AEREX MANUFACTURING COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000 to do a general mechanical and electrical engineering business. The incorporators are: F. R. Hansell, E. M. MacFarland and J. Vernon Pimm of Wilmington, Del.

THE CHARLES F. L. GOAD ENGINEERING COMPANY of Toronto, Ont., Can., has been incorporated by Goldwin L. Smith, 2 Wellington Street, East; Thomas B. Richardson, John R. Cartwright and others. The company is capitalized at $300,000 and proposes to manufacture electrical equipment, automobile supplies etc.

THE RANWOOD MANUFACTURING CORPORATION of New York, N. Y., has been incorporated by C. A. Wolf, 130 Fulton Street, Brooklyn; L. B. Morehouse, 132 Nassau Street, and J. B. Greene, 2 Rector Street, New York City. The company is capitalized at $200,000 and proposes to do electrical work and a general mechanical engineering business.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

New England States

MANCHESTER, N. H.—The Amoskeag Manufacturing Company is planning to erect a new power house at Amoskeag Falls. to cost about $500,000.

FALL RIVER, MASS.—Arrangements are being made by the American Thread Company for extensive improvements and additions to its plant, including the reconstruction of its power facilities and the erection of a large boiler plant.

GLOUCESTER, MASS.—Arrangements are beng made by the General Electric Company of Schenectady for the establishment of a new plant in a number of buildings recently acquired. The proposed work, it is understood, will specialize in armature-winding. The company is also planning to erect a new drop forge plant on property recently acquired on the Annisquam River, Boston.

MEDFORD, MASS.—Plans have been filed by the Warner & Childs Company, 15 Winchester Street, for the construction of a new power plant to be used in connection with an addition to its plant.

NEW BEDFORD, MASS.—Preliminary steps have been taken by the New Bedford Gas & Electric Company for an addition (60 ft.) to its Cannon Street power house, in which a 20,000-kw. generating unit will be installed. Contract has been awarded to the Stone & Webster Engineering Corporation of Boston, Mass.

SPRINGFIELD, MASS.—Arrangements have been completed by the Cheney-Bigelow Wire Works for the erection of an addition to its plant.

NEWPORT, R. I.—Considerable electrical equipment will be required in connection with the proposed new laundry building at the local naval station, Specification 4081, by the Bureau of Yards & Docks, Navy Department, Washington, D. C. The cost is estimated at about $60,000.

Middle Atlantic States

AVON, N. Y.—Notice has been filed with the Secretary of State by the Livingston-Niagara Power Company of an increase in capital stock to $150,000.

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company contemplates extensions and improvements to its plant, including the installation of a new turbine unit, during the coming year.

BINGHAMTON, N. Y.—Plans have been prepared by the State Hospital Commission for the installation of a new soot blower equipment at the power plant of the Binghamton State Hospital. Bids will be called at an early date. L. F. Pilcher, Capitol, Albany, is state architect.

GLENS FALLS, N. Y.—The Public Service Commission has authorized the Kanes Falls Electric Company of Glens Falls to transfer its property to the Adirondack Electric Power Corporation. The consideration is $125,000. The Adirondack Electric Power Company which is to be consolidated into the Mohawk Edison Company of Schenectady is to acquire the capital stock of the Kanes Falls Company, and the Mohawk Edison Company is to issue bonds to take over property and to assume the outstanding indebtedness of the Kanes Falls company.

LUDLOWVILLE, N. Y.—Contract has been awarded by the International Salt Company, 2 Rector Street, New York City, for the erection of a large steam power plant at its local plant, to cost with equipment about $250,000, to the R. H. Beaumont Company, 315 Arch Street, Philadelphia, Pa.

NEW YORK, N. Y.—The Western Union Telegraph Company contemplates an addition to its building at the corner of Broadway and Dey Street, to cost about $5,000,000.

NORTH TONAWANDA, N. Y.—Arrangements, it is understood, are being made by the Tonawanda Power Company for extensions to its plant and system, to cost about $200,000.

THIELLS, N. Y.—Bids will be received by F. A. Vanderlip, president board of managers, Letchworth Village, 7 Wall Street, New York City, until Jan. 15, for construction of storehouse, bakery, refrigerating plant and additional refrigeration equipment at Letchworth Village. L. F. Pilcher, Capitol, Albany, is architect.

WATERTOWN, N. Y.—The Northern New York Utilities, Inc., has petitioned the Public Service Commission for permission to extend its system to Clifton and for approval of a franchise granted by that town.

NEWARK, N. J.—Plans are being prepared by Lockwood, Greene & Company, architects and engineers, 101 Park Avenue, New York, N. Y., for construction of the power house of the Celluloid Company, 290 Ferry Street, to cost about $100,000.

NEWARK, N. J.—Plans are being prepared by the Arthur Emmerich Company, which operates a silk throwing mill, for the construction of a three-story electric power plant to supply power for its proposed new plant, to be located on Norfolk Street, which will be equipped with electric motor driven machinery.

PERTH AMBOY, N. J.—The local power house of the Public Service Electric Company was damaged by fire on Jan. 2, causing a loss of about $50,000.

RUTHERFORD, N. J.—Plans are being prepared by the Braender Tire Company, 32 Broadway, New York, N. Y., for the erection of a new power plant at its local works. Andrew Kidd, Jr., 95 Liberty Street, New York, N. Y., is engineer.

TRENTON, N. J.—Plans are being prepared for the construction of a power plant to cost between $9,000 and $10,000, in connection with the proposed new local plant of the H. R. Mallinson Company, 136 Madison Avenue, New York, N. Y., to be located on Parker Avenue. The company has recently purchased the former plant of the Reeves-Cubberly Engine Company, which it is remodeling and will equip with silk manufacturing machinery. The plant will be operated by electricity.

TRENTON, N. J.—Plans have been prepared by the American Bridge Company, 30 Church Street, New York, N. Y., for extensive additions and improvements to its plant, to cost about $1,500,000. The proposed work will include a new main building, templet shop, and other buildings. Two new 200-ft. crane runways will be installed, and the equipment will include electrically-operated traveling cranes, motors, and other electrical apparatus, etc.

WEEHAWKEN, N. J.—Contract has been awarded by the Independent Lamp & Wire Works, 538 Gregory Avenue, for the erection of a new building on Gregory Avenue to the Irvington Lumber & Door Company, 739 Broad Street, Newark. The company manufactures tungsten lamps and other electrical products.

WHARTON, N. J.—Extensions and improvements are contemplated at the plant of the Replogle Steel Company, formerly operated under the name of the Wharton Steel Company, including the construction of new blast furnaces, a new electrically-operated ore bridge, the installation of coke ovens, a new steel finishing plant and sintering works. H. M. Roche is consulting engineer.

AMBLER, PA.—Plans are under consideration by the Philadelphia Suburban Gas & Electric Company for the erection of a new substation, 25 ft. x 50 ft., in Ambler.

BETHLEHEM, PA.—The city of Bethlehem has signed a contract with the Central Station Equipment Company of New York, N. Y., for the installation of an ornamental lighting system, covering 5 miles of streets, maintained by underground wires, in the business section of the city. The cost is estimated at about $100,000.

EPHRATA, PA.—The Tri-County Electric Company contemplates the installation of 750 kva. in transformers, in units of 250-kva., at its main transformer station at Blue Ball, and also the erection of 6 miles of 6,600-volt transmission lines. G. L. Nies of Ephrata is president.

ORRTANNA, PA.—The Orrtanna Electric Light & Power Company is considering the installation of new equipment in its plant, including a 100-hp. suction gas engine, a new gas engine, and may also purchase 100 chestnut poles and 4 miles of No. 8 copper wire and 12 General Electric I-14, 5-amp., meters for 60-cycle, 110-volt service. Nothing definite has been decided upon. S. Z. Musselman is manager.

PHILADELPHIA, PA.—The General Carbonic Company, North Third Street, has awarded contract to H. McCloskey, Jr., 1620 Thompson Street, for the erection of a two-story power plant and garage building at 842 North Third Street.

PHILADELPHIA, PA.—Contract has been awarded by the Colonial Mills Company, Lena and Armat Streets, to Walter Dalton, Heed Building, for the erection of a power plant at its works.

PHILADELPHIA, PA.—Plans are under consideration by the Manufacturing Company of America, Twelfth and Hamilton Streets, for the installation of new boiler equipment in its power plant.

PHILADELPHIA, PA.—The American Manganese Bronze Company, Rhawn & Hegerman Streets, has awarded contract to Steward & Stevens, Ninth and Montgomery Streets, for construction of an addition to its power plant.

PHILADELPHIA, PA.—Contract has been awarded by the Philadelphia & Reading Railroad Company to H. L. Carhart, Penfield Building, Philadelphia, for the erection of a one and three-story signal tower and battery building at Myerstown, to cost about $25,000.

SCRANTON, PA.—Plans are being prepared by F. Koester, electrical engineer, for the construction of an electric power plant.

STEELTON, PA.—Arrangements have been completed by the Bethlehem Steel Company for the installation of a new motor-driven generator at its local steel mills. The present steam equipment will be discarded.

BALTIMORE, MD.—The American Sugar Refining Company, 117 Wall Street, New York, N. Y., is planning to establish a plant in Baltimore, which will involve an expenditure of about $8,000,000.

BALTIMORE, MD.—The Steinmetz Electric Mortor Car Corporation, recently incorporated with a capital stock of $2,000,000, is planning to erect a large factory for assembling motor cars. Dr. Charles P. Steinmetz, chief electrician of the General Electric Company, is to be chief engineer of the company.

OXFORD, MD.—The installation of a municipal electric light plant, to cost about $18,000, is under consideration by the town officials.

WESTON, W. VA.—Plans are under consideration by the Weston Milling Company for the erection of an electric transmission line to Seebert, to cost about $50,000. George I. Keener is president.

WIERTON, W. VA.—Arrangements, it is reported, have been made for a large extension to the blast furnace power station, providing for the installation of five 600-hp. boilers, equipped with underfeed stokers at the proposed new plant of the Wierton Steel Company. The equipment of the power plant will consist of two 7,500-kw. turbo-generator units, with switchboard and auxiliary apparatus for which contracts have been awarded.

RICHMOND, VA.—Plans are under consideration by the Virginia Railway & Power Company for extensions and improvements to its power plant and system, to cost about $1,100,000.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 26 for the elevator-door protective devices in the Department of the Interior at Washington, D. C. For details see Searchlight Section.

WASHINGTON, D. C.—The Potomac Electric Company has recently installed and put into service a 20,000-kw. General Electric turbine with a Worthington condenser in its Bennings plant; also two additional 1,000-hp. B. & W. boilers, equipped with Taylor stokers; 18 Taylor stokers have been installed on 12 of the 600-hp. B. & W. boilers, which were formerly equipped with natural draft stokers. A new intake chamber to condense the water has been completed in which four rex revolving screens have been installed. An extension was made to the turbine room to provide space for the generating unit. This work was designed and carried out under the direction of Francis R. Weller, Hibbs Building, consulting engineer. R. L. Weide was engineer in charge of construction.

North Central States

CHARLOTTE, MICH.—The City Council is considering the question of equipping the municipal water works station with electrically-operated machinery.

DETROIT, MICH.—A new proposal for a municipally-owned street railway system, it is said, will be submitted to the City Council. The plan, sponsored by Mayor James Couzens, provides for the construction of about 140 miles of track to cover as nearly as possible every section of the city.

PETOSKEY, MICH.—Work, it is understood, will soon begin on the construction of the machine shop and power plant for the Petoskey Portland Cement Company. A. B. Klise is president.

CINCINNATI, OHIO — Contracts will soon be awarded by the War Department, U. S. Engineer Office, Cincinnati, for the construction of a power house at Dam 35, Cincinnati.

DOVER, OHIO.—Bonds to the amount of $100,000 have been voted for extensions to the municipal electric light plant and to replace the natural gas engines now in use with steam engines.

FORT LORAMIE, OHIO.—The Fort Loramie Light & Power Company contemplates improvements to its plant, including the installation of three 10-kva. transformers; also the erection of 19 miles of bare copper line and the purchase of 50 Westinghouse meters and 12 lamps. Karl Schmeel is engineer in charge of the work. W. J. Sherman is manager.

KENTON, OHIO.—New equipment is being installed in the plant of the Hardin-Wyandot Lighting Company, including one 1,250-kva., Curtis turbine complete with No. 11 Le Blanc condensers and switchboard. P. M. Magly is manager.

LOUDONVILLE, OHIO.—The Board of Trustees contemplates the purchase of four 15-kva., three 10-kva. and two 5-kva., 2,300/110/220-volt General Electric transformers, 100 chestnut poles and 3 miles of No. 8 wire and 50 I-14, General Electric meters. Cleveland Bowen is superintendent.

WELLINGTON, OHIO.—New equipment, including two 330-hp. Heine boilers, two Murphy stokers and a 675-kw. General Electric steam turbine has been purchased for the municipal electric light plant. The Board of Commissioners is in the market for coal conveying equipment. Contract will be let in the spring for 14,000 ft. of 4-in. cast-iron water main. C. E. Gadfield is superintendent.

AUBURN, KY.—Surveys are being made by the Auburn Light & Water Company for the installation of an electric light plant in Auburn. The company was recently granted a franchise to operate here. The present address of the company is McCormack Building, Bowling Green. R. E. Turbville is manager.

INDIANAPOLIS, IND.—The Prest-O Lite Company is planning to erect a battery house, to cost about $400,000.

KOKOMO, IND.—The Pittsburgh Plate Glass Company is planning the erection of a new power plant, to cost about $800,000. The company also contemplates the erection of 100 houses for its employees.

SYRACUSE, IND.—Plans, it is reported, have been approved by the Syracuse Light & Power Company and the Baltimore & Ohio Railroad Company for the construction of a dam next spring. The project is for the benefit of the Syracuse company.

CHICAGO, ILL.—Plans are under consideration by the Federal Electric Company for the erection of a new plant, to cost about $150,000.

CHICAGO, ILL.—Plans have been filed by the Jewel Electrical Instrument Company, 1650 Walnut Street, for the erection of a new building adjoining its present works, to cost about $50,000.

CHICAGO, ILL.—Plans have been filed by William G. Garvey, 38 Dearborn Street, Chicago, for the erection of a plant at 5008-18 Bloomingdale Street, for the manufacture of electrical products, to cost about $90,000.

LAWRENCEVILLE, ILL.—The Central Illinois Public Service Company is planning to erect a 33,000-volt transmission line from its Illinois terminus to Vincennes, Ind.

MAHOMET, ILL.—Contract has been awarded to H. P. Kruse of Champaign for the erection of a high-tension transmission line from Champaign to Mahomet, at $22,000. A distribution system will be installed in the village of Mahomet. Electricity will be supplied by the Urbana & Champaign Railway, Gas & Electric Company of Champaign.

PEORIA, ILL.—The installation of a power plant, to cost $22,000, at the Proctor Hospital is under consideration.

COLFAX, WIS.—The Colfax Light & Power Company is planning to increase the output of its hydro-electric plant, at a cost of about $200,000.

EAU CLAIRE, WIS.—The Chippewa Reservoir Company is planning to build a dam in the Chippewa River during the coming spring. P. D. Kline, general manager of the Wisconsin-Minnesota Light & Power Company of Eau Claire is interested in the project.

SHEBOYGAN, WIS.—The Citizens Telephone Company is considering the construction of additional conduit and serial cables, to cost about $85,000.

SHEBOYGAN, WIS.—The Sheboygan Fruit Box Company, North Fifteenth Street, is planning to build an addition to its factory and power plant, to cost about $40,000.

WARREN, WIS.—The Tomah (Wis.) Electric Light Company is contemplating extending its electric transmission lines to Warren to supply electricity for lamps and motors here.

BENSON, MINN.—Plans are being prepared for changing the municipal electric light plant from direct to alternating current. New equipment including a new generator, switchboard and boilers will be installed. The cost is estimated at about $40,000. W. E. Skinner, 15 South Fifth Street, Minneapolis, is engineer.

GONVICK, MINN.—The town officials have granted Allen & Johnson a franchise to install and operate an electric light plant in Gonvick.

MAQUOKETA, IOWA.—Bids will be received until Jan. 20 for $65,000 electric light bonds. D. T. Bauman is city clerk.

MASSENA, IOWA.—The installation of a municipal electric light plant is under consideration by the city officials.

BUFFALO, MO.—The installation of a new street lighting system in Buffalo is under consideration.

POPLAR BLUFF, MO.—Investigations are being made by M. R. Cole of prospective sites for a power dam at Butting Rock, near Eminence. It is estimated that a 30-ft. dam located at that point would develop sufficient power to meet the requirements in this section.

ESMOND, N. D.—Improvements are contemplated to the local electric light plant, including the installation of a 15-kw., three-wire, or a 250-volt, two-wire, direct current generator, one switchboard panel; also the purchase of one 300-volt meter, one 100-volt meter, 5,000 ft. No. 10 weatherproof copper wire, 10 direct-current, 5-amp. meters for 110-volt service, 1,000 25, 50, and 75-watt lamps. C. A. Page is owner.

MILTON, N. D.—Bids will be received by the village of Milton until Jan. 14, for furnishing and installing an oil engine, generators, switchboard and distribution system for the municipal electric plant. Hans Berg is village clerk.

PEMBINA, N. D.—The Pembina Light & Power Company is installing a new 150-hp. unit in its plant. E. J. Teberg of Minneapolis, Minn., who has purchased the interest of H. R. Robowski, president, will take charge of the property.

GARRETSON, S. D.—The Council is considering calling an election to submit the proposal to sell the municipal electric light plant to Ralph Gardner. The installation of a new engine in the plant is also under consideration.

ROMONA, S. D.—Plans are under consideration for the installation of a municipal electric lighting system. The project includes the erection of transmission line to Oldham.

MERIDIAN, KAN.—Plans are under consideration for rebuilding the transmission line to Topeka a distance of 15 miles. W. B. Rollins, Railway Exchange Building, Kansas City, Mo., is consulting engineer.

NEODESHA, KAN.—Plans are under consideration by the Standard Oil Company, of Kansas, 5301 East Ninth Street, Kansas City, Mo., for the construction of a new refinery in Neodesha, to include 42 additional stills, boiler house, etc., at a cost of about $1,500,000.

NESS CITY, KAN.—Bonds to the amount of $50,000 have been voted for extensions to the municipal electric light plant. New equipment, including a 250-hp. engine and generator and other apparatus will be installed.

Southern States

BUCKNER, N. C.—The Green Light & Power Company of Pleasant Hill, contemplates extending its transmission lines to Buckner to furnish electrical service here. The street lighting system will consist of 24 lamps.

EDENTON, N. C.—New equipment will be installed in the municipal electric light plant, including the installation of a 150-hp. return tubular boiler, one 500-kw. General Electric turbo-generator set, transformers, etc. All machinery has been purchased. J. C. Martin is superintendent.

GUILFORD COLLEGE, N. C.—The North Carolina Public Service Company of Greensboro has contracted with Guilford College to supply electricity here. An electric transmission line will be erected from Greensboro to the college, between 3 and 4 miles long.

HERTFORD, N. C.—A bond issue of $125,000 for extensions and improvements to the municipal electric light plant and waterworks system has been approved by the Board of Trustees.

LAKEVIEW, N. C.—The Electric Light & Power Company has filed an amendment to its charter increasing its capital stock from $75,000 to $300,000. The company contemplates extensions and improvements to its plant. J. R. McQueen is president.

CARTHAGE, TENN.—The Smith County Electric Company has nearly completed the erection of an 11,000-volt transmission line to Gordonsville, Hickman and Brush Creek. R. S. Seese is manager.

BIRMINGHAM, ALA. — Arrangements have been completed by the Gulf Steel Company for increasing the output of its power plant from 3,000 to 7,000 kw.

NORTH BIRMINGHAM, ALA.—Ground has been broken for the construction of a large power plant to be erected in connection with the local by-products works of the Sloss-Sheffield Steel & Iron Company, now under construction.

CLARKSDALE, MISS. — Improvements are contemplated to the municipal electric light plant, including the installation of a 1,500-kw. turbo-generator, condenser, cooling apparatus, boiler, feed pump, for which bids will be received until Jan. 13. Walter S. Bobo is city engineer.

ARKANSAS CITY, ARK.—The Lambe & Denmarke Water & Light Company is contemplating the purchase of oil engines and other equipment.

MAGNOLIA, ARK.—Steps have been taken to organize a company to construct and operate electric light, water and ice plant. The company will be capitalized at from $75,000 to $100,000. Samuel Grason is reported interested in the project.

LAFAYETTE, LA.—The City Trustees are considering improvements to the municipal electric light plant and waterworks system.

NEW ORLEANS, LA.—The New Orleans Railway & Light Company contemplates extensions and improvements to its power house.

ARDMORE, OKLA.—The Consumers Light & Power Company is considering the installation of one 500-hp. Heine boiler and one 2,000-kw. General Electric Steam turbine. William A. Baehr of Chicago, Ill., is engineer in charge. J. F. Pritchard is general superintendent.

BROKEN BOW, OKLA.—The City Council is considering the construction of a municipal electric light plant, to cost about $135,000. The Hughes Engineering Company, Bank of Commerce Building, Tulsa, is engineer.

BYRON, OKLA.—Bonds have been authorized for the establishment of a municipal electric light plant in Byron.

CHANDLER, OKLA.—The Chandler Electric Company contemplates the purchase of a 200-hp. steam engine and one car load of poles. C. E. Kapp is manager.

DRUMRIGHT, OKLA.—The Oklahoma Gas & Electric Company contemplates the purchase of materials for 22 miles of overhead transmission lines and 500 meters for 60-cycle, alternating-current service. The Byllesby Engineering and Management Corporation, 208 La Salle Street, Chicago, Ill., has charge of the work. W. B. Miser is manager.

SALLISAW, OKLA.—Improvements are contemplated to the municipal electric light plant, including the installation of one 150-hp. boiler, one 250-hp. steam engine, one 250-kva. 60-cycle, alternating-current generator and switchboard equipment complete. Fred E. Johnston is city manager.

STROUD, OKLA. — Improvements are contemplated to the municipal electric light plant, including the installation of an oil or gas engine from 125 to 150-hp., one 90 to 125-kw. three-phase, 60-cycle, 2,300-volt generator. Bonds have been voted by the city for water and light extensions and the construction of a 10-ton ice plant, equipped with electric motor-driven machinery. The equipment will be purchased within the next 60 days. The city would like to receive estimates and prices on same. W. A. Hadley is chairman of board of trustees. John A. Walker is manager of the plant

GAINESVILLE, TEX.—The Gainesville-Sherman Traction Company has submitted proposals to the citizens of Gainesville, Whitesboro and Sherman looking to the construction of an interurban electric railway between Gainesville and Sherman, a distance of 30 miles. Burt C. Blanton of Dallas is general manager.

GOOSE CREEK, TEX.—The Humble (Tex.) Oil & Refinery Company, it is reported, contemplates the construction of an electric power station and transmission system, to cost about $500,000.

GOOSE CREEK, TEX.—The Gulf Production Company of Houston is planning to erect two large electric power plants and electric transmission system, to cost about $500,000, in connection with its works.

GOOSE CREEK, TEX.—The Goose Creek Light & Power Company, recently incorporated, is planning to build an electric light and power plant in Goose Creek. The company is capitalized at $75,000. W. W. Sloan, R. S. Sterling and T. D. Joiner, Jr., are among the incorporators.

HONDO, TEX.—The Hondo Light, Power & Ice Company contemplates the purchase of one second-hand boiler, and probably a steam engine and electric generator with switchboard equipment. A. G. Walker is manager.

PITTSBURG, TEX.—Improvements are contemplated to the plant of the Home Light & Ice Company, to cost about $30,000. New equipment, including motor-driven ice making machinery, boilers, etc., will be installed.

PRYOR, OKLA.—The City Council has engaged V. V. Long & Company, engineers, Colcord Building, Oklahoma City, to prepare preliminary plans for construction of water purification plant, pumping station and electric transmission line.

Pacific and Mountain States

FRIDAY HARBOR, WASH.—The property of the Friday Harbor Light & Power Company has been purchased by L. T. Mulvaney.

ROSEBURG, ORE.—A special election will soon be held to submit to the voters the proposal to establish a municipal electric plant. Surveys are now being made by the Engineering Department of the city of the proposed site at Rock Creek.

MODESTO, CAL.—Petitions calling for a special election to vote on the proposal to issue $2,000,000 in bonds for the Modesto Irrigation District's share in the construction of the Don Pedro reservoir, power plant and transmission and distribution system and the enlargement of the present canal are being circulated.

YUMA, COL.—Bids will be received by the Town Council until Jan. 19 for construction of a steam-driven electric light and power plant, to cost about $50,000. R. D., Salisbury, 1415 East Colfax Avenue, is engineer.

Canada

WINNIPEG, MAN. — Bonds to the amount of $500,000 have been sold by the Provincial Government, the proceeds to be used for improvements to the telephone service. Automatic telephones will be installed in Winnipeg and St. Boniface.

BELLEVILLE, ONT.—The Tivani Electric Steel Company is planning to erect a foundry and build piers in Belleville. The cost of the buildings is estimated at $250,000 and the reduction furnaces and rolling mills, $4,000,000. Hamilton and Hensall, 13 Park Row, New York, N. Y., are consulting engineers.

CAPREOL, ONT.—A by-law to provide $20,000 for the construction of an electric light plant in Capreol will be submitted to the ratepayers on Jan. 15.

FORT METACHEWAN, ONT.—A British syndicate, it is reported, contemplates a power development at Fort Metachewan, to cost about $250,000. Sutcliffe & Neelands of New Liskeard, are engineers.

KINCARDINE, ONT.—At the January municipal elections the proposal to provide $40,000 for the installation of a Hydro-Electric power system and to rebuild the electric lighting system will be submitted to the ratepayers.

LONDON, ONT.—Surveys are being made by the Hydro-radial surveyors for the proposed railway which is to run from Brantford East, and will enter London via the London & Port Stanley Railway, by making connections at a point 5 miles south of the city.

MERRILTON, ONT. — The Canadian Steel & Forging Company contemplates extensions to its steel plant and also to its hydro-electric power, lighting and heating plants, to cost about $200,000. J. J. Wernette, Housman Building, Grand Rapids, Mich., is engineer.

PETERBORO, ONT. — The Canadian Alladin Company, Canadian Pacific Railway Building, Toronto, contemplates the construction of an electric light plant in Peterboro, to cost about $75,000.

STOUFFVILLE, ONT.—A by-law to authorize $20,000 for the purpose of erecting an electric transmission line to connect the village with the Metropolitan line at Bond Lake, a distance of 7 miles, will be submitted to the ratepayers at the municipal election.

THOMAS, ONT.—Contracts will soon be awarded by W. C. Miller, city engineer, for furnishing and installing electric and gasoline auxiliary pumping equipment for waterworks station, to cost about $20,000.

WHITECHURCH, ONT.—The Township Council has approved a by-law authorizing the village of Stouffville to erect an electric transmission line between the townships of Markham and Whitechurch, from Yonge Street to Stouffville.

MONTREAL, QUE.—Plans are under consideration by the City Commission for the installation of two electrically-driven pumps of 25,000,000 gal. daily capacity at the city pumping station next spring. The cost of the pumps is estimated at $75,000.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Jan. 14 for telephone cable. Blanks and general information relating to this circular (1328) may be had at the above office.

PANAMA.—Bids will be received at the office of the general purchasing officer of the Panama Canal, Washington, D. C., until Jan. 24, for electric freight elevator, refrigerating plants, steel rollers, annunciators, panel boards, push buttons, copper cable, condulets, duct tile, lighting fixtures, switches, transformers, terminal tubes, magnet wire, screws, etc. Blanks and information relating to this circular (1329) may be obtained at the above office, or the office of the assistant purchasing agent, 24 State Street, New York, N. Y.; 606 Common Street, New Orleans, La., and Fort Mason, San Francisco, Cal.

Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 23, 1919)

1,325,521. Ignition-Lock for Motor-Vehicle; Alf Landgren and Max B. Ewers, Highland Park, Mich. App. filed Jan. 17, 1918. Short-circuit prevents theft.

1,325,539. Electric Furnace; Frederick T. Snyder, Oak Park, Ill. App. filed Mar. 1, 1917. Reduces air leakage.

1,325,554. Means for Locating Ore Bodies by Audio-Frequency Currents; Wendell L. Carlson and Earl C. Hanson, Washington, D. C. App. filed May 7, 1919. Exploring coil in balanced electrical circuit.

1,325,559. Vaporizer; Luis E. Eckelmann, New York, N. Y. App. filed April 26, 1918. Liquid heated before discharged onto vaporizing surface.

1,325,574. Secret-Signaling System; Harold William Nichols, Maplewood, N. J. App. filed Sept. 11, 1915. Distorts signals transmitted.

1,325,597. Automatic Electric Regulator; William A. Turbayne, Niagara Falls, N. Y. App. filed June 29, 1914. Maintains predetermined current for car-lighting systems.

1,325,598. System of Electrical Regulation; William A. Turbayne, Niagara Falls, N. Y. App. filed Dec. 11, 1915. Vibrating relay type for battery work.

1,325,653. Storage-Battery Cell; Lee J. Perry, Chicago, Ill. App. filed Mar. 10, 1916. Interlocks cell plates.

1,325,655. Switch Mechanism; Julius H. Richards, Newark, N. J. App. filed Dec. 2, 1916. For automobile starting system.

1,325,677. Combined Starter and Lighting Dynamo; Albert Henry Midgley, Acton Vale, Eng. App. filed Jan. 29, 1917. Cutout between two brushes of same polarity.

1,325,698. Auxiliary Fuse-Clip; Edward B. Milloy, Detroit, Mich. App. filed Oct. 14, 1918. For firm contact.

1,325,709. Insulating Electrical Conductor; Bela Bognar, New York, N. Y. App. filed Nov. 15, 1918. Inexpensive insulating material, hard, tough and flexible.

1,325,710. Battery-Plate Envelope; Campbell C. Carpenter, Niagara Falls, N. Y. App. filed April 16, 1913. Envelope integral with plate.

1,325,763. Flow-Meter; Jacob M. Spitzglass, Chicago, Ill. App. filed May 19, 1915. Pressure difference in U-tube actuates ammeter and water meter.

1,325,823. Electric Clock; Hihohichi Abe, Yamagata-Ken, Japan. App. filed Mar. 6, 1918. Operates accurately regardless of the electromagnet current intensity.

1,325,862. Electric Clock; Arthur F. Poole, Kenilworth, Ill. App. filed June 11, 1917. Conical pendulum swings in circle.

1,325,865. Vacuum-Tube Socket; Herbert E. Shreeve, Wyoming, N. J. App. filed May 20, 1916. For audion.

1,325,866. Vent for Storage Batteries; Thomas Spencer, Philadelphia, Penn. App. filed Nov. 26, 1915. Prevents overfilling jar.

1,325,871. Telephone System; Charles W. Keckler, Newark, N. J. App. filed May 24, 1917. Electromagnetic control of calling station with called station.

1,325,875. Electric-Lamp Socket; Alexander W. Limont, Bridgeport, Conn. App. App. filed Mar. 3, 1919. Corrugated shell.

1,325,879. Vacuum-Tube Circuits; Harold W. Nichols, Maplewood, N. J. App. filed Dec. 28, 1916. Prevents undesirable capacity effects between electrodes.

1,325,885. Signal Device; Charles Weber, Newark, N. J. App. filed May 22, 1919. Hand flashlight.

1,325,889. Protector for Electric Circuits; Austen M. Curtis, Brooklyn, N. Y. App. filed Nov. 1, 1915. Diverts power around receiving circuit.

1,325,899. Hanger for Conductor Wires; John T. Morgan, Charleston, West Virginia. App. filed June 6, 1917. Conductor supported without tension.

1,325,914. Lifting Magnet; Lewis D. Rowell, Milwaukee, Wis. App. filed Oct. 7, 1907. Load concentrated as released.

1,325,937. Motor-Cushioning Device; Samuel Fox, New York, N. Y. App. filed May 7, 1918. Electric shoe polisher.

1,326,005. Electrical Apparatus; Charles P. Steinmetz, Schenectady, N. Y. App. filed Jan. 14, 1915. Distribution of capacity in high-voltage transformer windings.

1,326,025. Pneumatically-Operated Controller; Frank E. Case, Schenectady, N. Y. App. filed July 10, 1918. For railway motors.

1,326,029. Incandescent Cathode Device; William D. Collidge, Schenectady, N. Y. App. filed Dec. 4, 1917. For X-ray tubes.

1,326,036. Spark Intensifier; Mahlon L. Dunbar, Akron, O. App. filed Mar. 16, 1918. Adjusts length of gap.

1,326,049. Electrical Apparatus; Frank C. Green, Pittsfield, Mass. App. filed Dec. 4, 1916. Prevents moisture in transformer oil.

1,326,$63. Trolley Wheel; Frank C. Karkalla, Fairhaven, Penn. App. filed Sept. 20, 1916. Replaces trolley wire.

1,326,083. Arc-Type Electric Furnace and Method of Operating the Same; William E. Moore, Pittsburgh, Penn. App. filed July 30, 1917. Two or more electrodes in polyphase formation.

1,326,104. Method for Modifying the Electrical Charge of Diaphragms; Botho Schwerin, Frankfort-on-the-Main, Germany. App. filed Nov. 16, 1914. Alters degree of absorption.

1,326,106. Process of Treating Colloidal and Finely Subdivided Substances; Botho Schwerin, Frankfort-on-the-Main, Germany. App. filed June 19, 1912. Subjects colloidal matter to electro-osmosis.

1,326,120. Induction Furnace; Magnus Unger, Pittsfield, Mass. App. filed April 21, 1919. Primary winding located above charge container.

Electrical World

The consolidation of Electrical World, Electrical Engineer *and* American Electrician

Volume New York, Saturday, January 17, 1920 *Number 3*

The Outlook and the Opportunity

THE year 1920 is one of promise for the electrical industry. Although 1919 was a year of turmoil, hesitancy and indecision, there is a perceptible rift in the lowering clouds of unrest, indicating a change for the better in the economic and social affairs of the country. This, if it come to pass, will naturally have a very steadying and salutary effect.

In the assurance of our economic power we have given little heed to the canker gnawing at the nation's vitals. It is estimated that it cost labor something like $725,000,000 and capital $1,250,000,000 to fight out the issue of higher wages in 1919. This has made little impression on the public mind, however, which does not exactly sense the great danger inherent in ultra-radical doctrines. It is true the world war has ended, but the nation is face to face with another great struggle. This one calls for work instead of fighting, conservation instead of waste, thrift instead of profligacy, and construction in place of destruction.

The general labor situation, while it has weighed heavily on all, has really been a boon to the electrical industry, serving to lift the profession and the trade in the public mind to a height never before attained. Everywhere the drift is toward labor-saving devices. In the factory, on the farm, in the office and in the home, there is a wider and keener appreciation of the general applicability of electricity to industrial and domestic processes, and as a result manufacturers have been unable to supply the demand. This of course, means a period of continued prosperity.

IN THE complex problem which the country is called on to solve lie immense chances for the engineer. Greater production is the need of the hour, and to make this possible in the face of a shortage of labor is the function of the engineer. Considering the pressing needs of the world, no impediment must be permitted to lie athwart the path of progress. When labor is scarce and high in price, means must be provided for meeting the situation. Therefore there is a greater call for engineering skill, power and electricity; but this want cannot be met by an industry already taxed to its capacity unless there is greater expansion and marked change in the attitude of investors toward public utility securities.

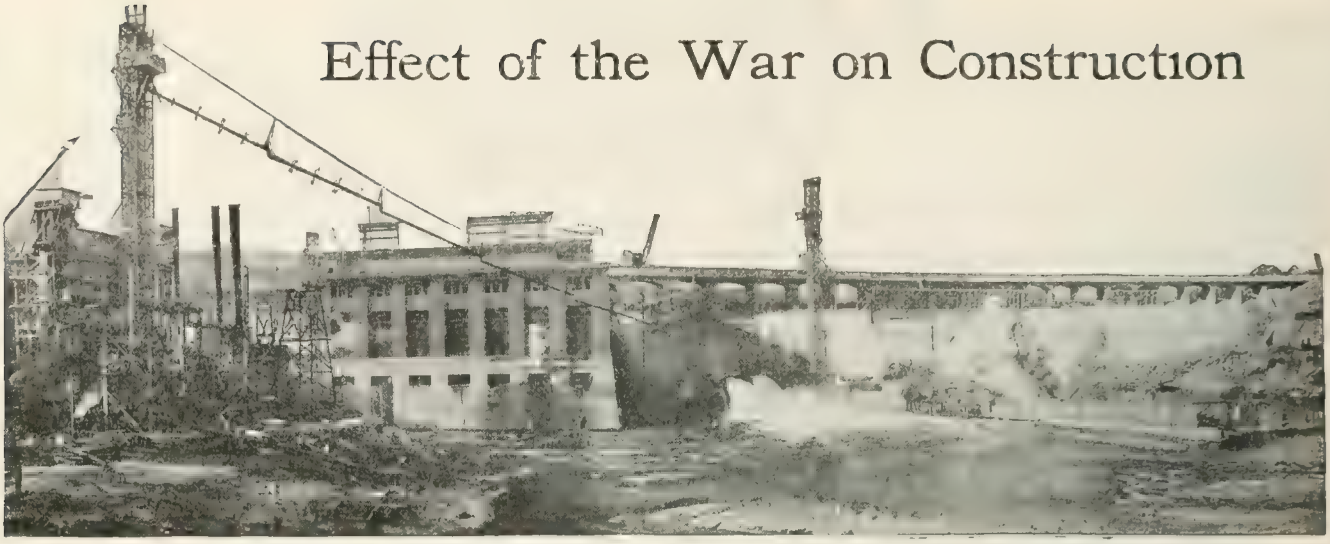
The industry needs approximately $1,000,000,000 of new capital right now to care for the expanded requirements of the country. Three-quarters of that amount can be employed in the central-station industry alone, and the rest could be absorbed by manufacturers, jobbers and dealers. General manufacturing east of Indiana and north of the Mason and Dixon line has expanded to such an extent that $500,000,000 is none too much to expend on electric utilities there, and it is the public duty of the industry to meet that obligation.

THERE is a grandeur and majesty in the irresistible onward march of the industry, and no one can contemplate the progress made without feelings of admiration. The opportunities for continued growth and expansion are still as great as ever, but now continued expansion is predicated on the ability of the industry to raise large sums of money, and this in turn hinges on the earning power of the investment. Utility managers and electrical engineers may be as alert and as aggressive as ever, but these qualities are of no avail without financial backing. Public utility securities must be attractive to investors if money is to be forthcoming, and the state public utility commissions have it in their power to make them so. Investors at present are not keen for public utility securities as a class. One need look no further than the security market for evidence of this fact.

A CHEAP and plentiful supply of power is a vital need of all industry, and while Congress flounders about on the water-power question the power situation grows worse and worse. North, East, South and West, large projects are held in abeyance awaiting favorable water-power legislation. Coal has generally doubled in cost, and despite all the economy of production and efficiency in distribution of electrical energy, the cost of producing electricity from steam has also practically doubled. On the Pacific Coast, where water power is abundant, new hydro-electric projects under construction and the possibilities of further hydraulic development render the power situation less serious than in the East. In the East coal is and will continue to be the chief source of power, but such hydraulic sources as there are—and they are only about one-third developed—must be utilized if the cost of electricity is to be kept at a minimum.

At present both the public utilities and the electrical manufacturers of the country have more work than they can comfortably handle, and while the electrical manufacturing companies are expanding their facilities rapidly, public utilities are not. This does not bode well for the future. Considering the dependence of the other branches of the electrical industry on the continued growth and expansion of central stations, the great problem of the year is for all to unite in winning financial support for the public utilities of the country so that they may continue to develop. The market is there and so is the willingness to grasp the opportunity. Only funds are lacking, and to get these all branches of the industry must help.

Effect of the War on Construction



Pressing Need for Construction Exists as Result of Conflict—Demand for Mass Production Requires Better Load Factor of Workers and More Efficient Use of Resources

BY COL. PETER JUNKERSFELD
Engineering Manager Stone & Webster, Boston

THE ultimate object of nearly all industrial and public utility construction is to facilitate production. The need of increasing production is worldwide. In our own country our most important and immediate economic problem, as a result of the war, is to take up the slack in production. This affects every consumer and every family.

Our best authorities and the world's best authorities all agree that the only method to reduce the high cost of living substantially is by increased production. In many instances it will be possible to accomplish this with existing facilities or with such betterment of existing facilities as requires only a relatively small amount of new construction. However, there can be no large increase in production and the necessary public service and transportation, unless additional facilities are provided, which in turn means in the aggregate a large volume of construction undertakings. This means correspondingly more electric power supply and other utility service and new construction for such purposes.

During the war practically all new construction was discontinued, except that needed for war purposes. At this date, while large commitments have been made, actual construction has not reached its pre-war level in volume. There has thus been about three years' interruption, which would mean, if all other factors remained as before the war, about 33 per cent increase in requirements above the pre-war level for each of the next three years, and a lesser annual increase if spread over, say, five years. This is offset in part by such of the war construction as is available for commercial purposes and for housing. The population of the country has continued to increase, and the requirements for more comforts and more luxuries have increased. These again demand increased facilities for production and increased housing. So much for the need and possible demand for construction.

If such possible demand, or even a considerably lesser demand, is experienced during the next year or more, can it be satisfied? The stocks of most materials and equipment were heavily drawn upon and many were depleted during the war. These stocks have not been replenished. The rate of production has averaged much below the pre-war rate. The result has been inevitable shortage and increasing prices.

During the war a very large percentage of the workers of the country were drawn away from their usual employment and environment. Not only were approximately 5,000,000 men called for military service, but very large numbers of workers were called away from their homes to engage either in their regular work or in entirely different work, such as in munition factories, shipbuilding and the like. The war work and the stoppage of war work necessarily caused much shifting of workers and much unrest. Many strikes occurred, some in basic industries and utilities. Unfortunately, the purchasing power of wages is much lower than it should be. The solution of this difficulty, however, lies very largely in more production per worker per year.

At the beginning of the year 1920 we are faced with an urgent need and possible demand for much additional construction, but also with great shortages in the necessary materials and labor output. What are the outstanding lessons of the war that can be applied to this situation? The usual answer would be: Better co-operation and more enthusiastic getting together and working together such as prevailed in a large way during the war.

The conditions to-day, however, are very different. There is no such common incentive as was furnished by the national determination to win the war. It is now largely a matter of effort for individual benefit or for the benefit, to a limited extent, of groups of individuals. This is probably as it should be, so long as any of these efforts are not against the general or national interest. The opportunity for individual initiative is our greatest blessing and has probably been the greatest factor in the development of our country. It also means a certain automatic selection in the commercial development of such commodities, luxuries or service as are most desired by the public. These may or may not be what are most needed.

Some things, particularly public or semi-public service, may be very badly needed; but, if the expected benefits affect as a whole the entire country or an entire state or an entire city and benefit individuals or groups of individuals to only a very small extent, it is quite likely to be a case of "everybody's business is nobody's business." In government construction, for example, there is great need for a national Department of Public Works. All the leading countries of the world, and also several of our own states, have put such work on a business basis by the organization and operation of a department of this kind. At present, however, our federal government construction work is distributed among the various Cabinet officers, many of whom, in addition to their primary functions, have a bureau or bureaus handling a large volume of construction business, these bureaus being entirely independent of each other. The American Society of Civil Engineers pointed out some thirty years ago the unbusinesslike organization of federal government construction. Several attempts have been made to correct the matter. The war has brought this deplorable situation to the attention of a very much larger number of people, and another and more determined effort is now being made to rectify it.

COL. PETER JUNKERSFELD

The country as a whole needs, and if business conditions permit there will be a demand for, more construction in order to secure facilities for more production and thus increase the purchasing power of wages. We cannot have more construction until we secure more production. Each of these processes is dependent upon the other. Each needs large numbers of workers and especially more output per worker per year. This means, first, a better yearly load factor for each individual worker and for all facilities employed in each process, and, second, the use of more labor-saving equipment and apparatus.

The total yearly wage of the worker is usually proportional to the yearly cost of proper living of such worker and his family. The cost per unit of output resulting from such wage is, however, proportional to the number of hours of diligent and efficient work done by the worker per year. Likewise, the cost of using labor-saving machinery and equipment is directly proportional to the number of hours' use per year. All this should mean a stronger incentive to improve existing facilities and so to organize and construct additional facilities as to encourage the best yearly load factor and best continuity of employment of workers and of facilities.

In power production it suggests encouragement of the policy found necessary to conserve fuel during the war, namely, interconnection of power stations wherever possible and operating the more economical of these as many hours as feasible per year and shutting down the least economical, or, if not possible, then operating the least economical as few hours per year as possible.

It also means immediate and vigorous attention to the further use of water powers. The use of water power results not only in saving coal and the consequent release of corresponding labor engaged in mining and transporting coal, but also a saving in labor required for a given kilowatt-hour output for water power as compared with steam stations. Water-power investments are becoming more attractive. The rapidly increasing price of coal, together with the coal strike and uncertainty of continuity of fuel supply for the future, all indicate a resumption of water-power development in America.

The war and other experiences with greatly increased output per dollar expended for labor have demonstrated that no business can remain solvent indefinitely with rising costs and fixed selling prices. This has applied to rail and water transportation, public utility service, large construction undertakings and any others in which it is necessary to predict prices for material and labor output per dollar far in advance in order to determine an acceptable selling price. Such uncertainties have resulted in the widely adopted "service-at-cost" basis for operation of many public utilities. In large construction work the fee basis of compensation for service is being used more than before as the most advantageous to all interested. Recent tendencies have been toward further increase in prices. If history is repeated, there must some time be a decline in prices. The "service-at-cost" and "fee basis" both provide for that eventuality with fairness to all parties.

The war has brought about a better appreciation of the economic advantages of mass operation, especially in railroads, public utilities, and in many manufacturing and construction operations. The fundamental advantages of diversity and resulting better yearly load factor and mass production have for some years been recognized in electricity supply and distribution. The better yearly load factor and the larger output justify and require the more efficient and high-grade equipment.

The same fundamental holds in manufacturing, in engineering and in construction organizations. A more or less isolated organization, if it attempts to carry sharp peaks caused by occasional large jobs, is at a great disadvantage economically on peak work, but not necessarily on such regular work when it can maintain a good load factor. The interest of the ultimate consumer would seem to indicate that more attention might be paid to the diversity and load factors of organizations. This means that some organizations shall devote themselves largely to non-coincident peak loads of a larger number of other organizations, with the result that both classes will have a better yearly load factor. It would also mean a better yearly load factor for all individuals in each of these classes of organizations.

Seeing the Optimism for the Electrical Industry

Chairman Tripp of the Westinghouse Company, Analyzing Present Conditions, Calls Attention to the Adverse Elements, but Emphasizes the Great Demand for Materials and the Need of Economical Production

QUIETLY dropping his civilian duties, Guy E. Tripp, chairman of the board of the Westinghouse Electric & Manufacturing Company, went to Washington in January, 1918, with the commission of colonel and the responsibilities of head of the division of production of the Ordnance Department of the United States Army. At the time of the armistice he had been promoted to assistant chief of ordnance with the rank of brigadier-general. When he was awarded the distinguished-service medal by direction of President Wilson the citation in army orders said that he had "displayed fine technical ability and broad judgment in systematizing methods and practices, resulting in the efficient co-operation of industries producing articles of ordnance for the army."

GENERAL GUY E. TRIPP

After the armistice was signed General Tripp returned to his company activities. He has been abroad twice in the last year. His experience at Washington, fused with his outlook as chief executive of the Westinghouse company, broadened further by the opportunity for personal contact with some of the conditions in Europe, leads him in analyzing the present situation to lay great stress on the importance of economical production. He has discussed the main factors which make up the business outlook with a representative of the ELECTRICAL WORLD. Notwithstanding the adverse elements, he believes that the balance sheet of the industry justifies optimism.

"More than a year has passed since the war demoralized all of the ordinary commercial life of the world, and we are still far from a normal state of affairs," said General Tripp. "The United States is alive with the activity which comes from intense industrial development, and we are in danger of failing to consider carefully all of the elements which can arrest or deflect that activity and leave other less desirable conditions in its wake. This country ended the war with its wealth the greatest of any nation, its man power only slightly reduced, its productive manufacturing capacity at the highest point. For more than a year we have had more business in all lines of industry than could be handled comfortably, and no end of the large totals is in sight."

HOW LONG CAN PACE BE MAINTAINED?

Chairman Tripp was asked how long, in his opinion, we can keep on at the industrial pace of the present time. "Will it be possible to maintain production at a high level, to keep labor continuously employed, to go on for one year, for two years, for three years, without change or slackening of speed?"

"It is of course impossible that present conditions can continue permanently," he replied, "because periods of quiet are certain to alternate with periods of intensified activity. Whether a change will take place soon or whether it will be at a date far in the future, whether it will be violent or easy, no one can answer accurately. All that a business man can do is to survey to the best of his ability and intelligence the influences which apply particularly to his own affairs and to reach the wisest conclusion that he can form. Even after the prudent manufacturer has reached a conclusion he will want to safeguard himself with a bulwark of the alternative possibilities; for there is always a chance of unexpected development.

"So far as the Westinghouse company is concerned, the bulk of evidence now points to a continuation of large totals in orders received. We are organized for this; we expect it. The demand upon our facilities is a heavy one. Even since the armistice there has been a call for electrical apparatus and supplies greater than we could meet, and it shows no signs of lessening. We have new facilities for manufacture, due to the construction of the new works at Essington, Pa. These works and the plant at Springfield, Mass., acquired in connection with war orders, provide a very substantial enlargement of our manufacturing resources as compared with those of a few years ago, and the elimination of war business for the government leaves the company free to use its entire resources for general industry. The situation is, therefore, that because of the expansion before and during the war and our completion of war orders we are able to largely increase our volume of production in regular lines. However, if business should continue to grow we should, to speak frankly, have to expand our facilities."

It was pointed out by General Tripp that, even with conditions as promising as they appear to be, there is an element of risk in plant expansion under any conditions like those now prevailing which a manufacturer cannot overlook.

"One factor in this risk," he said in reviewing these conditions, "is the excessive cost of construction. Another is that the manufacturers are necessarily carrying huge inventories. More plant means larger inventories and therefore greater possibilities of decline in the event of an unexpected sudden slump in business, with reaction in all prices.

"Another element of uncertainty is the labor situation. All labor is making high wages now and prosperity is widespread. Labor is in general less restive than it was a while ago. It is to be earnestly hoped that the need for production will appeal to labor in the electrical industries. Certainly this need is greater than ever before. The appalling conditions in Europe, the severe economic strain which the war has imposed upon all civilization, call for work, production and economy. Labor is not the only part of society that can help to solve the problem, for capital has an equal share in the responsibility. These two factors in production have a common duty to do all that they can to strengthen the economic structure of the world. If labor will do its fair part and the owners of capital will do what they can, such a spirit will have a leavening effect on the entire world."

THE INTERNATIONAL POINT OF VIEW

General Tripp declared that it is also important to consider the outlook from the international viewpoint. Disorder and restlessness abroad are the social symptoms which Europe exposes.

"But there is the financial one represented by the low level to which exchange upon European countries has fallen," he added. "In just what way improvement will be effected in the foreign exchange situation is not clear. I cannot conceive that such a problem will be allowed to drift indefinitely without concerted action to render it less harmful. Certainly it appears to be essential that a powerful co-operative influence shall be directed toward its solution in the near future. Until some steps of this character are taken, however, it is a large center of potential danger. It hovers like a menace over the economic well-being of Europe and it hampers our foreign trade."

Assuming for the purpose of this discussion that these various matters will be worked out in a way favorable to the continuation of trade and commerce on a great scale, General Tripp expressed confidence that export as well as domestic business of electrical manufacturers in this country is sure to increase steadily. As indicating the faith with which his company is moving forward, he mentioned the new arrangement which the Westinghouse company has made covering part of its foreign business. It has sold its holdings of securities in the British Westinghouse Company to a new English company, Vickers, Ltd. This company in acquiring these holdings also executes a trade agreement with the United States Westinghouse company.

"Under the agreement," General Tripp continued, "the two companies will try to supplement the facilities and organization of each other wherever that will be desirable. There will be exchanges of men and of technical knowledge. Such an arrangement will, we hope, be more than commercial in character. It is a fertile opportunity to promote the development of that cordial good feeling which will help in the solution of great world problems.

"Taking all of the conditions into account in what appear to me to be their relative importance, I feel a large degree of optimism in the future of the electrical industry."

California Asks Water-Power Development

Forty-eight per Cent of the Entire Area of the State Is Owned by the United States Government, and the Problem of Cheap Power Will Be Solved When the Natural Resources Are Utilized

BY JOHN J. BRITTON
Vice-President and General Manager Pacific Gas & Electric Company

THE intense development in the last few years in the possibilities of economical transmission of large blocks of power over long distances and the further intense development in large units of waterwheels and generators, making possible economical hydro-electric installations that have been left out of doors, have awakened new interest in the action of Congress—delayed now for nearly a decade—which it is hoped will result in opening the door kept closed by ultra-conservationists and nature lovers—that door behind which is the power that will make an empire of the West, not only agriculturally but industrially. The states with no great areas of public land have not suffered to the same degree by reason of the failure of Congress to enact proper legislation with respect to navigable streams as have the public-land states. This is particularly true of such states as California, where climatic conditions and absence of fuel other than oil render power developments essential not only to obtain power *per se* but also for irrigation in connection therewith.

We of the West are particularly interested in development on public lands and, as these seem to be the days to speak plainly on all public questions, I am free to state that I believe that sinister influences have been at work to retard this development, in order that nationalization might have a greater development. A desire to cater to this sentiment is noticeable in much of the proposed legislation of the past and present.

WAR SHOWS NEED OF MORE POWER

The war revealed the need of additional power to conserve the natural fuel resources, such as oil on the Pacific Coast and coal in the Eastern States. By reason of the delay of Congress in agreeing upon a proper leasing bill (so-called) the power companies of the Western coast particularly found themselves short of power to the extent of at least 100,000 hp., and had the war continued another year this shortage would have been increased to nearly 200,000 hp.

The western slope of the Sierra Nevada Mountains affords unusual opportunities for storage of water which can perform the double purpose of irrigation and power. The tremendous agricultural development in rice growing in California within the last two years has called for approximately 100,000 hp., and the shipyards needed as much more. This increased demand for power, added to the natural and normal growth in demand in all industries in California, has forced, in the absence of sufficient water-power development, the use of all the steam plants in California to a capacity of 100 per cent, and has exhausted and wasted between 1,500,000 barrels and 2,000,000 barrels of oil during 1919; and this condition will continue for the next two years at least, or until delayed construction can be made available.

In these days of large expenditures, when a billion dollars has become a common conception, it may seem small by comparison when it is assumed that there have been delayed in the State of California alone at least $150,000,000 in investments which would have been made in the last decade for water-power developments had a more liberal policy been pursued by those departments having public lands in charge. In the same time more than $50,000,000 has been expended in the erection and operation of steam plants for the generation of electrical energy. The next five years should show a development in California of at least 400,000 hp., and this amount can be obtained from the reservoirs and streams of the state. The cost of this development, without attendant connecting lines, will not be less than $100,000,000.

JOHN A. BRITTON

Had it not been for the co-operative work of all of the power companies of California in the interconnection of their systems, the problem of the supply of power during the last three years would not have been solved satisfactorily. The blame for the backward step which would have had to be taken in that event could have been placed only upon Congress and the apathy of those who would be most benefited by water-power development.

COMMERCE OF PACIFIC OCEAN WILL RIVAL ATLANTIC'S

The day is not far distant when the Pacific Ocean must teem with maritime commerce proportional to that of the Atlantic Coast. Our contact with the Oriental nations must grow stronger and bigger every day, and the natural fuel of the Pacific Coast—oil—must be the means of propulsion for the ships bearing the American flag that will ply the Pacific Ocean and Oriental waters, carrying trade to and from those ports which are developing so rapidly as to need as much of our commerce as we need of theirs. Delay in production of hydro-electric energy will result in hastening the depletion of oil lands, which would mean the substitution of other fuels at greatly increased prices, to the detriment of the growth and development of the Pacific Coast.

It may perhaps not be known generally to what a degree the public-land states of the nation are retarded in their growth because of the fact that they are public-land states. In California more than 48 per cent of the entire area of the state is owned and controlled by the United States government; every stream that finds its source in the frozen snows of the Sierras is marked and plotted on its way to the sea by power-site withdrawals, forest reserves and vacant lands. Such difficulties beset efforts to obtain possession of these for the developments which are needed so greatly as to make these developments in some respects onerous and impossible. God speed the day when sanity will rule in legislation affecting them!

I do not believe it is within the thought of the better minds of this country that the prosperity of a people can best be advanced by government ownership of public utilities engaged in the generation and distribution of light, heat and power. In the final analysis of service of this kind to the people of a state, the burdens and restrictions imposed by government control, whether by ownership or by regulation, inevitably react upon the ultimate consumer.

THROW OPEN THE PUBLIC LANDS

The solution of the problem of cheap power, which even under restrictive conditions California now enjoys, would be to throw open these land-locked government possessions to any legitimate corporation organized as a public utility and encourage its development in every way. The government could take this course safely, especially as the business of public utilities is so well regulated to-day that excessive profits cannot be earned; and by the very use of these natural resources for the benefit of the people the people themselves would be the beneficiaries in the end.

For the last seven years the subject of a proper bill regulating entry upon public lands for the purpose of hydro-electric development has been before both houses of Congress. When it has not been ignored it has been virtually talked to death in each session because of general ignorance as to its important effect on an integral part of the nation, one small in population but potential in its future both in population and political influence.

I have always contended as a Westerner that the problem could be solved if Congress, or the committee having under consideration the question of a proper bill, could only be induced to take the time to visit the entire Pacific Coast and visualize the splendid possibilities that these public lands would have if developed for a useful purpose, instead of, as now, being held for the mere purpose of ownership.

The success up to the present time of railroad electrification offers one of the best reasons that can be given for the encouragement of a proper use of government lands for these developments in the Western area. Such developments will speed the day when all the railroads in California will not be dependent upon the fuel from the ground but will be dependent only

Water Powers Await Proper Legislation

More than 44 per cent of the 54,000,000 hp. available water power in the United States lies in the Pacific Coast States, and its development is being delayed by want of legislation that will make the developments attractive to capital. Despite this condition some electric service companies are going ahead, in the interest of conservation, to develop water power.

The top view is the site of the Kerckhoff dam, which is being built by the San Joaquin Light & Power Corporation to impound water for a 45,000-hp. plant that will transmit power at 110,000 volts to McKittrick. The power developed will serve growing oil-field loads.

The bottom view shows a point on North Fork River where two tunnels will be driven through the mountains by the Great Western Power Company as part of a 40,000-hp. development to supplement the 75,000-hp. station shown.

upon the falling waters which are now unused though holding such potential powers. The arteries of transportation of this state run parallel with the greatest rivers in the state and across the mountain ranges where every year nature provides the means for transportation.

In conclusion it might be emphasized that primarily the power companies are not so much interested in the hydro-electric developments in public-land states as are the people of those states. The people are the ultimate beneficiaries of whatever developments may be made, developments which will result in cheapening power and awakening industry. That developments have been delayed for so long may be attributed in some degree to the apathy of the people themselves and the consequent more or less apathetic attitude of the representatives in Congress from all of the Western States.

We on the borders of the Pacific Ocean are so far away from the centers of the government that our cries are seldom heard. It is my hope, that the year 1920 will open up a new era for this coast, and no greater guarantee of a successful era could be given to its millions of people than that it might be permitted to enjoy its own land and the fruits thereof.

A Forecast of Public Relations in 1920

Utilities and Customers Have Met the Test of War Prices and Face the Future with Confidence—Corporate Good Citizenship a Factor in Getting Community Good Will

BY SAMUEL FERGUSON

Vice-President Hartford (Conn.) Electric Light Company

THE most important task of the central-station manager is the establishment and maintenance of sound public relations. Continuous first-class service must be supplied to satisfied customers, but this is not all. The good will of the entire community must be sought through a policy of fair dealing, constructive co-operation and what might be called corporate good citizenship.

In response to the request of the ELECTRICAL WORLD for an expression of views upon the outlook in the field of central-station public relations at the beginning of the new year, I point to the foregoing considerations as fundamental to the prosperity of the public utilities and the people whom they serve. To supply our customers with what they want may seem upon superficial examination a mere commonplace, yet it involves a willingness to appreciate and to accept their viewpoints upon matters often considerably removed from the immediate problems of distributing energy to the individual consumer. For example, the customers of the Hartford Electric Light Company strongly favored the daylight-saving plan and desire its re-establishment this spring; therefore the company has done everything in its power to make possible a continuation of the system locally this year, but with the clear understanding between it and the public that the loss of revenue will postpone the date when rates can be reduced.

It is encouraging to see a constant improvement in central-station public relations as the years pass. The increased cost of operation brought about by the war necessitated many central-station rate advances. Acceptance of these by the public with so little opposition testifies to a general comprehension of underlying conditions and is a most hopeful sign for the future. The Hartford company was the first in Connecticut in the war period to increase its rates—a clear indication that its former margin above expenses was only reasonable. This being clearly understood, the advance was willingly met by the public, and the continued high costs are recognized as sufficient reason for the maintenance of prices necessary to insure a fair return upon the capital invested in the system.

I believe that central-station customers as a whole throughout the country appreciate that increased prices for energy could not be avoided by the companies serving them and that the need of retaining rates which compensate for world-wide cost advances is generally recognized.

There appears no immediate probability of materially reducing central-station rates. Operating expenses continue high, and fixed charges upon post-war construction considerably exceed their predecessor costs. Until the war was considerably advanced fixed charges in many central stations were based upon much lower investment costs than were later forced upon the utilities. Between 1915 and 1919 the capacity of the Hartford plant was doubled, and the company takes pride in the fact that the cost of this expansion was but 38 per cent more than if the work had been done under prewar conditions. For some time, certainly, investment costs will be relatively greater, but it may be hoped that by increasing the volume and extent of electric service, by the development and interconnection of large stations, by the utilization of water powers susceptible of economic development, and by the most energetic engineering and commercial activity, central stations will be able to effect operating economies which will be reflected in decreased rates.

Electric service is a great and growing public necessity. It is gratifying that public relations have reached a plane of mutual confidence upon which costs, prices and a fair margin of profit from time to time can be analyzed and determined satisfactorily and harmoniously.

WE WHO have studied the problems of the development of the West know that the West will not develop ahead of its hydroelectric development. The greater portion of the Western territory depends upon hydroelectric pumping for irrigation of its arid lands, if agriculture is to be further extended. If factories are to be located West, cheap power must be obtainable.—*A. E. Wishon.*

Employee Representation in Industrial Plants

Works Council Plan Offers Hopeful Method of Securing Better Relationship Between Employer and Employee—Although Young in Years and in the Experimental Stage, the Plan Deserves Serious Consideration

BY MAGNUS W. ALEXANDER
Managing Director National Industrial Conference Board, Boston

THERE is no doubt that the subject of works councils is one of the important current phases of the labor problem—universal in interest among thinking executives.

It is an interesting fact that among American industrial concerns which have introduced works councils are some of the largest electrical establishments of the country.

Experience thus far with employee representation in industrial establishments in the United States has on the whole been favorable. In general, a conservative and intelligent type of employee has been selected to represent the workers, and apparently a better spirit between management and men has been promoted, according to the results reported up to this time. Experience has been too brief and too limited thus far to warrant final conclusions, but none the less it seems that a truly constructive method of dealing with a very difficult problem has been approached.

In itself, the works council is not a panacea for industrial unrest, but simply one kind of machinery to secure better industrial relationships. Its success or failure depends largely upon the spirit with which it is introduced and the environment under which it operates. Under some circumstances the works council may be impracticable or even inadvisable, as perhaps where harmonious relationships already exist in an establishment. The result and not the means are of paramount consequence.

The very essence of the movement is the principle of collective dealing between the management and its own employees in a given establishment. Under a plan of employee representation, questions previously settled between the employer and the employees individually are handled by representatives of the employees collectively, and, moreover, on a systematic basis. Recognition by the employees of individual establishments of the principle of collective dealing with their employers forms the very basis of the works council. Such collective dealing is, however, distinct from "collective bargaining" in the sense of dealing with an outside agency such as a labor union.

The desire on the part of the employer to establish more intimate contact with his employees, and, on the other hand, the wish of the workers for effective representation of their interests, have long been active forces in industry; but the works council in its present form is a comparatively recent development. The first example of a works council in the United States dates back only to 1904, and practically all existing works councils were established during the past twenty months. Their rapid increase in number during this period arose mainly from abnormal war-time conditions, particularly in the shipping industry and the metal trades. Works councils vary widely in their form and scope, but common to all is the election of employees' representatives by the workers themselves on some democratic basis of representation. The contact between management and men is on a definitely organized and systematized basis and is continuous.

A recent report issued by the National Industrial Conference Board on "Works Councils in the United States" points out that while a choice between the "govermental" and "committee" types of organization is largely a matter of personal preference, experience indicates that the committee type in general is the more desirable because of its greater flexibility. The report describes the many varieties of organization, among individual establishments, of these two types of works councils, presenting a vast amount of detail, both for the student of the subject and also for the practical use of the employer. The organization is often carried to considerable lengths in order to meet conditions encountered in very large establishments. Comparatively few deal with matters of general business policy, but in the main such subjects as the following are handled: Terms of employment, hours of work, wages, piece rates, personal grievances, shop discipline, hiring, promotion and discharge. In a majority of establishments using the works council plan no provision is made for further reference of disputes after the council has failed to reach an agreement, but it is interesting that in experience with works councils thus far matters have seldom reached a deadlock.

Experience is still too limited to permit extended deductions as to the effect of works councils upon production, labor turnover, reduction of labor difficulties, absenteeism, tardiness and improved working methods. In some cases beneficent results have followed in these directions, and the tendency appears to be toward the betterment of industrial morale in general. The permanent value of the movement cannot yet be measured, but about three-fourths of the employers having works councils from whom the board obtained an expression of opinion declared themselves in favor of this form of industrial organization, or that their experience had been favorable.

The movement for works councils is a very interesting experiment in the field of establishing such relations between employers and their employees as will stimulate individual effort, insure adequate compensation for the effort and create and maintain an atmosphere of mutual confidence and respect. It cannot be emphasized too strongly, however, that the works council movement is essentially an experiment which must be guided wisely and intelligently until its value in its present or in modified form is definitely established. One other point must be kept constantly in mind, and that is that different establishments need different treatment in respect to their industrial relations, and therefore a works council plan that may prove successful in one establishment may need more or less extensive modification to fit it for another plant. Nay, more than that, in two establishments of exactly the same character and size different methods of approach to the subject and different applications of the plan of works councils may be needed, because the basic conditions of industrial relationship may be different and different personalities may be the controlling factors.

Having thrown out these precautionary thoughts, I feel that the works council movement deserves earnest attention on the part of industrial managers. If a manager should conclude to establish a works council in his plant because of his belief that he can thereby improve his relationship with his employees, he should deal with this problem not in a sentimental fashion but in the sense in which he would inaugurate and develop a new engineering experiment.

Merchandising's Greatest Season—1919-1920

A Review and an Outlook on Electrical Merchandising Conditions Which Frankly Discusses the Tendencies That Are Visible and the Problems That Must Be Solved to Aid Further Development

BY E. A. EDKINS
General Manager of Electric Shops, Commonwealth Edison Company

AN AMAZING volume of wholesale and retail sales, a market in a chronically oversold condition, frenzied efforts by manufacturers first to double and then to quadruple their production, development of devices by individual manufacturers to provide a complete appliance line under one trade name, high prices generally, free from profiteering, and the introduction of new articles to apply electricity more broadly—these are the high spots, the important developments and tendencies which have stood out in the year 1919 as it is reviewed. Varied as are these indications of the electrical merchandise industry's progress, they all go back to a fundamental cause. High-priced labor made the year 1919 what it was. High-priced labor in spending its newly acquired wealth made the market. The same labor because it was high-priced and indolent precluded all posibility of meeting the demand.

Early in 1919 the conservative thinkers of the industry frequently urged caution in developing plans for expansion. Each such expression was answered immediately, however, by some sales enthusiast with staggering orders waiting to be filled. This division of belief in the future created some uncertainty, while the question of duration of the post-war prosperity was debated. The discussion ended in the customary compromise.

It is quite true that some manufacturers did double their outputs in the full belief that they were plunging. Some built new factories, some took over huge areas of factory space which had been devoted to war work. Quantities of material and labor which were then thought very large were bought and assembled. Present indications, however, are that even if the expansion plans of those early months had been quadrupled the manufacturers would have been acting conservatively.

August first found these appliance builders attempting to evade the taking further orders, and by Dec. 15, 1919, some were refusing to take any additional orders for 1920 delivery. Naturally in such a market shortages of goods become the chief topics of discussion. Notable among the lines that have been most difficult to obtain in adequate quantities are urn-type percolators, high-class plated ware, electric air heaters of the coil and reflector type, grills, toasters, vacuum cleaners and washing machines. Articles in the luxury class seemed to be most eagerly sought by the buying public, but no line escaped its share of attention.

Even in electrical stores where the buyers had been exceedingly bold, purchasing early in hitherto unheard-of quantities, the Dec. 31 inventory will be "taken with a whisk broom." Timid buyers have been forced to watch eager Christmas crowds surge to their stores only to find depleted shelves. The period for the traditional January clearance sale will find nothing to clear, unless the merchant has been fortunate enough to secure advance delivery on goods intended for sale in February and March. In that case early shipments can be offered, but the fact must be faced that the buyer is then two months behind his usual well-planned schedule.

The interest of the public, and especially the high-grade public, in things electrical during this year has been something at which to marvel. This has been made evident not only by the volume of sales but also by attendance at various electric shows. In Chicago, for instance, free tickets were not issued, yet there was a very large and satisfactory attendance, and it was the *profitable* attendance of a public not only exhibiting intelligent curiosity but also displaying desire and ability to buy. Within the crowd were many dealers from other cities seeking merchandising opportunities and eager to place orders for 1920 delivery.

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Consideration of these wide-awake dealers has become a part of the appliance manufacturers' problem for 1920. One result of this consideration has been determination on the part of the larger appliance makers to round out their lines. With this accomplished they can offer dealers a complete line under one trade name and can reasonably ask his individual attention to the sale of their goods.

While a part of the effort in rounding out lines has developed nothing more than additional makes of familiar devices, another part is devoted to producing improved models and entirely new things. Mechanical improvements in washing machines may be confidently expected. This expectation is borne out by the appearance of a considerable number of experimental devices during the last twelve months. Many keen minds are studying these problems and they will soon be solved.

FROM HOUSEHOLD TASKS TO HOUSEHOLD PLEASURE

Turning from a consideration of home drudging to home entertainment, it may be observed that the motor-driven talking machine will also bear close watching as a central-station merchandising proposition. As an energy consumer it just about equals the washer. Its big feature, however, is that it, like the washer, becomes an agency which further crystallizes the sentiment of the household favorably toward electric service. Development of this business in the past has been retarded by the fact that early designs permitted varying frequency and voltage to vary the motor speed, and this of course interfered with accurate reproduction. Newer types with motors and governors developed especially to overcome this trouble are entirely practicable, especially in larger centers where good electric service is given.

This talking-machine opportunity is one which deserves emphasis. Central stations which expect to do a merchandising business now realize that retail sales must be made to show a real profit. The lines which they handle are not all high-profit lines. To analyze this, goods ordinarily carried by electric shops may be divided into three classes. First are the lines such as portable lamps and silk shades which, figured on the basis of selling cost, carry a mark-up of at least 50 per cent. Second are the general appliances, which on the same basis show a gross profit of approximately 35 per cent to 40 per cent. Third are the wiring supplies, automobile accessories and the like with a margin of about 25 per cent to 30 per cent profit. Now, if the average electric shop overhead is 25 per cent, it is perfectly apparent that it behooves the management to be alert for more goods of the first class that can be legitimately sold in an electric shop. The talking machine is such a piece of goods. It carries a fair margin. The daily output in the United States is around 15,000. The side-line business in records is profitable. Moreover, art models are coming in to add further attraction to the line.

Other merchandising developments which are in progress or which should be sought include intense activity in the electrically operated daylight bakery business, motor-driven household refrigerating plants, dishwashers and American electrically driven toys. The vacuum cleaner, which has perhaps been perfected to a degree unequaled by any other motor-operated household device, could be still further improved if a motor could be built that would not give off the high-pitched whine of present models. There appears also to be a very real market for a dependable electric flatiron at $5. This is leading to the development of alloys which do not infringe existing patents and which are suitable for heating element construction. Irons which have these characteristics will without doubt appear on the market early in 1920.

PRICES TO GO STILL HIGHER

Prices for electrical goods generally in 1920 will be higher. This statement is based both on a knowledge of the oversold condition of the market and on the fact that electric flatirons, the thermometer of the appliance price list, are to be increased in price to $7.50 soon. Prices which will at least not be lower are the only natural thing to expect, because there is no hope of increasing the available supply of labor and labor is the big part of electric appliance costs.

Three principal factors enter into this labor situation. They are the high cost of labor, the scarcity of labor and the deliberate inefficiency of labor. While these factors are dominant a marked reduction in prices is out of the question. Moreover, with the manufacturers able to take only about 50 per cent of the domestic business being offered to them and with easily secured export trade awaiting development, firm markets must hold. Fortunately the electrical industry has been free from profiteering as a general thing, and it is the knowledge of this fair-price policy that enables the retailer to face the future unafraid.

The Responsibility Upon the N. E. L. A.

Electricity Is the Dependence of the Nation for Development and Increased Production, and Hydro-electric Utilization of Resources Is the Paramount Duty of the Present Day

BY R. H. BALLARD
First Vice-President Southern California Edison Company and President National Electric Light Association

AS WE enter the new year the extent of the large responsibility resting upon those in charge of the electric properties of this country is seen to be greater than ever before. From now until the annual convention of the National Electric Light Association in Pasadena, Cal., May 18 to 21 next, there is need for earnest work and constructive thought in matters affecting the industry. We are just beginning to realize that the nation must depend almost entirely upon electricity for its future development and for the increase of production which is the controlling answer to the problem of the advanced cost of living.

Hydro-electric development on an enormous scale is the paramount duty of the hour. Public opinion is behind this big work and will continue to support it, so long as we give the service which the people demand. Fuel famines and coal strikes are regrettable but effective educational forces, which enlighten people concerning the desirability of developing fuel, light and heat from natural powers. The world is only commencing to use these powers. Under regulation, the price of the service resulting from economical utilization is reasonable, and the securities upon which the development must be financed are non-speculative and stable.

R. H BALLARD

The great question of hydro-electric development is one which logically will come before the Pasadena convention. Statistics showing what the possibilities are, as set down by various electric power companies which have investigated them, will aid materially in formulating financial programs that may reach a quarter of a century into the future. Upon this development we will have a basis for predicating the number of acres of land which will respond to electric irrigation and add enormously in the production of foodstuffs. The acreage which can now be tilled under rainfall is growing less every year, and the reclamation of the desert lands by the electric motor is a very practical way of increasing production.

The electrification of steam railroads would mean a saving of vast quantities of oil and coal, which will be needed in the coming years for ocean transportation. The committee having the study of this important subject in charge for the N. E. L. A. has before it an enormous problem whose wise solution of necessity must have a great bearing upon all future time.

In electrically driven factories labor is most efficient with the largest output per unit of labor. Conservation is also enhanced by the displacement of steam engines by electric motors.

It is earnestly hoped that the number of geographic sections of the national association will increase and that they will do their work so thoroughly that the national conventions can become more and more representative and deal with questions which have been analyzed locally and brought to proper conclusions.

PLANS FOR THE PASADENA CONVENTION

At the Pasadena convention the policy will be to have practically all sessions general in character, and at these sessions big broad subjects affecting the industry at large will be considered. It is highly encouraging to find that men in the electrical business in all parts of the country are responding very liberally and enthusiastically to requests for service on committees.

A number of prominent operators and investment bankers are being invited by the Pacific Coast companies to go to the Pasadena convention and participate in the discussion of the subjects of country-wide interest as well as to become personally acquainted with the electrical and general business development of the Pacific Coast, which has been so substantial during the last few years. Representatives of state public service commissions are also being asked to attend the convention. A general face-to-face contact and rubbing of elbows between those who are really responsible for the electrical development of the country after a year of strenuous preparation and reorganization should make it the most helpful event of the year 1920.

For day-to-day helpfulness to all of its members, the N. E. L. A. is working out plans to provide real service to member companies on a member of important subjects. This, of course, is under the direction of M. H. Aylesworth, executive assistant to the president. Since becoming associated with us a few months ago Mr. Aylesworth has demonstrated great ability for organization and aggressive administration.

The first of January marks the close of the first half of our administrative year. It is gratifying to report that, through the splendid co-operation of Vice-presidents Martin J. Insull, M. R. Bump, Frank W. Smith and Walter H. Johnson and all officers of the association, sections and committees, considerable progress has been made. I am sure that this enthusiastic co-operation will continue, and we confidently expect to round out a year of helpful service, culminating in a rousing, working convention of accomplishment.

Company executives generally are interesting themselves in the educational courses formulated and distributed by our committee on education. Classes have been organized in a number of the larger companies, and they are directed by company engineers, accountants or executives, thus giving a personal touch to this educational work and providing a strong incentive to employees for greater advancement.

Physical arrangements at headquarters are being entirely changed by the elimination of dead walls and cubby-hole offices. Our new offices will be open, broad, light and airy. All members of the association are urged to make our offices their own on visits to New York. Personal contact with the officials in charge will be mutually helpful.

Electrical Conditions of 1919 and 1920

Insistent Demand Upon Every Part of the Industry in the Last Year Leads to a Volume of Electrical Production and Service in All Branches That Aggregates $3,225,000,000

BY THOMAS COMMERFORD MARTIN

NO ONE would expect the first year of peace after the greatest war in history to be a normal year, and it is very certain that 1919 will stand out through a long vista of time to come as most abnormal.

One of the two great problems of the period is, of course, the reconstruction and rehabilitation of the waste by war; the other is that of readjusting society to innumerable new conditions of living. Among the industrial and economic agencies upon which a special call is made in such strenuous times of transition is electricity, and in every department of the now vast electrical field the effect of the demand has been and is still felt most insistently, but not always beneficially. Just now it is more difficult to ascertain accomplished facts than to determine tendencies, especially as one of the notable features of affairs is the sudden revulsion, the swinging back of the pendulum. But yesterday the world was headed for everlasting smash by way of anarchy and Bolshevism; to-day the expression of public sentiment in the shape of strike failures and national elections is altogether encouraging to the belief that the strong foundations of human welfare still stand on bedrock foundations.

For many years the author furnished the ELECTRICAL WORLD with a review of each annual period, and it was interesting to see how steadily subsequent figures of an official character have justified the forecast. The practice is now resumed, having been suspended only for one year, when every energy and thought was bent on "winning the war" at any cost. Hence the statistics now given compare with those of 1916 and 1917. In those years the income from electric business, service, production and supply in general was set down roughly as follows, in millions:

	Value in Millions for 1916	Value in Millions for 1917
Central stations	$500	$550
Electric traction	750	800
Electric manufacturing	550	600
Telephony	400	425
Telegraphy	150	175
Isolated plants	150	150
Miscellaneous	125	125
Total	$2,625	$2,825

It will be seen that a general increase of 10 per cent is apparent or was assumed, following the development of the upward swing of the curve over a long range of years. The maintenance of the same rate of progress in 1918 and 1919 would bring the grand total for the year just ended to not less than $3,400,000,000 or, let us say, perhaps three and a quarter billions. A brief examination may be indulged in here to show what credence may be placed in such an enormous total.

CENTRAL STATIONS

The United States Census Bureau figures for 1917, issued last April, gave a total income for all central stations in that year of $526,886,408. It will be admitted that quite a creditable approximation had been made in the figure assumed in advance—$550,000,000. Examination of the figures shows that for the period 1912-1917 the percentage of increase was 74.3 and that the compounded rate of the period 1907-1917 was not less than 200 per cent. It is obviously not much out of the way to estimate total central-station income in 1919 at the sum of $650,000,000. The last two years have certainly seen the generating capacity of every steam central station and most water-power plants taxed to capacity, while there has been a general tendency in the

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direction of increasing rates, although it by no means follows that net income has been proportionately the gainer. Moreover, the latter year, while it witnessed some let-up in the demand for energy in war factories, saw also the factories of peace come again into their own, and the long-suppressed domestic cry for service has at last had a response, heralding a period of indefinite expansion. It is significant, for instance, that in a city like Minneapolis the local company should close contracts in ten months for 4,152 houses already wired. But the city which cannot show such figures must be the exception, and the growing scarcity of domestic help has enormously added to the day load shown by electric cooking and motor-driven appliances.

Electric Traction

In the estimate given herewith for 1917 the amount of $750,000,000 was set down for electric traction. It now appears from the census figures published for that year that the total income of electric railway companies was $730,000,000. If to that sum be added the earnings from electric operation on many steam systems, it will be seen that the estimated amount was well within the facts; so that for 1919 at least another $50,000,000 might be added to the sum due to be set down for 1918. Serious indeed as is the financial condition of many trolley systems, and desperate as is the need for their decent treatment by the public they serve, the fact remains that the gross amount of business done by the industry as a whole does not fall off but grows steadily, the greater aggregate wiping out completely any detail losses from the shutting down of a few miles of tracks here and there or the competition of the jitney.

Telephony and Telegraphy

There is no reason to suppose that the quantity and value of telephone service to the public has fallen in any degree in 1919 below its wonted rate of increase. There have been many reductions in telephone rates, but many increases also; and bad as the service was under the administration of the government, people had to have it just the same, while the return of the exchanges to private operation has brought new hope and vigor throughout the management. For 1917 the total income of the telephone was set down in the estimate at $425,000,000. The amount reported to the Interstate Commerce Commission for 1917 by the American Bell Telephone system alone was $284,112,385. The annual report of President Vail for the year ended Dec. 31, 1918, set down a hypothetical income for 1919 on four various bases, two of which furnished the sum of $375,000,000. From such bases it would not seem out of the way to infer a total for all telephony—Bell, independent, co-operative, etc.—in the year 1919 of $475,000,000, including of course a vast amount of interior service impossible to bring definitely to account.

The total earnings from telegraphy are at best difficult to set down on account of the range and multiplicity of service covered. In the census statistics for 1917 the total American operating income of land and ocean cable telegraph systems is given as close upon $107,000,000. To this should be added a total income of $1,385,000 of wireless companies. But these figures again would be seriously increased by the value of the service of the railway telegraph systems to the respective trunk-line companies, the press association telegraphic activities, and the value, if it could be expressed properly in income, of 1,329 municipal fire-alarm systems and 428 police patrol systems, supplemented by various private burglar-alarm systems in the great cities. There are also the American separate ocean cable systems, earning about $17,000,000 in 1917, and the government has a tidy little cable system of its own. All said and done, a total for American telegraphy in 1919 of $200,000,000 cannot be out of the way.

Electrical Manufacturing

Any comparisons of 1919 electrical manufacturing statistics with previous years as to totals are greatly perturbed by the inflation in values and prices of raw material and product, hardly yet culminating or showing signs of recession. A total value for 1917 was set down in the table given of $600,000,000. Last June the Electrical World published an interesting table of the sales for 1918 of three of the largest electrical manufacturers and distributers, viz., the General Electric, Westinghouse and Western Electric companies, showing a total of $522,421,000. From this it is evident that the estimated total was extremely conservative, including as it did the output of some 800 or 900 more electrical manufacturers with individual values reaching into scores and tens of millions in many instances. Besides this, the expansion has gone on in many old and new fields by new and old concerns. It was recently stated publicly that the sales of home electric lighting outfits for farms in America reached at least 100,000 in 1918 and would run far beyond that in 1919. Exports again have been markedly large, and a total not far short of $60,000,000 in 1918 may be reasonably accepted for the past year also. Hence a total value of output of $750,000,000 in 1919 may be proposed as probably not far from the mark.

Isolated Plants

There is a general impression that the number of isolated plants and the amount of business incident thereto does not tend to increase. Nevertheless it may be remembered that in 1916 the Electrical World, after a careful study of the subject, put the annual earnings of such plants as equivalent to $200,000,000. It seemed an excessive figure, but if 100,000 new plants can be installed yearly on farms and if account be taken of all the new isolated plant work needed for steamships, motorboats, yachts, etc., an amount of $150,000,000 does not look unduly large. The next national census should bring to bear many items of data not now available of that character.

Miscellaneous

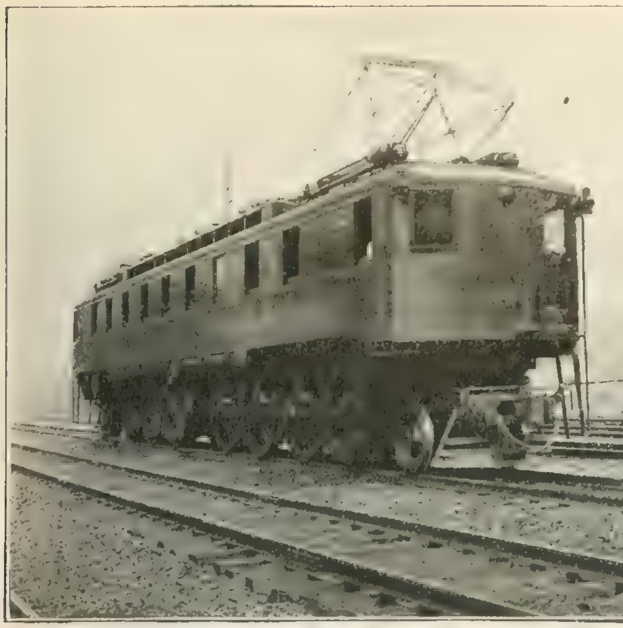
A total of $150,000,000 may be assumed for miscellaneous production and earnings. This would include as two main branches electric vehicles and electrotherapy. The electrical field includes a great variety of articles and supplies peculiar to itself, though not produced by electrical manufacturers, and which would not be made if the electrical arts did not call for them—goods in steel, wood, pottery, glass, etc.

The resultant table of the above totals follows:

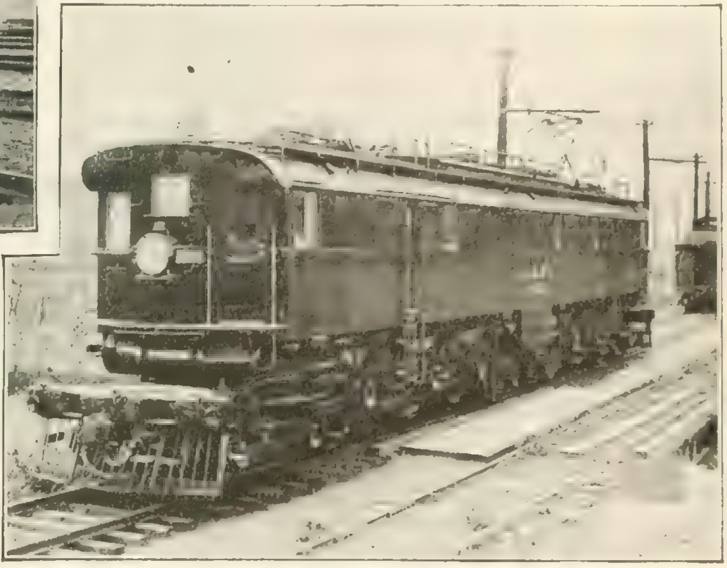
Central stations	$650,000,000
Electric traction	850,000,000
Telephony	475,000,000
Telegraphy	200,000,000
Electric manufacturing	750,000,000
Isolated plants	150,000,000
Miscellaneous	150,000,000
Grand Total	$3,225,000 000

Steam Railroad Electrification —the Spirit of the Times

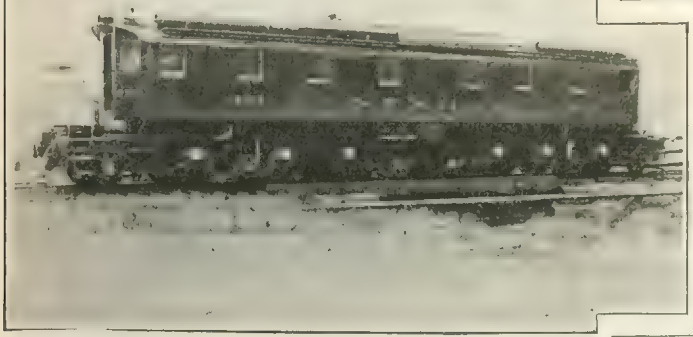
Advantage of only a few of the opportunities to electrify railroads has been taken, and the country may expect to see this field of development grow not only between densely populated cities in the East but, especially, in the mountainous territories of the West, where electric traction shows its greatest advantages over steam. Both direct and alternating current are employed, the highest collector voltages used in the United States being 3,000 and 11,000 respectively.



Direct-current side-rod-drive locomotive used by the Pennsylvania Railroad between New York and Manhattan Transfer, N. J. This railroad also operates an alternating-current locomotive which is the fastest electric locomotive built so far.

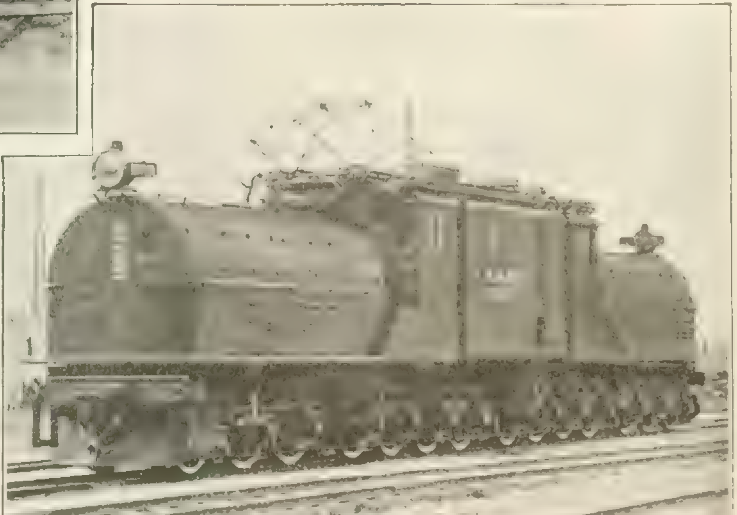


Twin motors are gear-connected to each driver of this 3,000-volt direct-current locomotive, a type which the Chicago, Milwaukee & St. Paul Railway is adding to its system.



Single-phase electric locomotive being used by the New York, New Haven & Hartford Railroad, one of the first companies to electrify a steam railroad in this country.

One of the latest types of gearless-drive locomotives, which have been found very satisfactory during the past ten years by the New York Central Railroad on its New York-Harmon division.



Gearless passenger locomotive weighing 265 tons and operating at 3,000 volts, direct current, that typifies one class of locomotive being used by the Chicago, Milwaukee & St. Paul Railway.

Generation and Protection

OIL AND POWDERED FUEL FOR CENTRAL STATIONS

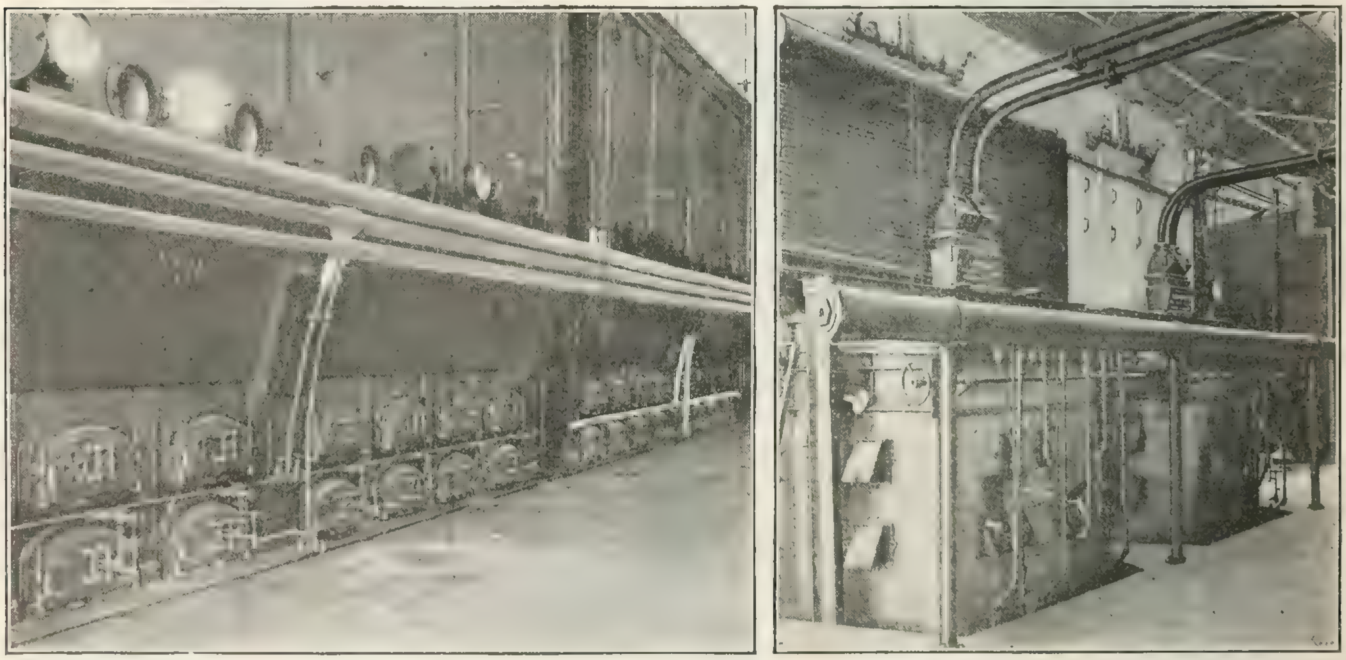
Far West Pioneer in Use of Both—Combustion of Powdered Coal Will Develop Around Mines—Mexican Oil on Atlantic Seaboard

BY C. H. DELANEY

Inspector Steam Department Pacific Gas & Electric Company

IT IS fitting that fuel oil and pulverized coal should be considered together, for there is a marked similarity in the methods of burning these two fuels and in the advantages obtained from them. Both are brought to the furnace through pipes and are blown in through openings in the furnace walls and are burned suspended in the furnace. The result of this suspended combustion is an intimate mixture of air with the small particles of the fuel so that it is possible to burn the fuel with a very small amount of excess air, resulting in high efficiency of combustion. There is no loss due to carbon in the ash, for in the case of oil there are no ashes and in the case of pulverized coal the fuel is so completely burned that what ash remains is entirely incombustible.

There is great flexibility of operation, as with either oil or pulverized coal it is possible to shut off a burner completely or to start up a fire very quickly so that there is no loss due to banked fires at times of light loads. There are no moving parts in the furnace, it being unnecessary to use mechanical stokers with either of these fuels. It is thus seen that many of the advantages of oil fuel apply equally well to pulverized coal. The principal difference between the two is the expensive preparation plant required for pulverized coal and the necessity of removing and handling the ashes. Both of these features are absent in the case of oil, resulting in its marked superiority as a fuel.



FIGS. 1 AND 2—A FEW OF MANY OIL-FIRED BOILERS BELONGING TO THE SOUTHERN CALIFORNIA EDISON COMPANY; BOILERS THAT HAVE BEEN ADAPTED TO BURN OIL, NATURAL GAS OR POWDERED FUEL

The development of oil burning has occurred to a very large extent in California owing to the fact that California was for many years the principal oil producer of the United States. There has thus been a gradual development of oil-burning methods in California during the last twenty years. During the last few years, however, the relative production of oil by the different states has changed in a marked degree as shown by the accompanying figures, taken from reports of the United States Geological Survey giving the production of the different states for the years 1913 and 1918:

PETROLEUM MARKETED IN THE UNITED STATES

	1913, Barrels	1918, Barrels	Increase per Cent.
California	97,788,525	97,531,997	
Oklahoma	63,579,384	103,347,070	+62
Illinois	23,893,899	13,365,974	—
Texas	15,009,478	38.750.031	+158
Louisiana	12,498,828	16,042,600	+29
West Virginia	11,567,299	7,866,628	—
Pennsylvania and New York	8,865,493	8,216,655	—
Ohio	8,781,468	7,285,005	—
Wyoming	2,406,522	12,596,287	+423
Kansas	2,375,029	45,451,017	+1815
Indiana	956,095	877,558	—
Kentucky	524,568	4,367,968	+734
Other states	199,642	228,926	+ 15
United States	248,446,230	355,927,716	+ 43
	1913	1917	
Mexico	25,696,291	55,292,770	+115

It will be noted from the table that while the production in California has remained stationary the production in certain other states has increased to an enormous extent. The production in Mexico has also increased very largely, and it is probable that as soon as ships are available for its transportation the amount of oil imported from Mexico to the United States will be very greatly increased. This will result in bringing large quantities of oil to the Atlantic seaboard, where active development has already begun in substituting oil for coal in large power plants.

During the time that oil-burning methods were developing in California there was a corresponding development in the Eastern States of coal-burning methods combined with increased capacity of boilers, so that it is now not uncommon to find coal-burning boilers operated by mechanical stokers up to 300 or 400 per cent of their rated capacity. The necessity for high capacities of boilers in oil-burning territories has not been so great, and few, if any, oil-burning stationary boilers are operated above 200 per cent of rating. On the other hand, in marine work oil-burning boilers are operated at very high capacities corresponding to 700 per cent of the boiler rating based on stationary practice. These high capacities of marine boilers are obtained by the use of mechanical atomizing oil burners rather than steam atomizing burners, which are used almost exclusively in stationary power plants.

EAST MAY SUPPLEMENT COAL WITH OIL

The introduction of oil into the Eastern territory will undoubtedly mean further development in increasing the capacity of oil-burning boilers, for the coal-burning plants will certainly not be changed over to oil-burning unless at least as high capacity can be obtained from oil as they are accustomed to obtain. It is probable that this development of increased capacity of oil-burning boilers will lead to the introduction of mechanical atomizing systems into stationary practice, for it is found that less furnace volume in proportion to the quantity of oil burned is required for the mechanical system than for steam-atomizing burners. The maximum quantity of oil that has so far been burned by steam-atomizing burners amounts to about 6 lb. or 7 lb. of oil per hour per cubic foot (95 kg. to 110 kg. per cu.m.) of furnace volume. With mechanical burners on marine boilers as much as 11 lb. or 12 lb. of oil per hour has been burned per cubic foot (175 kg. to 190 kg.) of furnace volume. It seems probable, therefore, that the next few years will see considerable development of the mechanical atomizing burner and its application to the variable load which occurs in an ordinary central-station power plant.

SEATTLE HAS LARGEST PULVERIZED-COAL PLANT

It is interesting to note that, notwithstanding the small deposits of coal in the West compared with the Eastern States, the Pacific Coast is also a pioneer in the burning of pulverized coal under boilers. There has been operating at Seattle for over a year the largest pulverized-coal-burning plant in the country, a steam-heating plant of 3,500 hp.

The coal found on the Pacific Coast is mainly lignite or low-grade bituminous coal. This coal burns very inefficiently when fired by the ordinary methods, but when pulverized and burned as a powder its efficiency of combustion is as high as that obtained from any other coal. It is, therefore, not surprising that pulverized-coal burning should be developed in a locality where the coal is poor.

Pulverized coal is burned in suspension and requires more furnace volume than is necessary where the coal is burned on grates or stokers. The furnace volume necessary is from 2 cu.ft. to 2½ cu.ft. (0.057 cu.m. to 0.07 cu.m.) per horsepower developed, so that if a boiler is to operate at 200 per cent of its rated capacity the furnace volume required would be from 4 cu.ft. to 5 cu.ft. (0.113 cu.m. to 0.142 cu.m.) per rated horsepower. The space occupied by this large furnace, however, is not greater than is usually found in modern stoker-fired plants having high boiler settings and basement ash pits.

The main difficulty in burning pulverized coal under boilers has been the removal of the ashes from the furnace. The ashes fall to the floor of the furnace either in flocculent form or accumulated in a molten mass, depending on the temperature of the furnace and the fusing point of the ash. A considerable proportion of the ash is also blown up the smokestack and carried away with the stack gases. This is a fact which would be objectionable in the case of a plant located in a city, and it is probable that future development of pulverized-coal burning will overcome this objection.

The relative prices of coal and oil in the particular locality considered will always determine which fuel should be used. Oil will always have the advantage where the price is approximately as low per B.t.u. as the price of coal, owing to its simplicity, low cost of installation and small amount of labor required for operating. For pulverized coal the cost of the pulverizing equipment counterbalances the cost of stoker equipment. The expense of pulverizing, including labor, repairs and power required, has been variously estimated at from 30 cents to $1.50 per ton of coal pulverized. This cost will be offset in many cases by the use of cheaper coal, and it is probable that the greatest development in the use of pulverized coal will occur in the vicinity of coal mines, where it is possible to burn by this means the mine refuse that would otherwise be wasted.

THE SITUATION REGARDING LARGE TURBO-GENERATORS

As Size of Stations Increases Simplicity of Operation Requires Larger Individual Units—Limitations on Design

BY DR. LOUIS BELL
Consulting Engineer, Boston

MUCH attention has recently been drawn to the development of turbo-generators for larger output and the particular problems of design that are concerned with such increase. In particular there have been a good many serious accidents to large turbines of a character to cause thoughtful consideration of the factors of safety and their bearing on the construction of the larger units. This is not said in order to disparage the big turbine in any way. As the size of stations increases simplicity of operation indicates the desirability of increase in the size of individual units. All hands would agree that a station say of 50,000 kw. rating is best intrusted to no more than three or four turbo-generator units. Suppose, however, the station capacity is to be 500,000 kw. Should one still adhere to a similar small number of units, in which case the individual capacities would run well over 100,000 kw., assuming of course that such machines could be successfully designed and would prove reasonably economical in construction and operation? This question of feasible size was rather thoroughly discussed at a recent Institute meeting.

There are two distinct phases of the problem, the design of the generator and that of the turbine itself. In the former matter the limitation to output is that imposed by the maximum safe peripheral speed complicated by the necessary limitations on heating. From a practical standpoint the situation is about as follows: The revolving structure cannot with present materials be pushed beyond a certain given peripheral speed. By this a limit is set to the workable diameter, and if the output is to be increased indefinitely there is trouble both in getting rid of the heat and in making the general electrical design satisfactory. No figures are yet at hand to show the practical limitations of output for peripheral speeds at present possible, brought about by these considerations. With the limitations on diameter, certainly, as was pointed out in this discussion, there is a point beyond which increase of output will mean sacrifice of efficiency of unwarranted extent, since for any given set of conditions, including diameter and speed, there will be found to be an output for maximum efficiency beyond which the losses will increase with a considerable degree of rapidity.

The general judgment seems to be that the losses are likely to become quite serious if one approaches or passes 50,000 kva. in a single structure. At present generator speeds the point of maximum electrical efficiency in design is probably quite a bit below this. If, however, there were great gains to be made in turbine efficiency by great increase in individual output, one could to a certain extent afford to forget the electrical side of the problem, since the efficiency of the combined unit, within heating limitations, is the matter finally to be considered.

SPEED STRESSES CAUSE DIFFICULTIES

As regards the turbines themselves an entirely different set of difficulties arise, owing to the stresses at the enormous peripheral speeds desirable on account of the steam velocity required if the highest thermodynamic efficiency is to be reached. Another complication is the very great size necessary in the lower stages if the full advantages of high vacuum are to be reached. At the present time there are many single turbo-generator units of 20,000 to 30,000 kw. output.

A good many items of design have to be taken into the reckoning when these big units are developed. The runners of turbines cannot be considered merely with reference to safe peripheral speeds alone. They are relatively complicated structures on which the stresses in action come at points which tend to increase the dangers of failure that arise from mere speed, and the vibration of the blades introduces periodic peripheral stresses in the buckets. One point which has required rather close attention is the danger of getting the vibration period natural to the buckets under stress into synchronism with the rapidly applied stresses. The mere securing of the buckets so as to wedge them firmly against displacement is no simple matter and is one which constantly causes the designer concern. As a machine gets bigger the stresses on the diaphragms may aggregate somewhat alarming amounts, and if by accident or in the course of operation of the turbine anything tends to run up these pressures trouble is close at hand and has more than once ended by wrecking the big unit. Improvement in the materials of diaphragms with the use of cast steel with welded blades has helped the situation materially.

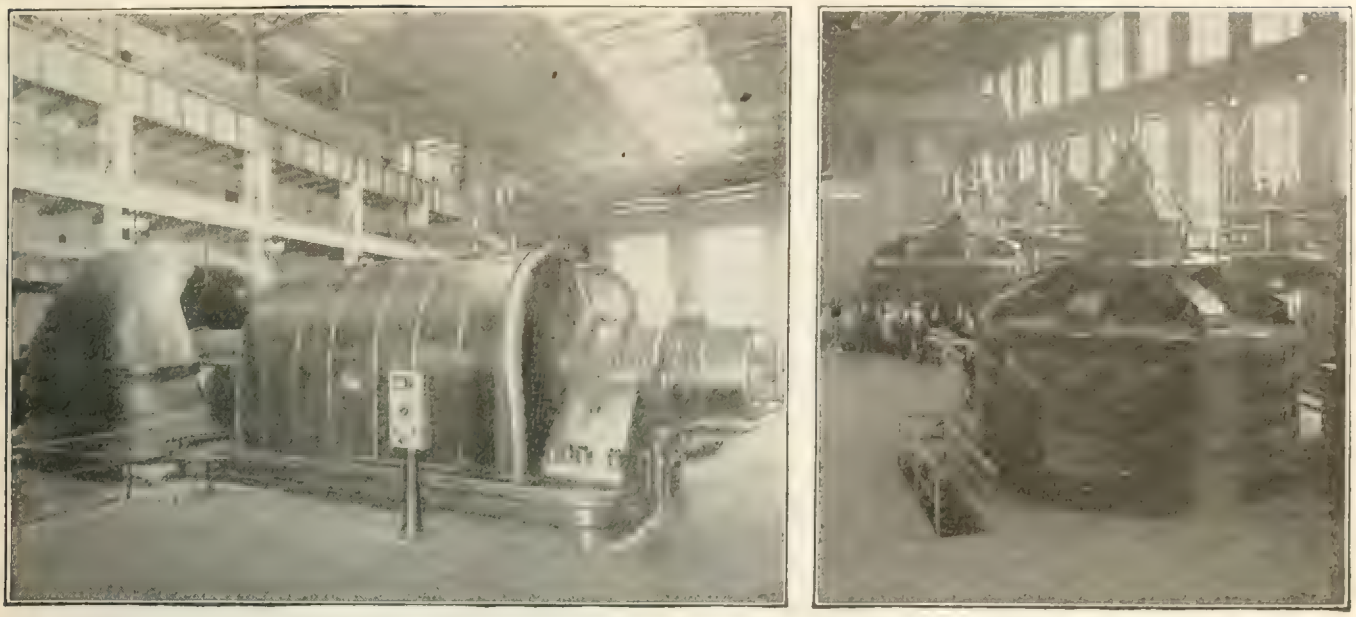
Then, too, as dimensions grow, the questions of clearance, both normal and as it may be complicated by the presence of condensate, have required increased attention, and to hold up efficiencies with the great areas concerned there has to be unusual care in finish and in balance as a factor in the feasible clearance. The result of all this has been that in the last year or two increased caution has been displayed in going into the very big single units, and the compound turbo-generators have found at least temporarily increasing favor. Of course, splitting the total stages into two or three units, each provided with its own generator by which the whole is electrically linked together, to a certain extent relieves the difficulties of the situation, and a number of these compound turbo-generators of total capacity ranging from 50,000 kva. to 70,000 kva. have been installed or are under construction. Just how far this expedient is effective from the standpoint of ultimate efficiency remains to be seen.

ADVANTAGES AND DISADVANTAGES OF MULTIPLE-STAGE GENERATORS

On principle, the electrical difficulties are considerably relieved, and there is an opportunity for raising the thermo-dynamic efficiency by the further use of multiple stages. There are, however, associated with this both mechanical and thermal difficulties, the total effect of which is as yet somewhat uncertain. Not sufficient experience is at hand to show plainly what the net result is likely to be. It will be extremely interesting to know, for example, what is the real final thermodynamic efficiency at the busbars as between, say, a pair of 30,000-kva. turbo-generators and a compound or triple machine totaling 60,000 kva. or 70,000 kva. When the facts in this case are clear there will be basis for proper judgment as to future policy. Of course, the compound machine gives a certain advantage in flexibility, but whether this is gained without compensating structural and operative difficulties remains to be seen.

Flexibility is a term in the name of which a good many engineering crimes have been committed; and the vital question regarding it is not whether under certain circumstances it may not be used to advantage but whether such advantage is not on the whole gained at too high a cost. Only experience can answer this question. When one considers the possibility of turbo-generator stations of 250,000 hp. and upward the use of very large units is naturally attractive. The number of running machines will not vary much whether single or compound turbo-generators are chosen, and in actual operation one must take account of the fact that in the former case the units are all alike and in the latter case of three different types which must be handled consistently and with efficiency.

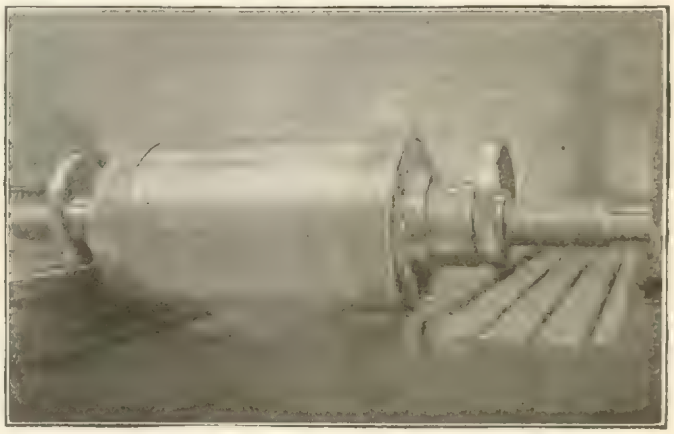
The most that can be said at the present moment is that the big compound turbo-generators are a most interesting and somewhat promising development, concerning which more information is needed in order to determine their real place in the art. Certainly the last word has not yet been said regarding the refinements of design in either class of turbo-generator as respects the mechanical characteristics of one end of the machine or the electrical possibilities of the other.



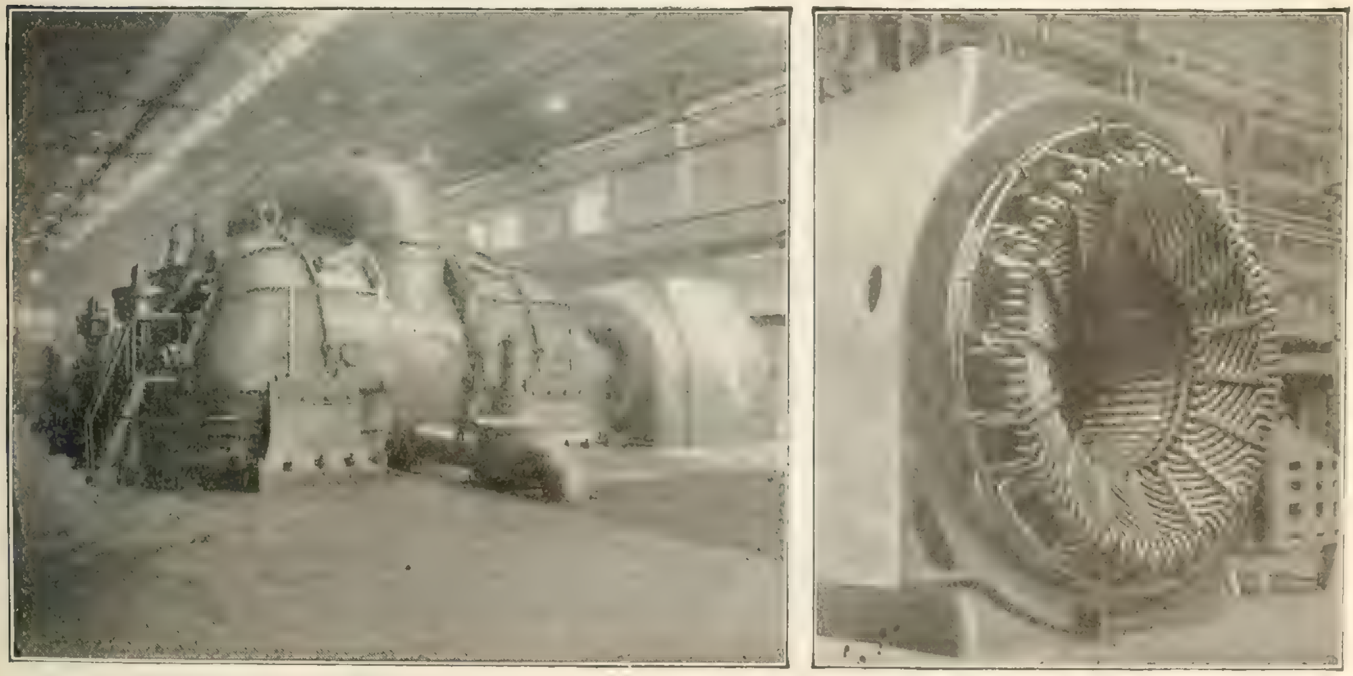
The illustration at the left shows the 45,000-kw. turbo-generator of the Detroit Edison Company, which is the largest single-shaft unit that has been installed in this country. Other similar-type turbines are in operation in Chicago, Boston, New York, Windsor, Buffalo and Philadelphia. The view at the right shows two of the three 32,500-kw. waterwheel generators which have recently been installed by the Niagara Falls Power Company. These units are the highest-rated waterwheels installed in this country. Some larger units rated at 45,000 kw. are being built for a development at Queenston on the Canadian side of Niagara.

Some Mammoth Generators Installed in 1919

During the past year some record-breaking steam and waterwheel-driven generating units so far as rating and economy are concerned have been installed. While there has been an improvement in water rates and efficiency with increase in size of units, the point has now been reached where the improvements in economy may not be so marked with further increases in size unless a new steam cycle is employed.



Rotor of a 20,000-kva., 1,800-r.p.m., 60-cycle turbo-alternator.



At the left are shown multi-shaft turbo-generators of which designs have been developed in two-shaft and three-shaft varieties the largest set of the last class being rated at 70,000 kva. and operated by the Interborough Rapid Transit Company, New York. A two-shaft unit is installed at Pittsburgh At right, stator of a 20,000-kva. generator, showing massive coil ends and bracing.

RECENT DEVELOPMENT IN TURBO-ALTERNATORS

Ratings Increased Greatly from 1913 to 1917, but Last Year a Tendency to Stop at 30,000 Kw. in Single Units Was Noticeable

BY F. D. NEWBURY
Westinghouse Electric & Manufacturing Company

DURING the five years from 1912 to 1917 there was a very rapid increase both in the aggregate kva. of turbo-generators and in the number of large units purchased by central stations. This movement was, of course, greatly accelerated during 1916 and 1917 by the demands made by the war on the electrical industry.

The total steam-turbine capacity supplied by one American manufacturer—which may be considered typical—doubled in 1913 as compared with 1906 and doubled again in 1917 as compared with 1913. These three particular years have been referred to because they represent peak years in the yearly curve of national business and prosperity.

The large increases in steam-turbine generator capacity in 1913 and in 1916-17 were due largely to the increase in the number of large units. Before 1912 the largest 1,500-r.p.m., 25-cycle unit or 1,800 r.p.m., 60-cycle unit was 8,000 kw. (10,000 kva. maximum rated generator). During the next two years a large number of 20,000-kw. and a few 30,000-kw units were purchased, and during the succeeding five years units of 20,000 kw., 25,000 kw. and 30,000 kw. became as common as units of 5,000 kw. and 10,000 kw. had been during the preceding five years.

This general use of very large units has resulted in a marked change in operating conditions in central stations. In many cases stations are carrying their entire load with two or three large units. In some medium-size stations one large unit carries as much as 50 per cent of the station peak.

During the last two years, however, there has been a noticeable slowing up of this increase in size of units. Few single-shaft units larger than 30,000 kw. have been purchased, and operating engineers seem inclined to take a "breathing spell" before making an additional step of any size in the direction of larger generating units. An important exception to this statement exists in the case of multiple-shaft cross-compound units. There have been a number of units of 50,000, 60,000 and 70,000-kva. generator capacity installed or purchased. Work has been started on a new station in the Pittsburgh district that is being laid out for five 60,000-kva. units, each consisting of three cylinders and three generators. However, with such units there is the same reliability and almost the same flexibility in operation as with the same aggregate capacity of 20,000-kva. units, and this is obtained without sacrificing the greater steam economy of the larger thermodynamic unit.

The successful development of electric drive for capital ships of the navy has opened up a new and important field for large turbo-generator units. A battleship or battle-cruiser equipment is as large as a good-sized central station and in the latter class the turbine equipment of a single ship is exceeded by very few single-central stations.

Methods of extinguishing fires in large units have received considerable attention during the past few years. The results of even minor insulation faults when once a fire is started are so serious that any possible protection is warranted. When it is remembered that in many stations a single large generator carries from 20 per cent to 50 per cent of the peak output the seriousness of the loss of output for weeks does not need emphasis.

Unfortunately, fire-resisting qualities and sufficiently good insulating qualities have not been found in any material that is also capable of being used for coil insulation. The only effective means of protection that has been developed so far has been fire-extinguishing systems employing either water or steam. Piping is arranged so that one or the other of these mediums can be directed on the armature winding within the inclosed end bells without delay. Systems of this kind using steam have had actual trial in service and have been found to be effective in extinguishing fires, and the steam has not damaged the insulation.

Government Investigations of Power

In his recent report Director George Otis Smith of the United States Geological Survey describes the work of the division of power resources during the war. This division has for its function the investigation of power development and utilization. During most of the last fiscal year its work was done in co-operation with the Bureau of Conservation and the Bureau of Statistics of the United States Fuel Administration. Some of the results accomplished are stated below:

An examination and study of the generation and use of power in and around Albany, N. Y., indicated that much coal could be saved by making use of existing interconnections of electric power plants made primarily for use in emergencies, by utilizing more completely a large hydroelectric plant, and by using for generating power water that was stored for navigation. As a result of a conference at Albany of state officials and representatives of the power companies, of the division of power resources and of the Fuel Administration, arrangements were made to utilize the interconnections of certain power plants and to replace steam power with water power. The plan was placed in operation Oct. 23, 1918, with an estimated saving of more than 50,000 tons of coal a year.

Investigations were made in New England with a view of developing and utilizing stored water to increase the power available at hydroelectric plants in the Connecticut River basin.

The power service furnished by the Central Illinois Public Service Company to the coal mines in southern Illinois was investigated, and a peculiarly difficult power shortage was adjusted equitably to the power users.

The municipal power plant at Nashville, Tenn., was shut down because it was shown that coal would be saved by purchasing power from a hydroelectric plant. A report was made on the conditions of water-power plants utilizing water from the power canal at Augusta, Ga. An investigation and detailed report was made on the possibility of saving fuel in the St. Paul-Minneapolis district, in Minnesota. Investigation of duplication of power plants at Grand Island, Neb., showed that about 7,000 tons of coal a year could be saved by interconnection, and action was taken accordingly. As a result of an investigation of power furnished to coal mines at Sheridan, Wyo., emergency installation of additional generating equipment was recommended and assistance was given to the power company in procuring the equipment required. A report was made on the desirability of interconnecting the plants of the Spokane Light & Power Company, Spokane, Wash., and the Washington Water Power Company. A report was prepared showing the quantity of coal that would be saved by utilizing the water power at the Austin dam, Texas.

PRESENT-DAY PRACTICE IN RELAY PROTECTION

Current and Directional Relays, Balanced, Relays, Undervoltage and Overload Relays in Parallel, Radial and Ring Systems

BY H. R. WOODROW
Assistant Chief Electrical Engineer New York Edison Company

CONSIDERABLE progress has been made in the past few years in the application of protective relays to transmission systems. This has been facilitated by the closer co-operation of relay manufacturers and operating companies, which has resulted in the former learning the operating needs more accurately and in the utility companies becoming better acquainted with the numerous advantages of these devices in reducing transmission investment as well as in improving the continuity of service. The relay problem has thus grown from a secondary consideration to one of the most important features in the determination of the transmission system.

The type of relay desirable for any transmission system is dependent upon the method of operation, the amount of current that can flow into a fault, the maximum time in which the short-circuit current can be held on the system, and the character of the system. Transmission systems may be classified into three different groups, *i.e.*, radial, parallel and ring or loop feeder systems.

For simplicity of equipment a straight current relay with inverse-time or definite-time characteristics is superior. On a radial system these relays have given very excellent results, but the time element necesary to secure selective operation with an interconnected system is objectionable. This prolonged time of holding a short circuit on the system has the disadvantages, first, of throwing the synchronous apparatus out of step, and, second, of causing prolonged surges, interruptions and heating factors on the system.

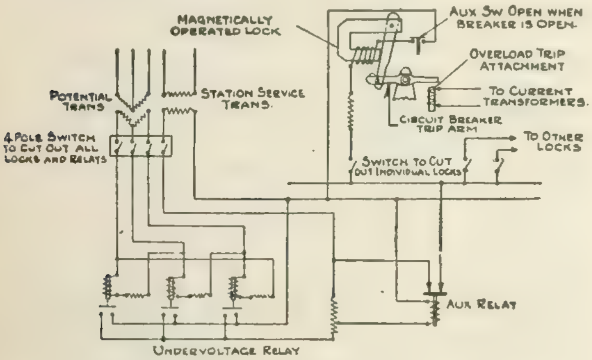


FIG. 1—COMBINED UNDERVOLTAGE AND OVER-CURRENT RELAY PROTECTION

In order to gain the many advantages of a parallel operated system with interconnections between substations the application of more complex methods of relay protection are necessary. These different methods may be classified into three general groups: Combinations of current and directional relays, balanced relays, and combinations of current and voltage relays.

Current and Directional Relays.—The combination of a directional relay with a time current relay gives three characteristics for selectivity—*i.e.*, the direction of the flow of power and the time and amount of current flow.

The flow of power from a main generating station is practically (with the exception of tie-line connections) always away from the power house, and it is therefore only necessary to have current relays with time characteristics on the outgoing feeders from a main generating station.

On the incoming feeders to a substation the flow of power in any particular feeder in trouble is away from the substation, but on the other feeders the flow of power is toward the substation. At this location a directional relay in combination with the current relay is desirable to select the defective feeder from the good feeders. The time element on the substation current relay should be lower than the setting of the current relays in the power station to assure operation of the substation switches on the defective feeder before operation of the relays in the main power house on the good feeders in parallel with it.

The accompanying diagrams illustrate those connections which are applicable to both parallel feeders and feeders forming a loop.

Special precaution should be taken in connection with directional relays inasmuch as the relay has both a potential and current element and a wrong connection in either element would give improper selectivity. A directional relay should never be used alone, as its object is to detect only the direction of flow without time-current characteristics and should be made as sensitive as possible. It has been found desirable to connect the potential element so that the potential will lag behind the current in the current element with unity-power-factor current flowing in the tripping direction.

Balanced Protection Schemes for Transmission Lines.—Theoretically, the balanced scheme of protection gives the quickest operation with a high degree of reliability, but this scheme is somewhat handicapped by its more complicated operation and more complicated equipment. Either electrically balanced or mechanically balanced relays may be used for parallel lines.

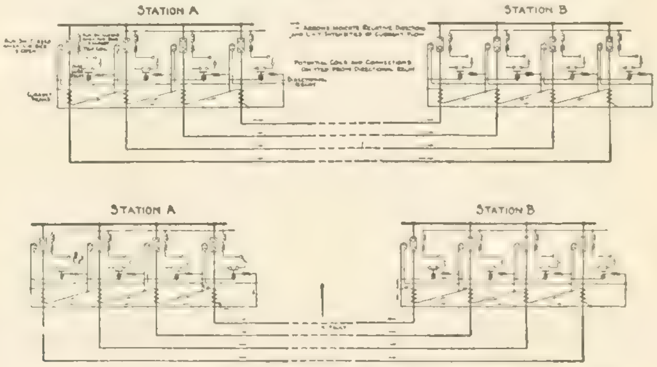


FIG. 2—BALANCED PROTECTION FOR THREE OR MORE LINES (DISCRIMINATING)

Two methods have been used for two parallel lines: One involves current relays only, the pair being tripped out in case of trouble on either; the other involves a combination of current and directional relays, in which case only the defective line is tripped out. Both of these systems have given very satisfactory operation under conditions where lines can be paired. The first form is simpler but requires at least two pairs of connections to prevent an interruption in case of failure, whereas the latter form, although more complicated in its relays, will give continuous operation with a failure on either line of the pair.

Balanced arrangements have also been extended to cover several lines in parallel and have given very satisfactory service both with the electrically balanced type having directional relays and with the mechanically balanced type. Where three or more lines are to be considered in operation at all times, it is not necessary to install the directional element on the relays, as the selectivity between the two lines feeding into a third is sufficient to give selective operation.

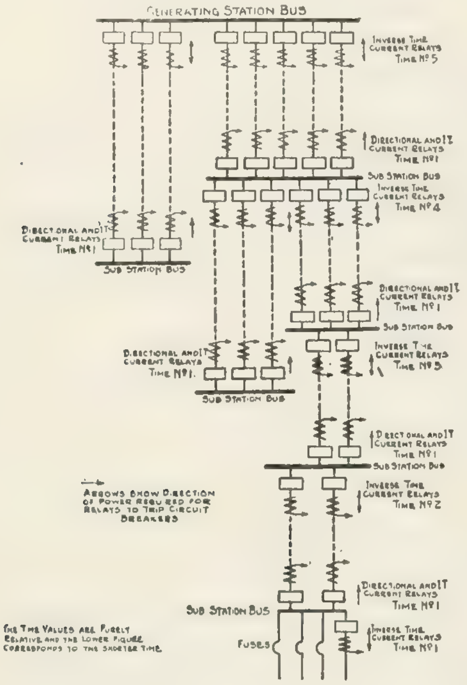

Generating Station Bus
Inverse Time Current Relays Time No. 5
Directional and I.T. Current Relays Time No. 1
Sub Station Bus
Inverse Time Current Relays Time No. 4
Directional and I.T. Current Relays Time No. 1
Sub Station Bus
Directional and I.T. Current Relays Time No. 1
Sub Station Bus
Inverse Time Current Relays Time No. 3
Directional and I.T. Current Relays Time No. 1
Sub Station Bus
Directional and I.T. Current Relays Time No. 1
Sub Station Bus
Arrows show direction of power required for relays to trip circuit breakers
Inverse Time Current Relays Time No. 2
Directional and I.T. Current Relays Time No. 1
Sub Station Bus
The time values are purely relative and the lower figure corresponds to the shorter time.
Fuses
Inverse Time Current Relays Time No. 1

FIG. 3—INVERSE TIME-CURRENT AND DIRECTIONAL RELAYS

The split-conductor system is a modification of a balanced-pair protection in which both lines of the pair trip out in case of trouble. The pair is made up into a split conductor cable so as to combine the two lines into one cable. This system has been employed by a few companies in this country which have reported very satisfactory results.

Some companies have used the pilot-wire system with balanced pressure wires and have obtained good results, although the system is complicated by the additional factor and expense of the pilot wires between stations. Unless the stations are very close together, this additional expense is hardly warranted with the other means of protection available.

Combination of Undervoltage and Overload Relays.—The combination of a voltage and current relay has been used for some systems, the voltage element being used to determine the locality of trouble. In low-voltage territories the current relay is depended upon to select the feeder in trouble.

For a widely distributed system forming a network this combination is reported to have given very good results, although its application may be somewhat limited, as systems with very heavy power lines feeding into a particular locality may not have sufficient selectivity in voltage between the location in trouble and other parts of the system to give the same satisfactory results.

Testing and Setting Relays.—The method and care of testing and setting relays is of paramount importance if selective operation is to be obtained. All tests should be made under conditions as nearly equal to the operating conditions as possible, which makes it desirable to include all the wiring and complete relay equipment in the test.

The old method of setting relays in percentage of load conditions, say 150 per cent to 200 per cent of full load, is a thing of the past, as the relays are not primarily installed to prevent an overload, but to selectively disconnect a defective feeder under short-circuit or ground conditions. The relay testing should be made with some form of a chronometer (the cycle-counter being the most simple form), as the old stop-watch method is entirely inadequate for fine calibration.

The determination of relay settings must receive careful consideration. An analysis of all circuit conditions is necessary, and a calculation of the short-circuit currents which will be produced at different points of the system is desirable so that selective time-current characteristic curves can be made comparative for the different points on the system. The calculating table has proved a great help in this study of system conditions.

Method of Tripping.—It is coming to be the general practice to use direct current for tripping of switches, thereby permitting the use of circuit-closing relays. The direct current should be supplied from storage batteries or primary batteries, as with motor generators lack of direct-current power for tripping may manifest itself in case of trouble on the system. The use of the direct-current excitation bus for control and tripping of switches should be discarded, as several very serious troubles have been traced to this practice on account of the high voltages produced on the excitation system in case of disturbances on the high-tension side.

Generator and Transformer Protection.—For the protection of generators and transformer circuits it is becoming the standard practice to install differential relays or differentially connected relays, which have in general given very good results, as they can be set to be very sensitive and require only a small amount of time for operation.

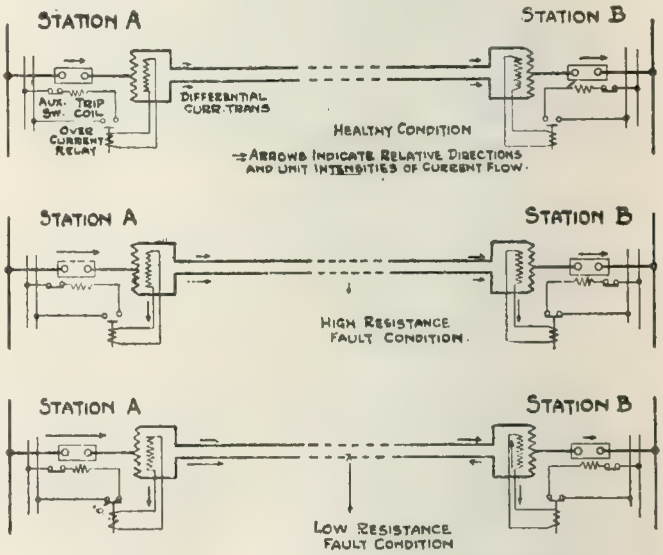

Station A
Station B
Aux. Trip Sw. Coil
Over Current Relay
Differential Curr. Trans.
Healthy Condition
Arrows indicate relative directions and unit intensities of current flow.
Station A
Station B
High Resistance Fault Condition.
Station A
Station B
Low Resistance Fault Condition

FIG. 4—SPLIT-CONDUCTOR SYSTEM OF PROTECTION SHOWING RELAYS

For a more comprehensive report of relay protection I would refer the reader to the paper on "Transmission Line Relay Protection" appearing in the report of the protective devices committee which was published in the *Proceedings* of the American Institute of Electrical Engineers for 1919, page 631.

OIL-CIRCUIT-BREAKER DEVELOPMENT IMPORTANT

Second Only to Major Genereting Equipment—Price of Primary Breakers Must Be Reduced, Otherwise It May Become Prohibitive

BY B. G. JAMIESON
Engineer of Inside Plant, Commonwealth Edison Company

THE approach of large central-station systems to a half-million-kilowatt rating, the possibilities regarding the future inclusion of small central-station systems with greater capacity high-tension networks, the higher standards in station equipment resulting from considerations of safety and the quickening of industrialism are factors that have been prominent during the past few years tending to place the development of oil circuit breakers in a position second in importance only to that occupied by major generating equipment. While the year just closed has not brought out any prominently new features in oil breakers, there have been numerous minor improvements in established types. Parts have been made heavier and more secure, the quantities of oil have been increased, the baffling of gases has been improved, and the speed of contact-parting elements has been increased, although speeds are still very low compared with possible attainable velocities. No changes appear in the conventional "down-break" nor in the essential actuating mechanisms. Single-pole "double-break tank elements are now standard, although high-duty switches with four breaks per tank are also standard with one maker. Copper terminals have superseded brass, and the use of arcing tips is extended to practically all oil breakers intended for 2,300-volt service and over. Changes in design have been made to obviate the unstabilizing effects of heavy short circuits on auxiliary contact surfaces.

During the past year leading manufacturers have placed at the disposal of operating companies several oil breakers for test at 750,000 kva. (at the arc), indicating their confidence in the rupturing power of their apparatus. Within operating companies, proposals to increase the capacity of oil breakers in service by the substitution of another fluid in place of the oil have been seriously considered.

Operating experience with breakers having breaking speeds of approximately a quarter second, used in conjunction with definite-time relays having time elements upward of two seconds, has indicated what operating people have realized for a long time—namely, that such rupturing speeds are too slow and that it is very important to make switch action sufficiently rapid to remove a faulty member from the system during the incipiency of the fault, if possible, or as soon after departure from normal conditions as practicable. This point is covered by communications to the American Institute of Electrical Engineers early in 1911. Unfortunately not all manufacturers were sufficiently impressed by it to begin development of breakers to meet this requirement. As a protective device oil breakers have been unique in that, while they were installed for the purpose of protecting the system, the operating characteristics of the breakers have been such as to protect the breakers primarily and the system secondarily.

The prospect of industrial installations connected in "solid" on central-station transmission systems, as proposed by several companies, is not reassuring. Just to what extent the installed cost of automatic oil breakers has influenced this proposal is not certain, but it is a fair assumption that if increased rupturing capacity could be secured in breakers of the grounded-tank type without prohibitive expense, the tendency would be toward a wider use of them and the general system of connecting industrial customers would be greatly facilitated.

With regard to rupturing capacity, another unique feature of the oil breaker on central-station systems is that it has the unfortunate faculty of becoming inadequate very quickly on a growing system, even though the load controlled remains fixed, and replacement is expensive and sometimes is even found to be physically impossible. This sort of enforced inadequacy is in a sense deplorable when considered as an inevitable result of the normal growth of healthy systems and as a future recurrent possibility. It is not an impossibility that, unless something be done regarding this point, primary oil breakers will tend to disappear because of prohibitive cost.

The attention of manufacturers is invited to this point; to the possibilities of economies in design as a means toward reducing installed cost, also to the desirability of extending the functions of the oil breaker to include other features, such as, for example, automatic reclosing, which will undoubtedly be required in the future with the advent of the automatic substation.

Electric Heating in Typewriter Industry

Comparative data showing the better economy and larger capacity of electrically heated ovens compared with gas-heated ovens for japanning typewriter parts have been based on a report from the Royal Typewriter Company under conditions existing in Hartford, Conn. This installation consists of a battery of six ovens, four of which are 7 ft. 5 in. (2.2 m.) high, 7 ft. 1 in. (2.1 m.) deep and 6 ft. 2 in. (1.9 m.) wide, while the other two are slightly smaller. Each oven has a connected load of 27 kw. Oven No. 1 is used for baking japan on the spacer bar of the typewriter, using a temperature of approximately 250 deg. Fahr. (121 deg. C.) for three hours for the first four bakes. The fifth and last bake is at a temperature of 275 deg. Fahr. (135 deg. C.), for the same period of time. The other five ovens are used for baking japan on the frames, ribbon spools, base plates, top dust plates, etc. The finish on these parts requires a more complicated system of baking and finishing. The parts are baked successively in the first and second of these ovens at 350 deg. F., and in the third and fourth at 400 deg. F. The following table shows the comparative capacity and cost of operation of the two ovens:

	Electricity	Gas
Capacity	300 frames	180 frames
Capacity	3,288 lb.	2,055 lb.
Fuel used per bake	123 kw.-hr.	1,100 cu. ft.
Rate	$0.015 less 40%	$0.85 – 12% – $0.75
Cost per bake	$1.10	$0.825
Cost per frame	$0.00366	$0.00458
Cost per pound	$0.000334	$0.000401
Fuel cost, full time:		
Cost per day	$4.62	$5.78
Cost per month	120.12	150.15
Cost per year	1,441.44	1,801.80
Saving per year	360.36	....

This information was set forth in a paper by A. M. Clark, at a meeting of the American Electrochemical Society, Sept. 23, 1919.

Transmission and Distribution

PROBLEMS INVOLVED IN INTERCONNECTING SYSTEMS

Outstanding Fact of Situation Is that Bankers, Managers and Engineers Are Studying the Future with Increased Breadth of Vision

BY H. A. BARRE
Southern California Edison Company

THE restriction of development during the war and the great increase in the demands for electric service since its close have made it necessary to provide for extensions of plant in large generating units, with a corresponding increase in transmission and distributing systems. The magnitude of the costs involved in making these large developments has made it necessary to study the probable requirements of the future for a longer period in advance than heretofore. Bankers, managers and engineers have undertaken this task with a new breadth of vision.

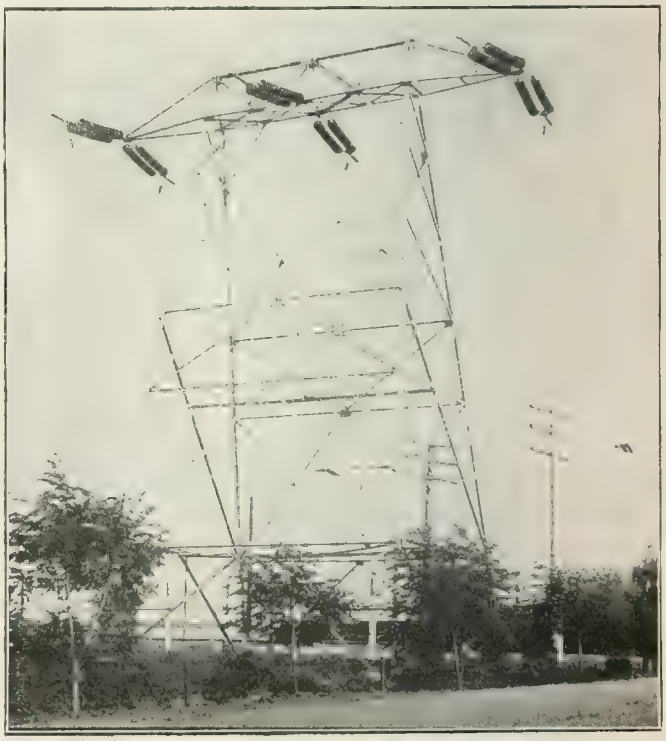
The results of interconnections made so far have shown the necessity of getting away from a too short-sighted view of a particular system and of studying the conditions and necessities of neighboring systems, so that when the inevitable growing together occurs the benefits of interchange of facilities can be obtained without serious modifications of existing construction and apparatus. Such a study was made in the paper read at the Los Angeles meeting of the American Institute of Electrical Engineers on a 220,000-volt busbar connecting all the large generating and load centers of California.

As the systems of the different companies grow into contact, interconnections will be made as soon as they become advantageous to the companies. Each interconnection will be financed in accordance with the economies of its individual case. In time it will become profitable to increase the capacity of the interconnections. With a study before them of a comprehensive plan for ultimately complete interconnections, the companies concerned can plan their work so that each part as built will be useful as a part of the completed whole. Growth of load can be taken care of to advantage by means of interconnections of heavy capacity. One company can install a generating plant or unit sufficiently large to provide for its growth for a number of years and dispose of its surplus capacity to a neighbor, which in turn can repeat the operation.

DEVELOPMENT IN SWITCHES AND LOAD DISPATCHING

While individual systems may grow at only a moderate rate, an interconnection of high rating frequently results in a concentration of power which may make facilities and methods which are adequate for either system alone inadequate for the interconnected systems. Furthermore, heavy interconnections between companies and systems are bringing about generation of power in larger units, longer lines and higher voltages. Since present standards of switching equipment may be seriously overtaxed thereby, much development in this line is necessary and a more comprehensive study of load dispatching and methods of operating is required. It may even be that for some time switching apparatus may limit the extent to which systems may be interconnected, and therefore the economies possible from concentrations of power generation may be unobtainable. In this connection it would seem that manufacturers of switching equipment have gone far enough in their attempt to make their apparatus compact and should devote their attention to other more important factors. Of course, there are some places where switches must be installed in a restricted space, but in the majority of cases room for adequate equipment is so easily obtainable that stations should not be obliged to sacrifice the advantage of more liberal design in order that the manufacturers may reduce the number of types or sizes of switches. For some of the installations now contemplated a Standard Oil tank containing a set of contacts mounted on the end of a wagon tongue would be a reasonably adequate switch, and it is hoped that manufacturers will not get too far away from such a design.

The next logical step in high-tension transmission is to go to pressures in the neighborhood of 220,000 volts because there are a number of instances in which the amounts of power and the distances to which it must be transmitted make a transmission voltage of this magnitude economically correct. A specific case in mind is that of a 150,000-volt line good for about 120,000 kw., on which the load must be doubled within three years. An increase to 220,000 volts will give the transmission rating required. While the line in question cost $5,000,000, under the prices likely to prevail in the next three years it could probably not be duplicated for less than $12,000,000. The clearances and other details of construction are suitable for 220,000 volts, so that an expenditure of $2,000,000 or $3,000,000 will permit all the changes necessary. These conditions alone are sufficient to justify very great efforts in perfecting insula-



BIG CREEK TRANSMISSION TOWER

tors and other apparatus necessary for the higher voltage.

With the present types of suspension insulators the distribution of dielectric stress over the end units is apparently the chief limitation to their application to higher voltages. As now used, insulators nearest the conductors would be stressed to the danger point with 220,000 volts. One remedy would be to increase the capacity of one or more units on the end of the string, thereby distributing the stress. Several practical ways have already been suggested whereby this may be done.

The quality of suspension insulators has largely improved during the past few years, and there appears to be no necessity for a radical change in design in order to obtain reliable material. About all that is needed is plain, ordinary, conscientious work on the part of the manufacturers in the selection of units suitable to be sent out on these important lines, and the elimination in the factory, rather than on the lines, of those units whose quality may be doubtful. The operating companies can afford to pay insulator manufacturers for the rejection of a considerable number of insulators in the factory rather than take the chances of placing units on their lines which may possibly become defective in two or three years.

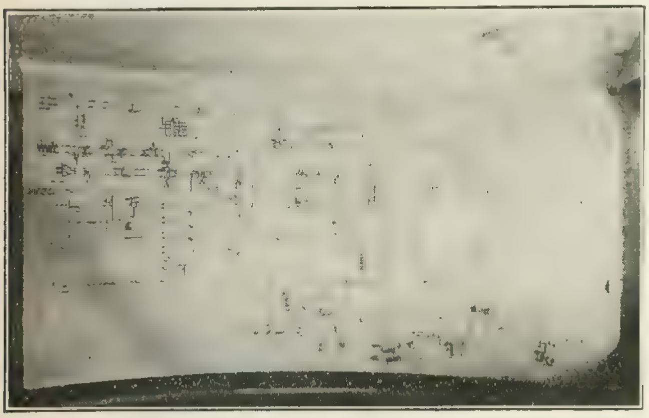


FIG. 2—LOAD DISPATCHER'S BOARD USED WITH INTERCONNECTED PLANT

There is still much work to be done in developing adequate dispatching systems for the control of large concentrations of power and complicated line and substation connections. Too much dependence continues to be placed on the dispatcher's familiarity with and memory of the conditions of the system he handles. The logical outcome is that dispatching sub-centers must be provided, controlled through the central dispatcher in all matters affecting the system as a whole, but competent to handle local business in emergencies and when communication with the chief dispatcher is interrupted.

The design of telephone systems for dispatching and other operating purposes, as well as the internal commercial business of the companies, must receive more attention. Quite a number of the larger companies have telephone systems involving greater investment than most telephone companies.

HIGHER SAFETY FACTORS PREFERABLE TO COMPLICATED PROTECTIVE SYSTEMS

The protective systems for isolating defective units of plant must be greatly improved, and it is going to be difficult to carry out this idea without too much sacrifice of plant simplicity. Experience is now showing that it is preferable to spend more money for high safety factors in lines and apparatus in order to minimize the possibilities of trouble rather than to increase the complication of relay systems to protect against interruptions, because of the possible increase of interruptions due to the failure of comparatively delicate apparatus to function properly.

The present fad is for outdoor station and substation equipment in providing interconnection facilities. However, it must not be allowed to go too far. Study of individual cases shows that too often the outdoor station merely looks cheap and is inconvenient to operate. It will frequently be found that properly housed apparatus is cheaper to install and that the additional care given it by the operators is of great value to the service rendered. The outdoor station unquestionably has its place, particularly in distribution, but it must not be assumed that it is the thing to use under all conditions. The steel work often costs as much or more than a building which would give the same isolation of apparatus and support of wires and devices, and the building gives the additional advantage of protection from the weather.

AUTOMATIC SUBSTATIONS ELEMINATE LABOR EXPENSE

Operating Features of Two Types, One for Industrial Service and the Other for Three-Wire Circuits—Yearly Expenses

BY R. J. WENSLEY
Switchboard Division Westinghouse Electric & Manufacturing Company

WHILE remote-controlled semi-automatic substations have been in operation for several years on the lines of the Detroit Edison Company, it has only been in the last year that a move has been made toward full automatic control of converting stations supplying 250-volt current to light and power circuits. Full automatic substations have been employed for railway service with decidedly good results for several years, nearly 100 being in operation or on order at the present time. To a great extent it has been the ability of automatic railway substations to operate with low maintenance cost and with a very real economy through the elimination of light-load losses that has stimulated the application of similar equipment to light and power service. Of course, the real economy of automatic control is the elimination of labor expense, although it has also permitted improving the trolley voltage and thereby speeding up schedules.

The labor situation with its ever-mounting wage requirement is rendering full automatic operation of converting equipment more and more desirable and profitable. The rapidly increasing cost of heavy duct line installation is also bringing to the front the possibilities of small automatic substations located in the basement of large buildings to supply the neighboring direct-current load.

AUTOMATIC SUBSTATION FOR INDUSTRIAL SERVICE

The first full automatic control for industrial service is in process of manufacture for a large motor-car company in Detroit. This control is to operate a 500-kw. synchronous motor-generator set in an outlying portion of the plant. The load during the period of small demand is carried by the central power plant. The automatic control operates when the local bus voltage drops below a certain point. The control is designed to start the motor from auto transformers in the usual manner, throwing on full voltage when the motor is in step.

THREE-WIRE AUTOMATIC SUBSTATION

The first full automatic substation for supplying current to a three-wire network is being manufactured for a large central-station company in Minnesota. This equipment consists of a 500-kw. synchronous motor-generator set. The generator is flat-compounded for 250 volts and is equipped with balance coils for three-wire operation. In this equipment no effort is made to parallel voltages before connecting the direct-current end to the line. The field rheostat is set for the proper running voltage and left at that point, the compound winding taking care of regulation under changing load conditions.

This set is to be installed in a large building sufficiently far from the nearest manually operated substation to have required a large amount of feeder copper to maintain voltage that would have been acceptable to the customer. The local network is to be tapped with cables of sufficient capacity to carry the entire load of the building in an emergency, but under these conditions the regulation will be very poor. A set of automatic contactor switches will be installed in these taps to insert resistance if the outflow of current from the automatic substation reaches an amount which would jeopardize the service to the building. These contactors will not operate on flow of current from the network into the building.

Load on the machine is limited by a set of load-limiting resistors normally shunted by contactors which open on excessive overload. The resistance is of sufficient value to limit the possible flow of current to 150 per cent of the machine rating. Relays are provided in the neutral circuit to cut the machine out on excessive unbalance. The load-limiting scheme is very similar to that used in the railway automatic substation except that provision has to be made for insertion of resistance into both sides of the circuit, since the machine is supplying a three-wire load.

This equipment will be started by an indication of low voltage and shut down on low current the same as the industrial substation above mentioned. This machine will help out the network immediately surrounding its location up to half its capacity, at which point the feeder resistors will operate to shift the load onto the large substation some two or three thousand feet away.

Copper feeders of sufficient size to give 5 per cent regulation if supplied from the nearest existing substation would cost approximately $45,000 installed. The automatic substation complete including the 4,000-volt supply cable will cost approximately $32,000 installed. The automatic substation gives better regulation than any amount of feeder copper within reason. It also gives better assurance of continuity of service, since in case of trouble on the network the automatic control will isolate the building and continue to supply service. In case the feeders had been installed rather than the substation the building would go out with the network.

On the other hand, in case the automatic substation fails to function properly, the building will still be supplied, though with relatively poor regulation from the network.

Indications are that the coming year will see a number of such substations installed and comprehensive plans laid for the development of 250-volt systems along the line of numerous small substations scattered at the load centers of various small districts rather than the concentration of large converting capacity in a few substations as is the present practice. Of course, to stabilize the system a few large units are desirable, and for the present no large central stations with 250-volt direct-current systems will attempt full automatic operation of the entire system.

Tentative plans have been made for the automatic operation of converting stations containing 4,500 kw. of 250-volt direct-current motor-generators. In the railway field there are now being considered automatic substations with 8,000 kw. installed. The largest railway substation so far sold with full automatic control contains two 1,500-kw. converters, making a total of 3,000 kw. in one station. This station is provided with blank panels and the control is arranged for a third machine of the same size. There seems to be no reason why the automatic control cannot be built for the largest converting equipment now in use.

YEARLY CHARGES ON AUTOMATIC STATIONS

The operating cost of the 500-kw., three-wire set above mentioned, capitalizing the investment at 15 per cent, will probably be:

Annual fixed charge, at 15 per cent	$4,800
Annual maintenance labor	300
Total annual charge	$5,100

If heavy feeders had been run from the existing manual substations, the operating cost would be the interest charges, maintenance and depreciation on the cable and duct lines as well as that chargeable to 500 kw. of the larger substation capacity. While a portion of the operating labor of the larger substations would undoubtedly be a proper charge against this 500 kw. capacity, yet for purposes of calculation we are omitting this item. This will give an annual charge against this method of supplying the load as follows:

Annual fixed charge on cable and conduit, at 10 per cent	$4,500
Annual fixed charge on 500 kw. of the large station capacity, being 15 per cent of $17,000	2,550
Total annual charge	$7,050

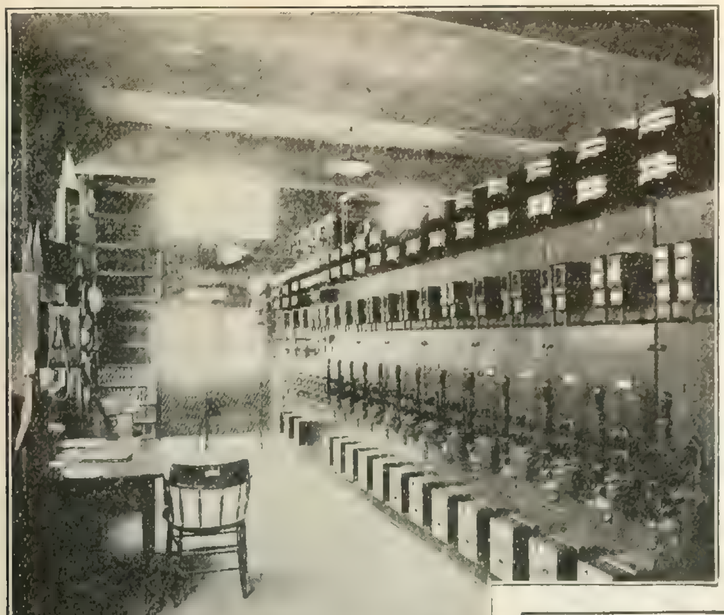
In the above figures no account has been taken of efficiencies, as it has been assumed that the relatively poorer efficiency of the smaller converting unit is balanced by the I^2R loss in the cables if fed from a distant point.

If the substation had been installed for hand operation, the total cost would have been about $30,000. This would have an operating cost as follows:

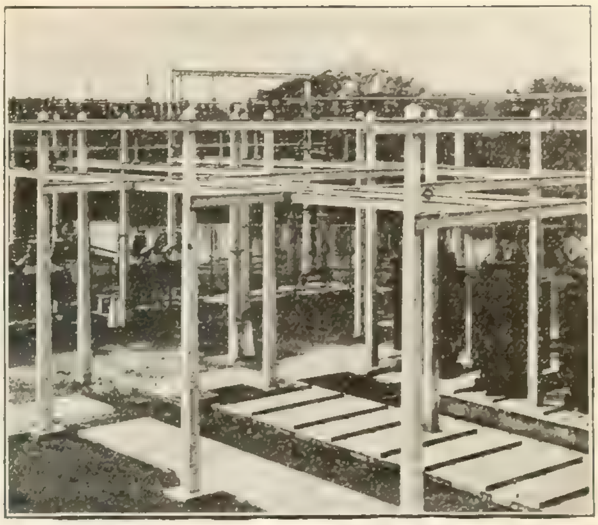
Annual fixed charge, at 15 per cent	$4,500
Operating labor	3,600
Total annual charge	$8,100

Thus, from the standpoints of first cost, continuity of service, quality of service and operating cost, the automatic substation proves best in the above case. While some applications do not show as great a possible saving, owing to varying local conditions, yet this will be very nearly a typical case of a good-sized load concentration on the fringe of the direct-current network.

From the present trend of inquiries a large amount of business will be done along these lines in the coming year.



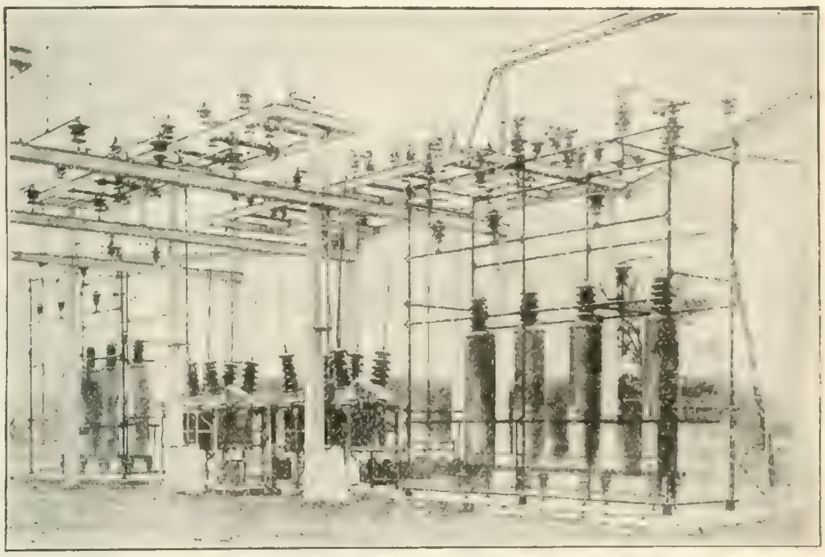
Low-tension control board for distribution circuits supplying 600-volt service for mill motors.



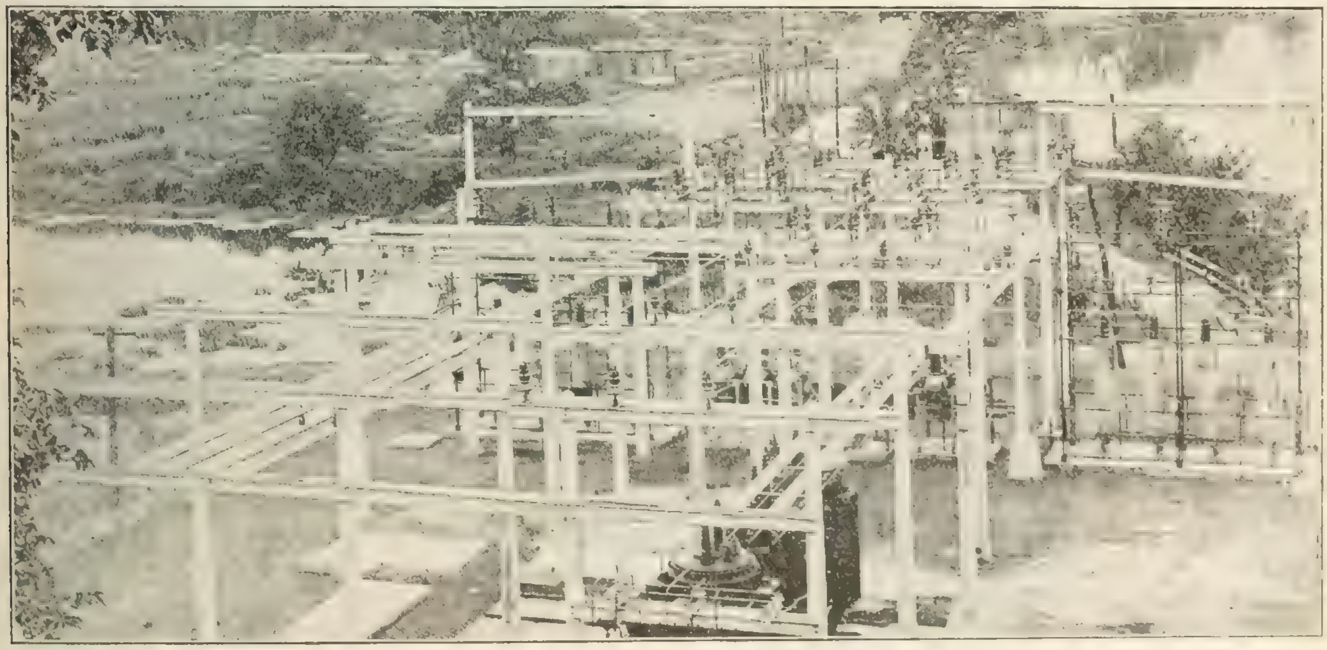
Reinforced concrete poles set on pile foundations used instead of steel columns to carry overhead buses.

Concrete Industrial Substation at Nashua, N. H.

An improved design of substation which reduces the steel work heretofore required. This substation is connected to lines which will eventually link generating plants on the Deerfield, Connecticut and Merrimac Rivers with tidewater stations at Providence, R. I., New London, Conn., and Boston, Mass., and further co-ordinate electrical transmission networks in New England.



High-tension side of substation at point where two 66,000-volt transmission lines enter. Note the use of pin-type insulators and rigid buses supported on steel channels bolted to the concrete posts.



General view of a 6,000-kva. substation which transforms 66,000-volt energy delivered by the New England Power Company for local mill service at the "West Mills" plant of the Nashua (N. H.) Manufacturing Company. Two transmission lines enter the substation, and in the near future an additional 6,000 kva. in transformers will be installed, making a total of six units at this point. Energy is stepped down from 66,000 volts to 13,800 volts and thence by local transformers to 600 volts for mill service.

TRANSMISSION SYSTEMS OF THE NEAR FUTURE

Trunk Circuits Between Hydro-electric or Coal-Mine Steam Plants and Terminal Substations from Which Intermediate Lines Will Radiate

BY A. E. SILVER
Electric Bond & Share Company

THE ever-present query is, "Where does the distribution voltage range end and the transmission voltage begin?" It is thoroughly appreciated, of course, that there is no well-defined dividing line between the two voltages. Instead, there is a rather wide zone of usage common to both applications. Consequently, any specific division can represent only an estimate of the weighted average usage.

Not more than fifteen years ago voltages of from 6,600 to 13,200 were undoubtedly in the transmission class. However, with the rapid growth of central-station systems and the even disproportionately greater increase in the rating of service units, lines that were initially built for transmission have, as the art has progressed, come to be relegated more and more to distribution uses. Determined by the conditions of to-day, the line between the distribution and transmission zones would at the very lowest be placed at 15,000 volts, while probably 25 kv. would be the upper limit. In other words, it must be admitted as debatable whether the 22-kv. step is more representative in the distribution than in the transmission range. It will be assumed in the notes that follow as belonging to transmission.

In the lower steps of the transmission voltages of to-day history is repeating itself. Voltages such as 22 kv., 33 kv., 44 kv. and 66 kv. are fast taking on distribution duty in the way of being utilized to serve direct large-capacity power customers. In other words, in keeping pace with the rapid increase in the size of power services which has been attendant upon the expansion of industrial plants, and upon the turning to central-station supply of many of the former isolated plants, these lower-voltage transmission lines are continually taking on more and more distribution duty and may be expected to continue to lean increasingly toward the distribution zone and gradually one by one to overbalance into it.

INTERMEDIATE TRANSMISSION VOLTAGES

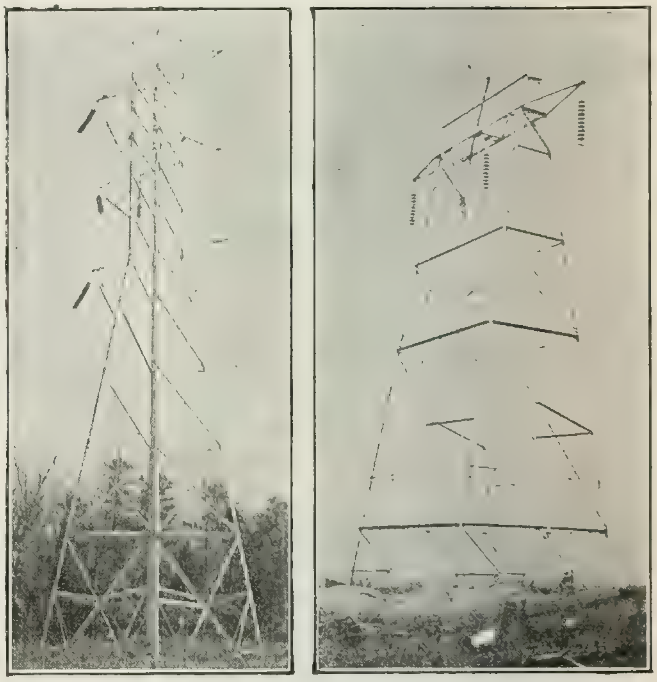
Similarly, with the developing of large-capacity systems supplied from distant power sources, there is building up around these voltages (22 kv. to 66 kv.) what may be termed an intermediate or secondary transmission usage, forming the link between terminal transforming stations at the receiving end of high-voltage transmission trunks (110 kv. and over), near the major load centers, and the purely distribution substations, at the cities and villages in the area, from which fan out the familiar lower-voltage primary feeders. The early future may be expected to find even 110-kv. circuits appearing in this secondary transmission usage, particularly with existing 110-kv. networks, where to meet heavy load demands resort is had to trunk transmission lines of considerably higher voltage to tap distant power sources.

The term "trunk transmission" is used in these notes in preference to "super-transmission," which just now carries a considerable popular appeal and is associated particularly with voltages of the order of 220 kv.

Particularly will this trend to higher transmission voltages be accentuated by an outcome of the water-power agitation which would stimulate hydro-electric development, or by a quickening of the tendency to locate large steam-electric stations directly in the coal fields, since in either case the large blocks of power and the long distances usually involved would economically justify the higher voltages.

MULTIPLES OF 11,000 VOLTS FAVORED

In the matter of numerical values of transmission voltage steps there has been made during recent years material progress toward unification through the elimination from favor of many of the large number of heterogeneous steps that have at some time been used. Even more recently there has been a definite advance toward standardizing in steps which are multiples of 11,000. Except for replacements and some extensions of existing installations, the steps now recognized are 22 kv., 33 kv., 44 kv., 66 kv., 88 kv., 110 kv., 132 kv., 154 kv. and 220 kv. Of these there are indications that 88 kv. will not long be required and that the need for the 33-kv. and 132-kv. steps may not be sufficient to retain a permanent position in the standard voltage schedule of the future.



154,000-VOLT TRANSMISSION LINES OF THE ALUMINUM COMPANY OF AMERICA

The feasibility of each of the voltage values mentioned in the foregoing schedule has been thoroughly demonstrated by experience with actual installations except in the case of 220 kv. However, the engineering features of the latter have been sufficiently studied to insure successful operation from the first installation carried through.

One material benefit of working toward a schedule comprising a reduced number of well-chosen steps will be the facilitating of the movement, mentioned later, for the general interconnection of central-station systems.

The most noteworthy example of high-voltage transmission line constructed during the past two or three years is the 154-kv. line of the Aluminum Company of America in Tennessee. It is of steel towers carrying 500,000-circ.mil. steel-cored aluminum conductors and is of thoroughly conservative and modern design.

In the building up of extensive transmission systems, variable condenser capacity, carefully planned as a complementary adjunct to the transmission circuits, must be looked upon as an essential integral part, not only for the effective system voltage control that can be gained thereby, but also because of an actual saving in first cost due chiefly to the materially reduced size of transmission conductors for equivalent results. With this application of condensers, the only remaining fundamental objection to 60 cycles, the now accepted frequency, that of inherently poor regulation for long-distance transmission duty, has been largely overcome.

In the development of transmission-voltage practices system electrical connections will play a very definite part. Experience gained during the past several years from large power systems has so clearly demonstrated the superiority of the grounded neutral connection over the isolated delta as to insure its adoption for any new system. This benefit is so marked as even to lead some systems originally constructed and operated with isolated delta connections to go to the expense of conversion.

The benefits of interconnection between transmission systems, which gained such an impetus during the war emergency, have been so clearly demonstrated as to insure the continuation and rapid widening of this practice. Initially, many of these interconnections may be intended only for interchange duty—*i.e.*, to gain the advantage of diversity between loads and to provide increased reliability and efficiency of operation, requiring the transfer of relatively not large amounts of power. In such cases, owing to existing arrangements and locations of lines which make for construction economy, the tie may frequently be effected between circuits of the secondary transmission order. However, with the spreading out of lines of the trunk-transmission order, interconnection at these higher voltages will doubtless prevail on account of the greatly multiplied scale on which all of the benefits can be realized.

TRANSMISSION OF THE FUTURE

Summarizing briefly, then, the typical power transmission system of the near future may be expected to comprise essentially the following: Trunk transmission circuits of 110 kv., 154 kv., 220 kv. or perhaps even higher, performing express duty between hydro-electric plants in the interior or steam-electric plants at points readily accessible to the coal fields, and terminal transforming stations at the hubs of the heavy load areas, here stepping down to 22 kv., 44 kv., 66 kv. or 110 kv. At one of these intermediate voltages, from these terminal stations and also from any relatively nearby generating stations, the secondary transmission circuits will radiate to serve directly the large power customers and to deliver the power supply to the distinctly distribution substations. For system voltage regulation, rotary condensers, carefully proportioned as an integral part of the system, will be basic. Interconnection of these transmission systems will be generally adopted, the ties being effected through the transmission trunk networks to gain the maximum benefits from heavy-duty, wide-range interchange, including that of seasonal equalization between hydro-electric and steam-power sources of supply.

STANDARDIZATION BEING APPLIED TO DISTRIBUTION

Four-Wire Primary Circuits — Balancing Secondary Copper Against Transformers—Fusing and Protecting Against Lightning

BY H. B. GEAR
Engineer of Distribution, Commonwealth Edison Company

THE progress of electrical distribution practice has been in the direction of standardization of principles, but with considerable variations in the details of the application of these principles to specific cases. The influences which produce these variations are in part those arising from individual preferences and in part those arising from local geographical and business conditions. The details of application are too numerous and varied in character to enumerate in this connection, but a review of some of the fundamentals of distribution practice and a discussion of some of its current problems may be of interest.

FOUR-WIRE PRIMARIES FINDING FAVOR

In a well-planned system the distributing feeders and mains are laid out in such a manner as to insure an approximately even distribution of pressure without an excessive use of copper. For general service, including power for industrial purposes, three-phase distribution is increasingly used, since it is readily derived from three-phase transmission lines. In the larger cities the four-wire system is finding increased fields of usefulness. Its introduction, however, is necessarily slow, because the change from other systems often involves the scrapping of equipment which is still in serviceable condition. Four-wire, three-phase distribution at 2,300/4,000 volts has decided economic advantages over 2,300-volt systems where the load to be distributed exceeds 2,000 kw. In rural distribution advantage has also been taken of this system operating at 4,600/8,000 volts, thus giving an adequate radius of distribution in well-settled farming districts. In the Far West, where irrigation and drainage loads are heavy, such systems have found extended application at 6,600/11,000 volts.

BALANCING SECONDARY COPPER AGAINST TRANSFORMERS

Secondary mains are arranged so as to secure proper balance between the cost of copper and the cost of transformers, excessive length of secondary mains being wasteful of copper, and an excessive number of smaller transformers too closely spaced being wasteful of transformer investment and losses. Where the local geography of the lines makes it advantageous to do so, secondary mains of adjacent transformers are interconnected to secure the benefit of the increased diversity. Where such a network covers a considerable number of transformers it is protected by sectionalizing fuses, or in some cases by fuses arranged to cut out the transformer in case it proves defective. Sizes of transformers are selected for the duty which they are to perform on the basis of experience with the demands of similar installations already in service. As load is added to existing transformers overloads are avoided by checking with maximum-demand indicators or split-ring current transformers, which eliminate the necessity of guesswork in determining when the capacity of a transformer should be increased.

Pressure regulation is secured by the use of automatic regulators on feeders which are adaptable for outside use as well as for substations. This equipment has brought to the more remote communities the possibility of having pressure regulation of a quality which was formerly unattainable.

FUSING TRANSFORMERS AND PROTECTING AGAINST LIGHTNING

The use of primary fuses is limited to the protection of transformers and equipment. The smaller link fuses furnished with transformers are quite satisfactory when new, but in the atmosphere of a city are gradually weakened by corrosion and in wet weather operate when there is no occasion for it. In the capacities required for transformers of 50 kva. to 200 kva. the problem is to get a design which will not be wrecked under short-circuit conditions. Of the various types available, those employing an oil-submerged fuse link seem to have the best prospect of ultimate success.

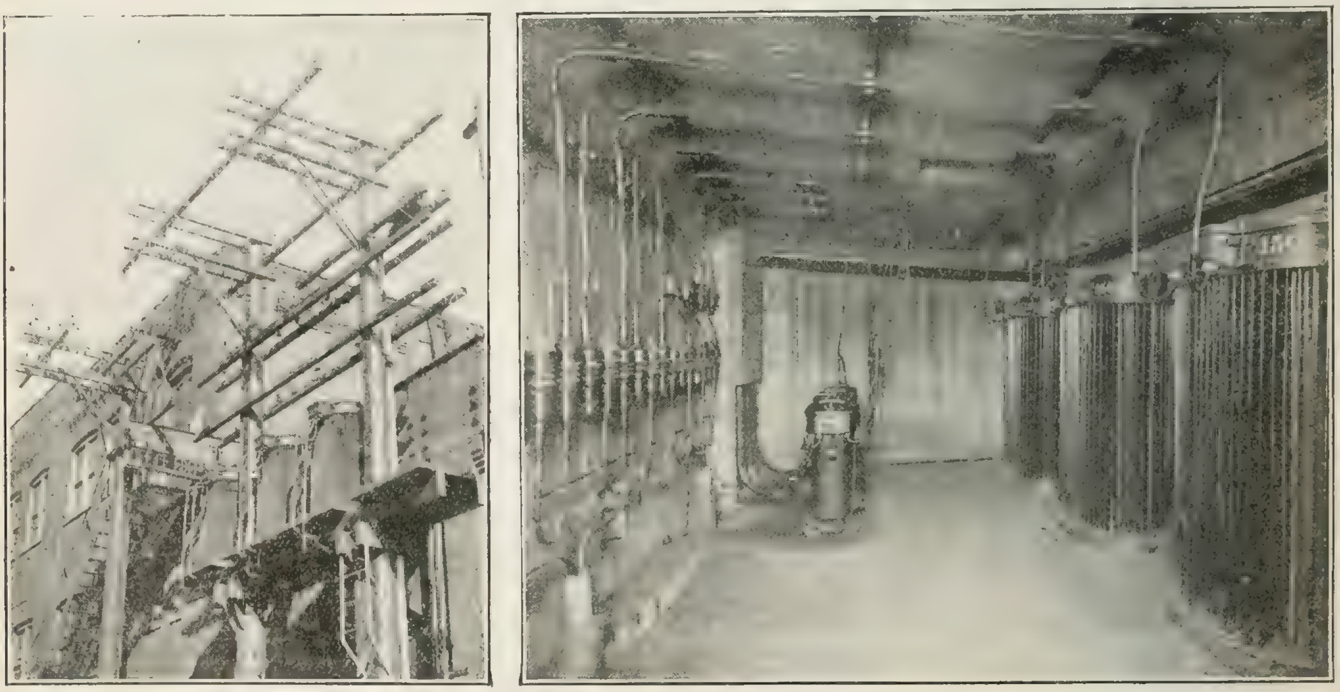
The protection of distribution transformers and cables from lightning has passed from the development stage to one of practical business policy. The standard types of arrester may be depended upon to protect the line equipment from damage (except a direct stroke) if the arrester is placed near the equipment to be protected. Further, the provision of an arrester at each transformer greatly reduces the number of interruptions due to blowing of fuses during lightning storms. The loss of transformers as averaged over a period of years is not sufficient to warrant the investment in arresters except for the larger sizes of transformers. Hence the use of arresters for all transformers is determined by the importance of the service and by the policy which the management wishes to follow as regards a reputation for reliability of service.

Perhaps the most engaging problem of distribution engineering in recent years has been that arising from the increased load densities in districts which had been considered well developed. This increase has arisen from the general introduction of electrical appliances, motors and other energy-using equipment, the wiring of old buildings, and from the increased application of electricity to furnaces and other purposes taking power in large quantities. In the older parts of the larger cities the former residential districts are being transformed into manufacturing or shopping districts, and the users of electricity require much larger quantities than did the residences which preceded them. The distribution system which served well in its day is no longer adequate to the greatly increased demands upon it and must be greatly reinforced.

In attempting to provide the needed reinforcement of the feeder system required by the addition of considerable numbers of consumers taking power in blocks of 100 kw. to 300 kw. the rate at which new 750-kva. feeders are required and spare feeder panels in substations are filled up so greatly exceeds original expectations as to point clearly to the fact that the general distributing system could not be expected to keep pace with such a situation. A feeder unit of larger capacity is plainly demanded. This is most conveniently obtained by the use of lines from the bulk supply or transmission system having a capacity of 3,000 kva. to 5,000 kva. With such lines overhead the problem is not difficult, if the space is available for transformer installation out of doors.

ECONOMICS OF UNDERGROUND DISTRIBUTION

With underground lines the length of an interruption in case of a cable failure is serious unless a reserve cable is provided by a loop or by a tap from another line. In the manufacture of ice, and in electric furnace and other kinds of service, the requirements of the process do not permit an extended interruption, and the service must therefore be provided in duplicate. The cost of extending the line underground and providing the necessary switching and transformer installation on



FIGS. 1 AND 2—TYPICAL BANK OF TRANSFORMERS SERVING INDUSTRIAL LOAD; VAULT-TYPE TRANSFORMER STATION WITH UNDERGROUND OUTGOING AND INCOMING LINES

the customers' premises is a considerable item as compared with the cost of the equivalent installation from the general distribution system in many cases. This appears as a considerable offset to the use of the bulk-supply feeder until account is taken of the value of the distributing substation capacity which is absorbed by the large consumer.

The cost of the installation of transformers and switching equipment on the customers' premises (with underground lines and oil switches) is about as much for a small installation as for a large one, and there is therefore a point where the cost of the bulk-supply service installation equals the value of the distributing substation and feeder capacity released by its use. For instance, with No. 4/0 cables at 13,200 volts, looped through oil switches with automatic relay protection, the cost of a bulk-supply installation is about the same as for a distributing system installation when the installation is one of 300 kva. With smaller installations it requires less investment to serve them from the distributing system, and with larger installations it is better to serve them from the bulk-supply system.

The cost of a customer-service installation is less with a tap connection than with a loop; where the nature of the service is not exacting the tap without relays may be used. In such cases the economic balance may be reached at about 150 kva. With overhead lines to an out-of-door installation the transformers are fused and the switches are commonly not automatic. The cost of the installation under these conditions does not greatly exceed that of a standard installation from the distributing system, and industrial installations smaller than 150 kva. may be advantageously served from the bulk-supply system.

FORMS OF CONSTRUCTION THAT REDUCE COST

The use of underground construction is increasing yearly as the load conditions in the central parts of growing cities reach a point where the investment is warranted and the practical conditions of operation demand it. This takes different form, however, according to local geography. In some cases the lines are built on business streets with primary and secondary mains in a conduit system and transformer vaults at intersections. In other cases, when alleys are available, the secondary mains and services, which are the most expensive part of an underground system, are kept overhead, the primary lines being carried through the district under ground. In still other cases, where houses are built in uniform style, the primary mains are carried overhead, and the secondary main is laid in a grass plot or parkway using a steel-taped cable without conduit. This method is not adaptable in business districts to any considerable extent, as parkways are not available.

The foregoing developments have led to the increasing use of cable-pole connections with detachable-type potheads, by which cables are quickly segregated from the overhead lines and trouble is located with a minimum expediture of time and money.

SERIES TRANSFORMERS FOR STREET LIGHTING

The development of street-lighting distribution has gone on apace but has not reached a condition approximating a standardization of practice. Series systems operated by alternating current are being developed in such a way as to utilize the series transformer for the purpose of reducing the voltage on the local lamp circuit to safe limits. With this is combined the use of smaller lighting units spaced more closely than has been customary with 500-watt units but using about the same amount of energy. This involves the use of armored cable laid in parkways in residence districts. The distribution system must, of course, conform to the street-lighting requirements, and as better distribution of lighting is demanded by public opinion the electrical distribution has fortunately sufficient flexibility to adjust itself to any standard of lighting which may be ultimately required.

Progress in England's Electricity Supply Bill

According to the London electrical papers, the government electricity supply bill is making progress on its legislative path, though many changes have been made from the original measure.

The government has withdrawn the clauses providing for the district electricity boards, the compulsory purchase of stations and transmission lines and the authority for the Electricity Commissioners to advance £25,000,000. These clauses, it is stated, will be incorporated in a new bill to be introduced at the next session.

The bill, however, retained the provision "for the expenditure of not to exceed £20,000,000 for the purpose of erecting generating stations urgently wanted in districts where there is a famine of power."

A memorandum to the House of Lords discussing the purchase terms of the bill was presented by the Provincial Electric Supply Committee of the United Kingdom, representing 130 electric supply companies. As printed in the *Electrical Times*, it is in part as follows:

The government answers to the companies' contentions and the rejoinders thereto are:

(1) That to pay for the stations on a present market value basis would be to give the companies a war profit, and to overload the capital accounts of the joint electricity authorities or district boards.

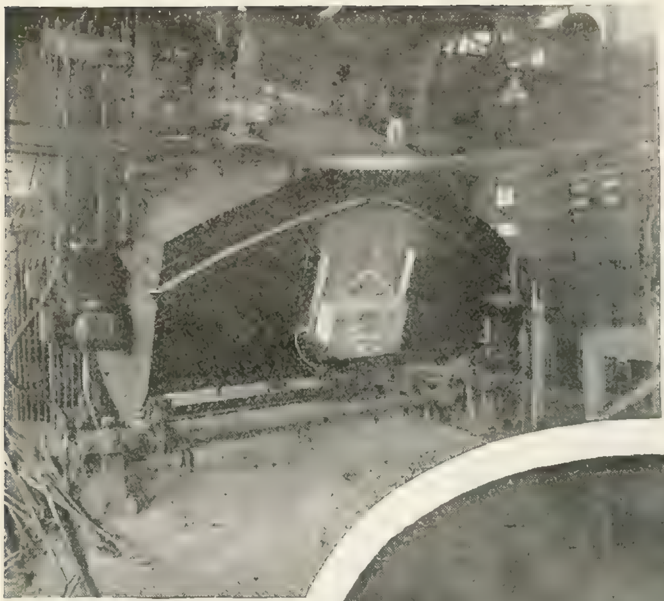
The companies' answer to this is that they do not seek anything in the nature of a war profit, but they equally object to the capital being put at a fictitiously low value at the expense of their shareholders.

(2) That there is no good-will value attaching to the stations as such. The companies make their profits on the distribution business—that is, by their sales. They will be entitled, under Clause 7, Sub-section 5 of the bill, to receive from the district boards as much electricity as their existing stations can supply, at a price not higher than they could have produced it themselves.

The companies' answer to this is that the costs of generation have been steadily reduced in the past by improvements in their stations, and that to deprive the companies of the opportunity to make further improvements of the same kind is to deprive them of part of the good will of their undertakings during the tenure guaranteed to them by Parliament.

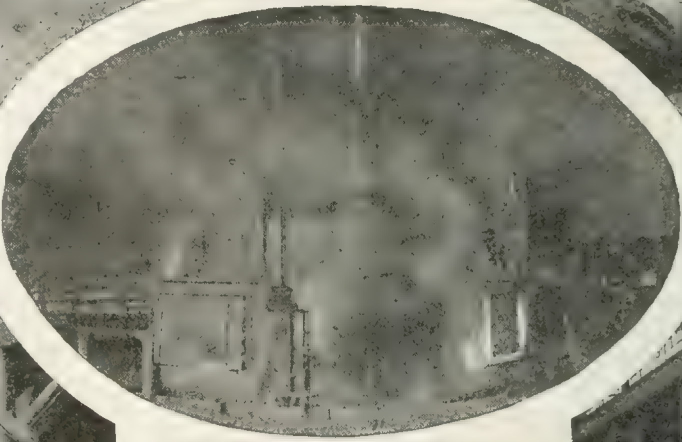
(3) That the companies whose generating stations are taken over are offered by Clause 12 of the bill the option, within two years, of transferring the whole of their undertakings to the district electricity boards, on the terms of receiving the capital expenditure on the undertaking properly standing in the books of the company as certified by an auditor appointed by the Board of Trade, less the amount received for the generating station, so that if they find themselves unable to continue in business and make reasonable profits under the new conditions, they can call upon the district board to purchase the whole undertaking on the terms above mentioned.

The answer to this is that while this provision is certainly some protection, it obviously will only operate in the case of companies that find themselves so much prejudiced that they prefer to sacrifice whatever chance they may have had of making more adequate profit.



Two-phase muffle-arc resistance-type Collins furnace.

An induction-type Ajax-Wyatt furnace used to melt brass.



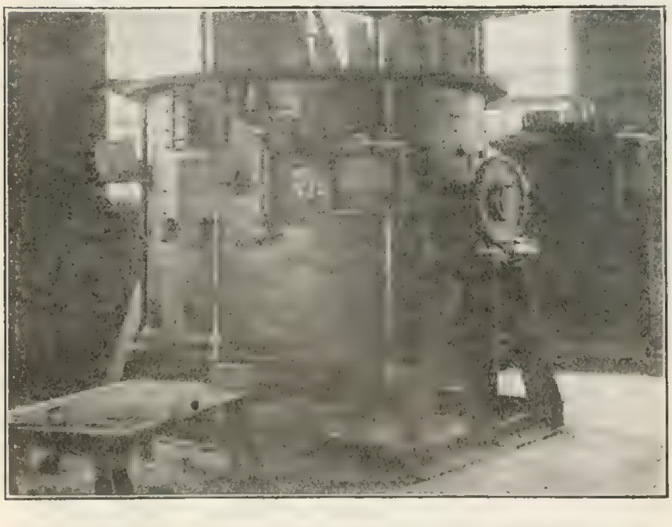
A Heroult furnace used by the United States Steel Corporation.

Electric Furnaces in 1919

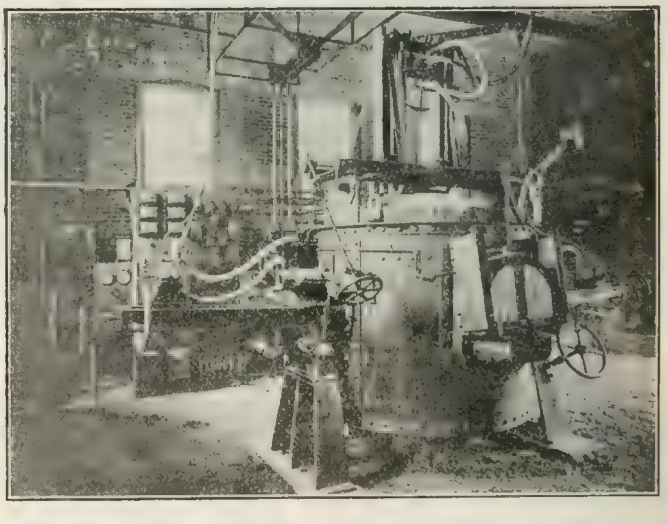
Although the United States used only 9 per cent of the total number of electric furnaces in the world in 1910, application of electricity to industrial processes received such an impetus during the war that 491 furnaces, or 36 per cent of the world total, are now installed in this country. (See page 161.)

Single-phase Snyder furnace of the direct-arc type.

Greaves-Etchells furnace, which was first used abroad.



Baily reverberatory resistance-type furnace used to melt non-ferrous metals.



A Rennerfelt electric furnace, which falls in the indirect-arc classification.

Industrial Activities

CURRENT TENDENCIES IN ELECTRIC HEAT TREATING

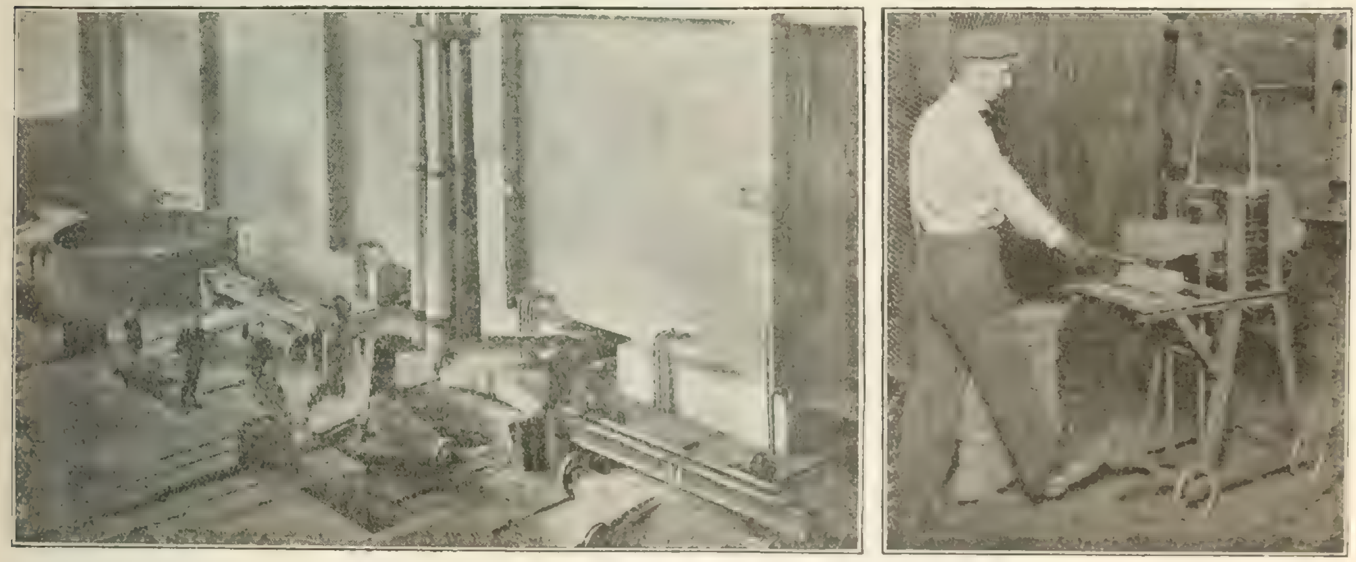
Metallic-Resistance Furnaces in Extensive Use—At Present Rate Industrial Heating Load Will Soon Surpass Light and Power Load

BY E. F. COLLINS
Enngineer Industrial Heating, General Electric Company

THE progress made during the last few years in the application of electricity to industrial heating has been exceedingly rapid. Prominent among these applications has been the more extensive use of electric furnaces in the melting of copper, brass, aluminum and other non-ferrous metals, for which they have been found to be particularly well suited; a very wide use in drying and baking operations, such as japanning, core baking, and particularly in the automobile industries for enameling bodies and parts; a rapidly broadening field in heat treating, annealing and similar operations. It is to the application of metallic-resistor furnaces to the latter group of heat-treating operations that it is desired particularly to direct attention.

Granular-carbon or coke resistance furnaces have been known and used for some years for this prupose, with some success, although for inherent reasons they cannot be built to have the highest thermal efficiency and are not adapted readily to accurate automatic temperature control.

Metallic-resistor furnaces of small size have been used in laboratories and for some minor industrial purposes for many years, but have not had a wide application and were not of sufficient capacity to be of any industrial importance. However, they have always been held in high favor because of the clean and uniform heat, always under convenient and accurate control. During the last two years this type, embodying many new principles in design, has been applied on a large scale to the manufacture of ordnance, where their use has been accompanied with very marked success.



FIGS. 1 AND 2—HEAT-TREATING LARGE GUNS BY ELECTRICITY, AND HEATING RIVETS

These vertical-cylindrical furnaces use a heavy ribbon of resistance alloy as the heating element, it being supported directly on the inside walls and thus being able to transfer the heat to the charge by direct radiation. The use of heavy ribbon is very desirable as it affords rugged mechanical construction, and the space available permits the use of a relatively large amount of ribbon; so that the temperature of the resistor is held only slightly higher than the temperature of the charge, thus giving a very conservative and safe design with large heat flow at low potential.

The walls are heavily heat-insulated, which gives a high thermal efficiency, and the inner refractory lining of firebrick, being subject to no wear or abrasion, will hardly ever need replacement or even repair, as demonstrated by the furnaces operated during the war.

If the proper resistance alloy be used for resistors, there is no progressive oxidation or deterioration at heat-treating or annealing temperatures (below 1,000 deg. C.), and the resistors are therefore assured a long life, particularly at the low-temperature gradients allowed in recent designs as distinguished from the small-resistance-wire furnaces first referred to, which invariably use high gradients. Moreover, the small furnaces were usually of the muffle type, which required that the heat be forced through the walls of the muffle chamber, screening the work from direct heating, and a quick response to temperature control. Suitable relays and temperature-control instruments have been perfected which permit a remarkably efficient and sensitive automatic temperature control and the operation of which may also be automatically recorded.

The furnaces used in the manufacture of ordnance were vertical cylindrical in form and were in several sizes, the largest being 8 ft. (2.4 m.) in diameter and 35 ft. (10.7 m.) high, requiring 700 kw. per hour while heating from three to twelve gun tubes or jackets simultaneously, depending on the size of the pieces. This type is now being built in various forms and sizes, both horizontal and vertical, and is finding a wide field of application. Ultimately it is likely to replace fuel-fired furnaces for heat treating and annealing, where accurate temperatures, automatically controlled and uniformly distributed, are essential.

The evolution of these large resistance furnaces for high temperatures, and their application on a large scale to industrial processes, is one of the most important developments in recent years, and indeed may be said to mark an epoch in industrial progress.

In addition to the high-temperature furnaces, there have been constructed a large number of low-temperature furnaces for operation up to 1,000 deg. F. for use in shrinking the jackets and hoops on guns and putting in and removing liners from large guns. These furnaces were built of short cylindrical sections stacked one upon another to make a furnace of any desired height and were in several sizes, the largest being 80 in. (2 m.) in diameter and designed to stack to a furnace 90 ft. (27 m.) high.

These furnaces can also be built in any form or size and are suitable for air drawing of carbon steels and the making of shrinking fits generally.

Already, owing to the developments of the past few years, industrial electric heating is rapidly assuming the importance of the electric lighting and power loads, and, according to its present rate of growth, it will surely in due time pass these in point of kilowatt-hours consumed yearly.

VALUE OF LIGHTING HAS AT LAST BEEN RECOGNIZED

Illumination Has Taken Its Place Among Other Standard Agencies for Increasing Production and Conserving Labor

BY WARD HARRISON
Illuminating Engineer National Lamp Works

THE year 1919 has witnessed no spectacular advances in the development of new light sources or accessories, but, contradictory as the statement may appear, the progress of the lighting art has nevertheless equaled or excelled that of any previous twelve months. Not until this year could it be said that the public had really begun to accept illuminating engineering, that in the minds of any considerable number illumination had risen above the "janitor service" class and had taken its place with the other standard agencies for increasing production and conserving labor. Heretofore new lighting equipment has usually obtained its entrée into an industrial or a commercial establishment through the purchasing agent or the maintenance department, both being interested chiefly from the standpoint of possible reductions in lighting expense. To-day its appeal is to the man who stands responsible to the stockholders of that establishment for production and profits. Many causes have contributed to this general acceptance of those views on lighting long advanced under more or less discouraging conditions by the comparatively few. One of the most prominent of these factors has been the steadily mounting cost of labor and material. Many plants have been content to operate more or less inefficiently under normal conditions but have now awakened to the necessity of a rigid investigation of every means of holding down the soaring cost of production. The war has not been without its good effects in this respect.

Far less difficulty need be anticipated in educating plants to increase their standards of light intensity than in convincing them of the necessity of taking adequate steps to diminish glare. The existence of a simple unit of light intensity, the foot-candle, and a simple instrument with which it may be measured brings intensity of illumination within the sphere of tangible concepts. The need of the present is for a correspondingly simple measure of glare. Any number of instances might be cited to show how those who have previously given the subject no considerable thought have, after the briefest period of study, been able not only to measure illumination but also to converse intelligently in foot-candles.

This transition of intensity of illumination from the vague to the definite, in conjunction with records of tests on production, has led to the recent installation of many lighting systems designed to provide intensities of the order of 10 to 15 foot-candles over the working areas. Unfortunately, however, equal thought has not always been given to shielding the eyes from light sources of necessarily increased power. On the other hand, the one new development in incandescent lamps of general application, the "white Mazda," has been in the direction of a better diffusion of light, and the tremendous demand for this lamp at least suggests the possibility of further development along this line in the future.

STEPS TO ELIMINATE GLARE

In the field of lighting accessories the tendency has also been toward refinement from the standpoint of increased diffusion of light rather than in the development of radically new types of fixtures. First of these in importance is the standardization of certain types of metal reflectors under the "Reflector and Lamp Manufacturers' Standard Specifications," a plan inaugurated more than a year ago by the reflector and lamp manufacturers but just now being put into full effect. The purpose of the RLM standard specifications for dome reflectors is to supplant older types with one which will render greater protection against glare without a material sacrifice of any of the desirable qualities of the dome. The specifications also establish rigid standards of quality for the product.

A still further refinement intended to protect the eye from specular reflection or reflected glare is the increased use of opal-glass caps or other diffusing media interposed between the lamp filament and the work surfaces. Again, glass inclosing units are becoming increasingly popular for certain factory installations, not only because of the protection which they afford against direct and reflected glare but also for the reason that they illuminate the ceiling and high side walls and thus produce a pleasing effect of "natural" lighting. To obtain a similar result from metal reflectors some manufacturers have placed on the market units in which a section of translucent glass has been substituted for a portion of the upper surface of the reflector and some light is therefore directed to the ceiling. Other minor improvements have contributed to the condition which has been expressed by prominent engineers as making possible for the first time installations which meet all the requirements of good factory lighting as we know them to-day.

ATTEMPT TO AVOID CLEANING HAS INFLUENCED COMMERCIAL LIGHTING

In the field of office and commercial lighting there has continued the marked trend toward the installation of complete lighting units of the totally inclosing type, or those formed by incorporating an upper reflecting surface, either opaque or translucent, in combination with a diffusing bowl. These units have a wide field of proper application, but often they have been installed in locations where strictly engineering considerations would point toward the use of some form of indirect or semi-indirect lighting. This is a condition which has been brought about not merely by sales effort but also by the more general realization of the inroads made by dust and grime and ceiling deterioration on the efficiency of units of the semi-indirect and indirect types, especially.

When properly organized, maintenance of lighting systems is simple and relatively inexpensive. However, instead of making the necessary effort to organize adequate cleaning service, many have taken the easier course of choosing a different type of lighting unit, which may not be so well adapted to their illumination requirements. All lighting systems require maintenance, and instances where the illumination intensity may be increased from 50 to 100 per cent simply by washing the units are all too frequent, a condition which will not be remedied until those who design and install lighting systems realize that their work is not completed and their responsibility to their client not terminated until an adequate system of maintenance has been organized to insure a permanently satisfactory operation of the system.

A NEW APPRECIATION OF LIGHTING BEING SHOWN

Lighting fixtures for use in residences, clubs and hotels fall for the most part into one of two mutually exclusive classes. Either they follow purely utilitarian lines and possess little or no artistic merit, or else, and more generally, the units are chosen for their pleasing and harmonious appearance, especially by day, and are incapable of satisfactorily illuminating the interiors in which they are used. Now, it seems that in this field also there are evidences of progress. A new appreciation is being shown of the value of light as a means of decoration, and already there are beginning to appear several practical types of fixtures which are capable of artistic treatment without a serious sacrifice of their illuminating qualities. Although the familiar glaring cluster of round-bulb lamps still dominates the fixture dealer's showroom, the time seems not so far distant when it will fail to occupy its accustomed place.

FIGS. 1 AND 2—GOOD AND BAD LIGHTING FOR THE SAME PROCESS

In the field of street lighting few changes of major importance have taken place either in the light sources or their accessories. The prismatic refractor has retained its position as the most satisfactory means of modifying light distribution. In the latest installations, however, there is a noticeable trend toward the choice of those designs which do not diminish the volume of light falling upon the road surface at points near the unit; in other words, the chief function of the prisms is now to divert into useful zones those rays which would otherwise escape in the upper hemisphere and those of the rays in the lower hemisphere which are so near to the horizontal as to prove a hindrance rather than an aid to vision.

STREET-LIGHTING CIRCUITS NEED ATTENTION

The problem of street lighting pressing for solution to-day is that of the choice of the system of electrical distribution. The simple series circuit, standard for so many years, has proved cumbersome and inadequate for the needs of many of our larger cities where increased density of traffic has rendered higher standards of illumination intensity imperative. For such locations both the operation of street lamps from existing multiple distribution systems and various combinations of series and multiple circuits have been advocated. In any event it seems probable that some standard method of distribution having greater flexibility and a lower installation cost than that of the series circuit will be developed.

The most conspicuous advance in governmental regulations covering artificial lighting has been the automobile headlight legislation adopted in New York, Pennsylvania, Connecticut and California. These laws have all been based upon reports of the Illuminating Engineering Society committee on automobile headlights, which made the first extensive engineering study of the requirements of headlighting for vehicles and established criteria for judging the suitability of various equipments.

Codes of industrial lighting are now in force in New

York, Pennsylvania, New Jersey, Wisconsin, California and Oregon. Ohio, Massachusetts, Oklahoma, Utah and about ten other states have either already formulated such codes or have them under serious consideration. As in the case of the automobile headlight laws, all of these codes have resulted from the work of the Illuminating Engineering Society through its committee on lighting legislation. In this connection it is of interest to note that in the more recent codes, those of Wisconsin, New York, California and Ohio, there has been shown a disposition to lay down somewhat more specific requirements than those at present included in the Illuminating Engineering Society's code. California, for example, has both a definite criterion covering glare similar to that in the code of Wisconsin and definite intensity standards for various industrial operations following the work in New York and Ohio. All of the codes make it clear that the standards of intensity which they require are based solely upon considerations of accident prevention and conservation of vision and that considerably higher intensities than these are usually desirable from the standpoint of the manufacturer.

In the outlook for the new year it appears that new standards rather than old ideas of practice are to predominate both in interior and exterior lighting.

ELECTRICAL ENERGY IN FIXATION OF NITROGEN

Arc Process Used Extensively in Norway—In This Country and Canada Cyanamid Process, Needing Less Power, Is Generally Employed

BY ERIC A. LOF
General Electric Company

AS MOST truly expressed by Rear Admiral Ralph Earle of the United States Navy: "The value of nitrogen in its various forms, both in peace and in war, to the life of a nation cannot be estimated in words, the maintenance of a source of supply that will be uninterrupted being absolutely essential to national existence."

The most important available sources of nitrogen are: (1) Natural deposits; (2) by-product ammonia; (3) atmospheric nitrogen. The natural deposits are chiefly to be found in the extensive nitrate-of-soda beds in Chile, while the second source of available nitrogen, ammonium-sulphate, is obtained as a by-product in gas works or in by-product coke plants.

The first two sources, however, were far from sufficient to meet the enormously increased demands for fixed nitrogen during the world war, so a most extensive introduction of atmospheric nitrogen fixation was resorted to especially by the Central Powers. While the many plants which were thus built during the war were chiefly intended for military purposes, it is to be hoped that steps will immediately be taken for converting them to a peace basis for the manufacture of fertilizers. In this manner it would be possible to materially increase the productive capacity of the soil and thus insure an abundant food supply, of which the world is now in need more than ever before in modern times.

There are three processes in commercial use for the fixation of atmospheric nitrogen, and besides these there are two others which as yet can only be considered in the experimental stage, but which nevertheless are worthy of consideration. These processes are:

1. The arc process, in which the nitrogen is directly oxidized in an electric arc.
2. The cyanamid process, in which the nitrogen is absorbed by carbide, forming cyanamide.
3. The synthetic ammonia process, in which nitrogen is directly combined with hydrogen to form ammonia.

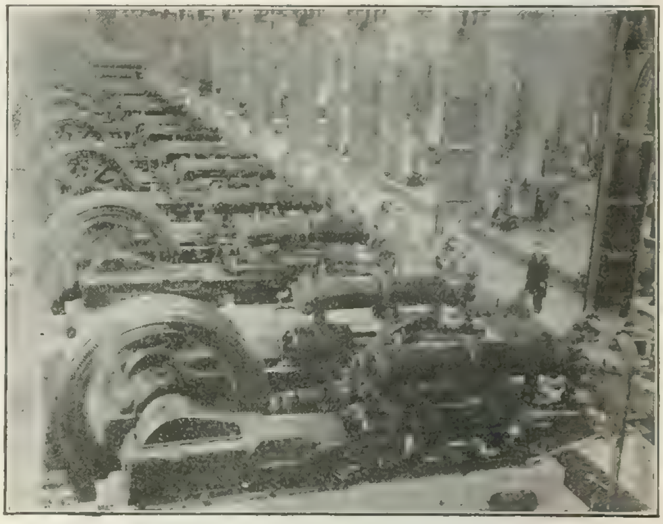


FIG. 1—LONG AISLE OF SYNCHRONOUS MOTOR-DRIVEN COMPRESSORS FOR NITROGEN FIXATION

4. The cyanide process, in which the nitrogen is fixed as cyanide.
5. The nitride process, in which the nitrogen is absorbed by a metal forming a nitride.

The Arc Process.—In this process a current of air is passed through an electric arc furnace, where it is heated to over 3000 deg. C. Only a small part of the oxygen and nitrogen contained in the air enter into chemical combination, and after leaving the furnace the gases must be rapidly cooled so as to prevent the nitric oxide thus formed from decomposing. This cooling is first accomplished by passing the furnace gases through ordinary steam boilers, in order to recover some of the heat energy, and afterward through water coolers. The gas is thereafter carried through an oxidation chamber, a large empty tank, so as to permit the nitrogen oxide to take up additional oxygen from the air to form nitrogen peroxide. This is essential for the absorption which then follows and whereby the gas is

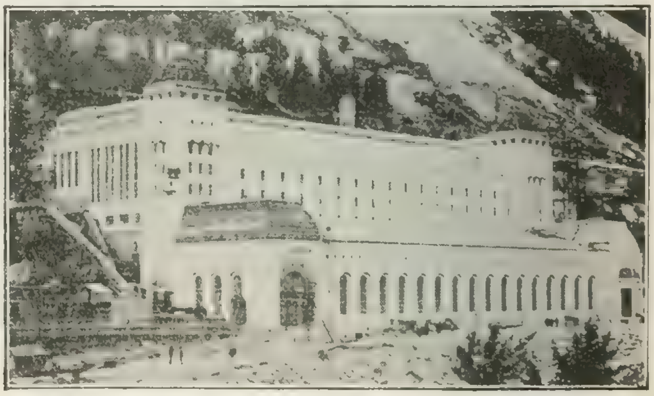


FIG 2.—RJUKAN II NITROGEN-FIXATION PLANT IN NORWAY

either absorbed in water to form weak nitric acid or in some alkali solution to form the corresponding salt. The solution obtained is afterward concentrated or crystallized.

The arc process has not found a foothold in this country on account of two facts. The first and most important is the high cost involved primarily on account of the immense absorption system required due to the very weak gases. The power requirements are also high, amounting to about 12 hp.-year per ton of nitrogen produced as strong acid, and for this reason the commercial success of the process would necessitate an electric power rate which would be hard to obtain in localities where a market could be found for the acid. For instance in the West, where cheap water power could be found, one would be confronted by the difficulties and expense of transportation. The second reason why the arc process has not been generally adopted here is that, inasmuch as the product is nitric acid, it is chiefly of interest to the explosive industry and not so much to the fertilizer industry, for which some form of ammonia compound is much preferred. The arc process is only extensively used in Norway, where about 350,000 hp. is utilized therefor, but the possibility is not excluded that it might be feasible to install such a plant in connection with some of the yet undeveloped large water powers in the East or South.

The Cyanamid Process.—This process is based on the ability of calcium carbide to absorb nitrogen. The carbide is produced from a mixture of lime and coke in huge electric furnaces. After the carbide has cooled it is crushed and ground to a fine powder, which is placed in large cylindrical perforated casings set in the fixation ovens. The latter are heated by electricity, and when the temperature reaches about 1100 deg. C. pure nitrogen, produced by liquefaction of air, is admitted. The carbide then readily absorbs the nitrogen, forming a chemical compound, calcium cyanamide. When the absorption has stopped, the cyanamide is removed, allowed to cool, after which the mass is ground to a powder. It is thereafter treated with a small quantity of water to remove the last traces of carbide, and is then known by the trade name "cyanamid," which contains about 19 to 21 per cent nitrogen, equivalent to an ammonia content of approximately from 23 to 26 per cent.

Besides its direct use in the manufacture of mixed fertilizers, cyanamid is also being extensively used as a source of nitrogen for many other products. The process was adopted by the United States government for its large nitrate plants during the war. Owing to the signing of the armistice only the large Muscle Shoals plant was completed, which has a capacity of 110,000 tons of ammonium nitrate per year. The cyanamid produced is treated with steam in large autoclaves and ammonia is formed. One-half of this ammonia is oxidized to form nitric oxide, which is absorbed in water to form weak nitric acid. This is thereafter neutralized with the remaining one-half ammonia, and ammonium nitrate in solution is formed. This goes to the evaporating building, where it is crystallized and is then ready for use.

It is thus seen that, with ammonia as the starting point, not only can nitric acid be readily produced by oxidation, but also a number of other useful compounds. The most interesting of these is undoubtedly ammonium-phosphate, which promises to be of unusual importance as a fertilizer. It is known under the trade name "Ammo-Phos" and is produced by absorbing ammonia in a solution of phosphoric acid, which acid in turn can be produced from phosphate rock in electric furnaces. It contains from 13 to 20 per cent ammonia and up to 47 per cent available phosphoric acid, thus more than 60 per cent of actual plant food, and is therefore many times richer in fertilizing value than ordinary fertilizer mixtures, which usually contain from 12 to 18 per cent actual plant food.

The Synthetic Ammonia Process.—This process was used by Germany to a great extent during the war and was adopted for United States Nitrate Plant No. 1 at Sheffield, Ala. It will, in the writer's opinion, have the greatest future in this country. Electricity will be of very great importance in connection therewith, as both the hydrogen and the nitrogen required will undoubtedly be made by a process which requires large amounts of electric power. In fact, one plant employing this process is now under way which will involve possibly above 50,000 hp.

This process has the greatest possibilities. It consists briefly in passing a mixture of three volumes of hydrogen and one volume of nitrogen at a pressure of upward of 100 atmospheres over a suitable catalyzer. This causes a part of the hydrogen and nitrogen to unite and form ammonia. There are, however, many difficulties involved due to the high pressure required and the absolute purity of the gases involved. These, however, will surely be overcome or a suitable catalyst will be discovered which will not require these extreme conditions.

In the Sheffield plant the hydrogen is produced chemically from water gas, which, of course, involves the rather tedious process of separating the carbon monoxide and the subsequent purification. It can, however, be produced directly in a pure state by electrolysis of water. In the Sheffield plant the nitrogen is also provided by introducing a sufficient amount of air with the steam for producing the water gas.

The Cyanide Process.—This process consists essentially of heating a mixture of soda ash and powdered coke with a suitable catalyst, such as iron, to a temperature of 800 deg. to 1000 deg. C., in an electrically or otherwise heated retort. Nitrogen is passed through this mass and sodium cyanide is formed, containing as high as 18 per cent of nitrogen or even higher. As with the cyanamid process, sodium cyanide can readily be converted into ammonia, and the process has a further advantage in that the sodium carbonate recovered in the conversion as well as the iron catalyst can be used over again.

During the war the government built a plant at Saltville, Va., having a capacity of 10 tons of cyanide per day. The plant has, however, been shut down, but it is to be hoped that researches will be carried on in order to determine what possibilities this process may offer when operated on a commercial scale.

The Nitride Process.—In this process nitrogen is absorbed in a heated mixture of alumina and carbon to form aluminum nitride. By decomposing the same product nitrogen is liberated in the form of ammonia, while from the solution pure alumina is obtained. This process has been used in Europe and to a small extent tried out in this country. It is understood, however, that the process is as yet far from being entirely successful.

Scientific and Industrial Research

SCIENTIFIC RESEARCH IN THE ENGINEERING SCHOOLS

Great Increase of Work Along These Lines Is Looked for, with Corresponding Increase in Service to Industry

BY DR. A. E. KENNELLY
Professor of Electrical Engineering, Harvard University, and Director of Research Division, Department of Electrical Engineering, Massachusetts Institute of Technology

THE great war has, as every one knows, profoundly affected the conduct of human life and the direction of human thought. By its immense destruction it has impoverished all the world; so that, as we phrase the fact, the cost of living has increased everywhere. By its division of mankind into two great opposing factions it has embittered all human relations that lie across the rift. These distresses will probably leave a marked influence on welfare and on thought for a long time to come. On the other hand, however, the very necessity for making up the shortage of war waste and destruction has already contributed greatly to the constructive influences among men.

These constructive impulses may, if favorably directed, lighten very greatly the after-burden of the conflict. On the material side these impulses are directed toward increasing production or productiveness on a larger scale; that is, toward engineering. On the non-material side they are directed toward closer fellowship between the allied peoples, greater understanding and trustfulness between nation and nation, in the direction of a final United States of the World. It is proposed here to confine attention to the material and engineering aspects of the subject.

A CERTAIN PROPORTION OF PROMISING MEN FROM COLLEGE LABORATORIES SHOULD RECEIVE SPECIAL TRAINING FOR RESEARCH

During the war it became evident to all receptive minds that applied science or engineering was, next to morale, of the greatest importance in carrying on the campaigns. This was partly because of the highly technical modes which the warfare assumed, in chemistry for gas and explosives, in aëronautics for airships, in mechanical engineering for tanks and ordnance, and in other directions too numerous to specify. It was also partly because the manufacture, testing and transportation of the vast supplies for a modern army become indistinguishable from engineering itself.

The result was a very great demand for technically trained men both in the armies abroad and in the factories at home. The technical colleges and the scientific departments of the universities gave up not merely their graduates to the war, but their senior classes and even their junior classes. Moreover, their instructors and professors became enrolled in army work to so great an extent that the government had to call a halt upon the exodus of the teaching staff from the colleges in order to enable the instruction of the entering classes to continue.

The mobilization of the technically trained men soon revealed two defects in the pre-existing technical education of the country from a national standpoint. First, the total army of available technically trained men was far below the need, considering the enormous amount of technical work that the war demanded. Second, the technical army had far too few non-commissioned officers, by comparison with the number of officers of higher rank available. There were too many colonels and too few sergeants. The latter is a weakness inherent in our whole system of industrial training.

Theoretically, all of the men who go into industry or production should first pass through a year of elementary technical training of the vocational type. They should then all enter commercial work, except those who in their final tests showed that they were say in the upper fifth of their classes. These upper-fifth men should then enter a second year of higher technical training, after which all should enter industrial work except the upper fifth. This second residual should enter for a third year of still more intensive training, and so on for say a total period of increasingly intensive scientific teaching lasting five or six years. The system should permit of sorting automatically the more highly trained officers from among the junior grades.

It would be very difficult to introduce and operate such a system of graded technical education, as above outlined, under our accepted democratic institutions, Each individual naturally aspires to be a general in the industrial army and seeks to take a complete technical college course leading to some one of the various degrees in engineering. The result is that, under the pressure of necessity, the lower ranks of leadership have to be filled not only by promotion from the rank and file of the workers but also by "demotion" from the superfluous or least capable in the upper ranks. But, although we may not be able to alter the existing system of technical education, with its numerous competing colleges for producing engineers, we may at least seek to encourage the greatly needed one-year, two-year or evening-school technical institutions, which aim to produce good shop foremen and industrial superintendents.

The pressing need for production, now that peace has returned, is paving the entrance to the technical schools throughout the country. We want more and better chemistry, more and better applied science generally, in order to produce more and better things that every one needs. The effect of this stimulus is to lay greater pressure on the teaching and on the learning of science and its applications throughout the world. As long as the population of the globe increases and becomes more enlightened the greater is the competitive pressure likely to become on the various nations to apply the laws of science and economics on improvements in controlling processes and in making life more agreeable.

One important side of technical educational training is the development of experimental research collaterally with teaching. A certain fraction of technically trained graduates, say 10 per cent, should be trained for industrial research by a year of post-graduate research study under the direction of teachers who are specialists. Such organized collateral research stimulates experimental study among teachers and students alike. It should so benefit the industries in providing young men qualified to undertake industrial research as to make it worth while for the industries to support the extra educational effort of the colleges in this direction. There is every reason to hope that as time goes on the industries and the technical colleges will co-operate more closely and understand each other better.

A danger in the present country-wide movement toward technical and vocational training is that it may be carried too far by the initial success of its own momentum. As we all know, life is more than mere production and consumption. After the material needs of a community have been met, the aspirations for the beautiful and the perpetually true clamor for their opportunity. A civilization devoted exclusively to the study of science must perforce leave the arts neglected, to the detriment of its own weal.

It is noteworthy that during the last century education has received constantly increasing financial support from the federal government and that the government is taking a continually increasing interest and share in the distribution of that support. Moreover, nearly all of the federal government money so expended on education during the last few decades seems to have been directed to purely vocational training. Without attempting to raise the question as to whether this exclusively vocational expenditure has always been wise, it may be proper to consider whether the great benefits of technical education in the community may not be too dearly won, if we should thereby come to neglect all the other learning and achievements of the world.

In conclusion, therefore, we may look for a great increase in applied scientific research in our leading technical schools, with a corresponding increase in service to industry and with a correspondingly closer support from the industries. The colleges and the manufacturing establishments are steadily aligning themselves for their mutual benefit and for the benefit of the world. We may expect to see more engineering schools co-operating with large factories for the benefit of the teaching of the subjects taught, of the students who learn and of the factories that produce. Theory and practice originally started without mutual recognition. Then they came to a bowing acquaintance. Already they have reached the stage of good understanding. In time they will probably become inseparable friends. Instead of scientific research being set up merely at the instigation of theory, it is coming to be recognized that from practice comes the most urgent demand for its rapid development. If necessity is the mother of invention, scientifically developed production is the mother of scientific research.

All of these tendencies are for the benefit of all mankind, provided that we do not go so far in these directions as to neglect the study of the other great fields of thought and action.

WHAT IS NEEDED TO DEVELOP GOOD RESEARCH WORKERS

Students Should Be Encouraged to Share the Inspiration of Engineering Work Instead of Being Subject Only to Fact Storage

BY W. R. WHITNEY
Director Research Laboratory, General Electric Company

"The Yankee boy, before he's sent to school,
Well knows the mystery of that magic tool—
The pocket knife."

THIS sounds ancient. It applied when written but the boy matured. The poem is a libel on the present lad. Our son, "before he's sent to school," has received Arlington wireless time and listened to Nauen on his home-made set. He knows more about automobiles and aëroplanes than his father does. When he goes to school, if he is sufficiently tamed, he makes the football squad and takes part in a system of enjoyable effort which is a thousand times more practically organized and attractive than the rest of the curriculum. Later, or incidentally, he looks forward disinterestedly to the grind which an inflexible system has arranged, having his eyes ever on the future stopping place, a job. He usually concludes that he does not want the kind of a job his teacher seems to fill, and frequently wonders if it would not have been better had he stuck around the garage.

Would this be true if that boy could get his hands into real experimental work with a professor who was earning $25,000 a year as a pioneer? What would be his reaction if the "prof" let him help in experiments on crossing the California redwood with the rubber plant? Might he not at least take natural interest in De Vries and the historical primrose, or Mendel and heredity in peas? If he assisted in diluting magnesium with chromium and saw the promise of light-weight aëroplane metals, might not even the freshman magnesium ribbon experiment interest him?

If he co-operated in subjecting cancerous mice or tuberculous rats to gamma rays, or watched monstrosities produced from fish eggs, might he not take part in the greatest war of his lifetime, the fight against disease?

If he wound a coil of wire around a space in which electrons moved and by the magnetic field produced a new deflection, might he not keep his mental trolley on longer and go further than any one ever went before?

Our American engineering education is always at the training table and practically never reaches the game stage.

We seem to have plenty of ambitious young men, plenty of schools, infinite distance to advance and countless directions, but our engineering students are seldom practiced beyond the "shoulder arms." There is such a gulf fixed between the receiving of information and the doing anything about it that Davy teachers and Faraday students are unheard of.

We Americans wish to be foremost in new constructive work. It is bred in our bones; it is in the free air we breathe; it sticks out of the pages of our history. We can scarcely think of foreigners as seeing through such unclouded, forward-looking eyes as ours. We look to America as the special laboratory of happiness, where the problems are just enjoyable kinds of motion. But there is something holding us back at school. This something is lack of contact with interesting work and inspiring workers.

Every technical school is now overcrowded with anxious students. Every technical teacher is so swamped by his need of imparting, in wholesale quantities, accumulated knowledge that he has no time to realize the tremendous strides which science is making, much less to take any active part in bringing them about. As for mature and material inquisitiveness, it is almost absent.

We live in a period when the extent and the rate of increase in our mental horizon is maximum, when happiness has its grandest possibilities, and when human toil is everywhere being displaced and amplified by better latent energies. Never before was the individual and collective reward for new constructive effort so equitable. We are served by coal, oil, gas

DR. WHITNEY (LEFT) AND DR. LANGMUIR AT WORK IN THEIR LABORATORY AT SCHENECTADY and water, with their countless accessories, better than ever before. Within a young man's lifetime we mined more iron, copper, coal and other ores, produced more kerosene, gas and gasolene, and put into use more of materials like cement and rubber than were produced by all the former inhabitants of the globe. And still the unfulfilled promises in Nature's books are greater than ever.

Can we live up to this recent heritage? When we do many of the teachers of science will also be workers in science and better appreciated. Engineering courses will prepare men to do new work where they now mainly create reverence for old. It is easier to appreciate past developments than to extend appreciation to the unknown future, but, just as there is always more air for the trees as they grow upward, so is there more new knowledge as the existing branches spread. It is at the growing ends of engineering science that we ought to train our engineers.

DR. W. D. COOLIDGE IN CHARACTERISTIC ACTION

To the devotee scientific research may well become a religion, but whether he sees in the infinite possibilities of matter only the necessary results of permutation among seventy-odd decaying elements or the hand of an all-wise Creator ever uncovering new principles to hopeful investigators, he cannot be blind to the blessings of new truth. This is not produced to order. Conventions do not establish it. It comes only from following with interest Nature's devious and unexpected ways, studying apparently irrelevant phenomena, learning by experiment, regardless of aim. And since it is important to us that pioneer effort be individualistic, wanton, clean, but vagabond, it is this rare type of teacher whom we must support.

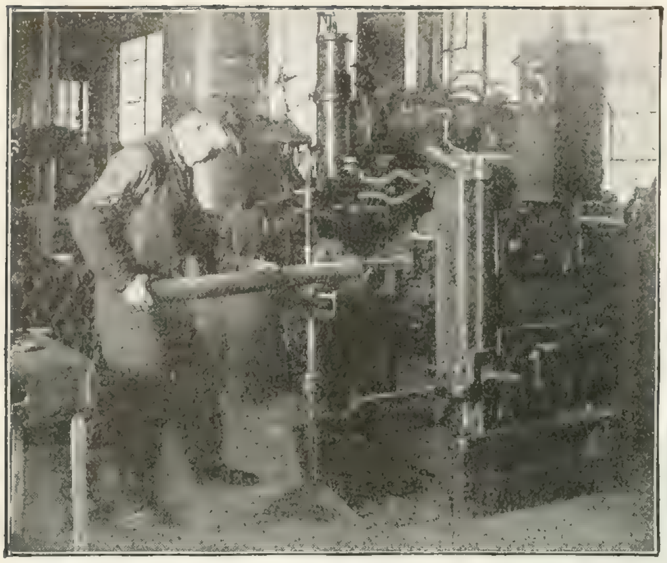
The history of voice projection well illustrates this point. At its speaking-tube stage the expert might well have said: "Metal pipes of a certain dimension make the best voice-carriers, not too small and certainly not stopped up; possibly we may improve them by trying different metals." But irrelevant new truths not only reduced the pipe to thread-size but plugged it up completely, and so the telephone is a long step in advance of the speaking tube.

At that stage the expert might have said: "Wire of a particular size is best, not too small and certainly not disconnected; soldered contacts preferred. To improve, try different kinds of wire." But vagrant truth, offspring of pure devotion and inquisitiveness, disconnected the wire and discarded it altogether, and the wireless voice goes around the world, reaching speeding ship and aëroplane.

Practice in doing and planning to do are part of good engineering training. This was the ground for the introduction of laboratory and field work into engineering schools. This develops our efferent system, which, with the afferent and the will, is necessary to a well-rounded individual. Our sports illustrate it. No college sport could be put over if it did not contain some of the same elements which make engineering attractive. No one would play the game if it were always a copy or a repetition. If there were no feared defeat nor hoped-for victory, no new stresses applied, no new materials discovered and no return but gate receipts, there would be no real amateurs and no sport. When this is applied to engineering proper it meets a perfect analogue. Few good engineers play for the gate receipts; they are led on by a will to accomplish. They seldom reproduce a move or repeat a major operation. They are usually trying some new stunt and are elated or depressed with emphasis because effects are relatively permanent. But the mental tools and processes are just like those of clean-cut sport.

During the season the ball team and the trainers work over all the novelties they can collectively invent. Groups of engineers do this all the time. Now, with a picture before us of a lot of healthy young Americans about the training table discussing moves never tried before, take a look at the present engineering professor and his class. Overlook the fact that the training table might be a good start for all of them. Are they wondering what would be the result of some new move, or raising questions not answered in the books? Usually not, because that would interruqt the orderly system of fact storage. The natural wish and will to try the new thus gradually weakens under the pressure of endless records of others' trials. The efferent nerve atrophies from lack of exercise, while the afferent palsies in exhaustion.

The heart of this note is the hope that we may realize that we must raise and support as teachers inquisitive searchers of Nature.

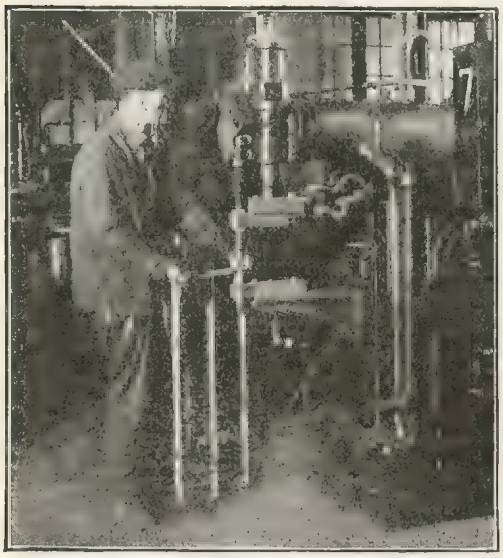


Spot-welding the seam of an automobile muffler instead of riveting it. This operation is accelerated by the electric welder.

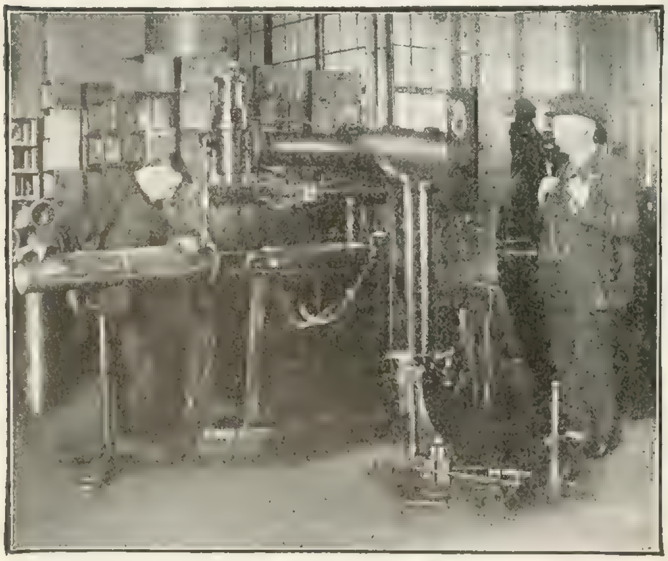
Heat-treating small automobile parts in an electric oven results in uniform wear and reduced failures owing to uniform treatment.

How Electric Welders and Heaters Are Used in an Automobile Factory

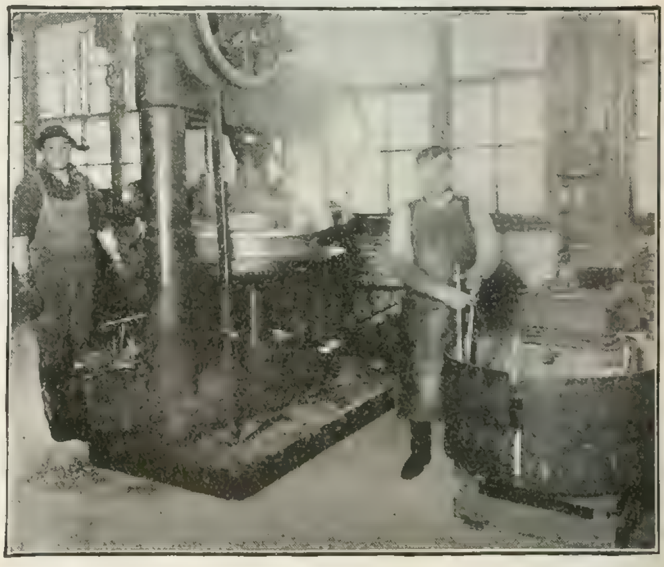
In the plant of the Pierce-Arrow Motor Car Company at Buffalo, N. Y., electric welding and heating processes are speeding up manufacturing operations. Some instances are shown in these illustrations.



Automobile trunk rack being assembled by the aid of an electric spot welder.



Joints of automobile muffler casing when spot-welded present a neat and strong construction.



Electric heater used to heat automobile truck rims preparatory to pressing them on wheel felloes.

What the Goodwin Plan Is Accomplishing—I

How the New Trade Spirit of Co-operation and Recognition of Service Rendered by Retailers Is Reflected in the Business, Profits and Functioning of Central Stations, Jobbers, Contractor-Dealers and Manufacturers

BY O. H. CALDWELL
Editor *Electrical Merchandising*

TWO and a half years ago the story of trade co-operation and harmony on the Pacific Coast was brought East by William L. Goodwin, formerly vice-president and general manager of the Pacific States Electric Company of San Francisco, one of the largest jobbing houses in the United States. At New Orleans, La., in October, 1917, during the annual meeting of the National Association of Electrical Contractors and Dealers, he pointed out in no uncertain terms some of the commercial ills of the electrical industry and offered as a remedy a plan of co-operation and education to co-ordinate the various interests in the electrical industry and to bring them together in harmonious action so as to establish retail distribution of electrical goods at fair prices to the consumer and with a fair profit to all parties in the transaction.

WILLIAM L. GOODWIN

His plain statement of facts and clear vision of the opportunities before the industry, as expressed at that time and in a series of addresses that followed, helped precipitate the remarkable awakening of trade consciousness among electrical men which was already developing as the result of the work of many earnest thinkers and leaders in the industry. Directly from Goodwin's work, however, came the reorganization of the National Association of Electrical Contractors and Dealers to promote right principles of merchandising electrical goods. Following this has developed also, among all groups of the trade, an educational movement for co-operation and scientific merchandising, which is now generally known as the "Goodwin Plan."

Although largely responsible for the initiative and clear thinking in this trade movement, Mr. Goodwin claims no personal credit for it. "I have nothing original," he has declared from the first in his addresses. "The doctrines I am preaching are only the collected best ideas of thinking men everywhere. The so-called Goodwin Plan is nothing new, but just plain common sense applied to the electrical industry. Read the planks for yourself and see if there is anything you can't agree with."

The results of the Goodwin Plan, however, expressed in the new spirit of trade co-operation and in the marked increase in merchandising facilities for serving the public by all branches of the industry, are ample reward for every advocate of the plan which now finds so many supporters.

New stores retailing electrical goods are being opened in unprecedented numbers in small towns and large cities. New records in the sale of electrical goods are being set daily. Central-station companies are showing a friendly interest in the merchandising efforts of their contractor-dealer allies and are reaping favorable public opinion in return. Jobbers and contractor-dealers are studying mutual problems of distribution and working together in their solution. Manufacturers are showing a true appreciation of the benefits resulting from scientific merchandising of their goods and of co-operation in the working out of marketing problems. And, last and most important of all, the public is being provided —adequately and conveniently—with the electric facilities and devices which save labor, increase production, augment human comfort and convenience and help to reduce the high cost of living.

HOW CENTRAL STATIONS HAVE BENEFITED

Of all of the trade groups concerned, certainly it is the central station that has already gained most from this trade movement and which, moreover, has the greatest opportunity for benefiting from the Goodwin Plan in the future. Immediate benefits to the lighting companies consist, of course, in: (1) More appliances sold and in use; (2) reduced costs in securing new business; (3) greater public appreciation of the utility's service resulting from the increase in number and use of electrical devices, and (4) a friendly attitude on the part of the electrical retail trade itself, which, being in intimate contact with the local public, can stimulate favorable public opinion if so inclined and be an active factor in correcting popular misunderstandings from which utility companies so often suffer.

In central-station circles there were misinterpretations of Goodwin's purpose early in the work, and unfortunately the central-station literature of the past

The Twenty-five Planks of the Goodwin Plan

A campaign of education, conducted principally through trade papers, trade organizations and other channels, to co-ordinate the various interests in the electrical industry and to bring them together in harmonious action, so that there may be established retail distribution of electrical materials at fair prices to the consumer and at a fair profit to all parties taking part in the transaction.

1. Free and unobstructed flow of trade along the most economic channels, without attempt to direct it arbitrarily through fixed channels.

2. Open meetings of all trade associations, including meetings of executive committees.

3. The electrical press becoming an integral part of each division of the industry by honorary or associate membership. Unrestricted publicity should be given to the proceedings of all meetings.

4. That each trade division of the industry establish a code of practice outlining its methods, policies, etc., in dealing with others than divisions within the industry.

5. That each trade division of the industry prepare a code of ethics outlining its own functions, relations and responsibilities to each of the other divisions of the industry.

6. That proper accounting methods be applied in wholesale and retail merchandising, particularly if either function is a minor department of a company. The cost accounting of each department should be kept separately so as to carry its own overhead.

7. A strong and representative National Association of Electrical Contractors and Dealers, and all interests are urged to lend immediate assistance to this end.

8. Recognition of the service functions of the contractor-dealer with a differential based upon the value of the service rendered.

9. Improvement in retail merchandising methods, better display and the encouragement of more retailers—hence more points of retail contact—by urging present contractors to open retail stores, thereby enlisting the support of central stations and jobbers and offering a broader and larger outlet for manufacturers.

10. Encouraging the sale of high-grade electrical material, the establishment of high-class specialty retail shops, improved specifications in wiring installations, and the introduction and liberal use of convenience receptacles.

11. Application by retailers of intensive sales methods in connection with small devices and appliances used in the home, factory, office, etc. (such as washing machines, vacuum cleaners, dishwashers, electric ranges, electric heaters, household heating devices, sewing-machine motors, fans, lamps, portables, fixtures, vibrators, hair dryers, ice machines, etc.).

12. That all interests conducting retail departments operate them at a profit. The adoption of this policy on the part of central stations and jobbers will result in a large number of concerns entering the retail field.

13. That central stations conducting retail departments for the sale of lamps, appliances, devices, portables, etc., should operate them in accordance with the ethics of retailing and with full regard to proper cost accounting and best economic methods.

14. The determining by jobbers, through proper accounting, of costs of warehousing and selling principal commodities, in order that each such commodity may carry its proper proportion of overhead based upon volume, selling expenses, turnover, etc.

15. That the service function of the jobber be recognized in the distribution of supplies with a differential based upon the value of the service rendered.

16. Recognition of the value to the public and the industry of professional services in connection with engineering problems, and the formation of a national association by consulting engineers, so that they may co-operate effectively with the other divisions of the industry in defining the functions of the several divisions.

17. The continuance, so far as practicable, of the work of the various war-service committees as relating to standardization, reduction or elimination of unnecessary types and styles of distributing materials and devices.

18. Standardization wherever practicable of materials, devices, appliances, and in particular, plugs and receptacles and similar devices used in homes and offices, or where handled by the general public.

19. Broader education of the public concerning the problems of the electrical industry, and concerning electricity, its use and the application of household devices.

20. The formation of a national lecture bureau with state and local staffs. The function of the staff would be to carry on educational work within the industry and before public gatherings. Service to be gratuitous.

21. Recognition of the principle that any action taken by one division of the industry which affects another division is seldom satisfactory unless each division affected is represented.

22. The appointment of committees by the various electric light associations, the Electrical Supply Jobbers' Association, the National Association of Electrical Contractors and Dealers, the American Institute of Electrical Engineers, the Associated Manufacturers of Electrical Supplies, the Electric Power Club, and such other associations as may be interested, to meet together to study the problems of the industry and to co-operate in finding their solution.

23. Consolidating or reconstructing overlapping organizations. A committee comprising representatives from each association should be formed to study this question and submit a plan.

24. Eventually a single organization in the electrical industry, consisting of national, division, state and local sections, with national group sections, for the solution of problems affecting the several sections or groups of the industry.

25. An appreciation of the responsibility which rests upon every individual and group in the electrical industry to render to the public, in the fullest way, the great service which the electrical industry alone can perform in increasing production, reducing the high cost of living and augmenting human efficiency and comfort. Here is a supreme purpose which—like the winning of the war—should inspire the untiring effort and earnest co-operation of every electrical man everywhere, until the great "job" of electrifying all industry and all the processes of living is accomplished.

two or three years has presented little about the Goodwin Plan to clear up these misunderstandings or to indicate the immeasurable benefits which the present movement is working for the privately owned central station's commercial development and for the strengthening of its position before its local public—if not actually the prolongation of its very existence as a private enterprise.

What harmonious trade relations mean to electrical development as a whole, and to central stations in particular, is perhaps best illustrated by the fact that whereas the use of electric service for the entire United States to-day averages annually only $7 per capita, a per capita consumption of $40 per annum is now a matter of record in California, where the work of harmonizing the local trade and building it up began ten or twelve years ago.

PUBLIC OPINION IS MOLDED BY ELECTRICAL TRADE

Consideration by the central station of the merchandising interests of its local retail trade has resulted in a new attitude of the trade toward the utility company, which has been in turn reflected in a more friendly public opinion toward the company. To-day, in such communities, there are dozens and hundreds of local electrical men creating good public opinion toward the electric lighting company, instead of bad opinion as was once so often the case. For contractors, dealers and other local electrical business men are effective forces in molding public opinion—a fact often overlooked by utility managers cultivating favorable public relations.

Central stations which operate merchandising departments have, since the present movement has been under way, sold more appliances than ever before. And they will sell an increasing number in the future—for with many other dealers also selling and advertising appliances the central station's own appliance sales are bound to be stimulated. Each appliance sold makes more prospects for further appliance sales, and the advertising of any one dealer benefits every other store offering similar merchandise for sale.

OPERATION OF MERCHANDISING DEPARTMENTS HELPED

Among some central-station men an impression was at one time current that the Goodwin Plan recommended central stations' quitting appliance selling and going out of the merchandise business altogether. Nothing could have been further from the fact, for it has been urged from the beginning only that central stations which do a merchandise business should sell on a merchandising basis, with due regard to the costs and ethics of retailing; that is, that central-station electric shops should be operated with respect to overhead and profits just like any other retail store in business without the central station's backing. In fact, the presence of a central-station shop in a local trade situation actually helps to stimulate the appliance business locally among other shops (if the company shop is operated on merchandising principles).

Most central stations have now seen the unfairness to their other customers of selling appliances to certain customers at a loss. By collecting, instead, a fair merchandising profit they have converted the cost of commercial department operation from an operating expense of the company into producing a substantial revenue which can be added to central-station income or devoted to local electrical advertising and promotion.

The increase in the number of stores selling appliances has contributed tremendously to central-station energy consumption, for every appliance sold, by whatever dealer, adds to the central station's revenue. And of course the more stores the more appliances sold; and the more appiances in use, the more energy sold.

In cities where lamps are now sold on a merchandising basis the central-station companies have saved thousands of dollars in distributing expense, while the customer is able to buy his lamps from a nearby dealer more conveniently than ever.

To-day, instead of the central station being required to organize and conduct house-wiring campaigns, this important activity is being handled by contractors, saving the central station much expense, time and trouble.

Changes in central-station merchandising policy have enabled dealers to finance their own installment sales, relieving the central station of this burden.

Better trade attitude and friendlier public opinion have resulted in encouraging more local buyers of utility securities, in turn creating an even more favorable public opinion situation.

The present merchandising activity has aroused the interest of hundreds of manufacturers who formerly could not get distribution through the central station alone. This has resulted in many new appliances and new lines of devices entering the local market, all contributing to increasing the central station's sales of energy.

The fact that jobbers are to-day carrying large local stocks from which central stations and others may draw has relieved the central station from itself carrying stocks with accompanying investments.

The work toward standardization of plugs and outlets is putting more appliances in use and keeping them in more frequent use, thus increasing off-peak energy consumption and improving central-station load factor.

Central stations have for years called for wider margins of profit on devices, and now with the help of the dealers have presented figures to the manufacturers causing the manufacturers to revise their schedules. From this revision the central stations have benefited.

CO-OPERATIVE NEWSPAPER ADVERTISING

Under the stimulus of this trade movement, newspaper advertising has been encouraged. In many cities central stations have co-operated with local dealers in doing their newspaper advertising, putting this powerful sales-producing medium behind the local retail appliance business and so increasing the effectiveness of the single-handed efforts of any one group.

Where contractors are receiving central-station co-operation, a better class of wiring is going in, more outlets are installed and better jobs generally are being done, than where local leadership is not exerted by the central station.

Central stations in some sections of the country (as in California) are enthusiastically co-operating in educational campaigns to make better electrical merchants, and are contributing as much as one-half of the total expenses of such campaigns, realizing that in any movement to better retail distribution of electrical goods the central station itself is bound to be the chief beneficiary.

[The benefits from the Goodwin Plan to the jobber, manufacturer, contractor-dealer and the public will be presented in a later issue.]

Jobbers' 1919 Sales $300,000,000

Stocks for the Most Part Are Low, but First-Quarter Buying for Replenishment Is Generally Heavy in Anticipation of a Very Prosperous Year

IN A YEAR that started wrong and finished in the greatest buying period ever experienced, the electrical supply jobbers, it is conservatively estimated, did a business of $300,000,000. This is 33 per cent, or $75,000,000, greater than in the big war year of 1918.

The armistice at the end of 1918 put a crimp in the regular jobbing trade. The only thing that went big at the start was the sale of domestic socket appliances, and strangely enough for the first half of 1919 the business in this line surpassed that in the regular wiring line. By that time, however, some of the new building had progressed to a stage where electrical material was required, and from that time forth the demand for electrical supplies increased. By the fall stocks began to run out here and there and deliveries to lengthen.

To a large extent this quick failure of stocks might have been prevented had the jobbers had sufficient foresight to anticipate the summer and fall demand for wiring supplies.

EFFECT OF CAUTIOUS BUYING

In spite, however, of repeated forecasts in the building trades papers, the daily press, the ELECTRICAL WORLD and from the banks, the electrical supply jobbers felt that it was best to be very cautious. For that reason, the buying by the supply houses was largely of a hand to mouth variety. Consequently, when the boom arrived stocks were not ample and the manufacturers were quickly swamped with orders.

The new year, therefore, opens with greatly deranged stocks, uncertain deliveries, a big demand. To show exactly how the electric supply jobbing branch of the industry stacks up, the ELECTRICAL WORLD has made a survey of the field, the results of which are presented in the table on the opposite page. Replies were received from about one-third of the electrical supply jobbing houses in the United States.

For the most part stocks are low. In many cases where the table shows high stocks reference is most surely had to value and not to tonnage or quantity of materials on hand. With but few exceptions houses that have a large total stock will find that it is more or less poorly balanced. This is shown conclusively by the data in the third column.

The items in that column are those in which stocks are particularly low. In many instances the reporting houses were almost destitute of some lines. Certain items are especially apt to recur. Rigid conduit stocks seem low almost everywhere. Generally it is the smaller sizes that are shortest. Flexible metallic conduit is short in spots. In the big industrial regions outside of New England there appears to be a marked scarcity of loom. Porcelain stocks, too, are low almost everywhere; the greatest difficulty seems to be in getting "Nail-it" knobs and tubes. A number of jobbers reported a serious shortage of outlet boxes and switch boxes. Only a few reported very low stocks of flexible armored conductor, and those for the most part were in the Middle Atlantic States. What shortages appeared in wire stocks were for the most part in the smaller sizes of rubber-covered and weatherproof, although here and there shortages of magnet wire and, more frequently, of lamp cord were reported. Push-button switches and pull-chain sockets are short in a good many stocks.

In the appliance line, heating-device and washing-machine stocks seem to be the lowest. Only here and there do vacuum-cleaner stocks seem to be especially low.

GOOD LAMP STOCKS

One thing is noticeable. With but two or three exceptions none reported low lamp stocks. At this time of the year, when consumption is at its maximum, the lamp stocks throughout the country appear to be ample.

A glance at the fourth column of the table shows that the jobbers have apparently learned the lesson of 1919 and are now heavily stocking. There are, however, certain other factors besides the demand which have an important bearing on this situation. Transportation delays, slow deliveries and the possibility of curtailed production later owing to labor conditions are causing the jobbers to buy heavily in order to protect their customers against delays.

Some of the more cautious, and these include some of the clearest thinkers in the industry, are not buying heavily. They take the position that manufacturers are going to be able to supply all requirements very soon. The principal reason for this belief is that the present rate of money exchange is going to prove such a handicap to American exports that production capacity set aside for export business will be idle unless turned over to taking care of domestic needs.

There is a feeling that in this event production will quickly catch up and before long there will again be a buyers' market. Whether this will bring lower prices is problematical. At any event, to certain jobbers the outlook is such that they do not care to load up heavily.

Materials most needed by jobbers for the first quarter are for the most part those in which stocks are especially low. Emphasis, however, is placed on wiring supplies for houses. There are a few needing pole-line supplies and here and there a house calling for industrial plant or mill supplies. There is a certain call, but not so marked, for domestic socket devices. The biggest demand by jobbers for these, of course, was just before Christmas.

OUTLOOK NEVER BRIGHTER

Never was the outlook, in the opinion of the jobber, more bright. Almost all are optimistic. Here and there, however, a jobber is found who is on the other side of the fence. There are, besides, a number who, while enthusiastic about the first half of the year, are not so sure of the succeeding six months. They view mounting prices with alarm. They feel that we are strangling the goose of golden-egg fame. They are not able to believe that the public will continue to spend its money in a reckless fashion with prices always going higher, and they can see a definite halt to new construction if prices continue to soar as they have.

Still higher quotas are being placed, one firm reporting a 40 per cent higher mark for 1920. If the prospects pan out as well as they look now to the field, a four-hundred-million-dollar jobbing year might be the prize for 1920.

DATA ON THE ELECTRICAL STOCKS OF THE UNITED STATES

Section	Condition of Stocks	Items in Which Stocks Are Particularly Low	Way in Which Jobbers Will Buy or Have Bought for First-Quarter	Materials Especially Needed for First-Quarter	1920 Outlook
New England States—7 replies	1—500% over 1914 1—50% high 1—25 to 50% high 1—25% high 1—Normal 1—15% low 1—Low	3—Rigid conduit 2—Flexible metallic conduit 3—Porcelain 1—Switch boxes 1—Outlet boxes 1—Armored cable 1—Steel products 1—Staples	5—Heavily 1—2 to 3 months 1—Low	5—Rigid conduit 4—Porcelain 2—Steel products 2—Loom 3—Flexible metallic conduit 2—Switch boxes 2—Wire 1—Schedule material 2—Armored cable 1—Central station supplies 1—Mill supplies 1—House wiring supplies 1—Fixture parts 1—Household appliances 1—Staples	All from good to excellent
Middle Atlantic States—23 replies	1—90% high 1—40% high 1—25% high 1—20% high 1—10% high 3—High 2—Normal 1—40% low 1—25 to 33⅓% low 1—30% low 2—25% low 1—20% low 1—4% low 5—Low 1—Very low	9—Porcelain 13—Rigid conduit 1—Molded materials 9—Armored cable 2—Rubber-covered wire 4—Wire 8—Loom 4—Boxes 3—Switch boxes 5—Domestic socket devices 4—Heating and cooking devices 4—Outlet boxes 6—Flexible metallic conduit 2—Silk cord 1—Motors 1—Steel products 2—Schedule material 2—Schedule B material 1—Washing machines 1—Ironing machines 1—Small connectors 2—Push switches 3—Sockets 1—Wiring devices 1—Standard fittings	13—Heavily 2—6 months 1—3 months 5—Normally 1—Continuously	9—Wiring devices and supplies 4—Armored cable 2—Construction material 2—Pole-line construction material 6—Rigid conduit 1—Staples 5—Domestic socket devices 1—Industrial wiring supplies 2—Sockets 4—Wire 1—Receptacles 3—Porcelain 3—Boxes 2—Switches 1—Silk cord 1—Schedule B material 1—Pipe fittings	18—Good to exceptionally bright 1—Very uncertain 2—Good first half, but doubtful about second half of year
South Atlantic States—2 replies	1—Large 1—Low	1—Interior wiring and line supplies 1—Rigid conduit, porcelain and wire	1—Normally 1—Heavily	1—Porcelain, wire, conduit, socket devices 1—Almost everything	1—Good 1—Good on appliances, other material problematical
South Central States—6 replies	1—60% high 1—25% high 2—25% low 1—20% low 1—Low	3—Porcelain 1—Lamp cord 4—Rigid conduit 5—Heating appliances 3—Washing machines 3—Schedule material 1—Metal products 1—Vacuum cleaners 1—Armored cable 1—Weatherproof wire 1—Outlet boxes 1—Line material 1—Lamps 1—Interior wiring supplies	5—Heavily 1—Normally	1—General line 3—Interior wiring supplies 1—Line construction supplies 2—Household appliances	From 20% increase to "largest ever"
Middle Central States—21 replies	1—100% high 2—50% high 1—25 to 30% high 2—25% high 1—10% high 2—High 3—Normal 1—50% low 2—25% low 1—20% low 3—Low	4—Wiring devices 10—Rigid conduit 9—Loom 2—Lamps 4—Heating devices 2—Building material 4—Porcelain 3—Household appliances 2—Brass and steel products 4—Wire 4—Switch boxes 1—Schedule material 1—Meters 3—Motors 1—Sockets 3—Switches (house) 1—Refillable fuses 2—Glassware 1—Lamp cord 1—Armored conductor	10—Normally 8—Heavily 1—60 days 1 { Heavy, housewiring Normal, devices Light, industrial	4—Wiring devices 2—Everything 7—Rigid conduit 6—Construction material 2—Steel products 1—Heating devices 2—Armored conductor 1—Brass materials 3—Loom 1—Outlet boxes 1—Switch boxes 1—Flush switches 1—Porcelain 2—Glassware 2—Wire 2—Appliances 1—Storage batteries	17—Good to "best ever" 1—Fair 1—Good first half, second half doubtful 1—Expects decline after building boom 1—Not good
North Central States—6 replies	1—25% high 2—Normal 1—50 to 75% low 2—Low	2—Loom 1—Rigid conduit 1—Schedule material 1—Switch boxes 2—Porcelain 4—Household appliances 2—Staples 2—Wiring supplies 1—Steel products 1—Push-button switches 1—Cross-arms and pins 1—Meters 1—Motors 1—Weatherproof wire	3—Heavily 2—Normally 1—4 to 6 months	4—Wiring supplies 4—Household appliances 2—Porcelain 2—Loom 2—Wire 2—Schedule material 1—Line construction material 1—Rigid conduit 1—Steel products	All good to "best ever"
Mountain States—2 replies	1—25% low 1—20% low	1—Wiring supplies 1—Schedule material, wire and household appliances	1—Heavily 1—Normally	2—Schedule material 1—Household appliances 1—Wiring supplies 1—Wire	1—Very bright 1—"Heaviest ever" for first half and then falling off
Pacific States—4 replies	2—Low 1—Normal	2—Porcelain 1—Domestic appliances 2—Rigid conduit 2—Boxes 2—Loom 1—Iron and steel products	1—Normally 2—Heavily	2—Porcelain 1—Building construction material 1—Loom 1—Boxes 1—Rigid conduit	Good to very good

Statistics on 1919 Production of Electrical Equipment and Supplies

	Value	Number of Units
Insulated CopperWire:		
Rubber-covered	$75,000,000	
Total code	21,000,000	1,400,000 ft.
No. 14	10,000,000	1,040,000 ft.
Weatherproof, magnet, etc.	45,000,000	
Motors:		
Fractional	35,000,000	
1 hp. to 50 hp	55,000,000	
51 hp. to 200 hp	8,000,000	
Above 200 hp	1,000,000	
Generators:		
Turbo and water-wheel	27,000,000	
Transformers:		
5 kva. and under		300,000 kva.
Above 5 kva.		600,000 kva.
Distribution type	9,500,000	
Power type	11,000,000	
Watt-hour Meters		2,000,000
Control:		
Industrial	15,000,000	
Steel furnace	2,000,000	
Lamps:		
Type "B"		130,000,000
Type "C"		25,000,000
Carbon		6,000,000
Miniature		70,000,000
Socket Devices:		
Heating appliances	18,000,000	
Domestic	16,900,000	
Industrial	1,100,000	
Fans		1,000,000
Washing machines	50,000,000	500,000
Vacuum cleaners	19,000,000	600,000
Wiring Supplies:		
Rigid conduit	15,500,000	130,000 tons
Non-metallic flexible conduit	4,500,000	
Flexible armored conductor		55,000,000 ft.
Schedule Material:		
Key sockets		12,000,000
Pull sockets		7,500,000
Keyless sockets		4,800,000
Flush switches		9,000,000
Exposed switches		7,500,000
Plugs and receptacles		10,000,000
Storage Batteries:	86,000,000	
Starting and lighting		4,000,000
Central station	31,000,000	
Vehicle	5,000,000	
Industrial	300,000	
Mining	350,000	
Dry Batteries		50,000,000

SALES of electrical manufactures during 1919, it is conservatively estimated, ran between $800,000,000 and $1,000,000,000.

In the table in the left-hand column are statistics on the year's output. The figures are compiled by the ELECTRICAL WORLD from estimates made by those who because of their connections should be able to give figures that are reasonably accurate. It is doubtful if any more nearly exact figures will be available prior to the middle of 1921, when the census of manufactures for 1919 should be forthcoming.

The table on this page does not include all electrical manufactures. It does, however, include electrical engineering equipment and supplies so far as they pertain to electric light and power utilities, industrial plants, construction work and the household. In some instances, however, no reliable estimates were available. No attempt was made, furthermore, to include telephones, telegraph or radio equipment, therapeutic or X-ray apparatus, magnetos, spark plugs, projectors, or repair work, which is always a considerable item in the aggregate figure.

The value of all products listed in the table amounted in 1919 roughly to $600,000,000, which is from 60 to 75 per cent of the entire output of electrical materials for the year.

Some of the lines showed smaller sales in 1919 than in 1918, but increases in other directions, particularly household appliances and automobile electrical equipment, more than offset the decreases.

Attention is called to the totals for appliances. The four lines listed in the table amount to more than $100,000,000. If to this are added the outputs of other domestic electric appliance lines, the prominent part these products play in the electrical industry becomes apparent.

Another line in which sales have mounted rapidly is storage batteries. In 1914 storage-battery output was valued at $13,000,000. The 1919 estimate is placed at $86,000,000.

The incandescent lamp output was about 10 per cent less in 1919 than in 1918. In comparison with 1914, however, when 74,000,000 tungsten and 14,000,000 carbon lamps were produced, the 1919 output shows a tremendous increase.

In 1914 motor sales amounted to $44,000,000. The estimates for 1919 production are almost $100,000,000.

Insulated wire and cable output was placed at $70,000,000 in 1914 and at $120,000,000 in 1919. This figure is, probably, much less than the 1918 total owing to the lower price of copper in 1919.

The entire 1914 sales of conduits of all kinds, including those for underground systems, were only $4,875,000. Rigid conduit 1919 sales alone totaled $15,500,000, while loom amounted to $4,500,000. This latter article however, was subjected to unusual heavy price increases because of the advancing price of cotton. In addition to these two kinds of conduits are flexible metallic, fiber and stone, for which no figures were obtained.

Transformer sales did not show a large increase over the five-year period. The 1914 production was valued at $13,000,000 and that of 1919 at $20,500,000. There is every indication, however, that the increase in 1920 will be large.

While no direct comparison can be made in watt-hour-meter production, it might be pointed out that the 1919 estimates are 2,000,000 meters, while the 1914 output was valued at $6,000,000.

Review of the Electric Furnace Industry

Survey Indicates a Large Increase of Electric Furnaces in the United States During 1919—It Also Emphasizes the Predominance of Arc Type of Furnace Over the Resistance and Induction Types

A SURVEY of the electric furnace industry for the past few years, from the standpoint of the manufacturer, has recently been completed by the ELECTRICAL WORLD. A further investigation of this important industry is now under way in which the users of the electric furnace are being questioned as to the performance of their furnaces, in the hope that some valuable operating data may be compiled which will be of considerable service to the industry at large. The figures obtained from the completed survey give the number of installed electric furnaces of various makes. These figures must be distinguished from the number of electric furnaces now in actual operation. It must also be borne in mind that the survey includes all three classes of electric furnaces—steel furnaces, non-ferrous furnaces and furnaces for reduction of ores. A number of furnaces have been discontinued since the armistice, especially in Europe, so it is doubtful if there are now more than 1,025 active electric furnaces in existence.

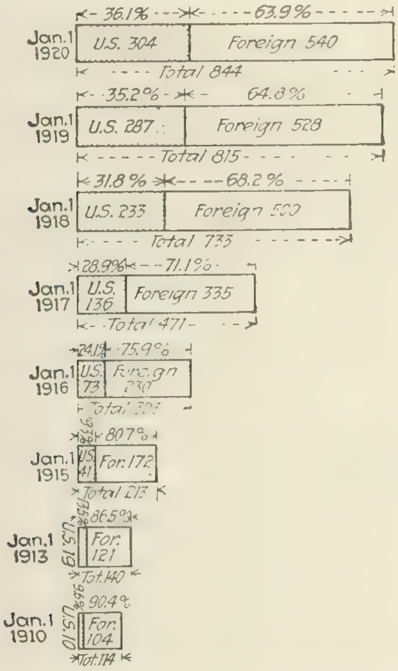


FIG. 1—ELECTRIC STEEL FURNACES INSTALLED IN THE WORLD

The survey indicates that there were on Jan. 1, 1920, approximately 1,387 installed electric furnaces in the world. Of these 491, or 35.4 per cent, are in the United States, and 896, or 64.6 per cent, are in foreign countries and Canada. Table I gives the number of installed electric furnaces in the world on Jan. 1, 1920, by trade names, and also the number of furnaces installed at various periods since 1910. Totals for the years 1910 to 1918 inclusive are the annual estimates made by the *Iron Age* and include active steel furnaces only.

While exact information as to the advances in the electric furnace industry among the European nations for the year 1919 is not available, a study of the metal production of these countries during the first part of last year indicates that little if any advancement has been made since the armistice. It is believed by some men in touch with the foreign situation that no extensive progress in this industry can be expected in Europe until the commercial and industrial life has resumed its normal tone. However, it should be remembered that from an engineering point of view development of electric furnace application in the Scandinavian countries has much in its favor because abundant water power is available without excessively long transmission lines.

The rapid growth of the electric steel industry in America is indicated very effectively in Fig. 1. The curve connecting the ordinates is decidedly upward and gives every indication of rapid development in the future. Although the United States could claim only 10 per cent of the electric steel furnaces installed in the world in 1910, it now has over 36 per cent of the total. The unstable condition of all industry in Europe makes it appear very probable that the United States and Canada combined will come very close to overtaking the rest of the world during 1920.

The tabulation of the most representative makes of electric furnaces operating in America (Table II) indicates the predominance of the arc type of furnace over the resistance and induction types, but it should be remembered that these are not used so extensively for non-ferrous metals. There are several makes not included in the tabulation, due to the failure of the manufacturers to reply, but the table indicates very effectively the rapidity with which the industry has advanced.

Tables III, IV and V give representative makes of furnaces classified as to character of metal handled. It is estimated that of the 491 furnaces installed in the United States on Jan. 1, 1920, approximately 62 per cent were steel furnaces, 35 per cent were non-ferrous furnaces and 1.5 per cent were used in the reduction of ores, while the remaining 1.5 per cent were used in making glass and in various chemical processes. Classified as to size, the steel furnaces average about 4.74 tons, the non-ferrous furnaces about 4.7 tons, and the reduction-of-ores furnaces, which are generally small, average probably around 2 and 3 tons.

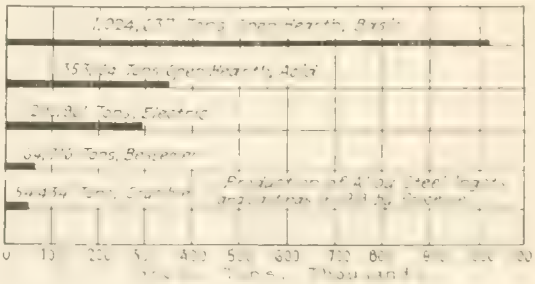


FIG. 2—STEEL PRODUCTION IN 1918 BY PROCESSES

Statistics of electric steel and total steel production in the United States from 1909 through 1919 are given in Table VI. The percentage column, giving the ratio

TABLE I—NUMBER OF INSTALLED ELECTRIC FURNACES IN THE WORLD (ALL CLASSES)

	Installed Electric Furnaces January 1, 1920																						Steel Furnaces Only							All Classes of Furnaces
Country	Name Unknown	Ajax-Wyatt	Bailey	Booth	Chaplet	Girod	Groenwall-Dixon	Greene	Greaves-Etchells	Heroult	Induction	Keller	Ludlum	Moore	Nathusius	Rennerfelt	Stassano	Snyder	Special	Vom Baur	Wile	Webb	Total Mar. 1, 1910	Total July 1, 1913	Total Jan. 1, 1915	Total Jan. 1, 1916	Total Jan. 1, 1917	Total Jan 1, 1918	Total Jan. 1, 1919	Total Jan. 1, 1920
						*	*	*			*						[illegible]			*		*								
United States		60	58	26		9	21	14	18	149	5		22	23		29	2	38	10	4		3	10	19	41	73	136	233	287	491
Austria-Hungary	53															3							10	10	18	18	18	31		56*
Australia	4																											1	4	4
Belgium	3																						3	3	3	3	3	3	3	3
Brazil									1							2													2	3
Chile													1			1		3								1	1	2	3	5
Canada	45		1				1	1		18						1							3	3	2	[illegible]	19	36	43	67*
China									1																					1
Denmark	2															3												2		5
France	72								3							2				1			23	13	17	21	29	50		78*
Finland																7														7
Germany	164															4							30	34	46	53	52	91		168*
Great Britain	125					1			35	53	2					7	4	10					7	16	16	46	88	131		237*
Holland																2														2
Italy	60								3														12	20	22	22	29	40		63*
India	1																	1										1	1	2*
Japan	15		1						1							2		2		4				1	1	1	2	4	11	25*
Mexico			1																				3	4	1	1	1			1
Norway	22																							3	2	6	9	12		22*
Russia	87															20							2	4	9	11	16	21		28*
Roumania	1															9											1			10
Switzerland	[illegible]															1							2	2	3	4	4	4		9*
Sweden	33															55							5	6	18	23	40	50		88*
Spain	2								7															1	1	2	2	2		9
South Africa	3																										2			3
Location not given																							12	9	21	21				...
Total in world																							114	140	213	303	471	733	815	1387

*Estimated.

TABLE II—SOME REPRESENTATIVE ELECTRIC FURNACES INSTALLED IN THE UNITED STATES, JAN. 1, 1920

Resistance Furnace		Induction Furnace		Arc Furnace		Total, 1914	Total, 1915	Total, 1916	Total, 1917	Total, 1918	Total, 1919
Make	No.	Make	No.	Make	No.						
		Ajax Wyatt	60			0	0	1	5	20	60
Bailey	58					3	5	10	18	40	58
				Heroult	149	18	40	79	126	145	149
				Snyder	38	0	0	8	18	30	38
				Greaves-Etchells	18	0	0	0	0	12	18
				Ludlum	22	2	3	5	6	9	22
				Rennerfelt	29						29
				Booth	12						12

TABLE III—REPRESENTATIVE ELECTRIC STEEL FURNACES* INSTALLED IN THE UNITED STATES, JAN. 1, 1920.

Furnaces	No.	Rating (Tons) Totals	Character of Metal Handled	Rating of Transformer (Kva. Total)	Type of Control
Heroult	56	221	Castings	Not given	Not given
Heroult	74	591	Ingots	Not given	Not given
Heroult	10	39	Castings and ingots	Not given	Not given
Heroult	5	30	Castings and pig iron	Not given	Not given
Heroult	2	10	Moulton ferromanganese	Not given	Not given
Heroult	1	¼	Cast tool	Not given	Not given
Heroult	1	1	Experimental products	Not given	Not given
Snyder	36	67½	Not given	19,900	Not given
Greaves-Etchells	11	43½	Castings	12,000	Eight Seede; three Thury
Greaves-Etchells	1	3	Ingots	1,000	Seede
Greaves-Etchells	3	6½	Tool steel	2,100	Seede
Greaves-Etchells	1	½	Steel alloys	300	Seede
Greaves-Etchells	1	½	H. S. steel	300	Seede
Ludlum	3	18	Castings	5,000	Not given
Ludlum	4	40	Alloy steel	6,000	Three hand; One G.E. auto.
Ludlum	3	15	Ferro alloy	2,250	Hand
Ludlum	1	6	Cast iron	1,500	G. E. automatic
Ludlum	1	2	Ingots, pig iron and steel castings	400	Thury automatic
Rennerfelt	7	9.9	Castings	Not given	Not given
Rennerfelt	5	3.1	Alloy and tool steel	Not given	Not given
Rennerfelt	1	0.4	Pig iron	Not given	Not given
Booth	10	16.5	Castings	Not given	Not given
Booth	1	3	Ingots and pig iron	Not given	Not given
Booth	1	3	Tool steel	Not given	Not given

*Arc type

TABLE IV—SOME REPRESENTATIVE ELECTRIC NON-FERROUS FURNACES INSTALLED IN THE UNITED STATES, JAN. 1, 1920.

Furnaces		Type	Rating (Tons) Totals	Character Metal Handled	Rating of Transformer (Kva.)
Make	No.				
Greaves-Etchells[1]	1	Arc	½	Nichrome	300
Snyder[2]	2	Arc	2	Bronze	400
Ajax-Wyatt	60	Induction	14.4	Yellow brass	2,880
Bailey	40	Resistance	296	Yellow brass	4,030
Bailey	3	Resistance	33½	Aluminum	655
Bailey	4	Resistance	32	Bronze	420
Bailey	1	Resistance	1½	Silver for ware	40
Bailey	1	Resistance	200	Electrode zinc	1,000
Bailey	1	Resistance	1½	Glass tubes	40
Bailey	5	Resistance	26	Test runs	375
Bailey	1	Resistance	8	Red brass	
Bailey	1	Resistance	2	Gray iron	50
Rennerfelt	1	Arc	1.1	Ferromanganese	Not given
Rennerfelt	2	Arc	¼	Nichrome	Not given
Rennerfelt	4	Arc	3	Copper	Not given
Rennerfelt	3	Arc	3	Copper and nickel	Not given
Rennerfelt	2	Arc	0.3	Aluminum	Not given
Ludlum[3]	1	Arc	Not given	Tin	350

[1] Seede control. [2] Automatic control. [3] Hand control.

of electrically produced steel to the total steel production, does not give a fair estimate of the prominence of the electric furnace in the steel industry at the present time. Electric furnaces cannot be expected to take the place of the ordinary cupola, such as is used for the making of common grades of cast iron. However, one should not lose sight of the fact that the electric furnace gives the smallest spoilage and waste of metal and possesses the greatest ability to produce uniform quality consistently. The products range from superior quality of cast and malleable iron to finer grades of crucible and tool steels.

The production of alloy-steel ingots and castings in the United States in 1918 by processes is shown diagramatically in Fig. 2, and the electric steel production for the years 1909-1918 inclusive is given by curves in Fig. 3. In 1909 the electric steel production was only about 13,000 gross tons, and more than five years later it was only about 24,000 gross tons; but one year later, during 1915, the large increase of about 45,000 tons, or over 180 per cent, had been recorded. Europe commenced calling for additional steel about the first of 1915, but it is believed that the large increase of electric steel production during 1915 was primarily due to the established and demonstrated economic value of the electric furnace as a producer of the highest quality of steel. Since 1915 electric production has advanced by leaps and bounds. The large increase in production during 1918 was probably due partly to the war, but all of the large steel companies at the present time are overstocked with orders, and there is every indication that the steel and iron production will largely increase during the present year, although it is probable that the percentage of yearly increase will be somewhat less than during 1918, the year of greatest war production.

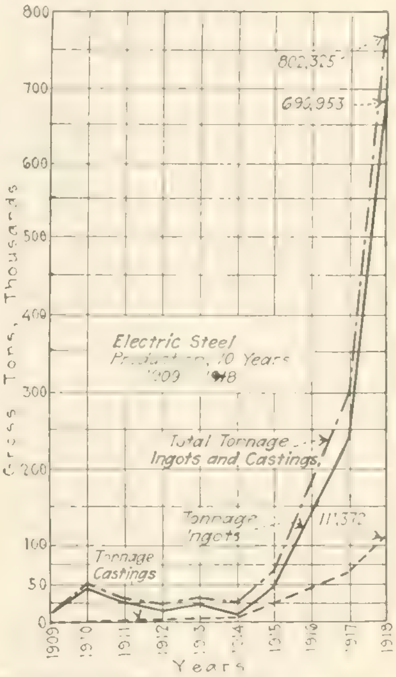


FIG. 3—ELECTRIC STEEL PRODUCTION IN UNITED STATES

Canada also shows some phenomenal increases in electric steel production. The production in 1918 was about 120,000 gross tons as against 50,467 tons in 1917, 19,639 tons in 1916, 5,625 tons in 1915 and 61 tons in 1914. This increase is as remarkable as that shown in the United States, and further large increases can be expected in the Dominion in the future.

TABLE V—SOME REPRESENTATIVE ELECTRIC REDUCTION-OF-ORES FURNACES INSTALLED IN THE UNITED STATES, JAN. 1, 1920

Furnace		Type	Rating (Tons) Totals	Character of Metal Handled	Rating of Transformer (Kva. Total)	Type of Control
Make	Number					
Bailey	1	Resistance	3½	Tungsten ore	150	Recuperative car
Rennerfelt	2	Arc	¼	Not given	Not given	Not given
Ludlum	9	Arc	Not given	Tungsten, vanadium, chrome	2,250	Hand and automatic

TABLE VI—ELECTRIC STEEL AND TOTAL STEEL PRODUCTION IN U. S. (GROSS TONS)

Year	Steel Ingots and Castings					Alloy Steels			
	Open-Hearth	Bessemer	Crucible	Electric	Miscellaneous	Open-Hearth Bessemer Crucible	Electric	Total	Per Cent Electric
1909	14,493,936	9,330,783	107,355	13,762	9,185			23,955,021	0.58
1910	16,504,509	9,412,772	122,303	52,141	3,194			26,094,919	0.2
1911	15,598,650	7,947,854	97,653	29,105	2,844			23,676,106	0.123
1912	20,780,723	10,327,901	121,517	18,309	2,853			31,251,303	0.058
1913	21,599,931	9,545,706	121,226	30,180	3,831			31,300,874	0.096
1914	17,174,684	6,220,846	89,869	24,009	3,622			23,513,030	0.102
1915	23,679,102	8,287,213	113,782	69,412	1,527			32,151,036	0.216
1916	31,415,427	11,059,039	129,692	168,918	604			42,773,680	0.395
1917	34,148,893	10,479,960	126,716	304,543	495			45,060,607	0.675
1918	34,459,391	9,376,236	115,112	511,364	329	1,496,801	290,961	46,250,284	1.74
1919								37,000,000	*

* Estimated.

Generating Capacity of Large Systems

Returns from Great Systems in United States and Canada Show Total Capacity of 5,890,000 Kw. at the End of the Year 1919 with Additions Proposed for 1920

STATISTICS reported to the ELECTRICAL WORLD by the large central-station systems of this country and Canada show impressive totals of generating capacity. They indicate, in brief, a generating capacity for the companies reporting of 5,890,000 kw. on Jan. 1, 1920, an increase of 745,000 kw., or 12.6 per cent, during the year 1919. These figures include both steam and hydro-electric capacity. They mean that the total generating capacity of these companies as of Dec. 31, 1919, reached the large figure of 6,635,000 kw. From this total there is to be an additional increase in 1920 of 520,000 kw., or 7.8 per cent.

This table, which now appears for the first time, includes the same companies which are the basis of the well-known table of "Data on Output and Load Factor of Largest Generating Systems in America," printed annually in the ELECTRICAL WORLD.

It may be noted that the total capacity as of Jan. 1, 1919, was divided as between 55 per cent for steam and 45 per cent for hydroelectric units; that the new capacity installed in 1919 in steam units was more than twice as much as that in hydro-electric units, and that roughly the same proportion holds for proposed installations in 1920, the percentage of new steam turbine capacity on order being a little larger even than in 1919.

For uniformity in the returns the companies were asked to state the rated capacity in kilowalts of the steam or water turbines and not of the generators. In all but two of the cases the returns are thus stated in the table below.

GENERATING CAPACITY OF LARGE CENTRAL STATIONS OF NORTH AMERICA—IN KILOWATTS§

	STEAM				HYDROELECTRIC			
	Capacity Jan. 1, 1919	Net Additions in 1919	Total Capacity Dec. 31, 1919	New Apparatus to Be Installed in 1920	Capacity Jan. 1, 1919	Net Additions in 1919	Total Capacity Dec. 31, 1919	New Apparatus to Be Installed in 1920
Commonwealth Edison Company, Chicago	478,000	67,000	545,000					
New York Edison and United Electric Light & Power Companies	381,000	82,000	463,000	20,000				
Philadelphia Electric Company	280,000		280,000	65,000				
Pacific Gas & Electric Company	75,000	15,000	90,000		*186,670		186,670	11,000
Niagara Falls Power Company (American side)					190,000	75,000	265,000	
Southern Power Company	30,400		30,400		131,800	95,000	226,800	
Southern California Edison Company and Subsidiaries	105,200		105,200		119,700		119,700	46,000
Public Service Electric Company	§268,055	§9,500	§277,555	§12,500				
Detroit Edison Company	208,000	10,000	218,000	115,000	4,275		4,275	
Montana Power Company	810		810		211,530		211,530	
Toronto Power Company	30,000		30,000		150,000		150,000	
Cleveland Electric Illuminating Company	128,000	50,000	178,000					
Shawinigan Water & Power Company					176,000		176,000	
Duquesne Light Company	155,200		155,200	60,000				
Montreal Light, Heat & Power Consolidated	16,500		16,500		136,660		136,660	10,000
Consumers' Power Company	176,850		176,850		75,900		75,900	
Ontario Power Company					121,000	29,000	150,000	
Edison Electric Illuminating Company, Boston	113,000	30,000	143,000	30,000				
Utah Power & Light Company	24,600		24,600		113,457		113,457	10,000
Brooklyn Edison Company, Inc	102,500	25,000	127,500	37,500				
Alabama Power Company	†60,000		†60,000		67,500		67,500	
Consolidated Gas, Electric Light & Power Company, Baltimore	62,000	60,000	122,000	20,000				
Virginia Railway & Power Company	66,000	27,000	93,000		21,000		21,000	3,000
Puget Sound Traction, Light & Power Company	19,230	8,970	28,200		81,250		81,250	
Wisconsin Edison group of companies	98,475	10,000	108,475	‡20,000				
Mississippi River Power Company					108,000		108,000	
Georgia Railway & Power Company	§21,500		§21,500		§96,700	§12,000	§108,700	
Washington Water Power Company					84,372	16,785	101,157	44,000
Great Western Power Company	32,500		32,500		66,000		66,000	
Tennessee Power Company	13,000	35,000	13,000		85,500		85,500	
Buffalo General Electric Company	60,000		95,000					
Pennsylvania Water & Power Company		20,000			88,000		88,000	
Potomac Electric Power Company	67,000	30,000	87,000	30,000				
Minneapolis General Electric Company	27,000		57,000		29,875		29,875	
Portland Railway, Light & Power Company	25,327		25,327		59,680		59,680	
Union Electric Light & Power Company, St. Louis	76,000		76,000	46,000				
Rochester Gas & Electric Corporation	35,500		35,500		38,500		38,500	
New England Power Company	5,400	10,000	15,400		56,000		56,000	8,000
Sierra & San Francisco Power Company	27,000		27,000		37,525		37,525	9,000
Great Northern Power Company	6,000		6,000		42,500	12,000	54,500	
Southwestern Power & Light Company	39,350	18,000	57,350	6,000				
Nevada-California Power Company and Southern Sierras Power Company	8,000		8,000		35,250	1,875	37,125	
Empire District Electric Company	39,500		39,500		3,750		3,750	
Michigan Northern Power Company					37,875		37,875	
Adirondack Electric Power Corporation	6,000		6,000		23,050		23,050	
Acme Power Company, Toledo	20,000		20,000	20,000				
¶Totals	3,229,986	505,570	3,735,556	379,500	2,659,979	239,660	2,899,639	141,000

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* Includes 42,610 kw. for Northern California Power Company, Consolidated, taken over Oct. 3, 1919.

† Includes 30,000-kw. unit installed by the United States government.

‡ The North American Company reports that these companies will install 20,000 kw. to 40,000 kw. in 1920.

§ The returns of certain companies are stated in kilovolt-amperes.

¶ These totals appear to be slightly out of balance, owing to the conversion to approximate kilowatts and inclusion of the companies which reported kilovolt-ampere capacity; in these cases a power factor of 80% was assumed.

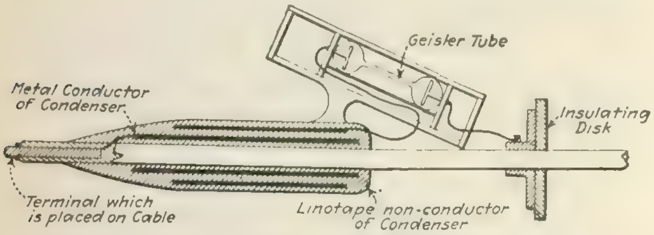
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

SIMPLE TEST ROD TO INDICATE "LIVE" CABLE

Glowing of Geisler Tube Indicates that Cable Being Tested Is Alive and that It Is Not Safe to Work on It

To make sure that cables are absolutely "dead" before working upon them, the Rochester (N. Y.) Railway & Light Company is using a cable tester which consists of a condenser and a Geisler tube mounted on a long rod. The instrument is used by holding the contact point on the cable to be tested. If there is a distinct glow between the electrodes of the tube, then the operator knows that the cable is alive and that it should not be handled. To make this positive tests are made in immediate succession on a live cable, on the one supposed to be dead and on the live one again. This assures the tester that the instrument is in working condition.


Geisler Tube
Metal Conductor of Condenser
Insulating Disk
Terminal which is placed on Cable
Linotape non-conductor of Condenser

WHEN LINE IS "HOT" THE GEISLER TUBE WILL GLOW

The condenser which is mounted on the tip of the test rod consists of two sheet-metal cylinders separated by "linotape" insulation. As the area of the cylinders is small and the distance between them is comparatively large, the capacity of the condenser is very limited and it will have a high impedance which will limit the current passing through it. One electrode of the Geisler tube is connected to the outer cylinder of the condenser, and the other electrode is connected to a binding post on the rod shield.

ARTIFICIAL VENTILATION FOR STATION GENERATORS

Allows Water-Power Machines to Be Operated at Rated Capacity During Summer Months When There Is a High River Flow

In the original design of the Holtwood station of the Pennsylvania Water & Power Company only natural ventilation was provided for each generator and no systematic arrangement was made to remove the hot air from the generator room or to force cool air into the power house. Owing to the large increase of the hydraulic prime-mover output over the original plans, a limitation in the capacity of the generators was reached during the summer months, caused by temperature rise in the windings. A number of ventilation tests were made on individual generators and on the station as a whole, and a double-inlet, single-width, multivane fan, rated at 150,000 cu.ft. (400 cu.m.) per minute, was installed to supply the first five units at the river end of the power house. A volute-shaped chamber was constructed beneath the fan to lead air into the pipe tunnel. This allowed the air to be conducted to the under side of the generator through a thrust deck and forced up through the generator windings. Without the use of artificial ventilation it would not have been possible to operate the generating station at rated capacity during periods when high river flow coincided with warm weather.

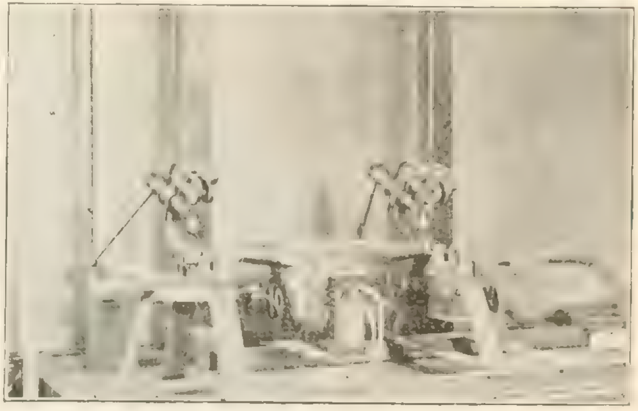
N. B. HIGGINS.

Baltimore, Md.

PIPE VISES HOLD CURRENT TRANSFORMERS ON TEST

Allows Quick Setting Up of Any Size of Transformer—Copper Jaws in Place of Steel Jaws Form Good Contact Surfaces

For quick setting up of current transformers to be tested the Commonwealth Edison Company, Chicago, has devised apparatus which consists of two pipe vises in which jaws of 0.5-in. (1.3-cm.) copper have been substituted for the original steel ones. The vises are mounted on legs of 0.25-in. (6.5-mm.) by 2-in. (5 cm.) iron. One of the vises is stationary and the other is fitted to slide on a track of 2-in. (5-cm.) channel bars so that a current transformer of any length may be accommodated. A flexible lead is bolted to the jaw of the moving vise, a rigid copper bar being bolted to the stationary vise. This device makes for very rapid work, as no heavy leads have to be bolted on the transformer. Where the transformers are nearly the same size so that the standard primary shunt does not have to be changed, one transformer can be checked for ratio and phase angle every ten minutes. Current as high as 1000 amp. is used with no overheating at the contact surfaces.



VISES OPEN, SHOWING COPPER JAWS

TWO CABLES INSTALLED FOR GENERATOR LEADS

Are More Flexible than One Lead and Have Greater Carrying Capacity on Account of Greater Heat-Radiating Surface

Because of greater flexibility and greater carrying capacity, two 1,250,000-circ.mil. cables, instead of one 2,500,000-circ.mil. cable, are installed in each leg of the generator leads of machines in the Long Beach steam plant of the Southern California Edison Company. If one cable should be destroyed, the machine would not entirely be out of service, for the other lead could carry part of the load while repairs were being made. The greater carrying capacity of the two smaller cables connected in parallel is accounted for in the fact that they have a greater heat-radiating surface. In fact, the safe current-carrying capacity of two 1,250,000-circ.mil. cables is 1600 amp., whereas that of one 2,500,000-circ. mil. cable is only 1270 amp.

Expressing this in another way, two 875,000-circ.mil. cables in parallel have the same carrying capacity as one 2,500,000-circ.mil. cable, and having 750,000 circ.mil. less copper they cost less. In general, when it is necessary to use cables larger than 500,000 circ.mil. it is cheaper and also easier to install two cables of smaller size in parallel.

F. B. Lewis,
Superintendent Los Angeles District.
Los Angeles, Cal.

GROUNDING PRACTICES OF CENTRAL STATIONS

Methods of Testing House Wiring, Effect of Ground on Accuracy of Meter, Etc., as Brought Out in Convention Discussion

There are almost as many varieties of grounding customers' connections as there are central stations, the variations usually being due to local conditions. Several methods were pointed out at a recent meeting of the Southeastern Section of the N. E. L. A.

When a metal-piping system is not available, the next best ground is one to permanent water depth, according to the experience of one engineer. In this connection it was pointed out that certain amounts of energy can be transmitted continuously by grounds without varying the resistance. After this amount has been transmitted the current dries out the surrounding earth, resulting in a rapid rise in resistance. This is an important consideration in surface grounds. Conductivity of grounds, it has been found by tests, can be increased as much as twenty-five times by frequent salting. With a uniform soil and moisture condition the contact resistance of a pipe ground is proportional to its length in the ground up to about 8 ft. (2.5 m.). Beyond that depth tests have shown that the contact resistance is not materially lowered by increasing the depth of pipe. Placing the pipe 16 ft. (5 m.) instead of 8 ft. lowers the resistance only about 5 to 10 per cent. The size of the pipe is largely determined by the driving requirements and the longer life of a large pipe, but not from difference in contact resistance. Doubling the size of pipes gives only about 5 to 10 per cent lower resistance, while driving pipes a few inches or a foot apart is equivalent to one pipe of a large size. Pipes driven not less than 6 ft. (1.8 m.) apart and connected in multiple give a combined resistance proportioned to the number of pipes.

Attention was called to the fact that lightning-arrester grounds should never be made to the same artificial grounds as secondary grounds or those of other electrical apparatus. Arrester grounds should therefore be at least 20 ft. (6 m.) from other grounds.

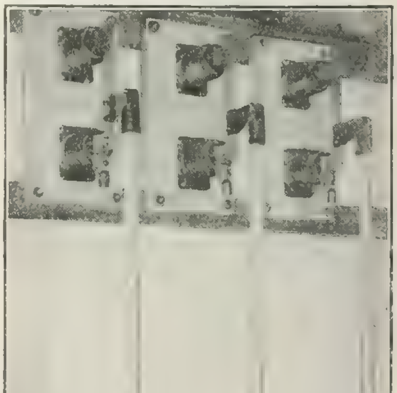
One central station in the South tests consumers' house wiring before making ground connections by means of a megger after all inside wiring grounds have been removed. The permanent ground connection inside the consumer's premises is made by the contractor, the central station making such ground connections only when connecting ranges the wiring of which the company installs.

On the lines of another company it was found that more meters ran fast on light loads when the secondary was grounded than on ungrounded systems. Furthermore, a higher resistance ground in the house wiring caused a meter to run on no load, and a lower resistance ground would blow a fuse.

DISCONNECTING SWITCHES OPERATED MECHANICALLY

All Phases Are Opened Simultaneously by Means of Handles, Preventing Accidental Opening of Phase of Adjoining Circuit

Accidental opening or closing of a phase of a circuit adjacent to the one to be operated is impossible with the mechanically operated disconnecting switches shown herewith which are in use in stations of the Philadelphia (Pa.) Electric Company. The three switches of the three phases of the circuit are interlocked so that the operation is easy, quick and safe to the operator.



HANDLE CONTROLLING DISCONNECT SWITCHES MAY BE LOCKED IN EITHER POSITION

INDUSTRIAL APPLICATIONS

The Economical Utilization of Electrical Energy in Mills and Factories
Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

ROTARY CONVERTER USED FOR INTERMITTENT LATHE DUTY

Machine Which Furnishes Alternating Current for Testing in a Motor-Repair Shop Does Double Duty

Situated in the heart of a direct-current district of New York City, the Peerless Engineering Company is called upon to repair comparatively few alternating-current motors. The alternating-current motors repaired, however, are thoroughly tested in this shop, a rotary converter operated inverted furnishing the necessary energy for this purpose. Because alternating current is not used very often, a pulley has been attached to the motor shaft so that the converter can be used to drive a speed lathe directly beneath it. The belt which is used for transmitting the power can be easily removed from the lathe when alternating current is needed. THEODORE C. KATSIGRIS.

New York, N. Y.

DATA ON STORAGE-BATTERY HAULAGE BY RAILROADS

Average Cost of Operating Thirteen Machines in Railroad Service Varies from 63 Cents to $1.48 per Service Hour.

Owing to the character of the work done by storage-battery-driven tractors and trucks and the length of haul made, there is considerable variance in the costs of operating these machines. The condition of roadway and the wages paid the driver are also different in different localities. Below are given briefly some of the conditions under which trucks operate at four different railroad shops:

At location No. 1 the trucks operate on paved streets and through no mud. The length of haul is about 1000 ft. (300 m.) and no grades are encountered. In location No. 2 there are no grades, but the trucks operate on gravel roads, which are sometimes very muddy; this condition sometimes causes the trucks to get stuck on the road. The maximum haul is about ½ mile (0.8 km.) and the average haul about 500 ft. (150 m.). Locations No. 3 and No. 4 are very much the same as No. 2.

An analysis of the data shows that the cost of service for all the items of operation, exclusive of wages for the driver, ranges from 16.6 cents to 55.4 cents per hour. The wages for the driver vary from $91 per month to $208 per month, but in the reality the labor expense is high because two men are used working on different shifts. The total cost of service per hour ranges from 62.9 cents in location No. 4 to $1.48 in location No. 2.

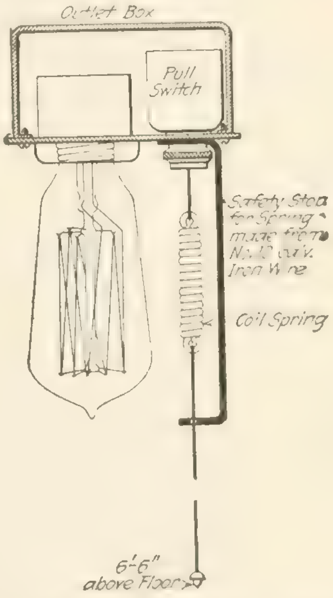
AVERAGE COST PER MACHINE PER HOUR OF SERVICE

Location No.	Number of Machines	Number of Months in Service	Average Hours Run per Month	Repairs and Energy: Cost of Material and Energy	Repairs and Energy: Cost of Labor	Repairs and Energy: Total	Repairs and Energy: Cost per Hours of Service	Driver: Total	Driver: Cost per Service Hour	Total Costs	Total Cost per Service Hour
1	1	11	No Record	$12.69	$11.69	$24.38	.	.....			
2	5	5	226	32.71	92.34	125.05	$0.554	$208.89	$0.924	$333.94	$1.478
3	4	4	210	24.01	46.67	70.68	.336	180.00	.857	250.68	1.193
4	3	7	197	1.22	31.55	32.77	.166	91.11	.463	123.88	.629

SPRING COIL AND STOP PREVENT SWITCH DAMAGE

Coil Spring Inserted in Cord of Pull Switch and Heavy Wire Stop Prevent Switch Breakage in Industrial Plant

The frequent breaking of switches because of rough and careless handling has been eliminated in the factory of the American Can Company of Chicago by the adoption of a foolproof switch cord. In this factory the lights are controlled by Cutler-Hammer pull-switches mounted overhead in outlet boxes, one type of which is shown in the illustration.



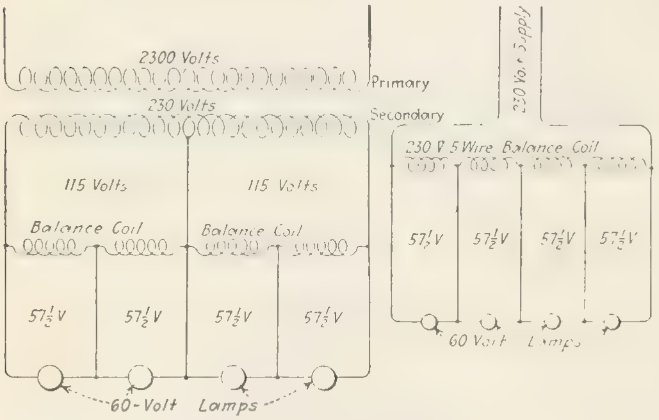
COILED SPRING AND WIRE STOP SAVE SWITCH

A small coiled spring is incorporated in the switch cord. Below this spring the cord passes through a hole in a stop made of No. 10 galvanized iron wire, so that if the string is jerked suddenly the spring will relieve the switch of any strain without interfering with the switch operation. Should a hard steady pull be given the string, the bottom coil of the spring will strike the wire stop and prevent injury to the switch mechanism. The reduction in frequency of cord breakage has proved the value of this device.

LAMP RENEWAL AND THEFT IN MINES ARE REDUCED

Service Changed from 230 Volts to 57.5 Volts—60-Volt Lamps Used—Circuit Changed from Two-Wire to Five-Wire System

The loss of lamps from breakage and theft had been so excessive in a group of iron mines on the Marquette (Mich.) range that some action had to be taken to eliminate the expense this incurred. The situation was handled by using 60-volt tungsten lamps in place of the 220-volt tungsten lamps which had been in service.



METHOD OF CONVERTING 230-VOLT CIRCUITS INTO FIVE-WIRE 57.5-VOLT CIRCUITS

Rewiring with heavier conductors was not necessary because the mines had been liberally wired for 220-volt carbon lamps before the units were changed to tungsten lamps of the same voltage. As a result the copper in the various circuits proved to be large enough to carry 60-volt tungsten lamps of the same wattage as the 220-volt tungsten lamps which had previously been in use.

The supply voltage to the lamps was changed in two ways. The bulk of the lighting was supplied through the standard 230-volt transformers by the aid of balance coils connected between each outer wire and the middle 115-volt tap. This gave a five-wire system with 57½ volts between adjacent wires. The circuits were divided up as equally as possible and connected to the transformers in this way. Where lighting service was connected at some considerable distance from a transformer the same results were obtained by the use of an auto-transformer with three equally spaced taps between the two outer wires. This gave a five-wire system, as in the other example.

The highest potential that the 60-volt lamps can be subjected to with this arrangement is 57½ volts, and some lamps receive a few volts less. This decreases the efficiency of the lamps, but it also increases their life, and the greater life is of more importance in this case than a slight difference in efficiency.

F. C. Stanford,
Cleveland Cliffs Iron Co. Chief Electrical Engineer.
Ishpeming, Mich.

CHANGE OF MOTOR IMPROVES OPERATION OF PAPER MILL

Squirrel-Cage Induction Motor Replaced by One with Wound Rotor, Eliminating Compensator Trouble and Line Disturbances

When a 100-hp., 2200-volt squirrel-cage induction motor was used to drive a hog in a pulp and paper mill, considerable trouble was experienced when knives were changed. In making the change, which was necessary twice a day, the motor had to be inched to bring the knives to the proper position and often contacts of the compensator would be burned during the process. In addition arcs were formed, burning the oil and fiber in the case. The trouble was eliminated by replacing the induction motor with a wound-rotor type because no line disturbance was caused by the wound-rotor motor in starting.

W. B. Smith,
Van Buren, Me. Aroostook Pulp and Paper Mill.

RADIANT RESISTOR FURNACE FOR DISTILLING SCRAP ZINC

Data for a Thirty-seven-Hour Run to Show Behavior of Furnace After Starting Up and Under Running Conditions

In 1915, when the cost of high-grade zinc increased so rapidly, experiments on the distillation of low-grade or scrap zinc began to be worth while and a furnace was built and operated at the Fitzgerald Laboratories at Niagara Falls, N. Y. Some of the operating results given by F. A. J. Fitzgerald before a recent meeting of the American Electrochemical Society are presented here. The data on a run of thirty-seven hours were taken to show the behavior of the furnace after starting up and also what may be expected from it with continuous running under constant conditions. Energy measurements were made at the furnace. The zinc was charged in a molten state, so that energy consumption for melting is not included. The data follows:

	Data for Entire Run	Condition During Last Nine Hours
Length of run, hours	37	8.9
Average power used during distillation, kw	55.2	54.4
Total energy for distillation, kw.-hr	2051	484
Minimum temperature of zinc entering condenser, deg. C	1040	...
Average temperature of zinc entering condenser, deg. C	1225	1250
Average temperature of zinc in premelter, deg. C	550	550
Weight of zinc condensed per hour, kg	43	51
Energy per kilogram of zinc, kw.-hr	1.29	1.06
Energy per pound of zinc, kw.-hr	0.59	0.48

The energy used for premelting during the last nine hours of the run is as follows:

Weight of zinc melted, kg	968
Energy consumed for melting, kw.-hr	216
Energy per kilogram of zinc, kw.-hr	[a]0.22
Energy per pound of zinc, kw.-hr	0.10
Weight of zinc transferred from melter to furnace, kg	63
Energy used to melt 632 kg. of zinc, kw.-hr	13

By referring to the figures given above for the last part of the distillation it is found that the total energy used in producing 455 kg. (1001 lb.) of distilled zinc was 623 kw.-hr.; hence the total energy consumed per kilogram of zinc was 1.37 kw.-hr. The zinc refined by distillation in this experiment was only 72 per cent of the amount charged, therefore the amount of zinc which had to be premelted was greater than would have been the case had the distillation been carried further.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics Including Methods of Increasing the Use of Electric Light, Power and Heat

THE RISING COST OF ELECTRICAL SERVICE

Commission's Data Show It Cost 3.87 Cents to Deliver Average Kilowatt-Hour in Town of 5,000 in 1918 and More in 1919

The unit cost of the Noblesville (Ind.) Heat, Light & Power Company for 1918 are given in the accompanying table.

Steam power generation	$0.0230
Transmission and transformation	.0004
Distribution	.0008
Consumption	.0009
Commercial	.0012
General	.0012
Undistributed	.0022
Taxes	.0022
Depreciation	.0038
Total operating expenses per kw.-hr	$0.0387
Gross revenue per kw.-hr	.0471
Gross income per kw.hr	$0.0084

These facts were brought out by the Indiana Public Service Commission in the recent rate case of the Noblesville company. The company at the time of investigation was operating 600 kw. in turbine and 450 hp. in engines to carry its electric and steam heating load.

In addition to bringing out these data "the commission's accountants have estimated the total revenue and total operating expense of the electric and heating departments for entire year 1919 on the basis of the actual revenue and expense for the first six months of the year. It is estimated that the total gross revenue of the electric department for the year 1919, corrected, will be $94,132.14, and the total operating expense, including taxes and depreciation, will be $78,758.46, which will leave a gross income of $15,423.68. It is estimated that the total gross revenue of the heating department will be $12,510.88, and the total operating expense including taxes and depreciation will be $11,718.36, which will leave a gross income of $792.50. On this basis combined income of the two departments will be $16,216.18, which is equivalent to a return of only 4.8 per cent on a value of $333,000.

"This return would not be reasonable within the intent of the law and would not be sufficient to maintain company's credit. The testimony of financial experts is to the effect that a utility should have a return of from 8 per cent to 10 per cent in order to maintain its credit. In these times, when the cost of money is unusually high and its purchasing power abnormally low, a return of 7 per cent on an investment of this kind cannot be considered excessive, and such a return was permitted in this case.

"The evidence shows that the annual expense will be heavily increased over the estimate shown in the audit mentioned above. The heating department for the whole year 1918 showed an actual operating deficit of $1,625.50, and it is unlikely that its showing will be improved this year. Certain increases in the cost of labor and material that occurred during the first six months are but slightly reflected in the expense account. Certain other increases have occurred since the close of the period ending June 30, 1919, covered by the audit. Wages and salaries in this case, as well as everywhere else, show a decided upward trend, without any indication that the crest has been reached. The upward trend of labor costs is indicated by the fact that petitioner paid for labor during the first six months of 1918, $12,377.22, during the last six months of 1918, $15,212.44, and during the first six months of 1919, $16,532.14.

"The audit indicates that the company's taxes for the year 1919, amount to $3,974.40. The evidence shows that taxes payable in 1920, which should be included in operating expense will amount to $6,093.40, an increase of $2,119.00, which should be taken into consideration in estimating the annual requirements."

DATA ON DAYLIGHT SAVING IN BOSTON RESIDENCES

Computation Giving Idea of What May Be Expected in Different Months Under Daylight Saving and No Daylight Saving

BY R. S. HALE
Superintendent Special Research Department, Edison Electric Illuminating Company of Boston

It has been very hard to compute the effects of daylight saving, since the figures for any month are affected first (though not most) by daylight saving and next by the growth of business; *i.e.*, if more new customers are connected in one month than another, that affects the income or consumption figures. The amount of sunshine during the month, the general condition of business, etc., all make it hard to compute separately the effect of any single cause such as daylight saving.

There is a method of computation that prevents the growth of the business from vitiating the computation as to the effects of daylight saving. This method is not to use the figures for, say, this July, as compared with last July, but to use the percentage that each July bears to the year's business. The year's business, however, may not be taken as the calendar year or fiscal year, but for each month in turn has to be taken to include the six preceding months and the five succeeding months, and then again as the year that includes the five preceding months and the six succeeding months, and then the two percentages are averaged. This should give accurately the figures for the relation or percentage that each month bears to a year's business, but of course it is necessary to wait six months to determine whether a high or low month is due to an increase of business or something that will affect all later months, or to some temporary cause, such as sunshine or daylight saving.

Using this scheme, it is not yet possible to compute the effects of daylight saving for the summer of 1919. A comparison between 1917 and 1918 has been worked out for residence customers, based on 10 cents per kilowatt-hour.

The following table gives the comparative results for a customer whose yearly bills total about $100 and for a customer whose yearly bills total about $20:

	1917 No Daylight Saving	1918 Daylight Saving	1917 No Daylight Saving	1918 Daylight Saving
Month	$100 customer		$20 customer	
January	$12.90	$12.90	$2.60	$2.60
February	10.70	10.70	2.14	2.14
March	9.50	9.50	1.90	1.90
April	7.90	7.40	1.58	1.48
May	7.10	6.40	1.42	1.34
June	6.30	5.80	1.26	1.16
July	5.00	4.50	1.00	0.90
August	4.20	3.70	0.84	0.74
September	5.80	5.40	1.36	1.38
October	8.50	7.90	1.70	1.54
November	9.90	9.90	1.98	1.98
December	12.20	12.20	2.44	2.44
Total	$100.00	$96.60		

It should be noted that the totals for the $100 customer add up to 100 per cent without daylight saving and 96.60 per cent with daylight saving, showing a gain to the householder of 3½ per cent.

In making up these figures the actual results come out a little over 100 per cent in the year without daylight saving and a little under 100 per cent in the year with daylight saving because the comparison necessary runs back into the preceding years. Slight adjustments have been made so that the year without the daylight saving gives 100 per cent.

Although the above figures are based on nearly 100,000 customers and on from 1,000,000 kw.-hr. to 2,000,000 kw.-hr. per month, yet the actual figures in the months of the past years vary somewhat from the table above given. For instance, comparing April 1917 with April 1918 there was a difference of about $1, as compared with the 50 cents in the above table (for the $100 per year customer). The reason for this was that April 1918 had considerable more sunshine than the previous April and this added to the effect of daylight saving. Vice versa, the actual figures for August 1918 were very nearly the same as August 1917, but this was because there was less sunshine in 1918 and this partly balanced the effect of daylight saving.

There are still other variations in the actual figures besides those for which sunshine and cloudy weather account. For instance, a big increase in business in some particular month would affect that month slightly even with the statistical methods here used. The question of Sundays and holidays also causes slight variation between months of different years even when the meters are read every day.

It is also very likely that the effect of daylight saving is slightly different in the months like June and July from what it is in April or September; and, furthermore, these figures ought to show slight effect of daylight saving in April, since the bills of April include some of March business, and again these figures ought to show some slight effect of daylight saving in the month of November, since the November bills include some of October business.

It is very hard to get any very accurate figures, especially for any particular month, because of the difference in hours of sunshine between one month and the same month of another year.

In the judgment of the writer, however, the table gives a good idea of what may reasonably be expected in the different months under the conditions of daylight saving and no daylight saving. It must be remembered that for any individual customers the difference is tremendously greater. It is as apt to be one way as another, however. The table shows the different averages to be expected and nothing more.

ISOLATED PLANTS COMPARED WITH CENTRAL STATIONS*

Twelve Modern Small Plants Averaged 9 Lb. of Coal per Kilowatt-Hour, Compared with 2.2 Lb. for Central Station

Some conclusive figures on the economy of central-station energy compared with that of small isolated plants were brought out in Chicago during the war. About a dozen small plants in the center of the city were not operated during the summer when the exhaust steam was not needed for heating, and central-station power was used in their stead. The total maximum demand of these plants was 2176 kw. They were modern in every way, having been installed within the last five years. The operating records of the test showed consumption of about 9 lb. of coal per kilowatt hour. The net saving in coal which was estimated on a conservative basis from the difference between the operating efficiencies was 13,000 tons per year. These 13,000 tons consumed in a large central station would furnish enough electricity for Marshall Field & Company's retail store for a year and a half, or would equal the consumption of a city of 35,000 for a period of one year.

Among small plants recently investigated is one of 5000 kw. capacity in three units. This plant is modern in every way. It is operated condensing and has available an unlimited quantity of cooling water. The actual operating record shows the plant is using 7½ lb. of coal per kilowatt-hour. This poor showing is probably due to the fact that the load on this plant is a variable one, but if this load were carried by the central station, the saving in coal would be about 5000 tons per year. In this particular plant no complications arise out of using exhaust steam for heating as the plant runs condensing the entire year. In another plant investigated, a 1000-kw., modern steam turbine, running condensing by the use of a cooling tower, has been using coal at the rate of 12 lb. per kilowatt-hour for several years.

These figures bring out the economies of central-station generating, which are due to the diversity factor of load, the greater efficiency of the larger units, and the smaller amount of reserve equipment required on account of interconnection of plants.

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*Extract from a paper presented by George H. Jones before a joint meeting of the American Institute of Electrical Engineers, Electrical Section of the Western Society of Engineers and the Illuminating Engineering Society of Chicago, Nov. 24, 1919.

DIGEST OF ELECTRICAL LITERATURE

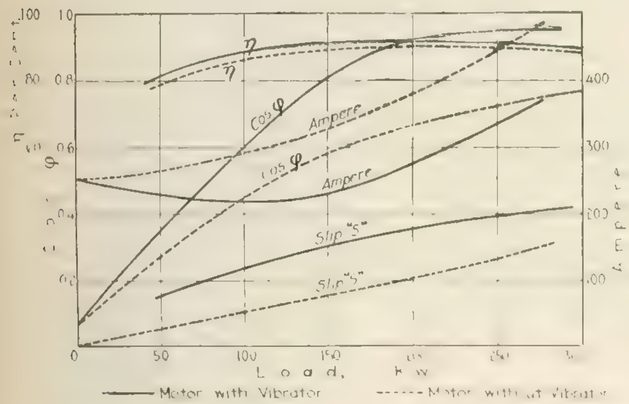
Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Form Factor.—F. M. DENTON.—The author points out that the commonly accepted statement that a peaked wave has a higher form factor than a flat-topped wave is often wrong. He discusses the bearing of form factor upon iron loss and finally describes a simple form of apparatus by means of which waves of voltage may be produced having a very wide range of form factors and the values of these form factors demonstrated.—London *Electrician,* Oct. 24, 1919.

Concrete Parts for Generators.—C. M. HACKETT.—The development of large hydroelectric projects requires the economical use of materials and manufacturing facilities in the construction of the electrical equipment. Some of the large alternating-current generators require stator frames and bearing support castings of enormous size, which tax manufacturing and shipping facilities as well as add considerable expense to the equipment. The author points out that the use of concrete may offer a solution to these problems in certain cases and calls attention to some of the possible uses of concrete in the construction of large units, setting forth some of the special features to be looked for in the design and installation. This construction, it is pointed out, would offer many advantages in the case of the outdoor type of generating stations.—*General Electric Review,* November, 1919.

The Kapp Vibrator and Its Use.—K. PERLEWITZ.—Various types of triple vibrators, as built by Bergmann-Werke and Oerlikon, are demonstrated by means of photographs and diagrams, and their application for decreasing the wattless magnetizing current of large three-phase induction-motors is considered. Best results are obtained when the phase compensation is supplied on the rotor side to large units of low speed and variable output, as in rolling mills and hoists. A set of curves indicate the improvement obtained in a 213-kw., 500-volt, 50-cycle, 167-r.p.m. induction motor, the full-drawn lines showing the conditions with vibrator and the dotted lines referring to the same motor when no phase compensation is used.—*Elektrotechnische Zeitschrift,* Aug. 21, 1919.



IMPROVEMENT IN INDUCTION-MOTOR CHARACTERISTICS

Generation, Transmission and Distribution

Additional Power Supply for Berlin.—During the latter part of the war a 100,000-volt transmission line from Bittefeld to Berlin was completed, which is said to have relieved the railroads around the capital to the extent of 300 to 400 tons of coal per day. The line is 132 km. (82 miles) long; it has three aluminum cables of 120 sq. mm. (somewhat bigger than No. 0000) on steel poles at a 250-m. (82-ft.) span, and transmits 20,000 kw.—*Helios,* March 9, 1919.

Efficient Operation of Central Power Stations.—J. D. MORGAN.—The efficient operation of central power stations involves knowledge of accurate records, both daily and monthly, of the operation of every unit and of the station as a whole, systematic testing of all units to detect any falling off in efficiency and the exact cost data and the distribution of total cost in the various departments of the plant. This article presents data and curves of importance to power-plant operators.—*Power,* Oct. 7, 1919.

Electricity's Future in French Agriculture.—A. DELAMARRE.—Holding that the application of electrical processes to agricultural labor can only be advantageous when applied to large stretches of land, inasmuch as it involves the tying up of considerable sums in capital expenditures, the author examines the two methods that present themselves. In the first, that of co-operative effort, he feels no confidence. He favors, rather, the other, which involves the "rejoining of properties too much cut up." That the French peasant could be brought to favor such a plan is, the author admits, more than doubtful.—*Revue Générale de l'Electricité,* May 31, 1919.

Hydroelectric Stations in the South of Italy.—A very important hydroelectric scheme has been commenced on the Sila Plateau, in the south of Italy. By damming the rivers Arvo, Neto and Ampollino, three large artificial lakes will be formed, having a combined capacity of about 235,000,000 cu.m. of water. This reserve of water, which will be harnessed by means of three successive generating stations, will maintain a constant stream of 8.50 cu.m. per second, with a mean maximum head of 700 m. The energy to be produced will amount to 168,267 hp. continuously throughout the year, and the capacity of the machinery to be installed will be 300,000 hp. In June last a contract was entered into for the immediate commencement of operations as regards the Ampollino, the artificial lake in connection with which will have a capacity of 61,000,000 cu.m. There is every reason for hoping, provided that the work was commenced at the above-mentioned time, that by 1921 no less than 50,000 hp. will be available for the use of the industries of the region in question.—*Technical Review,* Oct. 28, 1919. (Abstracted from *L'Industria,* August, 1919.)

Traction

Electric Motor Vehicles, Their Construction, Care and Upkeep.—F. Ayton.—The writer discusses the most important differences between the two main types of batteries at present in use. He states that, given the small amount of careful attention required in the case of the lead-plate cell, there is really nothing to choose between this type and the Edison type.—*Electric Vehicle,* November, 1919.

Electrolysis and Modern Cable Construction.—W. W. Walsh.—The writer discusses the use of negative feeder copper, the insulation of rails and the drainage of roadbeds to prevent leakage current in electric railway systems. The insulation of pipe in the vicinity of the rail returns and other means of reducing the destructive effects of electrolysis are also considered.—*Proceedings A. I. and S. E. E.,* April, 1919.

Electric Industrial Trucks.—The Allgemeine Elektricitäts Werke have produced electric industrial trucks with a carrying capacity of 1000 kg. The platform area is 2300 m. by 1300 m., and the height from the ground 540 mm. The platform is sprung on both axles, one axle being driven and fixed, the other being used for steering. The turning radius is 2 m. The motors are switched into circuit by a foot pedal that releases the brake at the same time. Two inclosed motors drive the axle by a 1: 8 reduction gear. Three speeds of 50, 100 and 150 m. per minute are obtainable. The battery is suspended in wooden crates under the platform, and is accessible by a trap door.—*Technical Review,* Oct. 28. (Abstracted from *Mitteilungen,* March, 1919.)

Installations, Systems and Appliances

Electropneumatic Device for Electrically Driven Air Compressors.—George J. Duckett.—In dealing with an electrically driven air compressor for intermittent service some difficulty was experienced in starting the compressor when the piston was half-way through the compression stroke. For this condition it would normally have required a starting device for a motor twice the size of that in use. By means of an automatic arrangement, however, which released the cylinder compression on starting up the motor, only the normal starting currents were drawn from the motor and the starter was very much relieved.—London *Electrician,* Oct. 31, 1919.

Motor Protection.—In certain types of motors, such as squirrel-cage induction motors, the starting currents are so great that ordinary fuses have to be chosen of too large a capacity to give adequate protection on normal load. For such cases the Allgemeine Elektricitäts Gesellschaft has designed special types of protective devices. In one form these are screwed plugs supporting a chamber containing the junction of two contact pieces, held together by solder, one of the contacts being under the action of a spring that causes the junction to open as soon as the solder melts. These plugs can carry six times the normal current for short periods without breaking the circuit, but operate with steady loads of 30 to 40 per cent above the normal. After they have opened, the contacts may easily be restored to their original condition by soldering them together again. The capacity of these plugs is up to 500 volts and 12 amp. For higher voltages and currents a second form of the same device is used. In this the moving contact is U-shaped, one arm of the U being hinged and the other being soldered to the fixed contact. A spiral spring causes the moving contact to rotate about the hinge so as to make a long break. The arc that is formed on breaking circuit is drawn through a slit in a non-conducting shield, in which contacts are open at their widest. This aids the extinction of the arc.—*Technical Review,* Oct. 28. (Abstracted from *Mitteilungen,* May, 1919.)

Miscellaneous

Some Tests of Light Aluminum Casting Alloys; the Effect of Heat Treatment.—P. D. Mercia and C. P. Carr.—The mechanical properties of a number of different compositions of cast light aluminum alloys have been determined, as well as the resistance to the action of alternating stresses of three commonly used alloys. Comparison was made of the resistance of some well-known alloys to corrosion in the salt-spray test. It was found that the effect of heat treatment of cast alloys, consisting of annealing at 500 deg. C. and cooling in air from that temperature, followed by aging for several days before testing, produced an increase in the tensile strength and the hardness, with an attendant decrease, usually, in the elongation. The application of such a heat treatment to light aluminum castings seems to have commercial possibilities.—*United States Bureau of Standards Technical Paper No. 139,* Oct. 24, 1919.

Dynamic Balancing of High-Speed Rotating Machinery.—H. Heymann.—Static unbalance is caused by a single force, dynamic unbalance by a force and a couple acting in a plane through the axis of rotation. The balancing consists in adding another force and another couple which just annul the unbalancing force and couple. For this purpose must be determined, first the plane of the couple and then the weights to be put in this plane. To obtain these data the rotor is spun in elastically arranged bearings and its resonance oscillations are observed. Various commercial machines operating on these principles are discussed, such as those due to the Norton Grinding Company, the Allgemeine Elektricitäts Gesellschaft, Ludwig Loewe and Akimoff. The author then proceeds to describe two balancing methods, due to himself, where no computations are necessary. The first is called the progressive method due to the stepwise approach to a balance. It is carried out in a machine by Schenck, where both bearings are mounted on vertical plane springs, balance being obtained successively with one or the other bearing clamped. Upon suggestion of Lawaczek the oscillations of the free bearing are traced upon a paper disk on the end of the shaft. The symmetry plane of the diagram is the plane of unbalance, and the necessary weight is proportional to the resonance deflection. Mechanical diagram-tracing devices are used up to 1500 r.p.m., but with optical registration a similar method is used even above 20,000 r.p.m. It is claimed that the plane of unbalance can be determined to 1 deg. or 2 deg., and that displacements of the center of gravity can be corrected for to 0.001 mm. or better. In the other, more recent method a complete balance may theoretically be obtained in one continuous run, during which size and position of the two weights necessary for a balance, are determined without any computation.—*Elektrotechnische Zeitschrift,* May 22-29 and June 5, 1919.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

News in Brief

Summary of Important Happenings in the Industry During the Week

The attention of the industry has been turned this week to the very promising progress of the Senate on the long-delayed bill to permit water-power development. As this issue goes to press the Washington correspondent of the ELECTRICAL WORLD telegraphs that the prospects for a vote within a few days are very encouraging. No element in the country has a keener appreciation of the economic importance to the entire nation of sure conservation and use of water powers than the electrical industry; none has labored more strenuously to press its conviction upon public consciousness. At last real action appears to be at hand.

President Ballard of the National Electric Light Association has left San Francisco on his way to New York to attend the important national committee meetings on Jan. 29 and 30. He will be joined later by John A. Britton, chairman of the public policy committee. Mr. Ballard is making stops at a number of cities on the way East to further association matters.

Secretary of War Baker has agreed to approve the Chicago South Shore improvements, including the Illinois Central electrification, if a few slight changes are made in the agreement principally to take care of conditions which may materialize in the future. The modifications required by Mr. Baker have been practically agreed to by the interested parties in Chicago, and the actual issuance of the permit is felt to be a matter of only a short time.

The electrical apparatus committee of the National Electric Light Association was scheduled to meet at Louisville, Ky., Jan. 15 to 17, inclusive. Reports of the sub-committees were to be discussed and the data compiled for presentation at the national convention. These data will be edited at the one remaining meeting of the committee.

Ground has been broken for the 200,000-kw. ultimate capacity of the Lakeside power plant of the Milwaukee Electric Railway & Light Company. The first section will be rated at 40,000 kw. and two additional sections of 80,000 kw. each will be added later. It had been planned to build this plant in 1917, but it was postponed on account of the war.

John B. Miller, chairman Southern California Edison Company, will be chairman of the convention committee at the N. E. L. A. gathering in Pasadena on May 18 to 22.

George Eastman of the Eastman Kodak Company, Rochester, N. Y., is revealed as the mysterious "Mr. Smith" who has given generously to the Massachusetts Institute of Technology. Mr. Eastman's gifts to this institution aggregate $11,000,000.

Stone & Webster have been advised by cable of new construction work which they are to direct for a 30,000 hp. hydro-electric development near Nagoya, Japan. The total cost will be in excess of $5,000,000. The property is owned by the Kiso Electrical & Industrial Company of Japan.

The Detroit Edison Company is asking customers to curtail service between 7 a.m. and 5 p.m. This action was made necessary by lack of generating capacity due to trouble with machinery in its plants as well as to the lack of reserve capacity resulting from war conditions.

A report of the Bureau of the Census on telephone systems in 1917 shows that the Bell system controlled over four-fifths of the total wire mileage and had over three-fourths of the employees of the industry.

Under the auspices of its lighting and illuminating committee the American Institute of Electrical Engineers held its three hundred and fifty-seventh meeting at Chicago on Jan. 9 and 10. Different systems of electrical distribution used for street lighting were discussed.

The Commonwealth Edison Company, Chicago, has decided to erect a new power station in an industrial district on the South Side of the city. The size of the units and the ultimate capacity of the plant will be announced later.

The Rockingham County Light & Power Company will construct a new hydro-electric development on the Lamprey River which will save 6,000 tons of coal annually.

Governor Smith of New York again urges state ownership development and operation of water powers.

Drought continues throughout the State of California. River waters are lower than at any other time in the previous twenty-five years.

The California co-operative campaign committee meets in San Francisco to lay plans for 1920. The proposed new budget of $27,000 is already practically subscribed.

The annual meeting of the Kentucky Association of Public Utilities was held at the Seelbach Hotel, Louisville, Ky., on Friday of this week. Addresses were delivered by a number of men prominent in Middle West electrical circles.

Only in the West did inventory taking seem to have any appreciable effect on the electrical supply market. The two weeks' lull there gave jobbers a chance to accumulate better stocks, as shipments just then came in from the East. Thus the West virtually starts the new season with fair stocks. Heavy buying, however, would soon break these up, as deliveries are tardy and irregular. In the East, on the other hand, stocks are pretty well depleted in wiring materials. Loom and flexible armored conductor cannot be stocked, as the material is virtually apportioned before it comes into the jobbers' hands. Small sizes of pipe are scarce and orders on this material are increasing. In the South some sizes of oil switches are low. In the East the scarcity of spot lead is holding up power cable to some extent. In the West jobbers are virtually out of steel reflectors and small motors are short.

In Chicago some jobbers are ordering now their loom requirements for 1920. Central stations are doing the same for meters, feeder regulators, etc. Seattle jobbers are ordering up to six months ahead to prevent delays due to bad deliveries. Other manufacturers of heating appliances increased their list prices about 10 per cent. In various districts price advances are shown on knife switches and safety switches, vacuum cleaners and flexible armored conductor. In the South interphones advanced 20 per cent. The Phelps farm light is up 9 per cent. Deliveries on motors, especially single-phase, are lengthening in New England, while on sockets they are in better condition.

Among the larger projects contemplated throughout the country is the construction of a large hydro-electric power plant at Green Spring, Mo., by the Missouri Iron & Steel Corporation of St. Louis, Mo., to supply electricity for its smelter near Brandsville for the manufacture of steel.

Preparations are being made by the Gulf State Steel Company of Birmingham, Ala., for extensions to its steel wire plant at Alabama City, Ala., and the installation of new electric generating and transmission machinery.

Bonds to the amount of $120,000 have been voted for the construction of a new municipal electric light plant in Portland, Ind.

Serving in the President's Industrial Conference

OWEN D. YOUNG

Owen D. Young, vice-president of the General Electric Company, is a member of President Wilson's second industrial conference, which is now meeting in Washington. In addition to his other duties, Mr. Young was recently elected chairman of the board of the Radio Corporation of America, in which the General Electric Company has a large interest.

RAPID PROGRESS IS BEING MADE ON WATER-POWER BILL

Senate Moves Ahead Steadily in the First Days of the Present Week and Prospect for a Vote Is Encouraging

Rapid progress was made on the water-power bill during the first three days of the week, and at this writing (Jan. 14) it is believed that a vote will be taken on the measure within the next day or two. It is recognized that many important changes will be made in conference and that considerable discussion and some delay are likely to precede the adoption of the conference report.

By a vote of forty to twenty-three the Senate defeated the proposal to strike out the words "which is accepted" in the following provision of the bill: "That in the event the United States does not exercise the right to take over, or does not issue a license to a new licensee, or tender a new license to the original license upon the terms and conditions aforesaid, which is accepted."

By an even more decisive vote the Senate declined to accept an amendment providing that the act shall not apply to the waters of the St. Lawrence or the Niagara River. The vote in the latter case was forty to sixteen. An important amendment was adopted in committee of the whole directing the Water Power Commission within one year of the approval of the act to secure the construction of a power plant at Great Falls on the Potomac River which is not to exceed a limitation of cost of $25,000,000. Another amendment was adopted providing that the secretary of the Water Power Commission is to be detailed from the Engineer Corps of the army.

The principal controversy centered around the words "which is accepted." Senator Lenroot, who led the fight to strike out these words, went so far as to make this statement:

"If Senators here really desire water-power legislation at this session of Congress, they will not adopt this amendment. I am satisfied that if this amendment should be adopted and agreed to in conference this bill never will become a law, and it ought not to."

This led Senator Nelson to ask whether Gifford Pinchot held the veto power over the bill. To this thrust Senator Lenroot replied: "No, but President Wilson does have a veto, and I think I know President Wilson's attitude upon this very proposition. If this amendment is agreed to in conference, President Wilson never will have rendered a greater service in the conservation of our natural resources than in the veto of this bill."

Senator Walsh of Montana, who voted with Senator Lenroot to strike out the words, did not agree that the amendment would kill the bill. "I am sure Senator Lenroot attaches too much importance to it," he declared.

The effort of the committee to alter the license charge clause failed by one vote. A separate vote will be taken in the Senate proper.

An amendment by Senator Knox providing that an existing company if it takes out a license automatically becomes subject to the regulatory power of any public power corporation within its state, and if it does not take out a license is subject to the commission, was adopted.

The committee amendment providing for license funds to be paid into the Treasury of the United States, part to be used in paying the cost of administration and the remainder for the operation of dams or other navigation structures, was agreed to.

An amendment designed primarily to protect existing contracts at Niagara Falls was adopted. It reads as follows: "That the provisions of this act shall not be construed as affecting any permit or valid existing right-of-way heretofore granted."

Another amendment was adopted to protect all municipalities against discrimination in favor of others in the distribution of power or electrical energy. The amendment was proposed by Senator Wadsworth and has the effect of making the agreement to refrain from discrimination a part of the conditions of the license.

Some of the Points Debated

In the debate on Jan. 13 Senator Williams of Mississippi sharply criticised the Senate for its delay in action and the failure of members to give proper consideration to the bill. Only eleven Senators were in attendance at the time.

"The people of this country are gradually rising to the point where they demand abolition of the Senate for failing to function," Senator Williams declared. "Here is a great bill before it and no attention paid to it, and I am inclined to agree with Benjamin Franklin, who declared the Senate of the United States was like the fifth wheel of a wagon."

The Senate rejected an amendment by Senator Harrison, Democrat, of Mississippi, which would have exempted the waters of the St. Lawrence and Niagara Rivers from its provisions. At an earlier session the discussion revealed that Senator Lenroot in committee had offered an amendment excluding Niagara Falls from the provisions of the bill, but that the amendment was rejected by the committee. "If the bill goes through in its present form," asserted Senator Lenroot, "knowing what I do about the Niagara Falls power project, in my judgment it will be a gift of a clear million dollars a year to the Niagara Falls company."

REVISION OF FEDERAL WATER-POWER MEASURE

Change in Amendment Dealing with Licenses Is Made by Commerce Committee of United States Senate After Discussion

After the discussion and speeches on the water-power bill during the week ended Jan. 10 the commerce committee of the United States Senate revised one of its principal amendments so as to read as follows:

> That the licenses shall pay for the license herein granted such reasonable annual charges as may be fixed by the commission, for the purpose of reimbursing the United States for the cost of administration of the act in relation to water powers developed under its jurisdiction, in the proportion that the water power developed by the project covered by said license bears to the total water power developed by all projects licensed under the act, and for that purpose such charges may be readjusted from time to time, not oftener than once in two years; the licensee shall also pay for the use and occupation of any public lands and lands in reservations, except tribal lands embraced within Indian reservations, necessary for the development of the project covered by the license such reasonable annual charges based upon the actual value of the government lands used as may be fixed by the commission; but in no event shall the annual charge for the foregoing exceed 25 cents per developed horsepower: provided, that when licenses are issued involving the use of government dams or other structures owned by the United States or tribal lands embraced within Indian reservations the commission shall fix a reasonable annual charge for the use thereof, and such charges may be readjusted at the end of twenty years after the beginning of operations and at periods of not less than ten years thereafter in a manner to be described in each license.

Considerable discussion was provoked by the provision of the bill repealing the existing statute creating the Newlands Water Power Commission. Senator Ashurst of Arizona proposed an amendment which would give all authority and power conferred upon the Newlands commission to the federal Water Power Commission. His position was sustained by several Senators who pointed out that the scope of the investigations to be undertaken by the Newlands commission had been determined upon after years of discussion and study and that since Congress had passed upon the matter once the results of that work should not be lost. Those favoring the Newlands commission believe that the Water Power Commission should have added to its functions a study of all matters involved in the utilization of water power.

STATE SHOULD DEVELOP WATER POWER, SAYS GOVERNOR SMITH

New York's Public Executive Declares that if People Are to Get the Full Benefit, the State Will Have to Do It

Governor Smith of New York again urges in his annual message to the Legislature a definite policy of state ownership, development and operation of water powers.

"Another year has passed and added further to our history the folly of permitting our great natural water resources to go undeveloped," says Governor Smith. "We are continuing to drag coal into the State for the purpose of generating electrical energy that could be brought into being by harnessing our great natural resources, and we sit by and permit this energy to run to waste. In every spot in this state where by our past policy we have permitted private development nobody has benefited but the individuals who have been lucky enough to secure the rights."

A. I. E. E. HOLDS SYMPOSIUM ON STREET ILLUMINATION

Multiple, Constant-Current and Constant-Potential Series Systems of Distribution Discussed in Detail

The three hundred and fifty-seventh meeting of the American Institute of Electrical Engineers, held at Chicago on Jan. 9 and 10, was conducted under the auspices of the lighting and illuminating committee of the Institute and was given over entirely to discussions of the different systems of electrical distribution used for street lighting. The Western Society of Engineers of Chicago and the Chicago Section of the Illuminating Engineering Society joined with the Institute for this occasion and contributed to the success of the meeting. President Townley was represented by Vice-president C. E. Skinner of Pittsburgh, who turned over the chairmanship of the meeting to J. R. Cravath, chairman of the local Institute committee on arrangements and chairman of the electrical section of the Western Society of Engineers.

Dr. Charles P. Steinmetz, consulting engineer of the General Electric Company, gave an address in which he compared the different systems of distribution for street lighting and laid emphasis on the advantages of the constant-potential series system. F. A. Vaughn of Milwaukee gave a description of the street-lighting system being installed in that city. Henry Nixon, deputy commissioner of gas and electricity, outlined the plans followed in Chicago, and Denney W. Roper, Commonwealth Edison Company, gave experiences of his company.

A record of accomplishment and standardization with the series system of street-lighting distribution was presented in a paper by W. P. Hurley, sales engineer of the Westinghouse Electric & Manufacturing Company. The author advocated the use of the simple-series system on account of its effectiveness, simplicity and efficiency in spite of the disadvantages of high investment cost per dollar of revenue and the necessary high voltage and special lamps.

Frank F. Fowle, consulting engineer of Chicago, told how telephone companies overcome inductive interference from street-lighting circuits. He also stated that hard-drawn copper-clad steel conductors gave good service as street-lighting conductors. Replying to a question from William A. Del Mar of New York, a number of speakers said that no inductive troubles had been noticed with steel-armored underground cables.

In a paper on the multiple system of distribution for street lighting, Ward Harrison, engineer for the National Lamp Works, Cleveland, said that heretofore this system had been used by adapting existing equipment to its requirements, and that its future depended upon the development of equipment to meet the multiple-system conditions, especially as to switchings, which is the limiting feature to-day. The basic reasons for the increasing interest in the multiple system of street-lighting distribution are its small investment cost, compared with that of other systems for given revenue, and the much greater load that can be carried on individual circuits.

SAMPLES OF FOREIGN-MADE ELECTRICAL SUPPLIES ON VIEW

Associated Manufacturers of Electrical Supplies, Co-operating with the Government, Has Samples Gathered by Department of Commerce

As a result of co-operation between the Bureau of Foreign and Domestic Commerce of the Department of Commerce of the federal government and the Associated Manufacturers of Electrical Supplies, a collection of about 230 samples of electrical supplies of German, Japanese, Chinese, Danish, English and Argentine manufacture has been placed on exhibition in the rooms of the association in New York.

These samples were gathered by agents of the Bureau of Foreign and Domestic Commerce in the markets of South America, the West Indies, Japan, China, New Zealand and Vladivostok, and through the instrumentality of Charles E. Dustin, general secretary of the association, have been loaned to the association by the Department of Commerce.

DISPLAY OF FOREIGN-MADE ELECTRICAL SUPPLIES

The international trade committee of the association, of which John J. Gibson is chairman, has issued a circular to members calling attention to the exhibit and giving an inventory of the samples.

"Some of the specimens are of unique manufacture, different from articles used in this country, adapted no doubt to the preferences of the countries where sold, and not without points of merit worthy of consideration," the circular says. "Various types of construction shown offer interesting comparisons with domestic-made products, especially in quality, appearance and possible cost. Every American manufacturer of electrical supplies who has entered or contemplates entering foreign fields will find the exhibit of interest.

"Samples from Germany, Japan and Spain are expected very shortly, and other specimens, as received from time to time, will augment this valuable assortment."

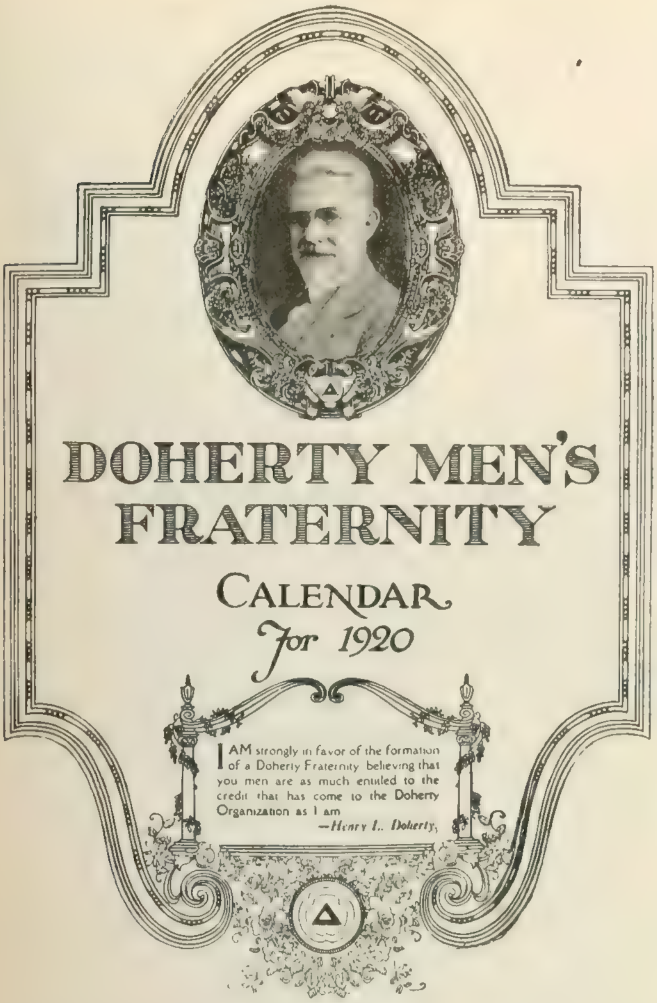
GEORGE EASTMAN'S GIFTS TO M. I. T. TOTAL $11,000,000

He Is Revealed at Jubilee Banquet as the Institute's Mysterious "Mr. Smith" Who Has Contributed so Largely

A secret of nearly eight years' duration was made known to alumni and friends of the Massachusetts Institute of Technology on Jan. 10, when a jubilee banquet was held in Cambridge celebrating the successful completion of a "drive" for $8,000,000 endowment to enable the institute to meet the new problems and increased costs brought about by the war. Since 1912 benefactions amounting to $11,000,000 have been conferred upon the institution by an anonymous giver, who has preferred to be known as "Mr. Smith" until the close of the present drive, and speculation as to his identity has been widespread throughout the fields of education and engineering.

In the presence of 1,100 alumni and guests, including not a few names famous in American industry and finance, it was announced that "Mr. Smith" is no other than George Eastman of Rochester, N. Y., and the success of the endowment drive was signalized by the receipt of a gift of $4,000,000 from Mr. Eastman which has been contingent upon the securing of a corresponding amount in cash, property or pledges by July 1 of this year.

The Doherty Calendar


DOHERTY MEN'S FRATERNITY
CALENDAR For 1920
I AM strongly in favor of the formation of a Doherty Fraternity believing that you men are as much entitled to the credit that has come to the Doherty Organization as I am
—Henry L. Doherty.

A large calendar has been issued by the Doherty Men's Fraternity, "a national organization of Americans pledged to the perpetuation of the business policies and business philosophy of Henry L. Doherty." Each day's sheet of the calendar tells the names of the members of the organization whose birthday is on that day and also prints a saying of Mr. Doherty's.

NEW HAMPSHIRE TO HAVE NEW HYDRO-ELECTRIC DEVELOPMENT

Improvement of Rockingham County Company on the Lamprey River Will Save 6000 Tons of Coal Yearly

The Rockingham County Light & Power Company, Portsmouth, N. H., is preparing to make a hydro-electric development on the Lamprey River in the town of Durham, which will prove a valuable source of energy when interconnected for full service with the company's tidewater steam plant at Portsmouth. It is proposed to raise a present dam 18.5 ft. (5.5 m.) high to a height of 35 ft. (10.5 m.) and by means of suitable canal and headworks to gain 15 ft. (4.5 m.) further, locating a plant just below Parkers Falls.

The present development is a small one of 100 kw. to 150 kw., formerly owned by the Newmarket Electric Company, and has little pondage, the present area in the river, excluding Mendum and Pawtuckaway Ponds. being about 82 acres. The new plan calls for additional flowage to the extent of about 475 acres. The flow of the river is of little value unless supplemented by the steam plant at Portsmouth.

President T. A. Belden recently stated that the Rockingham County company has built a tie line from the Portsmouth station which will be used in connection with the Lamprey River development. About 6,000,000 kw.-hr. a year can be obtained from the latter, representing a saving of 6,000 tons of coal at the efficient Daniel Street station in Portsmouth. It is planned to install two waterwheels taking 550 cu.ft.-sec. each and in the dam two Tainter gates, each 22 ft. long by 14 ft. high (6.6 m. by 4.2 m.), capable of caring for from 7,000 to 8,000 cu.ft.-sec. The maximum flow of the river is about 3,000 cu.ft.sec.

CENSUS REPORT ON THE TELEPHONE SYSTEMS

Bell System Controlled in 1917 More than Four-fifths of the Total Wire Mileage of the Country

According to the report about to be issued by the Bureau of the Census showing the results of the census of telephones covering the year 1917, there are 53,234 separate telephone systems and lines. These operated 28,827,188 miles of wire in the United States and connected 11,716,520 telephones and 21,175 public exchanges. The messages or "talks" aggregated 21,845,722,335.

The industry in 1917 gave employment to 262,629 persons, of whom 171,119, or over 65 per cent, were women. The sum paid out in salaries and wages amounted to $175,670,449. These employees operated plants and equipment valued at $1,492,329,015, which yielded operating and non-operating revenues of $391,499,531.

The Bell telephone system controlled over four-fifths of the total wire mileage, employed over three-fourths of the employees of the industry, paid over four-fifths of the total bill for salaries and wages, and received nearly four-fifths of the total revenue.

Over three-fifths of all the telephones in the United States bore the "Bell" sign, and two-thirds of all persons who were "wanted on the wire" were wanted on a Bell wire. The dominating part that the Bell system plays in the industry may be further illustrated by the fact that of all the other systems reported 96.1 per cent reported annual incomes of less than $5,000.

Comparisons with previous censuses bring out in a striking way the remarkable development of the industry. During the decade 1907-1917 wire mileage increased 129 per cent, the number of telephones 102.8 per cent, and the number of messages 90.5 per cent for systems having incomes of $5,000 or more.

A comparison by geographical divisions brings out the fact that considerably more than one-half of the telephone systems reporting annual incomes of $5,000 or more in 1917 were in the Middle West.

The financial statistics of the report show that while the revenue of the telephone companies has more than doubled during the decade 1907-1917, the expenses have increased at an even more rapid rate. Much of the increase in expenses was due to increase in salaries and wages paid. These had advanced from 47.4 per cent of the total expenses in 1912 to 54.2 per cent in 1917. For systems reporting annual incomes of more than $5,000 in 1917 the average total revenue per telephone was $38.41, average net income per telephone $6.13, and average surplus per telephone $1.46.

PRESIDENT BALLARD OF THE N. E. L. A. IS ON HIS WAY EAST

He Is Stopping at Various Cities and Will Be Joined in New York by John A. Britton, Chairman of the Public Policy Committee

President R. H. Ballard of the National Electric Light Association left Los Angeles on Jan. 11 for another tour of the East in the interest of the organization and to perfect arrangements for the convention of 1920 in Pasadena on May 18. At San Francisco Mr. Ballard and John A. Britton, chairman of the public policy committee, were given a complimentary dinner by the Electrical Development League on Jan. 12, which was attended by the prominent electrical men of central California. Much enthusiasm was expressed concerning the convention and plans were outlined for the work preparatory to the convention which will be carried on during Mr. Ballard's absence. Mr. Britton will join Mr. Ballard in New York later.

At Salt Lake City Mr. Ballard met Sidney R. Inch, vice-president and general manager of the Utah Power & Light Company, and attended a meeting of the prominent electrical men in that territory.

In Denver he met W. J. Barker, vice-president and general manager of the Denver Gas & Electric Light Company, and Norman Read, general manager of the Colorado Power Company and president of the Colorado Electrical Association. He also met a committee of Wyoming electrical men. The subject of a geographic section in that part of the country was one of the topics discussed.

At Omaha President Ballard expected to attend a meeting which had been called by J. E. Davidson, general manager Nebraska Power Company. Executive officers of the associations of Nebraska, Kansas, Iowa and Missouri were present, and the matter of forming a geographic section composed of these states was discussed.

M. H. Aylesworth, executive assistant to the president, and Frank W. Smith, vice-president, of New York are to meet Mr. Ballard in Chicago. A meeting is to be held at which Martin J. Insull, vice-president of the association, John G. Learned, chairman of the Commercial Section, and George B. Foster, chairman of the Electric Vehicle Section, and other prominent men will be present. Affairs of the national organization and the Pasadena convention are to be discussed.

During the stay of the N. E. L. A. officials at Cleveland some exhibits at the National Lamp Works of the General Electric Company are to be inspected by Messrs. Ballard, Smith and Aylesworth, together with Clarence L. Law, chairman of the lighting sales bureau. The meetings of the public policy and executive committees are to be held on Jan. 29 and 30 in New York, and President Ballard will check up the work at headquarters with Mr. Aylesworth and his official staff.

While in the East President Ballard will attend a few company section meetings, among them those at Baltimore and Pittsburgh. The tentative plans for his return trip to California include stops at Atlanta, New Orleans, Dallas, San Antonio and Albuquerque, N. M. He will attend the convention of the New Mexico State Association, to be held at the last-named city, Feb. 16 to 18, and leaving there will stop at Phoenix, where a big meeting of the Arizona electrical men will be held. From Phoenix he will return to his home in Los Angeles.

JOHN B. MILLER CHAIRMAN OF N.E.L.A. CONVENTION COMMITTEE

Is Appointed by President Ballard to Head the Committee Which Will Have General Supervision of the 1920 Pasadena Meeting

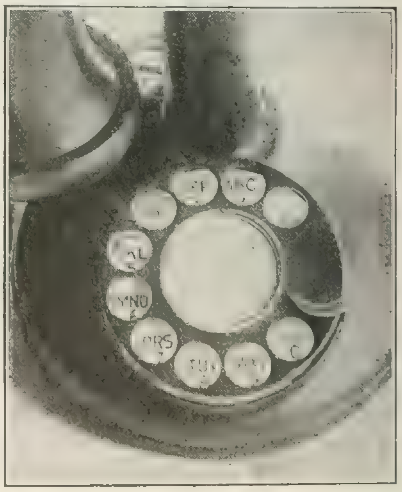
President R. H. Ballard of the National Electric Light Association has received the acceptance of John B. Miller, chairman of the Southern California Edison Company of Los Angeles, to act as chairman of the convention committee of the national organization, which will hold its convention in Pasadena from May 18 to May 22 of this year. This is the most important committee of the convention, and the fact that it will be under the personal supervision of Mr. Miller, a man of national prominence as a financier and head of a large public utility corporation, gives the assurance that the big working plan will be carried out in perfect detail.

Already committees are arranging an attractive program in which entertainment and education are excellently blended. The entertainment committee is working on plans which will make it possible for delegates to see much of the distinctive California life and some of the novelties of the Far West, and for those interested in engineering and development features of the Pacific Coast to gain first-hand information from visits to some of the large hydro-electric power generating plants and to see others under active construction. These committees have been designated as those on transportation, registration, entertainment, whips, program, publicity and farewell.

The convention committee, of which Mr. Miller is the head, will have general supervision over all of the other committees and will endeavor so to arrange the work that it will give the visitors the maximum of time for their duties and for enjoyment.

In announcing Chairman Miller's appointment, just before leaving for New York on Jan. 10, his second trip since the last convention, President Ballard added that every indication points to a very large attendance to the Pasadena convention, and he urged all who contemplated the visit to make their registrations as early as possible.

Automatic Telephone in New England



This indicates the general type of automatic telephone to be used by the New England Telephone & Telegraph Company. The automatic type of telephone will be introduced in the New England territory very gradually.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Increased Rates in Wisconsin. — In authorizing the Northern Power Company to establish a schedule of increased rates the Wisconsin Railroad Commission says: "The standard schedule which applicant now has in effect is regressive and is decidedly inequitable as between consumers unless adjustments are made when bills are rendered so as to eliminate the regressive features. It appears from the record that the Northern Power Company has equalized the difference between the steps in the standard schedule when billing consumers. It appears to us that this practice is only an expedient solution of the difficulties inherent in the regressive type of step rate. It is needles to argue that a regressive schedule is inimical to the interests of the utility and the smaller consumers, and the establishment of a schedule similar to the present alternate schedule will place all consumers upon an equitable basis. The rate schedule approved, while it will increase bills to consumers in some cases to a large amount above their present billing, will not yield an unreasonably large return on the company's investment. The rates fixed by the order are such as in our opinion will be reasonable in view of the circumstances."

Proper to Charge for Line Extension.—A decision on line extension for lighting service, affecting the British Columbia Electric Railway Company, Ltd., of Vancouver, B. C., has been rendered by Public Utility Commissioner Retallack. It follows a complaint of the municipality of South Vancouver in regard to the cost of making extensions and the charges therefor. The principle of requiring security or payment from the consumer for an extension costing more than the usual outlay for supplying one consumer and out of proportion to the revenue to be derived is upheld as just and reasonable. The existing basis, however, was declared unjust and a new basis requested by the two parties to the proceedings was outlined. The period of three years in which the company requires its expenditures for an extension to be repaid from revenue derived from such extension was held to be justified in the interests of the community. South Vancouver had asked that it be changed to five years. The decision says in part: "I cannot agree with the argument of counsel for the applicant that the principle of requiring security or payment from a consumer for an extension involving a cost greater than usual to one connection, and out of proportion to the revenue to be derived therefrom, should not be applied to South Vancouver. I consider the principle itself is sound, because, though there is an obligation on public utility companies, such as the respondent, to supply adequate, just and reasonable service, unlimited unprofitable extensions are not just and reasonable service. A public utility company should not make improvident extensions, and this commission should not order an extension unless such order is just. If an extension were made under either improper condition, the resulting loss would ultimately fall on the community, which has to provide a fair and reasonable return on the respondent's capital investment through its payments for service. The applicant has only shown that South Vancouver is a municipality with a population greater than many cities in Canada, and that a number of residents who desire the lighting system extended for their own benefit are unable or unwilling to pay a proportion of the cost of such extension. Could it also have shown that such population is compactly located, it would be entitled to have all such streets as might be occupied by such population completely equipped with service lines, but as, on the contrary, its population is scattered over a very large area, some of which is not as yet fully supplied with other conveniences, I do not consider that what it has shown justifies my holding that it should receive preferential treatment in the application of a principle which, for the reasons stated above, is just, and which, under similar conditions, is, in some form or other, universally in force in the principal cities of the Dominion."

Decision on Temporary Rates.—The Illinois Public Utilities Commission has entered an order in the case of the Southern Illinois Light & Power Company, St. Louis, Mo., continuing in effect for an indefinite period temporary increased rates authorized by the commission's order of Dec. 18, 1918, and March 3, 1919, subject to the following terms and conditions: "First, the burden of the proof of the reasonableness of the rates herein authorized shall be upon the Southern Illinois Light & Power Company in any complaint filed or upon the commission's own motion with respect to the said rates; second, the Southern Illinois Light & Power Company shall notify the secretary of the commission in writing within twenty days of the date of service of this order whether it elects to accept the terms and conditions of the order herein." This is a change in the Illinois commission's policy of dealing with temporary rates installed during the beginning of the high-cost period. Its previous practice has been to continue in effect the temporary rates for a short period with the commission retaining jurisdiction over the case. That this has not become a general policy of the Illinois commission, however, is evident from the fact that certain other cases of a similar character have been continued under the former basis.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., Los Angeles Section.—"Automatic Substations" will be discussed at the Jan. 20 meeting held by this section of the American Institute of Electrical Engineers.

A. I. E. E., St. Louis Section.—B. G. Lamme will address the Jan. 29 meeting held by this section of the American Institute of Electrical Engineers, his subject being "The Technical Story of the Rotary Converter."

San Francisco Engineers Hear About Hetch-Hetchy.—M. N. O'Shaughnessy, chief engineer of the city of San Francisco, recently addressed the Engineers' Club of that city, discussing the "Hetch-Hetchy Power Project."

Electric Club of Philadelphia.—At the annual meeting M. E. Arnold was elected president to succeed Frank H. Stewart. On Feb. 19 the club will entertain at dinner more than 500 former service men connected with the electrical industry in the city of Philadelphia.

A. I. E. E., Seattle Section.—An illustrated paper on "Applications of Electric Motor Drive to Auxiliary Equipment on Board Ships" was presented by Mr. Sweat at a recent meeting held by this section of the American Institute of Electrical Engineers.

A. I. E. E., Philadelphia Section, and Franklin Institute.—At a recent joint meeting of the Philadelphia Section of the American Institute of Electrical Engineers and the Franklin Institute, Lieut. Col. Nugent H. Slaughter of the Signal Corps gave an address on "Wireless Telegraphy."

New York Electrical Society.—W. L. R. Emmet of the General Electric Company talked before the society on Dec. 17, his subject being "The Electrical Propulsion of Ships." At this meeting fifty-one new members were elected and the membership committee reported a total of 474 active members on the rolls. This is practically double the number enrolled last year.

Engineering Council to Confer on "Payment for Estimating."—The Engineering Council has been requested by the Associated General Contractors of America to appoint representatives to confer jointly with them and the American Institute of Architects in regard to the question of "payment for estimating." The council has appointed Samuel G. Neiler as one of three representatives. It is expected that the meeting will be held in Chicago some time in the near future.

Indianapolis Lines Connected.—The Merchants' Heat & Light Company, Indianapolis, Ind., has completed a nine-mile 33,000-volt line which ties in with the Interstate Public Service Company. This will help supply energy for the traction lines between Indianapolis and Columbus and Seymour and for lighting and power in a number of towns, including Southport, Greenwood, Franklin, Columbus and Seymour, Ind.

War Finance Corporation Loan to Electrical Manufacturers.—It is announced that the War Finance Corporation will make four loans, aggregating $17,000,000, to commercial companies which will use the money to export needed machinery to European countries. According to the report, a loan for $5,000,000 will be made to an electrical machinery corporation, and this will be used in financing reconstruction of stricken sections of Belgium and France, where all electrical apparatus was destroyed by the Germans.

Cost-Plus Rates for Steam Heat.—A new rate for a steam-heating service has been granted to the Indiana General Service Company, Muncie, Ind., by the Indiana Public Service Commission embracing a "cost-plus" feature. There is a service charge of 13 cents per season for each square foot of connected radiation surface for the pressure system and 9.5 cents for the atmospheric-pressure vapor system. This will yield a revenue to the company of approximately 8 per cent on the commission's valuation of the heating property. In addition there is a condensation charge for metered steam which equals the cost of producing the steam as determined from the company's operating costs kept according to the commission's standards. The costs of depreciation will be met according to the wisdom of the company management and included in the operating costs. Taxes will also be added to the operating costs. Bills not paid within ten days of date will have an additional charge of 10 cents per 1,000 lb. of condensation but not less than $1. The minimum monthly charge will equal the service charge of each customer.

Association of Russian Engineers.—Alfred D. Flinn, secretary of the Engineering Council, has issued a circular relating to the Association of Russian Engineers in which he says: "The war brought to America many Russian engineers in the service of their country in connection with the manufacture of the many articles needed for the prosecution of hostilities. The revolution in Russia drove other engineers out of that unhappy land, and numbers of them have found their way to America. Among these engineers there was formed, Aug. 19, 1918, an organization which was incorporated under the laws of the State of New York. In its constitution the association declares that it 'is an organization loyal to the Allies and true to the democratic aspirations of the Russian people. The aim of the association is to establish the reconstruction of Russian industries, for which purpose the association is actively engaged in preparatory and creative work and promotes intercourse and mutual understanding between American and Russian technical and industrial circles, by the aid of meetings, lectures, reports and publications.' The association has an office in New York City, and its present membership is seventy-six, a few of whom have returned to Russia. A list of the members is on file in the office of the Engineering Council. Members of the association who called at the Engineering Council's office expressed the opinion that two or three years might yet pass before political and industrial conditions in Russia would be stabilized, but meanwhile connections are open to Siberia and southern European Russia. The members of this Association of Russian Engineers are also members of the great national organization of engineers in Russia, having about 60,000 members. It is purposed to have this American organization in time made a branch of the Russian national organization and thus bring about and establish mutually helpful relations between the engineering societies of America and the engineers of Russia. Some of these Russian engineers desire to become affiliated with the leading societies of engineers in America. They can contribute to the information of these societies concerning Russian engineering practice and the opportunities in connection with the development of their country which will surely follow when more stable political conditions shall have been brought about."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Against Public Ownership of Farms.—The Illinois Committee on Public Utility Information has completed a poll of editors of the state on the question of nationalization of farms as has been proposed by the radical element in connection with the "public ownership of all moneymaking industry," and upon issues of the efficiency of private operation in "sharing of profits." The ballots were sent to 610 editors, of whom 546 voted. The results of the balloting may be summarized as follows: Public sentiment as represented by the views of the editors is overwhelmingly opposed to any "nationalization of industry" schemes, 537 editors voting flatly "no," 6 favoring the taking over of farms by the government and 3 casting a "conditional" vote. Of the 546 editors, 535 voted in favor of private operation; 8 voted either for government operation or regulation and 3 ballots were "conditional." On the question of profit-sharing, 503 voted "no," 8 voted "yes," and 35 were "conditional." The ballots were sent to editors irrespective of their political beliefs.

Government Sales of Surplus Electrical Equipment.—The total sales of surplus electrical equipment by the office of the Director of Sales of the government during the past year amounted to $637,189, which represented a recovery of 59 per cent of the original cost of such equipment to the government. That figure does not include sales of electrical equipment amounting to $109,854, for which the original cost was unknown. Included in the sale of electrical equipment was approximately $250,000 worth of motors, which represented about half of the surplus supply offered for sale.

French Radio-Station Completed.—Press dispatches from Bordeaux, France, announce that the construction work on the Lafayette radio station has been finished by the United States Navy forces that have been building it. The eight steel towers are each about 900 ft. in height. It is stated that this station will be the most powerful in the world. It was planned to meet war needs, but when the armistice was signed the French government asked that the navy complete the work. The French government agreed to meet the entire cost of construction and to take over the property on completion of it.

Would Settle Labor Troubles Without Government Interference—Constructive criticism of President Wilson's Industrial Commission was presented before the Western Society of Engineers, Chicago, on Jan. 5, by Charles Piez, president of the Link Belt Company and until recently director-general of the Emergency Fleet Corporation. Instead of governmental machinery for arbitrating labor disputes, he suggested an organization to disseminate information on the earnings of industry in language that the workingman can understand. He believes in letting employers and employees settle their own differences without governmental interference.

Illinois Miner Gets a Wound and an Education.—In Belleau Wood a soldier who was formerly a miner was struck by a high explosive shell that caused a fracture of the spine and made lifting or stooping about as difficult as taking a machine-gun nest single-handed. Subtracting lifting and stooping, a miner's usefulness looked small—or that is what he told the agent of the Federal Board for Vocational Education in Chicago. The agent remembered that some one had said that what a man did with his spare time proved what kind of a person he was, so he probed around a bit and asked the soldier what he did in off hours. "Oh," he said deprecatingly, "I putter around with wires and electrical things," and he added shyly, "I like it." The upshot is that the man is taking a course at a school of engineering and getting ready to go back as an electrical repair man in his old mine.

Men of the Industry

Changes in Personnel and Position - Biographical Notes

Prof. Dugald C. Jackson and **Edward L. Moreland** have recently announced the establishment of a partnership as consulting engineers with offices at 387 Washington Street, Boston. The work of this new firm will include the preparation of plans and specifications, supervision of construction, general superintendence and management, examinations and reports, in continuation of the work of the firm of D. C. & William B. Jackson, Boston and Chicago, which has been dissolved. Professor Jackson is one of the best-known electrical engineers in this country and has been identified with important engineering undertakings and investigations for the past thirty years. He is a past-president of the American Institute of Electrical Engineers and of the Society for the Promotion of Engineering Education and author of several textbooks. Mr. Moreland was educated at Johns Hopkins University, where he received the degree of A. B. in 1905, and at the Massachusetts Institute of Technology, from which he received the degree of M. S. in 1908. In October 1908 he entered the employ of D. C. & William B. Jackson as assistant engineer, and in 1912 he was appointed manager of the Boston office of that firm. In January 1916 he was taken into partnership with D. C. & William B. Jackson. In April 1918 the members decided to dissolve the partnership and temporarily discontinue their business in order that all the members of the firm might go into the army. Mr. Moreland closed the office at the end of July 1918, was commissioned a captain in the Engineer Corps Aug. 10, 1918, and was immediately sent to France for duty with the technical board above mentioned. In December 1918 he was transferred to the war damage board as technical executive of the engineering department. He was promoted to the rank of major in the Engineer Corps in April 1919, returning to the United States in May and receiving his discharge in June. The new firm has been retained by the city of Worcester, Mass., in connection with a fare case before the Massachusetts Public Service Commission concerning the Worcester Consolidated Street Railway.

EDWARD J. MORELAND

Ralph R. Wallbridge of the Southern California Edison Company at Los Angeles, Cal., has recently been appointed district manager of the Porterville district of the Mount Whitney Power & Electric Company, a subsidiary property. Mr. Wallbridge will succeed A. L. Whitehead, who has been transferred to Alhambra.

S. M. Gallaher, who has been manager of railways of the Monongahela Valley Traction Company, Fairmont, W. Va., since 1917, has severed that connection to join the Cleveland (Ohio) Electric Illuminating Company, as head of the engineering and construction departments. Mr. Gallaher was formerly general manager of the Charleston (W. Va.) Interurban Railroad.

John W. Corning, formerly electrical engineer of the Boston (Mass.) Elevated Railway, has joined the staff of Jackson & Moreland, consulting engineers, Boston. Mr. Corning returns to the electrical field after an absence of several years, part of which was spent in foreign travel, and he is being cordially welcomed back to Boston by a wide circle of friends in the engineering profession.

Franklin W. Loomis, who recently resigned as sales manager for the Dallas (Tex.) Power & Light Company, has joined the staff of the Society for Electrical Development. Mr. Loomis' experience covers the contracting, manufacturing and central-station fields. At one time he was in business for himself as an electrical contractor, then in the power department of the Narragansett Electric Lighting Company, from which company he went to the Edison Electric Illuminating Company of Brooklyn as power agent, then to the Westinghouse Electric & Manufacturing Company as salesman. Later he was connected with the Stone & Webster Management Corporation as commercial adviser, with the H. W. Johns-Manville Company as lighting specialist and with the Holophane Company as sales engineer.

Prof. Harris J. Ryan, who during the war was engaged in important research work in southern California for the United States government, has returned to his post at Leland Stanford Junior University, Palo Alto, where he has served as professor of electrical engineering since 1905. He is devoting much time to the study of high-tension insulation problems in the laboratories of the university. Professor Ryan is well known from the important research work he has done outside his academic duties on high-voltage insulation and as consulting engineer of the Los Angeles Aqueduct Power Bureau. He has been a valued contributor to the *Transactions* of the American Institute of Electrical Engineers and is author of numerous monographs on electrical subjects. He is a fellow of the American Association for the Advancement of Science, a member of the American Institute of Electrical Engineers, the American Electrochemical Society, the Institute of Radio Engineers, the Society for the Promotion of Engineering Education and the American Physics Society.

HARRIS J. RYAN

Obituary

Ole J. Gronsdahl, manager of the Hartford (S. D.) electric light plant, who has recently died, was formerly secretary of the South Dakota Light & Power Association and was very active in association work. Mr. Gronsdahl was thirty-eight years old and had lived in Hartford for about twelve years. Last summer he was injured in an automobile accident, and the complications from this, together with sundry other troubles, were such as to necessitate his being taken to a Sioux Falls hospital.

Joseph I. Mitchell, assistant manufacturing superintendent of the Pittsfield (Mass.) Works of the General Electric Company, died Jan. 7 at Pittsfield after an illness of six months. Mr. Mitchell was born in Leicester, England, sixty-one years ago. He was first employed by the Thomson-Houston company in New Britain, Conn., later being transferred to Lynn, Mass., with the organization. He was the first foreman of the transformer section at Lynn and served in the same department at Schenectady. Mr. Mitchell had resided in Pittsfield since 1908. He was the oldest member of the "Quarter Century" Club of the Pittsfield Works.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

PAST YEAR WOUND UP WITH REMARKABLE STRENGTH

Soon After Midsummer Hand-to-Mouth Buying Gave Way to Tremendous Activity, Resulting in Low Stocks and Greatly Delayed Shipments

IN LIKE a lamb but out like a lion was the 1919 sales record of the electrical industry. It entered the year looking for business and closed with volumes of unfilled orders on its books.

Manufacturers still had in the early months of 1919 considerable business in back orders. At the same time there was a feeling that business would be light and that prices would drop. Steel and copper had receded, and this gave rise to the expectation that there would be a corresponding revision downward of prices of finished articles. For the first three months manufacturers' output was probably not more than 25 per cent under the maximum rate for 1918, and jobbers' business was reported 8 to 10 per cent above the same period of the previous year. Retail sales were probably larger than ever before. Deliveries to distributers were quicker so that retailers ordered smaller amounts more frequently. On many materials there had been gradual decreases in prices, but these had little stimulating effect. Price guarantees were given on some few articles.

SPRING BUSINESS PICKED UP

After the steel companies reduced their prices $5 to $7 per ton on March 21, at the suggestion of the Industrial Board, business picked up noticeably. Copper products likewise declined. From all sections came evidence of strong expectation of increased business activity. Building activities were resuming, and much work was about to start. Manufacturers could hardly keep up with the inquiries.

By the first of June the financial situation had become better. Architects and contractors were more busy and business conditions were becoming more stable. Building showed more activity, and industrial expansion was more marked.

The latter part of June found the volume of electrical business increasing appreciably. The curve of prices was distinctly upward, price cutting seemed to be a thing of the past, and but few concessions were being granted. Copper products were up, spot cotton in the middle of July sold for 35 cents, and it was predicted that it would go to 40 cents. Labor disturbances, coming in waves, were more active and increasing. But deliveries were beginning to lengthen and shortages already were appearing in some lines. Jobbers were ordering better for stocking by August, but they had held off too long and manufacturers were unable to make deliveries sufficient to fulfill all the orders which were coming in from all over the country. The steel strike called on Sept. 22 found electrical manufacturers as a whole well supplied. By the end of the year, however, the market was short of certain steel and iron products. Throughout the last quarter of the year prices advanced on many lines. Jobbers locally were boosting prices on material which was difficult to obtain. Wiring materials as a whole were short for stocking purposes.

During 1919 court decisions ruled that the seller had the right to choose his customer, thereby protecting his rights as a trademark owner (Colgate case); the Japanese Supreme Court upheld United States trademarks; the fundamental snap-shell patents were upheld (Weber vs. Cutler-Hammer and vs. Connecticut Electric); certain separable attachment plug patents were upheld (Hubbell vs. General Electric and vs. Bryant); the fundamental gas-filled lamp patents were sustained (General Electric vs. Nitro-Tungsten), and the Majestic portable radiant heater patents were upheld.

On Dec. 30, 1918, copper commanded 23 cents a pound. The new year opened with the metal dropping, and thereafter it continued to fall week by week until it reached its lowest point of 14.50 cents about March 3. Rising, it took till May 13 to recover to 16 cents, when it started with more vigor and continued in steady jumps to its highest point of 23.50 to 24 cents, which it reached about July 20. From Oct. 15 the market steadily dropped to a low level of 18 cents about Dec. 1, but during this last month it recovered and finished out the year at 19 cents a pound.

NEW YORK METAL MARKET PRICES

	—Dec. 30, 1918—	—Dec. 30, 1919—
Copper:	£ s d	£ s d
London, standard spot	112 0 0	116 15 0
	Cents per Pound	Cents per Pound
Prime Lake	23.00	19.00 to 19.50
Electrolytic	23.00	18.75 to 19.00
Casting	23.00	18.50
Wire base	28.75	21.50 to 22.00
Lead, trust price	6.00	7.50
Antimony	7.62½	9.62½
Nickel, ingot	40.00	41.00 to 42.00
Sheet zinc, f.o.b. smelter	13.00	11.50
Spelter, spot	8.15	9.00 to 9.10
Tin,	Govt. price 72.50	59.50
Aluminum, 98 to 99 per cent	Govt. price 33.10	32.00 to 33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.00 to 16.50	17.00 to 17.50
Brass, heavy	9.00 to 9.50	9.75 to 10.25
Brass, light	8.00 to 8.25	7.75 to 8.00
Lead, heavy	4.50 to 4.75	6.00 to 6.25
Zinc, old scrap	4.75 to 5.00	4.75 to 5.00

Rubber-covered copper wire base opened at 32 cents, gradually followed copper down, though considerably lagging in time behind the raw metal, and reached its lowest point, just under 20 cents, about May 3, two months after copper reached its bottom. Meanwhile stocks had been ample for all needs, but buying had been light. Standardization of rubber-covered wire eliminated certain sizes and types of wire. Toward the first of May the demand for wire became better and the demand for lamp cords from fixture manufacturers became heavy. Then as the base was raised from 20 cents the demand increased, seemingly each step, until the base reached 30 cents about Aug. 9, three weeks after the raw copper reached its limit of 23.50 to 24 cents. Demands continued heavy and shipments became slower during September, when silk-insulated cord almost vanished from the market. By October the mills were well booked for the remainder of 1919, with shipments averaging thirty days. In the last third of the year sales of lamp and heater cords were extremely brisk, and their prices were high and shipments long. By Dec. 30 rubber-covered base had receded to 27¾ cents. Sales booked of total code wire in 1919 were estimated at $21,000,000, equivalent to 1,400,000,000 ft., an increase of 40 per cent over 1918. Sales booked of No. 14 rubber-covered wire were estimated at $10,000,000.

Two new types of incandescent lamps were brought out last year, in February the mill-type lamp and in July the white 40-watt tipless, opal glass C-4 lamp. The 50-watt tungsten lamp gained fast in popularity, pushed by the central stations. Certain types of miniatures were cut from active lists. Discounts on carbon lamps in standard packages and five-hundred-dollar lots increased Feb. 1 about 15 points. A new packing was developed for lamps.

Stocks of lamps throughout the year were ample except in the early winter, when some stocks were broken. One of the problems of the year to which much attention has been paid by lamp manufacturers is that of proper stocking in order to quicken local turnover.

EXPORTS PROBABLY OVER $90,000,000

For the fiscal year ended June 30, 1919, electrical exports amounted to $80,712,110, surpassing not only those of the last fiscal year, $54,527,570, but also all previous years. For the ten months ended October, 1919, electrical exports amounted to $75,719,867, an increase over the corresponding period of 1918 of 64 per cent. On this basis exports for the calendar year 1919 should total over $90,000,000. The month of June provided the record figure of all months, with a total of just under $11,000,000.

There was little demand for large motors during the first six months, but throughout the last half of the year demand for large sizes increased considerably, with shipments running from eight to twenty-four weeks as against a normal of fourteen weeks. Normal industrial sizes from 1 hp. to 50 hp. were in pretty good stock up to the middle of the year. Shipments in these sizes at the close of the year were eight weeks to six months, against normal shipping dates of nearer eight to twelve weeks.

Fractional motors for appliances enjoyed a phenomenal season. Before the year was out it was virtually impossible for new customers to place large orders for shipment before 1921, and some shipping dates on especially large orders were scheduled for 1922. During the year certain single-phase lines were lowered 10 per cent in price, but this was recovered in the fall.

Sales of transformers were light over the first five months of the year as central stations were making few line extensions and few big industrials were in the market. Stocks of distribution sizes were ample until the middle of June, when increased activity began to drain them. Stocks improved again, however, until the fall, when they were again hard hit, and shipments went to six to ten weeks. Prices declined twice during the year, totaling about 20 per cent.

Voltage and feeder regulators saw considerable activity during the middle of the year. Meters, early in the year a stock item, and normally so, by the late summer reached such activity that manufacturers, even with increased capacity, were requiring three weeks to commence shipments on the large orders coming in.

WIRING SUPPLIES VERY SHORT

The second-hand-apparatus market, quiet for the first quarter, picked up and held a fair business throughout the year.

Extreme shortage in certain wiring materials prevailed throughout the latter half of the year. Stocks of flexible armored conductor were ample early in the year and shipments were three weeks. By April the remodeling and wiring of properties began to reduce stocks, which in May became rather short. Jobbers had not prepared for this demand, and although manufacturers attempted to add to their capacity, the supply of strip steel was inadequate and supply went from bad to worse in the last half of the year. From the second quarter on this material was rationed out piecemeal by the producers. A decline in price of $10 per 1,000 ft. in March was overcome for a net increase of $5 per 1,000 ft. in four jumps during the year. Lock-nuts and bushings had a heavy demand with the conductor, and although they declined in price 20 per cent in March, they advanced 40 per cent in December. Outlet boxes for flexible conduit were extremely short in the fall.

Outlet boxes for rigid conduit did not have so heavy a call till later in the year, when a heavy demand for conduit set in. This supply was somewhat affected by the steel strike, which also shortened the supply of pipe. Cards 41 and 42 came into being on Jan. 14 and March 21 respectively, each lowering the price, while in August some manufacturers issued card 43, increasing the price about 10 per cent.

Schedule material stocks were ample for current needs when the year started, and it was not until April that sales showed any appreciable activity. By then lighting fixture manufacturers had begun to enter the market for sockets in large amounts. Building and remodeling were starting a call for material. Factory output was 60 per cent of normal, but jobbers and manufacturers were disinclined to stock heavily. By August the demand for schedule material had got well under way, and the year finished with an extreme shortage of the material.

Flexible non-metallic conduit prices followed the cotton market closely and were about 50 per cent higher in December than in January. The demand, although light for six months, was very heavy in the fall, a great scarcity existing at the end of the year.

Fan prices were 15 to 20 per cent higher than those for 1918, the 20 per cent including the revenue tax of 5 per cent on manufacturer's selling price. As usual most of the distributers ordered well under their needs, some about 50 per cent, and the first few hot June days sent them scurrying to cover. Producers tried to deliver all over the country but couldn't fulfill the demand. Prices for 1920 show increases of 10 to 15 per cent. War standards in fans, followed in 1919, will be continued in 1920.

EXCELLENT APPLIANCE YEAR

Last winter's warm season had a deterrent effect on the radiant heater market, and jobbers' hold-over stocks were rather large, but the fall business was good and old and new stocks were absorbed.

The 1919 fall and Christmas heating-appliance demand was so far above expectations that stocks were utterly insufficient to supply. Jobbers are now ordering for their entire 1920 demands. Heating-pad sales surpassed all previous years. On Sept. 20 a new heating-device schedule went into effect, the first since August, 1918. A healthy advance in sales of industrial heating appliances was recorded throughout the year.

Poles, cross-arms and pins, subject only to a light demand early in the year, because of a quiet central-station outlet, reflected more activity in the summer and fall. Prices in this latter period generally advanced.

Insulator sales also moved faster as the year wore on, and prices increased about 15 per cent during the twelve months.

The storage-battery industry has increased by leaps and bounds, many new companies having entered the field. Capacities of the old companies were increased greatly.

Following the removal of the war-time ban on sign lighting, the year saw remarkable activity in signs.

BIG FIXTURE SALES

New residence building and the remodeling of commercial, industrial and residential lighting systems have made a large year for lighting-fixture and glassware manufacturers. During the third quarter a fixture shortage arose. Prices on fixtures rose about 40 per cent during the year. The glassware market showed similar conditions with prices up about 50 per cent and shipments up to three to four months.

Fuse sales were probably less than those of 1918, but more recently sales of the larger capacities increased. An important development in this market in December was the listing by the Underwriters' Laboratories, Inc., of certain lines of renewable fuses as standard. The market for this type of fuse increased considerably throughout the year.

The year saw a greater application of the safety inclosed switch, prices on which have advanced 30 per cent since the middle of July.

Little was done in the street-lighting business early in the year, except to lay plans. Some of these were executed before the year closed.

HUBBELL ATTACHMENT PLUG PATENTS UPHELD

Judge Thomas Finds Infringement by General Electric and Bryant in Patents Nos. 774,250 and 774,251 and Declares Burton Patent Invalid

In the suit of Harvey Hubbell, Inc., versus General Electric Company and Bryant Electric Company, for infringement of Hubbell patents Nos. 774,250 and 774,251, covering separable attachment plugs, decisions have been filed by Judge Thomas in the United States District Court upholding the Hubbell patents and finding infringement thereupon. Prior patents and prior uses relied upon by the defense were held not to be such as to defeat the patents. In the suit of Bryant Electric Company versus Harvey Hubbell, Inc., charging infringement of its Burton patent, a decision has been filed by Judge Thomas holding "that the claims of the patent in suit are invalid for lack of invention as the device discloses nothing more than an aggregation of an old parallel plug and an old tandem plug."

METAL MARKET SITUATION

Copper Is Holding Firmly at 19.25 to 19.50 Cents—Lead Again Higher, to 8.25 Cents

A fair demand continues in the copper market, and good sales have resulted so far this month. The ruling price for producers' prompt copper is 19.25 cents on large orders from consumers, while smaller orders have brought 19.37½ cents a pound. Their market for first-quarter delivery to consumers is 19.25 to 19.50 cents. Producers' second-quarter prices are 19.37½ to 19.62½ cents a pound. The outside market, on the other hand, is paying to producers premiums of from ½ cent to 1 cent per pound and is willing to purchase at this rate for late first-quarter and for second-quarter copper. Their selling price for spot is 19.25 to 19.50 cents, first quarter 19.50 to 20 cents and second quarter 20.12½ to 20.62½ cents. Many large consumers are well booked up for the next two months, and several large producers have their capacity nicely taken care of for this quarter.

The foreign market is bringing 20.25 to 20.50 cents for sales during first quarter. The volume of sales is fair, and inquiries show the amount of business waiting to be placed for delivery outside the country.

December was a record month for sales, according to reports coming in. It has been estimated that these amounted to 480,000,000 lb., of which about 20 per cent was for European needs.

Copper, brass and bronze products have advanced 1 cent—sheets, rods, tubes and wire. No change occurred in the seamless high and low copper and brass and bronze tubing.

Official lead price was advanced to 8.25 cents, but the outside market did not follow it up.

NEW YORK METAL MARKET PRICES

	Jan 6	Jan. 13
Copper:	£ s d	£ s d
London, standard spot	120 0 0	119 15 0
	Cents per Pound	Cents per Pound
Prime Lake	19.50 to 20.00	20.00 to 20.50
Electrolytic	19.00 to 19.25	19.25 to 19.50
Casting	19.00 to 19.25	19.25
Wire base	22.25	22.25
Lead, trust price	8.00	8.25
Antimony	9.87½	10.25
Nickel, ingot	42.00 to 43.00	42.00 to 43.00
Sheet zinc, f.o.b. smelter	12.00	12.00
Spelter, spot	9.50 to 9.60	9.50
Tin	63.25	65.00
Aluminum, 98 to 99 per cent	31.50 to 32.50	31.50 to 32.50

OLD METALS

	Cents per pound	Cents per pound
Heavy copper and wire	17.75 to 18.25	17.75 to 18.25
Brass, heavy	10.50 to 11.00	10.50 to 11.00
Brass, light	8.50 to 8.75	8.50 to 8.75
Lead, heavy	6.75 to 7.00	6.75 to 7.00
Zinc, old scrap	5.00 to 5.25	5.25 to 5.50

THE WEEK IN TRADE

ONLY in the West did inventory taking seem to have any appreciable effect on the electrical supply market. The two weeks' lull there gave jobbers a chance to accumulate better stocks as shipments just then came in from the East. Thus the West virtually starts the new season with fair stocks. Heavy buying, however, would soon break these up as deliveries are tardy and irregular.

In the East, on the other hand, stocks are pretty well depleted in wiring materials. Loom and flexible armored conductor cannot be stocked as the material is virtually apportioned before it comes into the jobbers' hands. Small sizes of pipe are scarce. Orders on this material are increasing. In the South some sizes of oil switches are low. In New York the scarcity of spot lead is holding up power cable to some extent. In the West jobbers are virtually out of steel reflectors and small motors are short.

In Chicago some jobbers are now ordering their loom requirements for 1920, while central stations are doing the same for oil switches, transformers, meters, feeder regulators, etc. Seattle jobbers are ordering up to six months ahead as insurance against long shipments.

Other manufacturers of heating appliances increased their list prices about 10 per cent. In various districts price advances are shown on knife switches and safety switches, vacuum cleaners, flexible armored conductor and interphones. The Phelps farm light is up 9 per cent. Deliveries on motors, especially on single-phase, are lengthening in New England, while on sockets they are in better condition.

NEW YORK

Midwinter buying continues in good volume, but shortage of material keeps down the volume of goods moved. Flexible armored conductor is still extremely short with no prospect of improvement unless demand decreases or more steel strip can be produced to feed the increased capacities of conductor mills. Pipe stocks are spotty, but rubber-covered wire is plentiful. Schedule material stocks too are spotty. Wire orders are large in number, producing a good total volume, but rather small in individual size.

According to the annual report of the Manhattan Bureau of Buildings, plans were filed in Manhattan during 1919 for 379 new buildings, at an estimated cost of $72,283,000, and for alterations to 3,583 buildings, at an estimated cost of $34,500,000, the total expenditure being over $106,000,000. The highest item was for forty-five office buildings, costing $23,269,000.

Prices have been stable this past week, although the Hotpoint line of heating appliances advanced on an average 10 per cent on list.

FLEXIBLE ARMORED CONDUCTOR.—There has been no improvement in supply and initial deliveries to-day are about 10 per cent of the total order. No. 14 single-strip commands around $86 for 1,000 ft., running up to $125 for less than coil lots.

RIGID CONDUIT.—Small-size pipe stocks are still spotty, and mills are behind on shipments. Prices on ½-in. black range from $68 to $72.40 in 1,000-ft. orders.

WIRE.—Jobbers' stocks of No. 14 rubber-covered are good but manufacturers' stocks are rather short. Demands on mills are increasing for immediate delivery. From one quarter comes the assertion that by May premiums will be asked on immediate delivery. Weatherproof base is about 28 cents, and bare 22.25 cents.

HEATING APPLIANCES.—Hotpoint list prices advanced an average of 10 per cent on Jan. 2. This is an advance of 50 cents on irons. Heaters go from $11 to $12.

SOCKETS.—Sales to fixture manufacturers are heavy and stocks are not always ample to meet demands. Producers' shipments are better.

SCHEDULE MATERIAL.—Stocks are variable in amount, in some cases being reported in excellent shape. Cut-outs are scarce.

POWER CABLE.—Shortage of spot lead is affecting this market, and prices are high to overcome premiums necessary to get the spot metal.

CHICAGO

Jobbers report that the annual let-up in trade which usually occurs in January is not present to any extent this year. There have been some cancellations by dealers of orders for Christmas delivery, especially on household appliances, but the jobbers are not canceling their orders with the manufacturers, as this business has grown from a seasonal business into a steady all-the-year trade. At least two large makers of heating appliances have raised their prices on their whole line of goods excepting ranges, and others are expected to follow. Non-metallic flexible conduit is still difficult to obtain and some jobbers are placing orders for 1921 delivery. Chicago building permits for the week were higher than the low level of the last month and a half, amounting to a total of $3,340,000, but one building for the Chicago *Tribune* accounts for $2,500,000 of this amount, leaving less than $1,000,000 as the total for all other structures.

WIRE.—Shipments are better than they were three months ago, but stocks are still low and scattered. Rubber-covered prices are firm at a 30-cent base, but weatherproof varies from 28 cents to 29 cents. This lowers the price of the larger sizes, but the differential added to the smaller sizes on account of the high price of cotton has increased the net prices.

HEATING APPLIANCES.—Universal, Hotpoint and Edison appliances have advanced in price, and it is understood that other makers will follow shortly. On Jan. 1 Universal irons advanced 50 cents, six-cup nickel percolators $1, toasters $1, heaters $1.50, chafing dishes, nickel, $3. Hotpoint and Edison irons advanced on Jan. 12 50 cents; six-cup nickel percolators $1, toasters 50 cents. Electric range prices have not changed.

WASHING MACHINES.—The demand is still far greater than the output. Manufacturers are having such great difficulty in getting motors that they are buying from electrical jobbers and even hardware jobbers. This, however, has not released the strain on the motor manufacturers, for the jobbers are now pressing them for shipment. It is reported that the price of motors in 100,000 lots sold to one large washing-machine manufacturer is $14 each. The Inland Electric Company, Chicago, has signed a contract for $1,000,000 worth of Crystal washers to be distributed in 1920.

FRACTIONAL-HORSEPOWER MOTORS.—The scarcity is reflected in the fact that the Buttercrisp Company is buying motors from $\frac{1}{10}$ hp. to $\frac{1}{4}$ hp., although its popcorn machine requires only a $\frac{1}{10}$ hp. motor.

FARM PLANTS.—As an indication of the large volume of business, one watt-hour-meter company estimates that its output for farm plants alone will amount to 450 per day during 1920. The price of the Phelps farm-lighting plant has been increased about 9 per cent.

NON-METALLIC FLEXIBLE CONDUIT.—This material is almost impossible to get, and some jobbers have placed orders for delivery as far ahead as 1921. Current prices quoted on 5,000-ft. lots of $\frac{7}{32}$-in. loom are $28 to $30 per 1,000 ft.

POWER-STATION EQUIPMENT.—Some manufacturers state that central stations should order their 1920 supplies within the next sixty days to get delivery during this year. Some large utilities have already placed their orders for estimated requirements during 1920 for oil switches, transformers, circuit breakers, meters, insulators and regulators.

BOSTON

Business is extremely active, with little evidence of slackening demand for either products or service. Prices are stiffer on heating appliances, wire, cartridge-fuse cut-outs, non-metallic flexible conduit, and some makes of radio apparatus. Fir cross-arms are also up. Shortages in some classes of wiring material are severe, but wire itself is in good supply. Deliveries are improving on sockets but tend to lengthen on motors of single and polyphase design. Collections are improving, owing in part to the resumption of billing by contractors on partly completed jobs on which they lack material for finishing the work. Jobbers' stocks are uneven but represent very substantial gains in some cases over last year. New building and engineering contracts in New England to Jan. 8 totaled $4,401,000, compared with $2,183,000 for the same period last year and exceeding all corresponding records in the past twenty years. Industrial-plant expansion is active in the Connecticut and Merrimac valleys. The New Bedford Gas & Edison Light Company will add 20,000 kva. to its plant this year, and a five-hundred-thousand-dollar hydroelectric plant is contemplated by the Amoskeag Manufacturing Company, Manchester, N. H.

WIRE. — Stocks are improved, permitting immediate shipments of both large and small sizes. Hardening copper prices are reflected in reduced discounts from the following bases: Bare, 24 cents; rubber-covered, 30 cents; weatherproof, 28 cents. A prominent New England factory reports good stocks in hand.

RADIO APPARATUS.—A vigorous holiday demand is followed by continued brisk trade. Factories are understood to be from one to three months behind on orders. Some makes reflect firmer prices, but, by and large, quotations are fairly steady.

MOTORS.—Deliveries tend to become longer and the demand appears insatiable. Stocks are hard hit, and the market is growing so fast that manufacturers are unable to keep up with it. A reflex intensive trade is being handled by second-hand-motor dealers. Recent price advances have not been followed as yet by all the larger producers.

NON-METALLIC FLEXIBLE CONDUIT.—In few cases can this material be found for delivery in any quantity. Manufacturers intimate that the present tale of woe will last at least a year. Normal quotations Monday were $30.50 per 1,000 ft. for $\frac{7}{32}$-in. and $33.50 for $\frac{1}{4}$-in. conduit.

RIGID CONDUIT.—In the smaller sizes the supply is rapidly fading away, with an unpromising outlook. One-half-inch white pipe brought $84.60 per 1000 ft. in 2500-ft. to 5000-ft. lots and $88.85 net in less than 2500-ft. lots, the corresponding quotations on black pipe being $79.50 and $83.75.

LAMPS.—Stocks are improving steadily. A representative lamp man said Monday at Boston that he had never known the situation to be so good at this time of the year as now. One concern increased its sales in November alone 50 per cent over the same month a year ago and still met its customers' requirements. Stocks were pulled down heavily in the holidays but are now being increased every day.

METALLIC FLEXIBLE CONDUCTOR.—The supply has increased considerably, but incoming shipments are soon absorbed. Two carloads for one house were at once disposed of last week. No. 14 double-strip brings $90 per 1000 ft.

SOCKETS.—Stocks are more favorable. Quotations Monday were: Pulls, 47.5 cents; keys, 27 cents, and keyless, 25 cents each. Porcelain is hard to get, but factory production is increasing on wiring devices.

WASHERS.—The demand is so great that in many cases shipments are being made by the distributer from the sidewalk where the express trucks unload. Prices are steady and competition very keen.

SNAP SWITCHES.—Stocks are being well sustained. Prices are from 17 to 15 per cent off list, with healthy demand.

ATLANTA

The inventory period over, jobbers are reporting the receipt of large orders for equipment in all lines, especially in those lines in which shipments are reported poor. The movement in jobbing lines will be accelerated as plans are announced for improvements and additions following the annual meeting of industrial companies, and jobbers are expecting to receive larger orders than is at present the case.

The superintendent of electrical affairs in the city of Atlanta announces a ruling, effective on Jan. 1, requiring that all knife switches except those installed on switchboards must in future be of the approved safety type, operating from the outside of the box and of such design as to indicate without opening the box whether the switch is closed or open.

Bank clearings in this section continue to show a healthy gain and collections are good.

CONDUIT.—Jobbers report an increase in conduit orders as contractors are anticipating their requirements and placing their orders in carload lots for the spring deliveries. Stocks of enameled in this section are reported low, but stocks of galvanized are reported in fair condition, ½-in. sizes excepted.

CONDULETS.—The first two weeks of the new year ushered in an increased demand. Stocks are reported fair, while factory shipments in special condulets are holding up fairly well.

WIRE.—Nos. 12 and 14 rubber-covered are very scarce, but Nos. 6, 8 and 10 weatherproof stocks show some improvement. A brisk demand is noted, with weatherproof quoted at 31 cents base and rubber-covered at 28 cents base.

OIL-ENGINE GENERATING SETS.—The large amount of funds in the rural districts is stimulating the movement of this apparatus, especially in sizes of from 25 kw. to 100 kw. The demand for the smaller sets up to 37½ kw. is mostly for 220/110-volt direct-current service, while the sets in excess of that capacity are of the alternating-current type. One of the large dealers in this line reports shipments good, with stocks in fair shape.

OIL SWITCHES.—The demand in sizes of 100 amp. to 400 amp., 2300-volt, three-pole type exceeds the supply. Local stocks are depleted, with factory shipments quoted at two weeks.

KNIFE SWITCHES.—Brisk demand is noticed and a sharp price advance has been registered. Quotations for three-pole, single-throw fused switches, 100-amp., are $8.25; 200-amp., $12.60; 400-amp., $27.50. Stocks are in fair condition and good shipments are the rule.

FLEXIBLE METALLIC CONDUCTOR.—A price advance is announced and the scarcity continues, with no hope of the situation being bettered unless shipments are materially improved. Jobbers are quoting double-strip, No. 14, two-wire, lots of 1,000 ft. to 2,500 ft., $108.75 per 1,000 ft.

VACUUM CLEANERS.—Local stocks are reported badly depleted in spite of good shipments. Incoming shipments are being diverted to fill back orders. There is an average 20 per cent increase in price.

SAFETY SWITCHES.—Owing to the new ruling made effective by the local municipal superintendent, the demand for safety switches has been greatly stimulated. Fair local stocks and shipments, however, have so far forestalled any shortage in this line. Prices quoted on three-pole, single-throw switches are as follows: 30-amp., $7.25; 60-amp., $15.11; 100-amp., $22.66; 200-amp., $39.46; 400-amp., $61.96. Discounts up to $50 list, 10 per cent; $50 to $200 list, 18 per cent; $200 to $500 list, 25 per cent.

POLES.—Despite brisk demands, jobbers are quoting prompt shipments on standard poles, chestnut or cedar. Inability to obtain cars, however, causes cypress pole shipments to become much slower. Prices remain as quoted last week.

INTERPHONES.—The large apartment-house construction throughout the section has caused a steady demand. Stocks are depleted, and poor shipments are the rule.

SEATTLE-PORTLAND

A majority of jobbers in Seattle report current business normal. Immediately succeeding the holidays there was the usual lull, but beginning shortly after the first of the year sales volumes began to show increases and last week's business as a whole was satisfactory. Indications are that the next three or four months will be good, but after that few care to venture a prediction. Stocks are in better shape than for months past, owing to the light buying of the past few weeks. Materials of all kinds are extremely hard to obtain, owing primarily to the fact that factories are behind in orders and shipments are coming through slowly and irregularly. This condition also applies to household appliances and motors. Jobbing houses, in order to maintain stocks, are ordering from two to six months in advance of actual needs. Appliance prices are fluctuating. For instance, one line of washers or cleaners will increase a few dollars and another line will drop. However, this fluctuation is not affecting the sales volumes.

The Tacoma district reports the closing of a year of prosperity by all. Indications for the early months of the year are extremely favorable. Stocks are in fair shape with the exception of domestic appliances and larger size motors, although they are not in position to stand heavy or continued buying. Residence construction is progressing excellently, considering the season of the year.

Portland manufacturers and jobbers report business to be opening up in fine shape. Shipments from the East are improving. Stocks in general are in fair condition, but there is a marked shortage of small motors, which will grow worse instead of better for some time to come. There have been no price changes of note recently.

MOTORS.—With the anticipated conversion to electrical drive in several large lumber mills this spring as a foundation, jobbers believe the first four months of the year will see a healthy volume of business. Several industrial enterprises still in the formative stages also plan for the installation of electric drive. Stocks are low and shipments are light and irregular.

WIRE.—Stocks are spotty and shipments very irregular. Demand is showing some increase, and it is believed this will continue. No recent price changes are noted.

SAN FRANCISCO

From all sides come reports of a December business that broke all previous California holiday records. Shipments from the East have been good. Checks made by the California co-operative campaign show that energy-consuming devices added to the power lines during 1919 exceeded by at least 50 per cent the total wattage of similar devices added during 1918.

Building permits filed in December in San Francisco, Los Angeles and Oakland amounted to $2,000,000, $3,611,000 and $783,000, against $509,000, $603,000 and $281,000 in December, 1918. It has been widely remarked that the interior cities are building all out of proportion to their previous records and their comparative size. As an example take the city of Fresno, where building permits totaled in 1918 for December $39,000, while December 1919 permits totaled no less than $570,000.

WASHING MACHINES.—Business slumped slightly, caused probably by the usual holiday depression and also because, large back orders having arrived, dealers are well stocked and are not repurchasing. Various plans of financing time payments through jobbers or manufacturers have been little patronized, most of the sales being for cash.

FIXTURES.—Just as a few years ago big campaigns were made to rewire and reswitch industrials, such as canning factories and the like, so this year an effort is being made to relight them, and this demand has caused an absolute dearth of reflectors in California jobbers' stocks. Heavy sales are being made just now of the portable stand lamp with fancy silk or parchment shades.

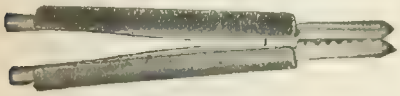
SCHEDULE MATERIAL.—Demand for stand lamps is also influencing the sale of special double sockets to contain the lamps, shipments being sold long before their arrival.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Handle for Welding Electrodes

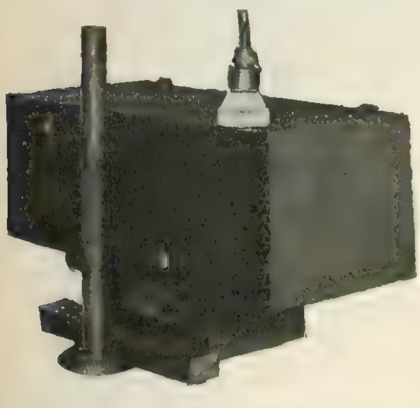
A welding handle that is said to require no pressure to hold the electrode, which can be released with one hand by slight pressure on the handle, has been recently developed by the Electric Arc Cutting & Welding Company, 222 Halsey Street, Newark, N. J. By the use of this new handle, according to the maker, the electrode can be burned to within ½ in. (3 cm.) of its length. The handle is made of metal which, it is said· will not melt at the welding temperature of the arc, and to keep it cool is arranged in two parts with an air space between and around. The grip of the handle is covered with "Bakelite Dilecto" and is equipped with a very flexible double lead.



EFFECTS ECONOMY IN ELECTRODES

Electric Oven for Opening Storage Batteries

An electrically heated oven, known as the "Hyrate," for quickly and evenly softening the sealing compound and rubber parts of storage batteries without injury to plates, has been placed on the market by the Service Station Supply Company, 30 East Larned Street, Detroit, Mich., for use in service stations and garages handling batteries.

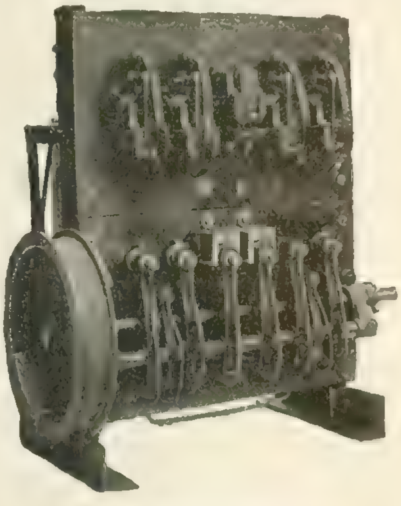


REAR VIEW OF OVEN CONTAINING A STORAGE BATTERY

The battery oven consists of a metal box open at the bottom and containing in its upper portion three electric heating units designed for operation on direct-current or alternating-current lighting circuits of from 110 volts to 125 volts. The back of the box is attached to an upright pipe standard, on which it slides up and down, so that the height may be adjusted to fit any standard starting, lighting and ignition battery. The front side of the oven is hinged so that it may be opened for examining the condition of the battery that is being heated.

Direct-Current Controller for Elevator Motors

For starting and stopping electric motors used in elevator service the Warner Elevator Manufacturing Company of Cincinnati, Ohio, has placed on the market its type Z direct-current controller.



NO PILOT CONTACTS OR DASH POTS USED

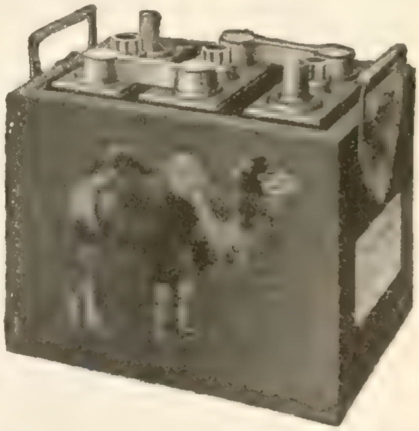
The upper panel of the new controller comprises the rheostat and controls the starting resistance. Sections of the starting resistance are automatically cut out of the armature circuit as the motor speeds up. This is accomplished without the use of pilot contacts or dash pots. The accelerating contacts are of the butt type, copper to copper, and are not used to open the circuit. The starting resistance is constructed of wire spirally wound and supported on the rear of the controller by an angle-iron frame.

The lower panel carries the main line switches. They are operated mechanically by means of a cam shaft rotated by a flexible cable from the car, resulting in the elimination of all electric interlocks, pilot contacts, etc., yet retaining, the maker points out, the features of full magnet switch control, including slow-down and dynamic braking. The main line contacts are of the copper-to-carbon type, of large size to prevent heating and to give long life under heavy service. Where the main line is opened, the contacts are equipped with magnetic blow-outs to suppress all arcing and burning. The contacts are opened by the action of cams on the cam shaft working against rollers on each contact arm. Contact is made by means of separate compression springs on each arm, and the contact pressure is independent of the rapidity or force with which the shifter sheave is operated. The panels are of electrical slate 1½ in. (3.8 cm.) thick.

Storage Battery with Improved Terminal Post

A new electric storage battery is now being produced by the Campbell Electric Company, 1529 Wyandotte Street, Kansas City, Mo., which claims as a feature an unbreakable and unleakable terminal post. There is also a large-vent plug hole to facilitate refilling the battery with distilled water and make possible the use of an especially constructed vent plug.

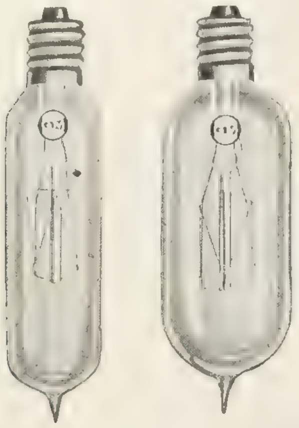
The plates are hand-pasted, and the grids used are designed for great strength and flexibility. The battery jars are designed to withstand a strain of 3,600 lb. (1,632 kg.) to the square inch and a current of 36,000 volts. The separators are made of resawed Port Oxford white cedar, and the cases are constructed from kiln-dried oak, dovetailed, no nails or screws being used.



HAND-PASTED PLATES USED

New Switchboard Lamps

To meet the need for a more efficient switchboard lamp, the Lord Manufacturing Company, 105 West Fortieth Street, New York City, is putting out a tungsten lamp called the G-M tungsten switchboard lamp. These are made in two styles, the T6, a narrow lamp, and the T8, a wider lamp shown herewith two-thirds actual size.



NEW 15-WATT, 12-CP. SWITCHBOARD LAMPS

These new lamps are rated at 15 watts, 12 cp. and 150 volts.

These lamps come packed fifty to the package.

Washer with Combined Vacuum and Agitation Operation

An electrically operated clothes-washing machine designed to combine the advantages of the vacuum and agitation principles has been placed on the market by the Rue Nelson Manufacturing Company of Amboy, Minn.

CLOTHES CLEANED BY VACUUM CUPS AND SLOPING SIDES OF TUB

The new washer has an oblong tube and two vacuum cups. An outward motion forces the clothes toward the ends of the machine. These ends slope inward so that the clothes are alternately pushed outward only to slide back to the center. The cups work in opposite directions in order to subject the clothes to constant agitation, suction and forcing of water through the meshes.

The machine's motor-driven wringer can be swung into four positions. A reversing switch makes it possible to wring the clothes in either direction, and there is a quick-acting safety release of the fulcrum type.

The inside of the tub can be obtained in two styles—either galvanized or galvanized steel with copper lining. The tub's outer covering is a battleship-gray enamel.

High-Power-Lamp Commerical Fixture

A series of commercial fixtures for use with the Ivanhoe Ace, Phoenix and other recently designed glass units employed in connection with high-powered lamps is announced by the F. W. Wakefield Brass Company of Vermilion, Ohio.

DUST-PROOF BRASS COMMERCIAL FIXTURES

These fixtures are made of brass, and include porcelain receptacles, the makers state, of special patented design built into the holders. They are designed to be dust-proof.

Split-Phase Electric Motors

Two new ½-hp. split-phase motors—type 73430-HA, with a speed of 1750 r.p.m., and type 73630-HA, with a speed of 1150 r.p.m.—have been announced by the Emerson Electric Manufacturing Company, 2032 Washington Avenue, St. Louis, Mo., to replace types 7340-JA and 8162-AA respectively.

Either of the new types can be furnished for operation on 110 volts or 220 volts of 60 cycles. Both types have starting clutches, sliding bases and adjusting screws. Terminal plates have been omitted on the new motors and four leads are brought out through the field ring, these leads being interchanged to reverse the direction of rotation.

Electric Radiator

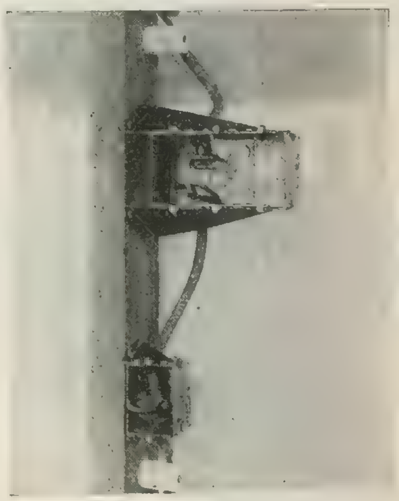
Electric radiators for use in bathroom, bedroom, nursery, office and other places have recently been developed by the Hale Electric & Engineering Company, 206 Savings Society Building, Cleveland, Ohio. They are ironclad and have no live contacts or exposed heating wires. The dimensions of these new radiators are 20 in. (50.8 cm.) long, 5 in. (12.7 cm.) wide and 15 in. (38 cm.) high. With the radiators are supplied the customary plug for lamp socket connection and a length of cord.

Metal Switch-Box Support

Metal supports which save labor, material and time in the installation of switch-boxes and base receptacles have been developed by the E. & B. Manufacturing Company, 965 Woodward Avenue. Detroit, Mich., and approved by the Underwriters' Laboratories.

These supports are triangular in shape, one of the sides being bent over for attaching to the switch-box or base receptacle and another side being bent over so that it may be screwed to the building. Two supports are used with each switch-box or base receptacle, holding it rigidly in place.

No clamps are used with the new supports. Gang supports allow single boxes to be set at any distance between studs. These supports can be used from either side of the stud and fit all standard switch-boxes. To avoid possible obstructions where a large support is used there are four screw holes in the new metal supports. These supports shorten the distance between the box and the knobs. The supports are enamel-coated.



KNOCKOUTS UNOBSTRUCTED; USED IN GANG OR SINGLY

Manufacturers' Activities

THE UNGER STORAGE BATTERY COMPANY, Wilmington, Del., will build a new one-story addition to its plant. Plans for the structure have been filed.

THE GENERAL ELECTRIC COMPANY is preparing plans for the construction of a new six-story structure at its Schenectady plant to facilitate operations. The structure will be about 54 ft. by 219 ft. and is estimated to cost $400,000.

WILLIAM E. QUIMBY, INC., 209 Parkhurst Street, Newark, N. J., manufacturer of electric pumping apparatus, etc., has filed notice with the Secretary of State of an increase in its capital from $125,000 to $200,000, to provide for proposed business expansion.

THE NORMA COMPANY OF AMERICA, ball and roller bearing manufacturer, has moved its general offices from 1790 Broadway, New York City, and its factory from 144th Street, Bronx, New York City, to its new factory building in Anable Avenue, Long Island City, N. Y.

HENRY M. FOLEY, formerly assistant to the local manager of the Central Massachusetts Electric Company, Palmer, Mass., has joined the staff of the American Electric Service & Maintenance Company, Springfield, Mass., as sales engineer for the Massachusetts and Connecticut trade.

JOHN F. VAUGHAN ENGINEERS, 185 Devonshire Street, Boston, Mass., announce that they have secured the services of Henry D. Abbot, recently resigned as New England manager United States Shipping Board, Emergency Fleet Corporation. Mr. Abbot becomes an associate of the firm.

THE CRESCENT INSULATED WIRE & CABLE COMPANY, Olden and Taylor Streets, Trenton, N. J., is considering plans for the construction of a new addition to its plant. The company has completed negotiations for the acquirement of additional property on Webster Street as a site for the proposed structure.

THE RISDON MANUFACTURING COMPANY, Naugatuck, Conn., is the new name taken by the former Risdon Tool & Machine Company. The company will continue under the same management, the manufacture of the same line of electrical goods. The company states that the name was changed because the former name was misleading to the trade.

C. G. BOYDEN has resigned from the Eastern Massachusetts Street Railway to become sales engineer of the Lincoln Electric Company, with headquarters at 10 High Street, Boston, Mass. Mr. Boyden is making a specialty of electric welding and is covering the New England territory in that connection, including industrial plants as well as utilities.

R. S. MUELLER, & COMPANY, Cleveland, Ohio, engaged in the manufacture of electric test clips and battery charging clips, have been dissolved as of Dec. 1,1919. Ralph S. Mueller having purchased the interest of George B. Dusinberre. Mr. Mueller will consolidate the clip business with that of the Mueller Electric Company and under that trade style will continue the manufacture of clips, attachment plugs, battery handles and other electric specialties at 423 High Avenue, Cleveland.

LIPPINCOTT - CARWEN CORPORATION, Erie Avenue, east of Richmond Street, Philadelphia, Pa., has purchased the assets of the Carlson-Wenstrom Company and the Carwen Steel Tool Company, manufacturers of screw machine products. A. H. Lippincott is president, F. H. Lippincott, vice-president, A. A. Cavanaugh secretary, J. A. Ganster works manager, and Jacob Lundgren chief engineer. The Carwen dynamic balancing machine and all classes of special machinery will be manufactured in conjunction with screw machine products.

GOODRICH RUBBER SELLS INSULATED WIRE DEPARTMENT TO ROME WIRE COMPANY.—T. L. Barnes, manager of sales, insulated wire department, B. F. Goodrich Rubber Company, Akron, Ohio, announces that this department of the Goodrich company has been sold to the Rome Wire Company of Rome, N. Y., in order that the Goodrich company might expand still further in manufacturing goods entirely of rubber. The kind of wire concerned is National Electric Code, automobile wires and cables, mining machine and other types of rubber-insulated wire.

THE NEW DEPARTURE MANUFACTURING COMPANY, Bristol, Conn., announces the promotion of William E. Wightman from assistant treasurer to treasurer and Charles S. Joy from credit manager to assistant treasurer.

FRANCIS H M. RILEY, formerly associated with Vaughn & Meyer, consulting engineers, Milwaukee, Wis., announces his appointment as Wisconsin representative for the Vulcan Soot Cleaner Company of Dubois, Pa., the Vulcan Fuel Economy Company of Chicago, Ill., and the Green Engineering Company, East Chicago, Ind. Mr. Riley is established at 614 Security Building, Milwaukee.

J. E. MELLETT, formerly commercial engineer with the Georgia Railway & Power Company, has joined the executive staff of the Carter Electric Company, Atlanta, Ga. Mr. Mellett has resided in Atlanta for eight or nine years, and before joining the Georgia Railway & Power Company he had been one of the sales engineers of the General Electric Company and at one time manager of its Chattanooga office.

J. E. MELLETT

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An importer in France, (No. 31,395) desires to secure an agency for the sale of electrical supplies.

A firm in Spain (No. 31,269) desires to secure agencies for the sale of electrical material, supplies and copper wire.

Engineers in England (No. 31,407) desire to secure an agency for the sale of electrical engineering equipmont.

A commercial agent from Australia (No. 31,158) desires to purchase and secure agencies for the sale of electrical goods.

A firm in Argentina (No. 31,229) desires to secure agencies for the sale of elevators for large buildings. Correspondence may be in English.

A firm in Greece (No. 31,450) desires to secure an agency from manufacturers for the sale of electrical material for lighting, power and telephones.

A manufacturer with a storehouse in Spain, (No. 30,807) desires to secure agencies for the sale of electrical supplies. Correspondence should be in Spanish.

An agency is desired by a man in Italy (No. 31,203) for the sale of hydraulic turbines, and electrical machinery and supplies. Correspondence may be in English.

Capt. H. Gauteveau, electrical engineer, 3 Villa Niel, XXVII E., Paris, France, desires a Paris agency for motors, generators, meters, heating apparatus, etc. In addition he requests information on new inventions of electrical devices. Addresses of motor and generator manufacturers will assist in entering into commercial relations with American houses.

Trade Publications

PANELBOARDS AND CABINETS.—Bulletin P-20 on panelboards and cabinets has been got out by the Penn Electrical & Manufacturing Company of Irwin, Pa.

INCUBATORS AND HOVERS.—The Improved "Reed" electric incubators and hovers are the subject of a folder issued by the Liberty Manufacturing Company, of New Orleans, La.

SWITCHES.—The Trumbull Electric Manufacturing Company, Plainville, Conn., has issued its bulletin No. 3, dated December 1919 and covering "Safety' externally operated switches.

RADIO EQUIPMENT.—Radio telegraph and telephone equipment is the subject of an eighty-three-page booklet which the Wireless Specialty Apparatus Company of Boston has prepared.

INDUSTRIAL TRACTORS.—Bulletin No. 32 has been issued by the Industrial Truck Company, division of the Cowan Truck Company, Holyoke, Mass, on type U industrial electric trucks.

TICKET SELLERS AND CHOPPERS.—The Caille Brothers Company of Detroit, Mich., has issued a booklet in which are described its electric ticket sellers and electric ticket choppers.

WASHING MACHINES.—The Brokaw-Eden Company of St. Louis, Mo., and New York City has issued several booklets descriptive of the "Eden" electrically operated washing machine.

AUTOMATIC TOASTER.—The new automatic electric toaster made by the Strite Toaster Company, 422 Plymouth Building, Minneapolisfi Minn., is described in a recently prepared mailing folder.

ELECTRIC TRACTORS.—Bulletin No. 28 has been issued by the Industrial Truck Company, division of the Cowan Truck Company, Holyoke, Mass., covering type "EL" industrial electric tractors.

TOWERS.—Catalog No. 10 issued by the Milliken Brothers Manufacturing Company, Woolworth Building, New York City, covers transmission towers, radio towers, and pin-lock poles as well as steel buildings.

METERS.—The Cutler-Hammer Manufacturng Company, of Milwaukee, Wis., has issued trade publication No. 479 covering electric space heaters and entitled "Miscellaneous Applications of Electrical Heat."

FARM LIGHTING PLANTS.—The Automatic Electrical Devices Company, 120 Opera Place, Cincinnati, Ohio, describes its new self-starting "All Purpose" lighting and power plant in a folder of recent issuance.

CENTRIFUGAL PUMPS.—The Allis-Chalmers Manufacturing Company, of Milwaukee, Wis., has issued bulletin No. 1632C, a fifty-two-page publication covering the centrifugal pumps and pumping units made by this company.

RHEOSTAT AND COMPENSATOR OPERATING MECHANISM. — Bulletin No. 47,702A, superseding No. 47,702 and covering rheostat and compensator operating mechanisms, has been published by the General Electric Company of Schenectady, N. Y.

New Incorporations

THE HAAS ELECTRIC SALES COMPANY of Cleveland, Ohio, has been incorporated with a capital stock of $20,000 by L. D. Goldhamer, Max L. Haas, A. E. Goldhamer, H. Klein and M. Walters.

THE AMERICAN ARMATURE ENGINEERING COMPANY of Bluefield, W. Va., has been chartered by A. A. Grant, and A. D. Knight. The company is capitalized at $25,000 and proposes to manufacture armatures, etc.

THE ACETYLENE & ELECTRIC WELDING MACHINE COMPANY of New York, N. Y., has been incorporated by L. Scheuer, R. E. Polhemus and S. Dannenberg, 407 East Fiftieth Street. The company is capitalized at $11,000.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

New England States

BIDDEFORD, ME.—Steps, it is reported, have been taken to equip eventually all the mills of the Pepperell Manufacturing Company for electrical operation. The company, it is understood, has placed an order with the General Electric Company for a 7,500-kw. generating unit, to be installed in the Laconia division. All the power for the mills eventually will be furnished from the Laconia division and the Clarke Power Company. The large No. 3 mill will be equipped within a year and later on No. 1 and No. 2 mills.

COLUMBIA, ME. — The Washington County Light & Power Company of Portland is building a hydro-electric development at Columbia. This plant will have a generating capacity of 2,400 hp. E. S. Lincoln, 534 Congress Street, Portland, is treasurer and general manager. The Eastern Electric Construction Company of Portland has contract for construction of plant.

SQUIRREL ISLAND, ME.—The Squirrel Island Electric Company, recently incorporated with a capital stock of $25,000, contemplates the construction of an electric light plant at Squirrel Island.

FALL RIVER, MASS.—Plans are being prepared for building an addition and remodeling the Shawmut Mills, at a cost of about $400,000. The installation of electrically driven machinery is included among the proposed improvements.

PEPPERELL, MASS.—Work will soon begin on the erection of the proposed electric transmission line extending from line of the New England Power Company at Dunstable to a point near Pepperell to supply energy for the paper mill of the Nashua River Paper Company.

RUSSELL, MASS.—At a special town meeting held recently the proposal to construct a municipal electric lighting system was carried.

SOUTHBURY, CONN.—The Woodbury (Conn.) Electric Company is contemplating extending its electric service to Southbury.

STONINGTON, CONN.—The Eastern Connecticut Power Company has petitioned the Public Utilities Commission for approval of a proposed 33,000-volt transmission line from its White Rock substation in Stonington to the Rhode Island state line in Pawcatuck, and of a change in the construction of the present 16,000-volt line between White Rock and the company's station at Preston. The company has applied for permission to erect a transmission line in the town of Thompson.

Middle Atlantic States

BATH, N. Y.—Contract has been awarded to the Ames Iron Works, Oswego, for the construction of the proposed new addition to the municipal light and power plant. The cost is placed at about $25,000.

BERKSHIRE, N. Y.—Application has been made to the Public Service Commission by the Berkshire Delco Lighting Company for permission to construct an electric light plant in Berkshire and for approval of a local franchise. The cost is estimated at about $6,000. Charles A. Partridge and James Dormody are interested in the company.

BINGHAMTON, N. Y.—Bids will be received by the State Hospital Commission, Albany, N. Y., until Jan. 28, for renewal of electric wiring in the main building, and for laundry equipment for the Binghamton State Hospital. Plans and specifications may be obtained at the Department of Architecture, Capitol, Albany. L. F. Pilcher, Capitol, Albany, is state architect.

BROOKLYN, N. Y.—Plans are being prepared for the erection of a new plant for the McPhilben Lighting Fixture Company, 264 Fulton Street, to be erected on property recently acquired fronting the right-of-way of the Long Island Railroad near Jamaica Avenue, Jamaica.

BUFFALO, N. Y.—Negotiations have been completed between the Chamber of Commerce and the Dunlop Tire & Rubber Company of London, Eng., whereby the company will establish a plant in Buffalo for the manufacture of automobile tires, to be operated under the name of Dunlop America, Inc. A site has been secured on the River Road for the proposed plant, which will cost with machinery and equipment about $10,000,000.

MARTINSBURG, N. Y.—The Public Service Commission has granted Harry S. Lewis and Harold Cornwall of Beaver Falls permission to transfer the property and franchises of the former Hirschey & Lewis electric plant in the town of Martinsburg to the Otter Creek Power Corporation. Authority was given the latter to issue $24,000 in capital stock.

NEW YORK, N. Y.—Plans have been prepared by the Hemco Electric Company, 246 Third Avenue, for improvements to its plant, located at First Avenue and Fortieth Street, to cost about $12,000. Ferdinand Savignano, 6005 Fourteenth Avenue, Brooklyn, is architect.

NIAGARA FALLS, N. Y.—The United States Light & Heat Corporation, Highland Avenue, is considering rebuilding its battery building, recently destroyed by fire.

BUTLER, N. J.—The Borough Council is considering plans for extensions to the municipal electric light plant, to cost about $30,000.

DOVER, N. J.—Plans have been approved by the State Board of Health for the construction of the proposed municipal disposal plant to be located below the Boonton dam. Considerable electrical and mechanical equipment will be required in connection with the work.

ELIZABETH, N. J.—The Consumers' Ice & Cold Storage Company, 1079 East Grand Street, is planning to erect an addition to its plant, to cost about $50,000. Considerable electrical equipment and refrigerating apparatus will be required.

FREEHOLD, N. J.—The Board of Freeholders has approved the issue of $62,000 in bonds, the proceeds to be used for the construction of an electric plant to supply electricity for lighting and heating the local court house and penitentiary.

HIGHTSTOWN, N. J.—The Council is considering the purchase of the electric plant of the Electric Light & Power Company of Hightstown, to be owned and operated by the municipality.

NEWARK, N. J.—The proposed budget of the New York Telephone Company calls for an expenditure of approximately $7,749,999 in the northern New Jersey district, including the erection of over 30,000 telephone lines and the installation of 200 new switchboard positions, construction of pole lines, installation of new cable, new trunking facilities for central office service, etc.

NEWARK, N. J.—Arrangements are being perfected for the construction of the initial unit of the proposed new plant to be erected by C. R. Curtis, formerly manager of the Splitdorf Electrical Company, and associates, at Warren, Plane and Hackett Streets. The building will be about 60 ft. by 172 ft., eight stories high, and will be devoted to the manufacture of automobile accessories, etc. The plans, it is understood, provide for the construction of the second unit of the works during the coming spring.

TRENTON, N. J.—Arrangements are being made by the Original Trenton Cracker Company, 17 South Stockton Street, for increasing power facilities at its plant. Electricity is to be furnished by the Public Service Electric Company.

WHITEHOUSE, N. J.—Plans are under consideration by the Township Committee for the installation of a new municipal street-lighting system.

CHESTER, PA.—Plans have been prepared by the American Locomotive Works for the installation of the large boiler units at its local plant.

PHILADELPHIA, PA.—Plans are being prepared for the erection of a power house for the Abrasive Material Company at James and Fraley Streets.

PHILADELPHIA, PA.—Contract has been awarded by William F. Read & Sons Company, 209 Chestnut Street, for the construction of a new power plant at its works at Twelfth and Jackson Streets, to William F. Newberry, Otis Building.

PHILADELPHIA, PA. — The Turner Construction Company has been awarded the contract for the construction of the new warehouse and power house for O. H. Wilbur & Sons, Inc., to be erected on Bread Street south of New Street. The warehouse will be 80 ft. x 90 ft., and the power house 40 ft. x 200 ft. Oil will probably be used for fuel, although the boilers are designed so that coal may be used. The Schofield Engineering Company are engineers in charge of the power house.

PHILADELPHIA, PA.—Plans are being prepared by Neel-Cadillac Company, 144 Broad Street, for a service and repairs works for automobiles at Parkway and Twenty-fifth Street, to cost about $500,000.

PHILADELPHIA, PA.—The Philadelphia Paper Manufacturing Company, River Road, Philadelphia, contemplates the construction of a machine shop and engine room, 165 ft. x 295 ft., at Nixon and Fountain Streets, to cost about $145,000.

PITTSBURGH, PA.—The Cambria Steel Company has announced part of its construction program, involving an expenditure of about $15,000,000. Work will start in a few weeks on the construction of two central power plants, to cost about $2,000,000. To meet the increasing demand for steam, the company will install 12,000 hp. in boilers and superheaters. The company has also authorized the construction of a plant for building tank cars, at a cost of $1,750,000.

READING, PA.—The Metropolitan-Edison Company has filed notice with the Secretary of State of an increase in capital stock from $4,150,000 to $5,500,000, part of the proceeds to be used for the installation of additional equipment, extensions to transmission lines, etc.

TULLYTOWN, PA.—Plans are being considered by the Tullytown Electric Company, recently organized, for the installation of an electric light, heat and power plant in Tullytown.

HYATTSVILLE, MD.—The installation of an electric lighting system in Hyattsville is under consideration.

SALISBURY, MD. — The Cambridge (Md.) Gas, Electric Light & Power Company; the Idlewild Electric Light, Heat & Power Company of Federalsburg; the Salisbury (Md.) Light, Heat & Power Company, and the Peninsular Light & Power Company of Denton have been consolidated under the name of the Eastern Shore Gas & Electric Company, with headquarters at Salisbury. Arrangements, it is understood, have been made by the Eastern Shore company for an issue in capital stock to provide for expansion.

SOUTH CHARLESTON, W. VA.—The South Charleston Utilities Company has applied to the Kanawha County Court for a franchise to extend its electric transmission lines to the eastern corporate limits of St. Albans to furnish electrical service in that town. The company will probably serve the residents between South Charleston and St. Albans with electricity.

NORFOLK, VA.—Plans are being prepared by the Reliance Electric Company, 771 Granby Street, Norfolk, for the erection of an electric repair and service works, 40 ft. x 104 ft., at Jamestown Boulevard and Monroe Street, to cost about $70,000.

WASHINGTON, D. C.—Bids will be received at the office of the Chief Signal Officer of the Army, Washington, D. C., until Jan. 30, under Proposal 2347-1CP, for furnishing fifty telephone hand sets, fifty hand set receivers and fifty transmitters.

WASHINGTON, D. C.—Bids will be received at the Machinery and Engineering Materials Branch, Munitions Building, Washington, D. C., until Jan. 21, under Circular M E 142, for furnishing 12,800 Mazda lamps, 300 nitrogen lamps, 288 2-cp. lamps and 288 4-cp. lamps.

WASHINGTON, D. C.—Bids will be received at the office of the Chief Signal Officer of the Army, Washington, D. C., until Jan. 27, under Circular PR 1991-3CP, for furnishing two apron panels complete, three distributing frames for fire-control switchboard and 20 ft. strip copper.

WASHINGTON, D. C.—Bids will be received at the office of the Chief Signal Officer of the Army, Washington, D. C., until Jan. 27, under Proposal PR 1626-1CP, for furnishing thirty direct-current ammeters, ninety alternating-current radio frequency ammeters and thirty portable direct-current micro-ammeters.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until Jan. 20, Newport News, Va., Schedule 5362—7,640 ft. leaded and armored cable. Until Jan. 23, Philadelphia, Pa., Schedule 5383—two telephone motor-generators and two ringing dynamotors. Brooklyn, N. Y., Schedule 5386—miscellaneous lighting and power wire. Until Jan. 27, Brooklyn, N. Y., Schedule 5369—miscellaneous electric cable and wire. Until Feb. 10, Eastern and Western yards, miscellaneous electric water heaters Applications for proposal blanks should designate the schedule desired by number.

North Central States

DETROIT, MICH.—The Mutual Electric & Machine Company, 232 Fort Avenue, is planning to erect a machine shop on Porter Street.

DETROIT, MICH.—Plans are being prepared for the erection of a new plant at Fort and Boyd Streets for the Columbia Motor Company, 1256 East Jefferson Avenue, to cost about $500,000. Horace H. Dane, Dime Bank Building, is architect and engineer.

MUSKEGON, MICH. — The Superior Seating Company is considering extensions to its works, including a power plant, to cost about $350,000.

CANTON, OHIO.—The Arctic Ice Machine Company contemplates the construction of a machine shop and power house. The company, it is understood, will purchase equipment for steam power plant and other machinery.

CLEVELAND, OHIO.—Work will start at once on the construction of the first unit of the proposed manufacturing plant of the Eaton Axle Company, to be located at East 140th Street and the New York Central Railroad. The first unit will cost about $1,000,000, and will include a main factory building, 300 ft. x 400 ft., a power house and a separate heat-treating building, these buildings being planned to serve four large factory units. J. O. Eaton is president.

MONTPELIER, OHIO.—The Board of Trustees is considering the installation of a new engine and generator. Nothing definite has been decided upon. A. G. C. McKalip is superintendent.

RICHWOOD, OHIO.—Improvements are being made to the plant of the Richwood Light, Heat & Power Company, including the installation of a 150-kw. frequency changer, 25 to 60 cycle; motor and generator for frequency changer, three 50-kva. 19,200/2,300/110-volt transformers. Contracts for the work have been let. Edward A. Schamb is manager.

TOLEDO, OHIO.—The Mutual Heating & Light Company contemplates the erection of a new concrete or brick smokestack. As yet nothing definite has been decided upon. W. J. Blebesheimer is president and manager.

VENEDOCIA, OHIO.—The capital stock of the Venedocia Electric Light Company has been increased from $5,000 to $10,000.

VERSAILLES, KY.—Bids will be received by the city of Versailles until Jan. 27 for construction of waterworks, power and filtration plant and laying 31,800 ft. of pipe line. Plans and specifications may be obtained on application to Edgar B. Kay, chief engineer, 1416 R Street, N. W., Washington, D. C.

COLUMBIA CITY, IND.—Improvements are contemplated to the municipal electric light plant, including the installation of additional equipment. Frank Schultz, city electrician, will have charge of the work.

COLFAX, IND.—The Colfax Electric Company has applied to the Public Service Commission for permission to issue $20,000 in bonds for extensions to its system.

GREENFIELD, IND.—Bonds to the amount of $6,000 have been issued for improvements to the municipal electric light plant.

INDIANAPOLIS, IND.—The Sanborn Electric Company has been awarded the contract for wiring the first unit of the Academic and Trades Building for the Arsenal Technical Schools, at $12,500.

LOGANSPORT, IND.—The Cass County Chamber of Commerce will have a survy made of the Wabash River at Logansport with a view of utilizing the power for an electric light and power plant.

BROCKTON, ILL.—The Council is considering the question of securing electric lighting service for the town. For further information address C. B. Miller.

CHICAGO, ILL.—The Stromberg Electric Company has purchased a new site on which it will erect a factory building 220 ft. x 200 ft., to cost about $160,000.

JACKSONVILLE, ILL.—Extensions to the municipal electric light plant, to cost about $40,000, are under consideration.

GREEN BAY, WIS.—Plans are being prepared by Vaughn & Meyer, engineers, Security Building, Milwaukee, for the installation of an ornamental lighting system in the business district.

MASSENA, IOWA.—The installation of a municipal electric light plant is under consideration by the city officials.

MESERVEY, IOWA.—Bonds to the amount of $93,500 have been voted for the installation of a municipal electric lighting system. The Iowa Falls (Iowa) Electric Light Company will erect a transmission line to Meservey and furnish electricity to operate the plant.

BUCKNER, MO.—The Green Light & Power Company of Pleasant Hill contemplates extending its electric transmission lines to Buckner to furnish electricity for lamps and motors. The street-lighting system will consit of twenty-four lamps.

ST. JOSEPH, MO.—The St. Joseph Public Elevator Company is planning to build a grain elevator to cost about $250,000.

ST. LOUIS, MO.—Plans have been completed by the Bridge & Beach Manufacturing Company for the erection of a plant, including a molding shop, a cleaning and grinding building, polishing and nickelling building, japanning room, a three-story mounting building and a three-story warehouse. A center group of buildings will include the boiler house, engine house, enameling building, pattern storage building and pattern shop. The entire works will be operated by electricity generated at the plant.

FORTUNA, N. D.—Arrangements are being made for the installation of an electric light plant in Fortuna. P. J. Quarne is reported interested in the project.

STICKNEY, S. D. — The local electric light plant, owned by C. D. Bennet, has been purchased by C. H. Nelsen.

WATERTOWN, S. D.—Bids will be received by the city of Watertown until Jan. 19 for the sale of $175,000 in electric light bonds.

BRUNO, NEB.—Bonds to the amount of $10,000 have been authorized for the installation of a municipal electric light plant.

CANTON, KAN.—Bonds to the amount of $18,000 have been voted for improvements to the municipal electric light plant; also $37,000 for waterworks.

HUGOTON, KAN.—Bids will be received by the City Commissioners until Jan. 30 for construction of an electric light plant and waterworks system. The cost is estimated at about $60,000. The Ruckel Engineering Company of Hutchinson is engineer.

Southern States

HENDERSONVILLE, N. C.—The Home Electric Company is contemplating extensive improvements and extensions to its plant at its power site No. 1 on Big Hungary Creek. The present rock dam will be rebuilt with concrete and the height raised to 50 ft.

NEWTON, N. C.—The Council is considering an issue of $73,000 in bonds for improvements to the electric light, water and sewer systems.

SUMMERVILLE, N. C.—Bonds to the amount of $40,000 have been voted for the installation of an electric light plant.

WINDSOR, N. C.—The Council is considering an issue of $45,000 in bonds to construct water and lighting systems.

SUMTER, S. C.—Bids will be received by the Mayor and Board of Commissioners of the city of Sumter until Feb. 3 for construction consisting of power house, 100 ft. by 85 ft., for electric plant; coal bunker, boiler foundations and brick-lined concrete smoke flue and machinery foundations. Plans and specifications may be obtained at the office of Gilbert C. White, engineer, Durham, N. C.

GREENSBORO, GA.—At an election held recently bonds were voted for improvements to the waterworks system and electric light plant.

STILLMORE, GA.—The installation of a municipal electric light plant is under consideration by J. R. Warren, Mayor.

MELBOURNE, FLA.—The installation of an electric lighting system is under consideration by the Melbourne Beach Company.

MOORE HAVEN, FLA.—Bonds to the amount of $69,000 have been voted for extensions to the electric lighting system, waterworks and street paving.

ARKANSAS CITY, ARK.—The Lambe & Denmarke Water & Light Company is contemplating the purchase of oil engines and other equipment.

MONROE, LA.—Work will soon begin on the construction of the new municipal electric light and power plant and waterworks system and the new car barn for the street railway. The cost of the electric plant and waterworks system is estimated at about $450,000 and the car barn from $50,000 to $75,000. The city is also planning to expend about $100,000 in rebuilding the street railway system.

OKEMAH, OKLA.—Improvements are contemplated to the municipal electric light plant, including the installation of two 100-hp. boilers, two engines, 125-hp. and 175-hp., and a generator from 75 kw. to 125 kw. E. W. Baker, superintendent, will have charge of the work.

KENEDY, TEX.—The power plant of the Kenedy Light & Power Company was recently destroyed by fire.

Pacific and Mountain States

PUGET SOUND, WASH.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Jan. 21 for construction of extension to central power plant, 50 ft. x 42 ft., to cost about $40,000, Specification 4024. A deposit of $10 will be required for the plans.

BAKER, ORE.—The Eastern Oregon Light & Power Company is contemplating a number of improvements to its system, including a new generating station, during the coming year. As yet nothing definite has been decided upon. J. P. Lottridge is manager.

JOSEPH, ORE.—The Enterprise Electric Company contemplates the construction of a new electric plant at Joseph. The equipment will include one 650-hp. waterwheel, horizontal double runner, to operate under net head of 170 ft., oil-pressure waterwheel governor with balanced valve preferred, and one 400-kva., 60-cycle, 2,300-volt generator. The project also includes 5,600 ft. of 4½-in, or 5-in. wood-stave pipe to use 75 second-ft. of water under a maximum head of 186 ft., or 4,600-ft. wood pipe and 1,000-ft. steel pipe, and also gate for above pipe line to serve under a head of 25 ft. The general offices of the company are at 521 First Avenue, Spokane, Wash. B. L. Sivyer is manager.

LEBANON, ORE.—Work will start about Feb. 1 on the installation of new equipment at the plant of the Lebanon Electric Light & Water Company. The new machinery, which has already been purchased, will include one 220-hp. vertical and one 75-hp. horizontal Morgan Smith waterwheel, one Woodward oil-pressure waterwheel governor, one 150-kw., three-phase, 60-cycle, 2,300-volt General Electric generator and a three-panel switchboard. S. I. Stewart, manager, will have charge of the work.

ROSEBURG, ORE.—Preliminary surveys are being made under the direction of Floyd Frear, city engineer, of Rock Creek in connection with the proposed municipal electric light and power plant. The proposal to establish a municipal plant will soon be submitted to the voters.

STAYTON, ORE.—The Stayton Light & Power Company will make improvements to its plant, including the installation of two boilers, 60 in x 18 ft., one 125-hp. engine and a 50-kw., 60-cycle, 2,300-volt generator. The company is looking for a second-hand engine and generator. O. D. Gilbert, 511 Henry Building, Portland, Ore., is engineer in charge.. H. J. Rowe is secretary and treasurer.

DEL MONTE, CAL.—Plans have been prepared by P. V. Tuttle, architect, 565 Lighthouse Avenue, Pacific Grove, for construction of bath house, 225 two-room and three-room cottages, and also for converting boathouse into power house and extending pleasure pier. The cost of the work is estimated at about $500,000, and it will be done by day labor under the supervision of C. L. Lyon of New York, N. Y.

LOS ANGELES—Plans are being prepared for the plant of the Electrical Products Corporation, 941 West Sixteenth Street, to be erected on West Sixteenth Street, near Burlington Street, for the manufacture of electrical specialties.

LOS ANGELES, CAL.—Plans have been approved by the City Council for providing funds to complete the municipal power plant No. 2 in San Francisquito Canyon. The total amount needed is placed at $750,000, of which $375,000 wil be loaned by the City Council if necessary. Arrangements have been made by the Public Service Department to supply power to the plant of the Goodyear Tire & Rubber Company, located near Los Angles, now under construction.

SAN FRANCISCO, CAL.—Plans have been completed for the proposed new hydro-electric plant of the Pacific Gas & Electric Company at Big Bend. The plans provide for an expenditure of $10,000,000 during the next thirty months.

SAN FRANCISCO, CAL.—Application has been made to the State Water Commission by R. G. McDonald of Mina, Nev., for permission to utilize .300 cu.ft. per second of water from West Walker River in Mono County. The amount to be stored aggregates 95,000 acre-ft. in two reservoirs, one of 75,000 acre-ft. at Pickle Meadows, one of 20,000 acre-ft., at Highway Bridge. The plans provide for a development of 30,000 hp. The cost of the project is estimated at $4,500,000. Scott McArthur of McArthur, Shasta County, has petitioned the commission for 200 cu.ft. of water per second from the east fork of the Tule River, a tributary of Fall River, for the development of 1,400 hp., to cost about $75,000. Mr. McArthur has also asked for permission to take an additional 100 cu.ft. per second from the same source for irrigating 8,000 acres of land, to cost about $160,000.

WOODLAND, CAL.—An ordinance providing for the construction of a general conduit system for all electric wires, to cost about $100,000, has been approved by the City Trustees.

SEIBERT, COL.—Bids will soon be asked by the town of Seibert for the construction of a municipal electric light and power plant, to cost about $40,000. R. D. Salisbury, East Colfax Avenue, Denver is engineer.

Canada

WINNIPEG, MAN.—The Packard Electric Company, Confederation Life Building, has been awarded the contract for furnishing and installing six 1,000-kva. transformers for the City Light and Power Department, at $26,940.

WINNIPEG, MAN.—Bids will be received by the committee on fire, water, light and power until Jan. 26 for furnishing and erecting in the power house at Point du Bois two three-phase generators for direct connection to double reaction turbines and for spare parts for same, and also for one additional or extension set. C. J. Brown is clerk.

OTTAWA, ONT.—The City Council is having plans prepared and will soon ask for bids for construction of Memorial Hall, to cost $700,000; police station, $300,000, and fire hall, $150,000. W. E. Noffe, Union Bank Building, is architect; A. J. Macallum, City Hall, is engineer.

WINDSOR, ONT.—Plans are being prepared by Albert Kahn, architect, Marquette, Mich., for the construction of a factory building and power house at Windsor for the Burroughs Adding Machine Company, to cost about $250,000.

Miscellaneous

PANAMA—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Jan. 28, under Circular 1331, for furnishing copper wire, steel rope, panelboards, service boxes, steel conduit, condulets, cut-outs, flush plates, rosettes, vacuum receiving tubes, varnished cambric, etc. Further information may be received at the above office.

Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 23, 1919)

1,326,133. Electric Bed-Warming Device; James Otiochi Kinosita, Los Angeles, Cal. App. filed April 8, 1918. Footstool with inclosed incandescent lamp.

1,326,134. Electrode for Electrolytic Apparatus; Ralph D. Mershon, New York, N. Y. App. filed April 2, 1917. Corrugated.

(Issued Dec. 30, 1919)

1,326,169. Telephone-Repeater Circuits; Edgar D. Johnson, East Orange, N. J. App. filed Jan. 4, 1918. Connected between lines for two-way signal transmission.

1,326,212. Party-Line Telephone Exchange; Nils E. Norstrom, Chicago, Ill. App. filed March 20, 1916. Battery-operated motor-generator for sending impulses.

1,326,215. Cigar Lighter and Ignition System; Rex. W. Sencenbaugh, Washington, Ill. App. filed May 4, 1918. Vapor lighter attached to electric circuit.

1,326,223. Coil Structure for Transformers and the Like; Chester H. Thordarson, Chicago, Ill. App. filed Nov. 6, 1916. Strengthens winding structurally.

1,326,227. Converter; William A. Turbayne, Niagara Falls, N. Y. App. filed April 12, 1915. Voltage ratio varied.

1,326,297. Electrolyte for Electrolytic Condensers; Joseph Slepian, Pittsburgh, Pa. App. filed Jan. 16, 1919. Aqueous solution of sodium aluminate.

1,326,301. Electric Switch; Theodore Staehle, Chicago, Ill. App. filed March 16, 1917. Solenoid-operated auto taillight.

1,326,303. Commutator Cylinder for Dynamo-Electric Machines; Norman W. Storer, Pittsburgh, Pa. App. filed Sept. 27, 1916. Special construction for high voltages.

1,326,304. Automatic Fire Alarm; Frederick A. Swan, Cliftondale, Mass. App. filed July 2, 1917. Thermo-electric detector.

1,326,307. Method of and Means for Supporting Electric Conductors; Percy H. Thomas, Upper Montclair, N. J. App. filed Nov. 7, 1914. Suspension insulator for high-voltage utilizing narrow towers.

1,326,308. Insulator; Percy H. Thomas, Upper Montclair, N. J. App. filed Feb. 12, 1916. Hollow open-end insulator.

1,326,315. System of Control; Charles C. Whittaker, Wilkinsburg, Pa. App. filed Dec. 20, 1916. Limit switch in regenerative system inoperative until current is built up to desired value.

1,326,326. Locomotive Gathering Reel; Joseph Le Conte Davis, Pittsburgh, Pa. App. filed Sept. 18, 1911. Mine motor reel with independent driving motor.

1,326,328. Regulator for Variable-Speed Generators; John B. Dyer, Pittsburgh, Pa. App. filed Nov. 7, 1917. Automobile starting and lighting system.

1,326,340. Dynamo-Electric Machine; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed June 19, 1915. Desirable magnetic conditions combined with reliable mechanical construction.

1,326,341. System of Control; Rudolf E. Hellmund Swissvale, Pa. App. filed April 18, 1917. Manual-controlled system for regenerative control.

1,326,349. Molded Commutator Cylinder and Method of Forming Same; Willard H. Kempton, Wilkinsburg, Pa. App. filed Sept. 10, 1917. Bakelite applied in plastic condition.

1,326,354. Controller for Transformers; Edwin Lehr, Pittsburgh, Pa. App. filed March 7, 1916. Alternating-current regulating transformer.

1,326,355. Electric Relay; Edwin Lehr, Pittsburgh, Pa. App. filed June 30, 1916. Contact-making voltmeter operates, causing regulator to function.

1,326,359. Circuit Interrupter; Joseph N. Mahoney, Wilkinsburg, Pa. App. filed Dec. 2, 1915. For core members actuated by the tripping electromagnet.

1,326,360. Control Apparatus; Paul L. Mardis, Wilkinsburg, Pa. App. filed Nov. 7, 1916. Drum controllers for railway motors.

1,326,366. Method of Making Electric Coils; John L. Milton, Louisville, Ky. App. filed Feb. 7, 1913. Bakelite or condensite between layers of wire.

1,326,442. Cyanamide Oven; George E. Cox, Niagara Falls, N. Y. App. filed July 21, 1919. Paper sleeve around inside of oven.

1,326,443. Automatic Electric Cooker; Theodore A. Cutting, Campbell, Cal. App. filed Dec. 26, 1918. Current passing through resistance of poorly conducting liquid.

1,326,447. Direct-Current Voltage Transformer with Series Excitation; Oscar Guttinger, Baden, Switzerland. App. filed Aug. 1, 1918. Voltage practically unaltered under large variations of load.

1,326,456. Telegraph Transmitter; Charles L. Krum and Howard L. Krum, Chicago, Ill. App. filed June 18, 1912. Continuous advance of transmission tape in definite timed relation.

1,326,475. Telephone-Exchange System; William R. Brough, East Orange, and William L. Dodge, Maplewood, N. J. App. filed April 22, 1918. For completing connections between lines terminating at different central offices.

1,326,479. Electric Rivet Heater; William L. Churchill, White Plains, N. Y. App. filed Oct. 7, 1918. Prevents overheating and burning.

1,326,481. Refillable Fuse; Albert F. Daum, Pittsburgh, Pa. App. filed April 17, 1916. End cap and a member within threaded to skirt of cap.

1,326,498. Switch Box or Outlet Box; Don H. Hayden, Cleveland, Ohio. App filed Jan. 12, 1917. To receive wall switch.

1,326,502. Electric Motor Having Improved Side Frames; Hervey Hentzell, Gary, Ind. App. filed Oct. 31, 1917. Changes coils quickly.

1,326,510. Indicator for Vehicles; William F. Hutchinson, Sr., Fort Worth, Tex. App. filed April 11, 1916. Battery-operated stop sign for automobile.

1,326,529. Impulser for Magnetos; Harlie O. Putt, Elkhart, Ind. App. filed Dec. 9, 1918. Cushioning device for impulser.

1,326,546. Telephone-Exchange System; Dawson M. Taggart, East Orange, N. J. App. filed Sept. 25, 1917. Eliminates disagreeable clicks.

1,326,559. Road Clearer; Joseph W. Ady, Colorado Springs, Col. App. filed April 18, 1919. Electromagnetic road clearers.

1,326,578. Warning System for Gas or Oil; Jesse T. Curtis, Sebring, Ohio. App. filed Jan. 31, 1918. Battery-operated signal.

1,326,588. Electric Drying or Finishing Press; William S. Hadaway, Jr., New Rochelle, N. Y. App. filed Dec. 16, 1915. Heats a matrix drying press at high temperature.

1,326,595. Process of Treating Diaspore; Otis Hutchins, Niagara Falls, N. Y. App. filed June 28, 1919. Reducing to powdered form, driving off major portion of combined water, mixing with reducing agent, and fusing in electric furnace.

1,326,601. Electrode-Locking Device for Electric Welding Machines; Joseph Ledwinka, Philadelphia, Pa. App. filed May 19, 1919. Electrode easily adjusted.

1,326,605. Arc-Lamp Electrode; William R. Mott, Lakewood, Ohio. App. filed Jan. 23, 1919. Moisture absorption a minimum.

1,326,631. Ozonizing Apparatus; Raoul R. Bayeux and Jules Richard, Paris, France. App. filed June 8, 1918. Concentric solenoid type.

1,326,632. Electrical Connector; John H. Becker, Philadelphia, Pa., and Warren S. Bellows, Worcester, Mass. App. filed Nov. 30, 1917. Spark-plug attachment.

1,326,645. Current Regulator for Incandescent Lamps; Ralph T. Cheeseman, Lynn, Mass. App. filed Dec. 14, 1917. Adjustable impedance used in supply circuit.

1,326,665. Process for Producing Coal-Tar Dyes; Edward D. Kendall, Elizabeth, N. J. App. filed April 5, 1918. Electrolyzing nitro-bodies, acetone, water and sulphuric acid.

1,326,680. Automatic Telephone Trunking System; Anders M. Malmberg, Chicago, Ill. App. filed Feb. 5, 1916. Talking circuit completed over a different path from that used in selection of called line.

1,326,698. Alternating-Current Rectifier; Harry B. Snell, South Bend, Ind. App. filed Feb. 3, 1916. For charging storage batteries.

1,326,719. System of Generating Electrical Currents; Otto A. Freund, New York, N. Y. App. filed May 18, 1915. Single source for two or more types of current with minimum of accessory apparatus.

1,326,727. Selective Wave-Transmission System; John Hays Hammond, Jr., Gloucester, Mass. App. filed April 30, 1912. Transmission of radiant energy from one point in groups of waves having two or more group frequencies.

1,326,732. Electrically Operated Crane or Other Raising and Lowering Machinery; Edward M. Holme, Manchester, England. App. filed March 23, 1915. Portable controller.

1,326,743. Arc Welding; Otis A. Kenyon, New York, N. Y. App. filed May 22, 1919. Reduction of skill required in handling of arc.

1,326,781. Timer; Maxilliam E. Primbs, Pittsburgh, Pa. App. filed Feb. 13, 1917. Lead wires not subjected to wear or action of oils.

Electrical World

The consolidation of Electrical World, Electrical Engineer *and* American Electrician

Volume 75 New York, Saturday, January 24, 1920 *Number* 4

Water-Power Development in Sight

THE passage of the so-called "administration" water-power bill by the Senate a week ago is a matter of congratulation for the industry. Never before has the legislative situation been so favorable for the final enactment of a water-power measure. While the "administration" bill passed the House and the Senate at the last session, the conference committee report was caught in the legislative jam at the closing session and died with the Congress. For a decade the urgent necessity of water-power legislation has been brought before various Congresses. Numerous bills were presented and passed in one of the houses of Congress, but agreement could not be had in both. The most famous of these former bills were the Ferris and Myers bills and the Adamson and Shields bills. Certainly none of the measures was so all-embracive as the present one. and it is generally agreed that capital can be commanded for development under its provisions. In its main features the bill provides for a commission to control all water power on navigable streams, in public lands and in the forest reserves; a fifty-year lease, and recapture by the government. Preference is given to national, state and municipal governments in the matter of priority of licenses and also in the matter of charges. The entire burden of sustaining the cost of the administration of the act, however, will fall upon private citizens and corporations who care to take out licenses. No doubt some modifications will be made in the act by the conferees, but the main features of the bill will remain, since both houses are in agreement on essentials. Its final enactment into law may be expected in the spring, and while the measure is not so deep as a well nor so wide as a church door, 'twill serve so far as the electrical industry is concerned. The sooner the bill is signed, sealed and delivered, the better.

What may be looked upon as electrical freaks and fads to-day may become standard practice to-morrow if they are based on sound engineering principles. There may be exceptions, but anything scientifically correct cannot easily be overthrown.

Richard Cockburn Maclaurin

THE sudden death of President Maclaurin of the Massachusetts Institute of Technology almost at the moment of greatest rejoicing in the history of that great school formed a tragic climax to an endowment drive of overflowing success and has deprived the world of science and education of one of its master minds. The work of this modest savant, who combined in an unusual way the qualifications of a legal expert, a mathematical physicist, a philosopher and an executive educator, can hardly be appraised in a few lines of type; but there is no question that the sixth president of "Boston 'Tech'" will go down in history as one of its most constructive leaders, foremost as a good citizen, and influential on behalf of breadth and depth of engineering on more continents than one.

He was no cloistered recluse, but a man among men, fired with the insight of a practical imagination, devoted to the last to the upbuilding of civilization through trained agencies, at home in the library of the philanthropist and alike welcomed by students and representatives of the people. Deeply versed in science and himself a specialist of renown, Dr. Maclaurin appreciated to an extraordinary degree the mutual obligations of science and industry, and with all the power of his great personality he strove for and achieved their greater recognition. His tasks on earth are finished—too soon, from the human standpoint—but they were not finished until the great institution whose buildings and whose life bear eloquent testimony to his self-sacrificing zeal had attained a maturity and preparedness for future service which must long have been the vision of its lamented and honored chief executive.

A subdivision of gross revenue and profits from the sale of electrical merchandise should be a standardized practice of central stations. To lump together gross appliance sales without analyzing their make-up throws little light upon the wisdom of a commercial policy. Besides, it is poor business.

The Doctrines of Goodwin

ELECTRIC service to-day is all-embracing. It requires the product of thousands of widely separated generating stations and the output of three thousand electrical manufacturing plants to make electricity available in our homes, offices and workshops. It is just as available to the humblest home as to the largest factory. To make this possible an army of workers has been required equal in number to the American fighting force which was sent to France—an army similarly made up of field divisions and stay-at-home divisions—contractor-dealers and jobbers representing the first division and manufacturers and central stations representing the second division. The building of this army has called for and still demands the finest skill of the engineer and the business man, for to-day the electrical industry has developed commercial problems that are governed by the same business principles that govern any other pursuit where completeness of service to the masses is a measure of success.

Although this fundamental fact has been recognized from the start, it has required the exigencies of a great war and the results of indifference, selfishness and greed in unscrupulous competition to bring about a trade co-operation in supplying the demand for electrical service. In pointing the way to the proper functioning of central stations, jobbers, retailers and manufacturers, the homely philosophy of William L. Goodwin has during the past two and one-half years worked as leaven in the bread. From the West to the East and up into Canada he has spread the doctrines of a new spirit of trade co-operation in which the service of the retailer must not only be recognized but solidly established and the various interests in the electrical industry made to work in harmony so that there may be established a retail distribution of electrical goods at fair prices to the consumer and at fair profits to all parties to the transaction. Moreover, he is preaching these doctrines with the knowledge that the retailer will not only sell more goods but create a broader conception of the value of electric service in the minds of the American public. For instance, a washing machine sold by a prosperous and enthusiastic contractor-dealer is most effective support for the central station in cultivating favorable public relations. To convince all of the skeptical and accomplish all that these principles stand for in a night would be expecting too much, but the Goodwin plan is well launched and will gain in strength as its benefits are better known. In last week's issue some of its benefits to central stations were reviewed, and in this number what has been accomplished for the jobber, the contractor-dealer and the manufacturer is outlined.

How wasteful of our national water-power and fuel-power resources we of 1920 will appear to posterity when it looks back at us from the year 2000! No doubt our descendants will wonder why we could not develop men with vision and ability enough to save for them some of their national birthright.

Vector Diagram Subscripts

THE alternating-current circuit is the home of the plane vector and the field of application for vector diagrams. Such vectors may be regarded as divisible into two species, namely, first, numerically derived vectors, representing complex numbers, as when an alternating current obtained by dividing a voltage by an impedance is indicated as a line of length and direction to fit the required amplitude and phase, and, second, geometrically derived vectors which are laid down on the basis of place displacement without resorting to complex numbers. For example, when we mark off a delta or star connection of three-phase electromotive force, these vector diagrams do not necessarily involve any reference to complex numbers.

Whether vector diagrams represent arithmetical or geometrical concepts, their usefulness in connection with alternating-current circuits is very great. Indeed, they are almost indispensable to a clear comprehension of alternating-current circuit phenomena. It is necessary, however, to adopt a certain technique in the use of vectors if misunderstanding is to be eliminated from the mind of the writer or the reader, or both.

Lewis A. Terven draws attention in the article printed in the ELECTRICAL WORLD for Jan. 10 to the desirability of using two-letter subscripts in delineating and describing vectors. This practice has been indorsed by a number of writers. The article gives several useful examples of vector diagrams in which the two-letter subscripts are easily set in their proper order, but which might easily be brought into error if the subscripts were omitted. The principal point to be remembered is that a reversal of the order of subscript letters is equivalent to a reversal of the vector.

Meter connection problems in relation to polyphase circuits are sometimes very complicated, especially when both voltage and current transformers are involved. As indicated in the article, the subscript vector diagrams of these cases are very helpful in clearing up the complexity.

While individual systems may grow at only a moderate rate, an interconnection of large capacity necessarily results in an immediate large concentration of power. Facilities and methods which are adequate for the isolated systems immediately become inadequate for the interconnected systems, and expansion becomes imperative.

Preparation for Rate Advances

THE necessity for increased charges for electrical energy may appear self-evident to the central-station manager confronted with the rising cost of operation, but something more than general statements is essential in bringing such knowledge home to the local public. A good many public utility executives do not realize the importance of making out a sound case from the standpoint of the ordinary business man, but appear to think that if a few items like recent wage increases, present-day coal prices and typical repair outlays are set forth, nothing further is necessary. In a time like this, when material can be found on almost every side to demonstrate the inadequacy of many existing rates, an executive who fails to handle the subject comprehensively lays himself open to the charge of poor management.

The public in many places is thoroughly alive to the value of data filed by operating companies in their returns to the state commissions and makes no hesitation in using this information in attacking a rate increase. Hence it is most important from the company viewpoint to present data in defense of rate changes which are consistent with these returns, and if apparent discrepancies are evident, let the reasons therefor be made plain. The value of a complete record of plant and system operation is not always sufficiently appreciated in connection with the preparation of advertisements, press statements, circular letters, petitions and briefs advocating higher rates. Thus, if a company using both steam and hydro-electric generating units is obliged for a period during plant reconstruction to burn more and perhaps poorer coal than normally, this factor in cost increase should not be overlooked in analyzing the operations of the period for popular interpretation. Specific information as to the number of days or hours of extra steam service required will be accepted by the public at its face value; whereas if a general statement only is made, covering the net increased cost per kilowatt-hour for the year, let us say, the opponents of a rate advance will frequently attack the figures as misleading in the light of the company's performances over an earlier and more efficient period. If certain allowances are increased in the final new rate per kilowatt-hour set by the company, the management should be prepared to show their reasonableness; otherwise the gap existing between the obvious cost increase and the proper advance to cover all local conditions may be charged up by the representatives of the public to mere profiteering.

A mere announcement that the cost of coal has risen from the former to the present level forms in many cases a most inadequate plea for revised rates, although it may justify radical changes in the schedule of charges. All along the line the reserve information at the manager's hand should be brought into action. Figures used should be used accurately and should check whenever possible with published information. A little care in preparing for rate advances is worth many times its cost.

It is gratifying to see the steady progress in National Electric Light Association affairs. The committees, the officials and the headquarters staff are getting many matters in fine shape for presentation at the 1920 Pasadena convention.

Induction-Motor Wiring Rules

WE WERE glad to call attention a week or two ago to the subject of the rules commonly enforced in the installation of induction motors, a topic on which this journal has touched before. The point here at issue is the confusion which seems to exist in the minds of certain inspecting authorities regarding the practical distinction between starting and running currents in induction-motor service. It is perfectly possible to start an induction motor with very moderate currents, just as one can start a direct-current motor very gently if necessary. As a matter of fact, the induction machine is so rugged in constitution that it is neither necessary nor desirable to go to the complication required in gently starting it by slow degrees unless this result is in itself important to be attained. If the direct-current motor were as tough as the induction motor, and like it sparkless under all conditions of operation, it would be similarly treated. Practically most induction motors have rotors of the squirrel-cage persuasion and are started at reduced voltage by a compensator, unless they are small enough to be thrown squarely on the lines. The torque characteristics of the induction motor are such that starting with a compensator implies a rather heavy demand for current over a very brief period while the rotor is gathering speed. When thrown over on to the running points this current is diminished to the running value for the required load. The motor cannot come to speed until the compensator is thrown to the running points, and consequently there is no danger of its being left to run under starting conditions. Even if it were so left, if it were properly fused or even approximately so, it would be automatically cut out of circuit.

Now, the protest which we here voice, coming from some very good judges of induction motor practice, is against the installation rules which demand that the branch wiring to the motor must be of a size which corresponds to permanent use of the currents met during starting, and in which no distinction is made between this brief starting current and the running conditions, possibly of overload. There is no possible reason for demanding that the wiring itself should in the ordinary case be such as to carry permanently, with conservative rise of temperature, the whole starting current, since this current is heavy for only a few seconds. The wiring in fact need only be heavy enough to carry the full overload current met with in the motor in service, perhaps a maximum overload of 25 per cent. If this wire be fused properly so as just comfortably to carry the starting current under normal starting conditions, it will be adequately protected as regards running conditions from severe overload. The motor will stall long before it will burn out, and the fuse will take care of the situation. In other words, the starting-fuse capacity should be separated entirely from the copper capacity since the former depends on temporary conditions only, the latter upon more or less permanent ones. Every properly made fuse has a sufficient overtime lag to transmit the momentary starting current and yet act on a continued overload. And it is only in the latter case that the size of wire cuts any figure. By grouping motors of similar characteristics it is easily possible and certainly desirable to produce standard regulations for installation which will save a great deal of copper now wasted and at the same time meet all the requirements of safety.

If any central-station company has misjudged its true costs of operation in the past, it has a large obligation to itself to avoid any error of this character in the future; and not only to its corporate self does it owe this duty but it owes it also to security holders, to employees and to the people.

Hydro-electric Power Conserves Materials

THE worldwide shortage of completed products brings home to the engineer the importance of conserving materials and finished equipment alike. The economical use of productive resources is incumbent upon us all. Where simpler forms of equipment will answer the purpose, now is the time to utilize these, and in this connection a close adherence to well-established standards in design is very helpful. Fixed costs are too high to justify as free a hand in designing and specifying apparatus as would ordinarily be the case.

Hydro-electric plant development is peculiarly advantageous from this point of view. Comparatively little, we believe, has been said about the conservation of material and equipment involved in such projects, but the engineer who contrasts the amount of labor and fabricated material required to provide a steam plant of given capacity with that needed for an equivalent hydro-electric station will be surprised at the difference in favor of the water-power station. Even though the initial investment cost per kilowatt of primary power may be greater in some cases in the hydraulic plant, considering the cost of reservoirs, dams, pipe lines and headworks, the drain upon the manufacturing resources of the country is in general less with the hydro-electric scheme, owing to the complication of boiler-plant equipment and auxiliaries associated with steam-power production. The relative simplicity of the hydro-electric installation affects the entire productive cycle, including raw material assembly, designing, shop work, transportation, permanent outlay in highly specialized auxiliary equipment and structural intricacies.

Steam generating plants bid fair to retain their firm hold upon the power equipment market for a long time to come, and few mistakes are more easily made than to assume that water-power developments *per se* are inevitably justified in competition with steam stations. But the country is in sore need of the water power which only awaits the establishment of a sound and encouraging policy on the part of the government to go forward, and among the many arguments in favor of this immensely important work conservation of material and equipment is far from the least.

Problems in Electric Furnace Smelting—I

Furnace Losses Are Greatly Decreased by Rearranging Transformer Leads—Irregularities in Operation Between Electrodes of Shaft Furnace Are Discussed and Remedies Pointed Out

BY F. HOLMGREN

INTRODUCTION.—It is well known that the earliest blast furnaces were built in Sweden, and Sweden also first successfully developed the electric shaft furnace for the production of pig iron directly from the ore. The reason for this is naturally to be found in the facts that Sweden has an abundant supply of very high-grade iron ore and, besides this, of cheap water power, which is essential for the commercial success of the process. Coal is very expensive in Sweden and with small exception the entire supply has to be imported. It is for that reason that it has been more profitable in the past to export several millions of tons of ore annually, but it is hoped that with the successful solution of the electric shaft furnace and its more general adoption a large part of this ore may be reduced at home and used in expanding the steel-mill industry of the country.

Besides iron ore and limestone, charcoal has in the past been the other necessary raw material, but it is stated that recent improvements in the construction of these furnaces make them equally suitable for the use of coke in place of charcoal. The scarcity of charcoal in the United States is undoubtedly one of the reasons why this type of furnace has not been more extensively tried out in this country, and if it be true that coke is a satisfactory reducing agent, we shall undoubtedly soon find many of these furnaces installed here.

There are at present thirteen of these furnaces in operation in Sweden and four under construction in ratings up to 6000 kw. each. There are also seven under construction in other countries, several of which are said to be for use with coke as a reducing agent. The productive capacity varies from three to four tons of pig iron per kilowatt-year, depending on the quality of the iron produced.

The following article is of considerable interest in that it deals with a number of investigations which were made on existing furnaces in order to determine the best arrangement of electrodes, leads, etc. In one case the losses were reduced from 474 kw. to 282.5 kw. by changing the connection from transformer leads to electrodes. The power factor, moreover, was raised from 0.7 to 0.91. The article also explains the intimate relation between the electrical and metallurgical phenomena within the furnace, and how the operation of the furnace can be controlled for the highest output by a close observation of the electrical measuring instruments. E. A. L.

Investigation of Furnace Operation

The Helfenstein Furnace.—The investigations were begun with furnace No. 3 at the Domnarfvet steel works. This furnace was built by Helfenstein and showed the poorest results as regards both operation and power consumption per ton of pig iron. The heat had a tendency to rise higher and higher in the stack and the heat losses were considerable. The electrode potential could not be brought up to the desired value, and it was thought that this was due to too short a path of the current. To overcome this, water-cooled bridges were provided between the electrodes in the furnace dome in order to force the current to pass through the bath. The energy losses in the leads between the transformers and the electrodes were measured by the three-voltmeter method and found to be not less than 17.5 per cent of the total capacity.

The above changes and numerous other tests and trials failed to improve the results, and similar investigations were started at the Soderfors steel works.

The Soderfors Furnace.—This furnace, which is of the "electro-metal" type, had shown much better operating results than the Helfenstein furnace at Domnarfvet, but, on the other hand, the power factor was lower than for furnace No. 2 at Domnarfvet, which also was of the electro-metal type. Electrically, the principal difference in the arrangement was that with the former the transformers were installed in a separate room about 6 m. from the center of the furnace, while for the latter they were placed close to the furnace wall. The frequency in the former case was 50 and in the latter 60.

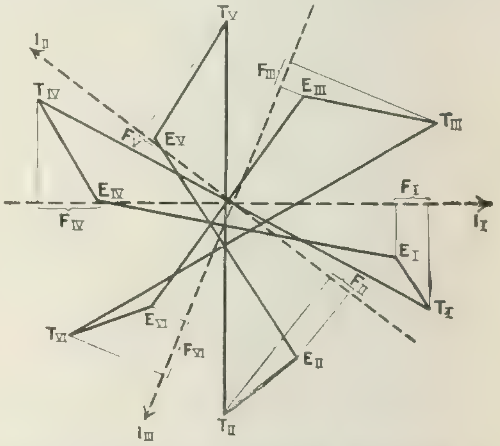


FIG. 1—CURRENT AND VOLTAGE RELATIONS IN SODERFORS FURNACE

I is transformer and *E* electrode voltage. *F* represents power loss.

In these tests complete voltage diagrams were drawn by means of the three-voltmeter method, whereby the losses and the inductive voltage drop in the different leads could be determined. All the measuring instruments had before always been connected to the transformer terminals or near these, whereby the effect of the leads from the transformers to the electrodes was included. This, of course, was not the correct method, as what is most valuable for a study of the furnace operation is a knowledge of the current and voltage at the electrodes proper.

In the first test of the Soderfors furnace a relatively

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[*] Abstracted and translated from the *Transactions* of the Swedish Iron Institute by E. A. Lof.

symmetrical voltage diagram (Fig. 1) was obtained, and the losses amounted to 474 kw. or to about 16 per cent of the total capacity. In the diagram the losses *F* are shown as the projection of the voltage drop on the current *I*. Points *T* represent the transformer terminals and *E* the electrodes. The diagram shows, however, that the furnace was not symmetrically connected, so that the six electrodes will not follow one another in the same sequence in the voltage diagram as in reality.

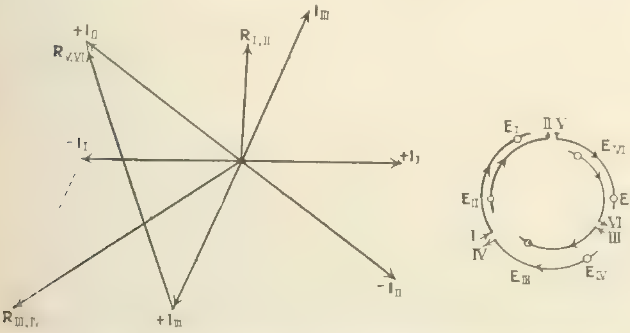

FIG. 2—MAGNETIC FIELDS AND ELECTRODE CONNECTIONS FOR FIRST TEST

R is the resultant magnetic field.

With currents up to 20,000 amp. or more, which are common with these furnaces, the magnetic fields set up about the conductors become very strong if not compensated for. In this installation, which is three-phase at 50 cycles, the direction of current will change 100 times for each second, and the three currents will be displaced with respect to each other in one-third period. If now the same current is carried forth and back through two adjacent conductors (one going and one return conductor), then the electromagnetic fields set up by the two conductors will be equal but opposite. The conductors will therefore compensate each other, and there will, practically speaking, be no electromagnetic field. If, however, a conductor is placed adjacent to another, and one carries a different current, or current of a different phase from the other, then the electromagnetic field will be greater or less, depending on how the fields set up by the two currents will combine vectorially.

In the diagram Fig. 2 are shown the results from the first test of the Soderfors furnace. The strength and phase displacements of the currents are drawn to scale and represent also the electromagnetic fields set up. Besides this, there is shown in the smaller diagram the leads around the furnace and the direction of the currents therein. The directions of the arrows thus correspond to one another in the two diagrams. We see therefore in the smaller diagram how the arrows of the conductors between electrodes *I* and *II* have the same direction, while between the other electrodes this is not the case. The resultant of the two currents, therefore, gives a field proportional to $R_{1,2}$. The two others will, on the other hand, be respectively $R_{5,6}$ and $R_{3,4}$. The electromagnetic fields which thus surround the conductors will be increased by adjacent iron structures which will lower the magnetic reluctance. Such structures are the furnace casing, iron pillars, etc. In these iron parts eddy currents are now in turn set up, which are converted into heat. The less compensated the leads, the greater will be the iron losses thus created. The fields will, besides, set up electromotive forces in the conductors themselves, which may cause a drop and even a rise in the voltage.

LOSSES REDUCED BY INTERCHANGING ELECTRODE LEADS

The terminals of the transformer for electrodes *III* and *IV* were then changed so that the direction of the current in the circuit was reversed. The result was measured and is shown in Fig. 3. At a first glance it would seem as if the first connection would have been the correct one on account of the symmetrical and otherwise clear vector relations. The unsymmetrical diagram depends, however, on inherent conditions in the furnace which will be dealt with later.

From the diagram it follows that certain losses ($F_{2,4\ and\ 6}$) have become negative, that is, that a power increase has taken place instead of a loss. This is readily explained. On account of the above-mentioned mutual induction a certain amount of power has been transformed from one lead to the other, in that the former has acted as the primary winding in a transformer and the latter conductor as the secondary. The adjacent iron structure has served as the necessary "transformer" core. If we consider the fields which could have been formed around the conductors, we find (Fig. 4) that in the latter case these have become much smaller, which must result in lower additional losses. This proved to be the case, as the losses went down to about 375 kw.

The low power factor caused by the relatively large inductive voltage drops (represented in Fig. 1 by the lines at right angles to the currents) could not, as expected, be improved by this reconnection, and it was then suggested that the transformers should be connected to adjacent electrodes instead of to opposite ones as had been done before. Investigations involving the inherent electrical conditions of the furnace

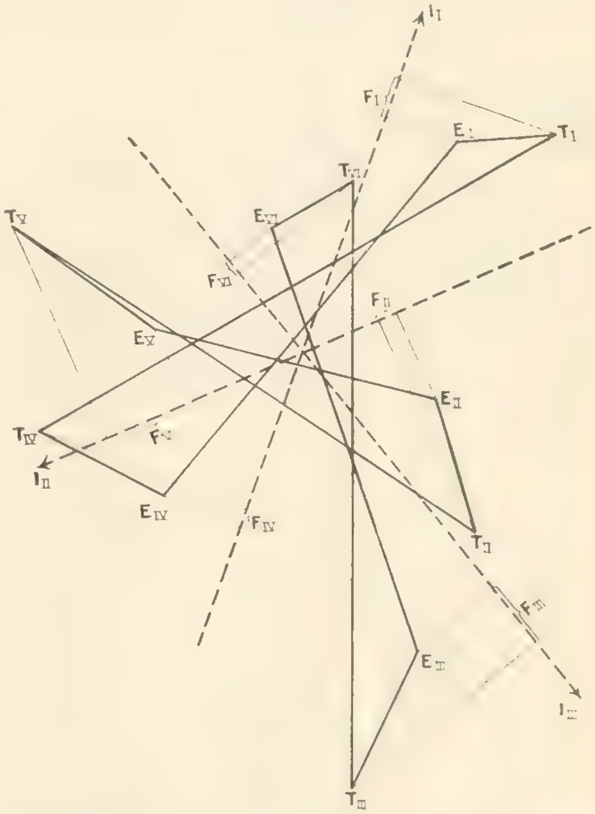

FIG. 3—DIAGRAM WITH LEADS TO III AND IV (FIG. 2) REVERSED

were made, and it was found that this suggestion was practicable.

If we assume that an electrode of circular cross-section with radius r cm. is lowered to a depth of h cm. in a conducting homogeneous mass with a specific conductivity c, then the resistance which the current has to overcome in its travel from the electrode to a concentric cylinder area with the radius R cm. is:

$$M = \int_r^R \frac{dx}{x} \cdot \frac{c}{2\pi h} = \frac{c}{2\pi h} \log_e \frac{R}{r} \text{ ohms.}$$

From this we get the voltage

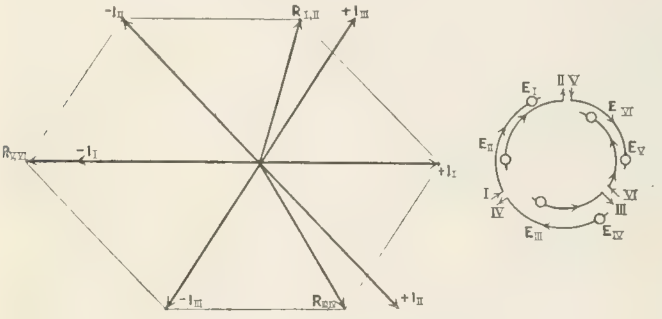

FIG. 4—REDUCED MAGNETIC FIELDS WITH LEADS TO III AND IV REVERSED

$$E = \frac{Ic}{2\pi h} \log_e \frac{R}{r}.$$

The energy production per unit volume will therefore be

$$\frac{dU}{dx} = \frac{1}{x^2} I^2 \frac{c}{2h} = \text{const.} \frac{I^2}{x^2}$$

and will drop rapidly the farther the distance from the electrode.

The zone nearest the electrodes may be considered as consisting of a number of parallel arcs, where the resistance and the voltage drop presumably follow other laws. Oscillograph tests of the applied current and voltage have shown that these have a practically sinusoidal wave shape. Whether this was due to the impossibility of connecting the oscillograph sufficiently near the arc itself, to the heat capacity of the arcs, or to other causes could not be determined. This resistance may depend, however, upon the current density, the temperature, the composition of the charge and the distance between the electrode and the bath. Besides this, the gas currents and finally the electromagnetic field may have their influence.

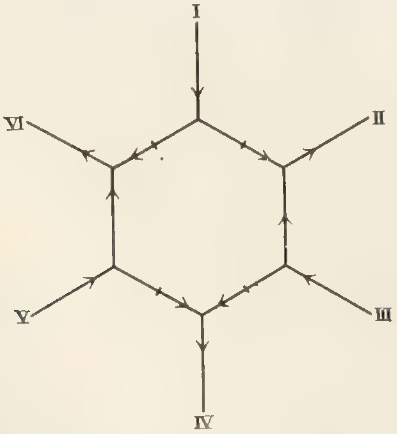

FIG. 5—CURRENTS IN THE FURNACE FOR BALANCED CONDITION

Transformer terminals connected to opposite electrodes. Power factory unity.

It is in this zone where presumably the principal direct energy generation takes place. Outside of the zone, the above laws may hold, excepting that the resistance will increase with a falling temperature. The energy generation drops therefore less rapidly than the formula would indicate. In the former zone we thus have the real "working resistance" and in the latter the "conductor resistance" to the next working zone.

There is no doubt that the "working resistance" preponderates, but it is not quite clear what rôle the "conductor resistance" to the next working zone plays.

This electrical condition with two such zones is known by the term "free" electrodes and represents a normal operating condition. If no arc zone exists, we say that the electrodes are "frozen." This occurs when the potential required for maintaining the arc cannot for some reason or other be produced. The condition appears as a lowered "working resistance" (consequently increasing current), rising temperature in this part of the hearth and reduced production.

Regarding the effect which the "conductor resistance" in the mass itself may have and its effect on the heat development in the furnace, it may be of interest to determine how the different currents proceed through the crucible.

Fig. 5 represents the progress of the currents within the furnace when complete symmetry exists; that is, when the currents in the three phases are equal, the furnace connections symmetrical and non-inductive and when the currents enter and leave the crucible through opposite electrodes. We find that the currents entering will divide according to the parallelogram law into components such that the current between either of the electrodes will be equal to the current entering.

In connection with the first investigations of the Soderfors furnace it was found after the shut-down that the lining was more corroded between certain electrodes than others, and it may be assumed that the greatest effect in the mass took place there. It is, however, difficult to say whether this really had anything to do with the two conditions referred to or to some other circumstance.

It has not been possible to determine the effects of the unsymmetrical condition and the different currents passing through the charge, but from the voltage diagrams it is fairly evident that even the "conductor resistance" of the mass is a factor which must not be lost sight of in considering the heat distribution in the furnace. The diagrams thus show that there is far from a common neutral point, for which reason it must be assumed that work has also been done by the currents in the mass. Cold spots between certain electrodes were thus found in the Soderfors furnace. There is some uncertainty as to the magnitude of the work done in the mass itself between the electrodes and its effect on the thermal procedure within the furnace.

BEST RESULTS BY CONNECTING TRANSFORMER LEADS TO ADJACENT ELECTRODES

Regardless of how the effects are distributed on the arc zones and in the mass itself, we see that the current paths will not be any longer if the transformer terminals are connected to two opposite electrodes than if they are connected to two adjacent electrodes. It was therefore decided to change the connections so that each phase was connected to two adjacent electrodes. The result was, as expected, a considerable reduction of the losses in the conductors, which went down from 375 kw. to 282.5 kw. with the same operating condition of the furnace. The power factor furthermore was improved to such an extent that from a power consumption of 4420 kva. now only 3395 kva. was required, or a saving of not less than 23 per cent in kva., resulting only from the rearrangement of the leads. The power factor improved from 0.7 to an average of 0.91.

Electro-Metal Furnace No. 4 at Domnarfvet.—This furnace showed, to begin with, the same trouble as the Soderfors furnace before the leads were rearranged. Furnace No. 4 has eight electrodes arranged with a double "Scott" connection and is therefore equivalent to a doubling of the set at Trollhättan.

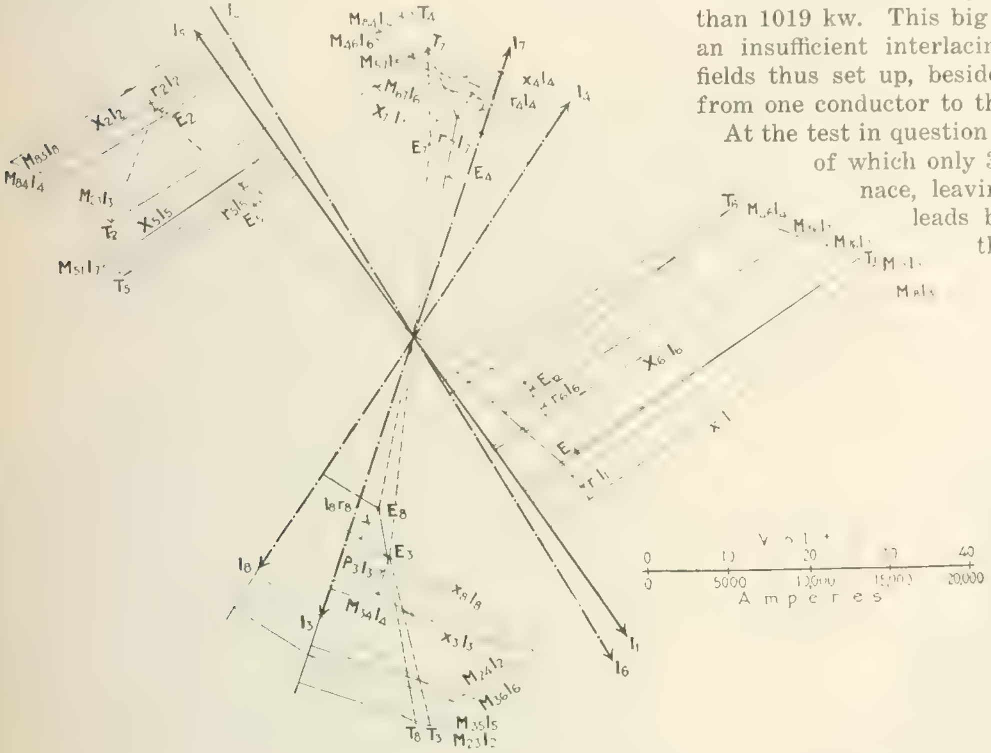

FIG. 6—COMPLETE VECTOR DIAGRAM FOR FURNACE NO. 4 AT DOMNARFVET

The power factor was found to be low, hangings occurred, and the operation was for this reason uneven at the different electrodes. The leads were arranged as for the Soderfors furnace; that is, the terminals of the respective transformers were connected to diametrically opposite electrodes. Very thorough investigations were made on the furnace.

In Fig. 6 is shown a complete vector diagram for this connection in which the magnitude and direction of the currents and voltages are marked. As there is no real neutral within the furnace, that shown in the diagram will be regarded as fictitious. The great difference, both in magnitude and direction, between the voltages at the transformer terminals and at the electrodes is at once apparent. For electrode 6, for example, the voltage between the corresponding transformer terminal and neutral is about 41 volts, while between the electrode itself and the neutral it was found to be only about 15 volts. The phase displacement with reference to the fictitious neutral was in the former case only about 0.16 and in the latter about 0.8. It is therefore apparent what little help we have from instruments connected to the transformer terminals as a guide for the operation of the furnace.

From this diagram it was now possible to determine approximately the distribution of the losses in the different parts of the conductors, and the values so obtained have been combined in Fig. 7. This shows still more clearly the faulty interpretation one may get from the instruments as regards the load on the different electrodes. So, for example, the wattmeter indicated a load of 1020 kw. for electrodes 4 and 8, while in reality the electrodes only received 637 kw. Still more peculiar is the result at electrodes 2-6, where the meter indicated 744 kw. while in reality the electrodes received not less than 1019 kw. This big difference can be explained by an insufficient interlacing of the conductors and the fields thus set up, besides the transformation of work from one conductor to the other.

At the test in question a total of 3942 kw. was applied, of which only 3392 kw. was useful in the furnace, leaving a 603-kw. loss in the 80-m. leads between the transformers and the furnace. These were segregated as follows: Losses in the contact terminals at the electrodes, 122.2 kw.; in the leads themselves, 164.2 kw.; in surrounding iron structures, 316.6 kw.; total, 603 kw.

From one set of conductors to another there was transformed no less than 544.4 kw. With a rearrangement of the leads to correspond to that at Soderfors it was estimated that the losses could be cut in two. Regarding the furnace leads, these rules can therefore be laid down:

The low-tension conductors should be arranged so that adjacent electrodes are connected to two opposite transformer terminals and that these + and — circuits are carried the shortest distance and in such an interleaved manner that the magnetic fields will be neutralized.

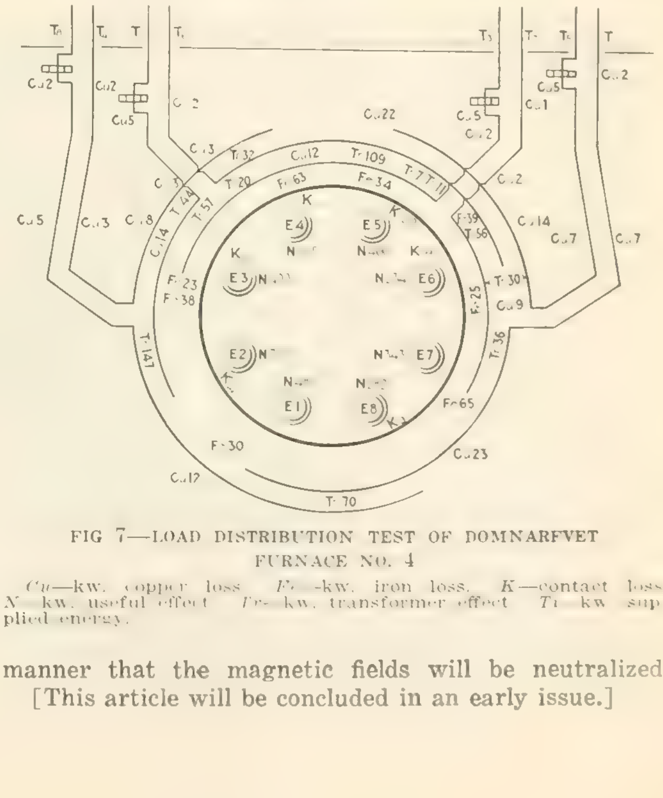

FIG 7—LOAD DISTRIBUTION TEST OF DOMNARFVET FURNACE NO. 4

Cu—kw. copper loss. *Fe*—kw. iron loss. *K*—contact loss. *N*—kw. useful effect. *Tr*—kw. transformer effect. *Ti*—kw. supplied energy.

[This article will be concluded in an early issue.]

The Economic Outlook in Industry

Increased Production and Better Human Relations Must Be Combined to Attain Lasting Success—Surplus Wealth Relatively Small and It Is Needed in Productive Agencies

BY HENRY I. HARRIMAN
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ONE of the effects of the artificial conditions under which we are living has been to intensify the general belief on the part of the people that there is enough wealth now in existence to make every one comfortable if only there was a proper distribution of it. There is also a very general belief that our present standard of living can be maintained with very much less work than the world is now doing. The huge borrowings of the governments of the world during the war and consequent enormous expenditures, the high wages, the fact that work was done regardless of cost—all have intensified this feeling that there is a boundless amount of wealth which is now unjustly seized by a very small minority and that if it were more equitably divided all could subsist with very much less effort and in very much greater comfort.

HENRY I. HARRIMAN

In 1914, according to Bowley, $665,000,000 of the annual income from Great Britain went to capital and management after allowing 4 per cent on the actual money invested in industry. Much of this was returned to the state in the form of taxation, but, omitting this payment, it is evident that if the entire amount were divided among the population of Great Britain, each individual's annual income would be increased less than $16. When it is considered that this reservoir of wealth is the source from which new capital is drawn, and that much of it is actually reinvested in productive machinery, it can be appreciated how great would be the loss if this annual income were divided and entirely expended each year.

In America the per capita income increased from $69 in 1850 to $262 in 1910, and the total national income from $2,200,000,000 to $30,500,000,000. These figures indicate enormous expansion of resources and industry, but they also indicate how close is the margin of subsistence; how necessary it is to maintain production at the highest point possible, and how fallacious is the reasoning that there is an unbounded reservoir of wealth which, if equitably divided among all, would give every one all that he desired. Whereas 57 per cent of the wealth of this country belongs to the rich, this same class receives but 20 per cent of the national income; and whereas the poorest class own but 5 per cent of the goods of the country, their income is 38 per cent of the national income. The best figures available show that upon the entire wealth of the United States, estimated at $200,000,000,000, there is not earned over 2½ per cent, or say $1 per person per week, omitting taxation.

MARGIN OF PRODUCTION IS NARROW

Thus the best available figures both for Great Britain and for America show a narrow margin of production upon which mankind must subsist. These figures also show that, while distribution may be faulty, the unequal distribution of to-day is far better than the equal distribution which our Socialist friends desire. The savings of the rich are the source from which the productive capital of the future is drawn. If these savings ceased to exist and there was an equal distribution of property, our present capital would fail to be maintained; we would not be able to add to our available supply, and this failure would result in lowering production and lowering the standard of existence.

In the last analysis the standard of living in any country is what it produces divided by its population. If, for instance, the present output of shoes in America is 300,000,000 pairs per annum, that is three pairs per capita; and if in the future we reduce this production to 200,000,000 pairs, then our standard of living so far as shoes are concerned has been reduced from three pairs to two pairs per capita per annum. So it is in the entire gamut of production. The old Biblical saying, "As ye sow, so shall ye reap," is as true to-day as it was two thousand years ago. If we produce much, there will be much to divide; if we produce little, want, misery and starvation will be the lot of the nation. There is indeed a justice in shortening the hours of labor when it is necessary in order to conserve health and to give opportunities for education, but to shorten the hours of labor beyond such necessity is a crime against civilization. Where that line is it is hard to say, but that it exists and that it is being encroached upon is most evident. The world is to-day short of all kinds of goods, and the need of production was never so great as it is in this year.

The war has worked great havoc in the physical wealth of the world, but it has probably worked even a greater havoc in the psychology of the world's thinking. It is not merely the natural or potential wealth of the country that measures its real progress. It is equally the psychology of the nation, the kind of thinking which its people do; and I can conceive of few more important tasks than a campaign of education that the people of this entire nation may think straight, may know the facts and may appreciate that only by effort and work can prosperity continue.

The imperative need of increased production brings home to every thoughtful person the question of how this greater supply of goods can be produced. What are the factors that now retard production, and what is essential to increase it? The last century may well be called the age of mechanical achievement. Its early decades witnessed the creation of many of the fundamental inventions which have revolutionized the whole course of the world and given to each worker infinitely greater powers of production. The thought of the world was centered in those early days (and in fact throughout all of the nineteenth century) upon the mechanical rather than the human side of production. The machine was extolled, and the man as a human being was partially forgotten. We conceived that if we could produce much it was of little importance how we produced it, and out of this philosophy came the intolerable conditions of labor throughout much of the last century.

HOW THE FACTORY HAS CHANGED CONDITIONS

The creation of the factory system also to an extraordinary degree removed the worker from contact with the master. In the days of the small hand-operated plants the owner worked side by side with his men and knew them intimately. But the factory changed this. It put up a barrier between the owner and the workmen, and it is doubtful if the manager or owner of a modern factory knows personally even a small fraction of his employees. The factory system has also added to the monotony of human occupation in effecting such a high degree of specialization in labor. I recently visited a factory where to my personal knowledge a workman for over twenty years had furnished steel blanks to a machine that was making nuts. In season and out for twenty years the same simple mechanical task had been the sum total of his daily occupation. No wonder that his brain was atrophied; no wonder that he had become almost as much an automaton as the machine that he served.

Out of these conditions of factory life have arisen the discontent of labor and its insistence that the human relations shall be improved. Out of these conditions has grown the trade union, at first weak, then growing stronger, until in some trades it has become dominant. Out of these conditions has also grown the discontent that finds its expression in the I.W.W., anarchy and Bolshevism. These are but expressions, crude and unthinking, of the feeling that the industrial system of to-day is wrong, and that the distribution of wealth and the condition of labor is unreasonable. If we are to allay this unrest, we must remove the cause of the discontent; we must eradicate the plague by destroying the infection; and we must recognize that the conditions under which men and women are to work are of the utmost importance.

As the nineteenth century was the century of mechanical achievement, the twentieth century must be the age of bettered human relations, if production is to increase and if the world is to advance, as I believe it will, to a higher and higher degree of civilization. I do not look upon the unrest of to-day as an ill omen; I look upon it as a good sign. Progress has never come from fat contentment. The man who strives and yearns, even though ignorantly and foolishly, is the man who is helping to advance the human race; and it is our function to see that this yearning for better conditions of living, for a greater variety and interest in occupation and for a participation in the conduct of business is granted to the workers. I do not believe for one instant that the capitalistic state is to pass. Capitalism is the only human device ever conceived by which saving was effected; and only as saving is made, only as a part of the great fund of human effort is conserved for the creation of productive machinery, is there any possibility of advance. Not until some other mechanism or economic factor can be shown to have the power of creating saving is there any possibility that the capitalistic state will cease.

Likewise, the wage system is as yet the only means of measuring and recompensing human service which is applicable to many classes of industry. I believe that the wage system will continue, but that it will be modified by profit-sharing, by a bonus and by giving to workmen a greater and greater interest in the management; and I believe that these changes will come because I believe they are necessary in order that human production may increase.

The problems of peace are no less serious than the problems of war. The disorganization of the complicated mechanism of our modern life, particularly in Europe, cannot be rectified without the lapse of long periods of time and the exercise of much patient effort; but as we have won the war, so I believe we will win the peace by self-sacrifice, by bravery, by plainly facing the facts as they are, and then by so rectifying and improving human relations that men will be satisfied because they know they are getting a square deal and because they appreciate from personal knowledge that their share of the total output is fair, reasonable and just.

THE THREE FUNDAMENTAL FACTS

I have tried to present what seem to me the three underlying facts of the present economic situation: first, that there is no great body of surplus wealth; second, that if we are to prosper we must produce; third, that if we are to produce to the maximum we must improve human relations in industry.

IT IS not a policy of recession that is proposed but a policy of conservation. All progress is the result of economy. In this the government ought always to lead. In a time of national peril economy has a different meaning than at a time of security. We have encountered and overcome our peril. But there is a tendency to maintain the same lavish expenditure. Government expenses must now be reduced from a war to a peace basis . . . . There is a limit to the taxing power of a state beyond which increased rates produce decreased revenue. There is before us a danger that our resources may be taxed out of existence and our prosperity destroyed. — *Governor Coolidge of Massachusetts.*

Progress in the Art of Communication

Development of Machine Switching of Telephone Circuits and Further Applications of Vacuum Tubes Marked the Year 1919 – Physical Plant Being Restored After Demoralization Due to War Conditions

BY BANCROFT GHERARDI* AND FRANK B. JEWETT†

THE year 1919 witnessed a very considerable activity in all branches of electrical communication. In addition to new researches undertaken during the year much of the development work which was practically completed during 1918 was finished during 1919 and much work that had been deferred on account of war conditions was undertaken. This was particularly the case in the telephone and transoceanic communication fields.

With the possible exception of long-distance radiotelegraphy, the war very seriously restricted and curtailed the growth of all communication facilities required for normal peace-time conditions. Outside of the United States not only were there no additions to plant to take care of normal growth requirements but in many cases existing facilities deteriorated greatly during the period of hostilities. The situation was particularly acute in the telephone and submarine cable fields. In both of these fields practically no large additions to plant had been made for four years. Further, the old and highly trained operating forces in these fields as well as in the land telegraph field had been greatly demoralized and depleted, and the changed economic conditions made it exceedingly difficult, if not impossible, immediately to re-establish efficient service on the basis which prevailed prior to the war.

Although the situation in the United States during the last year of the war was by no means so abnormal as in most of the other countries, the sudden endeavor to resume business along old channels on a greatly enlarged scale put an unprecedented demand on the operating companies at a time when both material and help were difficult to obtain.

A PERIOD OF STRENUOUS ENDEAVOR

The year 1919 has, therefore, been a period of strenuous endeavor to re-establish communication facilities on a very much enlarged and improved scale. Not only have large additions to plant with the old forms of standard apparatus been undertaken, where such apparatus could be obtained and used to advantage, but new developments which had been retarded during the war were rushed to completion.

While the war was a serious handicap in one way, in another it resulted in a forced development of apparatus and mechanisms which is likely to prove of great value to the communication industry. This is particularly true of the development work which was done on the vacuum tube and its various applications and of the developments which followed the efforts to supplement manual operations by machine operations. With the cessation of hostilities, all of the results of war-time work which might be of interest were immediately scrutinized to determine their adaptability to normal conditions. This scrutiny covered not only the physical but also the changed economic and labor situations. At the present time there is every prospect that the year 1920 will witness a decided improvement over the conditions of 1919, and during 1921 there should be a still greater approach to a satisfactory state of affairs.

RECENT ACTIVITIES IN TELEPHONE FIELD

Machine Switching.—During the year there has everywhere been great activity in the development and production of central office apparatus. Greatly increased and still increasing costs of labor and material, combined with the difficulty of obtaining an adequate supply of operators to give the required service, utilizing pre-war methods, have to a very great extent altered the factors previously existing.

During the year just past a number of the telephone companies of the Bell system have announced plans for the introduction of machine switching or automatic switchboards to provide the additional central office facilities to take care of growth in the large cities. This step has been made possible as the result of studies and development work of the most comprehensive character extending over a number of years and dealing both with the mechanism itself and with the commercial and traffic conditions. Not only have intricate mechanisms been designed and thoroughly tested in service to establish their satisfactory working, but the requirements of the service and the needs of the public have been fully considered. The system and methods which have been developed meet adequately the various service requirements from the point of view of a purely automatic system, and, in addition, they include all of the arrangements needed to provide complete and easy interconnection with existing types of switchboards so that the two work together in an efficient and economical manner. By the use of this type of mechanism to take care of growth and necessary replacements, the telephone companies will avoid the necessity of employing an increasing number of operators for local business, such as would be required if the larger traffic had to be cared for by other methods

Activities similar to those in the United States are evident in many of the European countries where the conditions are similar to those obtaining here. In some countries, notably the Scandinavian, as in the United States, installation work on large machine switching units is already in progress. In others, such as England and France, the matter of formulating final plans for the ultimate type of equipment to be employed in the large metropolitan areas is under way.

Telephone Repeaters.—During the year many installations of telephone repeaters were made for the purpose of improving transmission over existing circuits or of providing satisfactory commercial service between points hitherto remote. In general the type of repeater which has been installed has been that employing the vacuum-tube amplifier in the so-called two-two circuit described in the paper on "Telephone Repeaters" pre-

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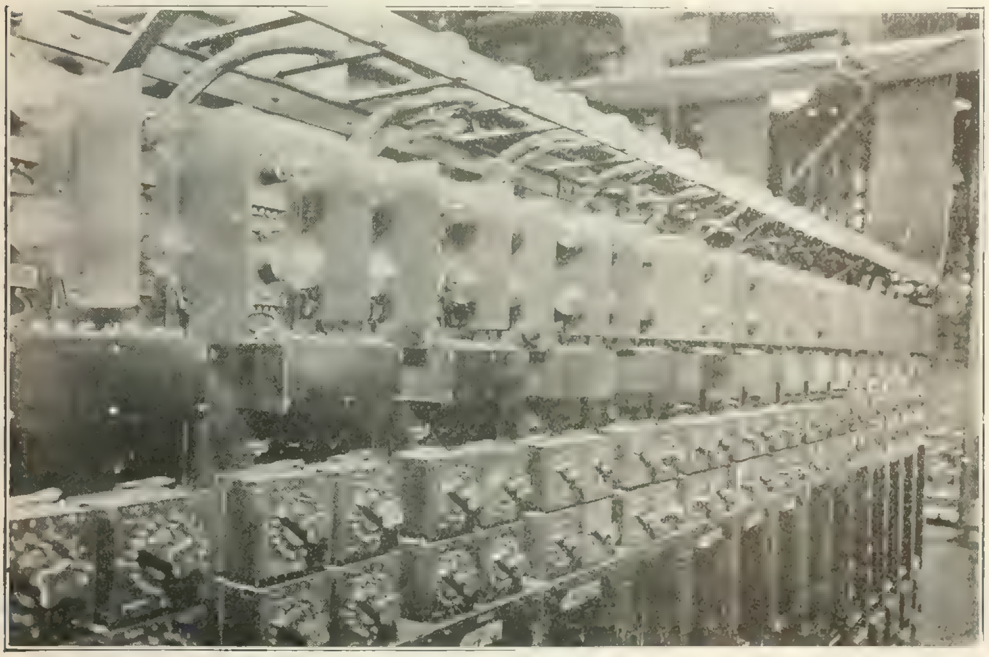
*Chief engineer American Telephone & Telegraph Company.
†Chief engineer Western Electric Company, Inc.

sented before the American Institute of Electrical Engineers on Oct. 1, 1919. During the year considerable improvements in this type of circuit have been effected, particularly with regard to its use on circuits composited for superimposed telegraph.

Toll Cables—Four-Wire Circuit.—During the year the principal difficulties remaining as a bar to the use of very long loaded toll cables have been removed and many miles of this type of cable have been installed. Most of this cable has been in locations where it forms the initial links in the cable network intended ultimately to provide an all-cable system connecting the principal cities of the United States. Much of the cable installed has been of the type designed to employ the four-wire circuit arrangement described in the Institute paper above referred to. The type of construction employed requires four loaded conductors of small gage for each telephone circuit, and has been found to have many very decided advantages over the two-wire cable circuit for certain conditions. It is expected that very considerable additions to the ultimate long-distance cable network will be installed during the forthcoming year.



FRONT VIEW OF TWO-WIRE VACUUM REPEATER RACKS

Carrier Current Multiplex Telephony.—In the latter part of 1918 announcement was made of the successful commercial operation between Baltimore and Pittsburgh of a carrier current system of telephony which in that particular installation provided for four telephone circuits on each pair of wires in addition to the ordinary metallic circuit. Further installations of the improved apparatus have been engineered and are under way and still others are projected. While this stystem offers great possibilities in some directions, it has inherent limitations which will restrict its use to particular conditions.

NEW TELEPHONE CABLE FROM HAVANA TO KEY WEST

During 1919 the engineers of the Bell system completed the development work on a telephone cable from Havana, Cuba, to Key West, Florida. The problems involved in this cable were extremely difficult of solution, due not only to the distance and the depth of the water existing in the Florida Straits but also to the fact that it was desired to provide a link sufficiently good so that the universal service of the United States could be extended to include Cuba. In addition to the purely physical aspects of the case, the relatively small amount of traffic made it necessary to secure a solution that did not involve unwarranted expenditures, either in first cost or future maintenance. Following the successful solution of the problem plans were immediately undertaken by the American Telephone & Telegraph Company and the Cuban Telephone Company to obtain and lay one or more telephone cables across the Florida Straits at this point.

During the year many extensive telephone cable networks have been projected in different European countries—in particular, England, France, Sweden and Holland — and some work, notably, the Amsterdam-Rotterdam cable, is already under way. All of these projected systems are to employ methods developed and already in use in the United States.

The present situation throughout the world is one involving a very large shortage in submarine cable facilities. The situation is particularly acute in the United States, where at the present time we have not sufficient cable facilities to conduct our world communication in satisfactory fashion and where also we have no present domestic facilities for supplying our own needs. As is well known, the submarine cable industry has for years been essentially in the hands of British manufacturers. The need for new cables for extensions and repairs to British systems is such as to tax the facilities of the English cable factories for a number of years to come.

Under the conditions existing the Western Electric Company, Inc., decided in the past year to erect a large submarine cable factory, and the work on the plans for this factory, which is to be located on deep water at Norfolk, Va., is being pushed with the hope that by the end of 1920 there will be in operation in the United States a source of supply for such submarine cables as may be required by our communication systems.

PROGRESS IN TELEGRAPHY

No advances of a radically new kind in telegraphic methods have been announced during the year. The period has been, however, one of considerable readjustment in plant to accommodate a great increase in traffic. Also there have been some interesting improvements in certain of the mechanisms employed for printing telegraph service.

At the time announcement was made in 1918 of carrier current telephony, mentioned above, the fact that this same general system was also available for telegraph purposes was set forth. During the year a great deal of work has been done and an additional large installation of carrier current of telegraphy has been made. Numerous other installations are being engineered and installed. Within its field and under proper conditions it bids fair to come into general use. The telegraph channels provided by this system can be employed for any of the purposes and with any of the terminal methods now in operation.

IMPORTANT RADIO DEVELOPMENTS

Radio-Telegraphy.—The outstanding events of 1919 in the radio field have been the completion of numerous large long-distance stations undertaken during the war and the paper by E. F. W. Alexanderson before the American Institute of Electrical Engineers on Oct. 1 in which was described the high-power alternator and its attendant system for rapid long-distance and semi-directive radio-telegraphy. In the United States as well as in foreign countries the situation in the entire radio field is unsatisfactory owing to uncertainty as to the ultimate national and international legislation designed to control this phase of electrical communication.

Radio-Telephony.—During the war great progress in radio-telephony, particularly in short-range radio-telephony, was made. During 1919 the developments which started in the preceding two or three years were carried on vigorously with a view to determining the extent to which radio-telephony was commercially available for service either alone or in conjunction with wire telephony. This work has tended to demonstrate the feasibility of commercial radio-telephony as a supplement to wire systems where natural conditions preclude the use of wires.

Goniometry.—Probably one of the most important developments in the radio field during 1919 was the establishment by the United States Navy of a considerable number of stations adjacent to the principal harbors designed to provide ships at sea with a statement of their exact position at any given instant. While these installations have not been completed and while the system has not been reduced to its final form, it bids fair to be one of the most valuable adjuncts yet devised for the safeguarding of navigation at sea.

RESEARCH WORK IS KEY TO PROGRESS

The fact that practically all of the important developments of 1919 and the two or three years immediately preceding it were the result of intensive research has enhanced still further the importance of this already important branch of the electrical communication business. Innumerable researches and developments in telephony and telegraphy, both wire and radio, are under way, and an increasing staff of highly trained scientists are directing their efforts to the solution of the problems intended to extend and better the service in these fields. The year 1920 should see some very marked improvements even though no startling new system is developed.

The results which have followed from the researches made on and with the devices that have grown out of the improved De Forest audion indicate that in this instrument electrical engineers and scientists have a most potent tool for advancing the art not only in the communication field but elsewhere. While many new and important uses employing the principles involved in the audion have been developed, the limits to the extent of its applicability are not yet in sight. It is probable that at no time in the world's history have so many physicists been engaged in a single piece of work as are now involved in the study of thermionic problems.

Maintenance of Interior Lighting Systems

Some One Should Always Be Responsible for Cleaning Lamps, Reflectors, Walls and Ceiling —Case Is Cited Where Illumination Was Raised from 2.7 to 7 Foot-candles by Simple Expedients

BY WARD HARRISON AND J. R. COLVILLE
Engineering Department National Lamp Works, Cleveland, Ohio

DIRTY reflectors, walls and ceilings darkened by smoke and dust, blackened lamps left in service as long as they continue to burn, empty sockets, unobserved burn-outs and replacements with lamps of wrong size or improper voltage rating are prime causes of inadequate illumination.

An office lighting installation recently examined is a case in point. The installation consisted of indirect units and had been in operation two and one-half years. The ceiling had been painted a flat white and the walls finished in a light buff. At the time the installation was made the intensity of illumination was adequate.

The engineer who investigated this installation, in response to a complaint, found that the average illumination intensity on the desk tops was 2.7 foot-candles—unquestionably too low for office work.

(1) The reflectors had been wiped out at fairly regular intervals, but were nevertheless taken down and thoroughly washed. The illumination jumped at once to 3.7 foot-candles—an increase of over 35 per cent arising from washing what appeared to be fairly clean reflectors.

(2) The lamps had been in service for more than two years. Furthermore, it was found that their rating was several volts higher than the average voltage of the circuit. When new lamps of the proper voltage rating were substituted the illumination increased to over 5 foot-candles.

(3) The ceiling in this office had originally been finished with a paint which had been tested and found to reflect 75 per cent of the light striking it. In two and one-half years it had become so soiled through soft-coal smoke that a comparison with paint samples whose reflection factors were known demonstrated that it was reflecting but 50 to 55 per cent of the incident light. The side walls had depreciated in like proportion. Refinishing the office in its original tone further increased the illumination by about 40 per cent, or to a total of over 7 foot-candles.

Here is a case where failure to observe simple maintenance requirements resulted in an intensity of 2.7 foot-candles where an intensity of over 7 was being paid for.

There are two methods by which the maintenance of any selected value of intensity can be assured—first, by allowing for an enormous depreciation in the light and consequently using much larger lamps than would ordinarily be considered necessary; second, by maintaining the system properly and allowing for reasonable depreciation. The second, or generally practical, method involves:

1. The use of a depreciation factor, or factor of safety, in the original design of the system to insure adequate illumination when the system has depreciated a normal amount.

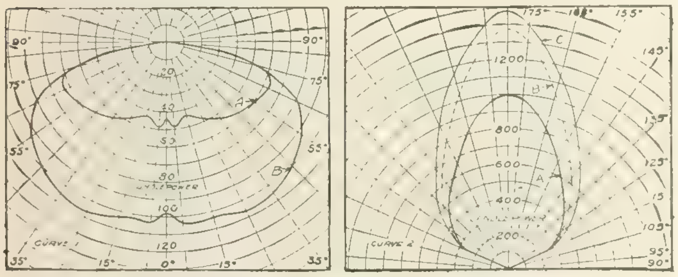


FIG. 1—DIRT DESTROYS THE EFFECTIVENESS OF LIGHTING EQUIPMENT

A—Reflector dirty
B—Reflector clean

A—Reflector dirty
B—Reflector wiped out
C—Reflector washed

2. The cleaning of lighting units at frequent, regular intervals.

3. The replacement of lamps which have become blackened in service by abnormally long life.

4. The use of lamps of the correct voltage rating for all replacements.

5. The refinishing of ceilings and walls at reasonable intervals.

THE DEPRECIATION FACTOR IN ILLUMINATION DESIGN

The purpose of the depreciation factor is to insure adequate illumination when the installation shows maximum depreciation under the system of cleaning adopted. For example, where units are cleaned and inspected every three weeks the illumination just before cleaning may be 15 per cent lower than immediately after. Furthermore, the ceiling and walls will gradually become darkened, so that the illumination at the end of a year, even with the lighting units thoroughly cleaned and the lamps in excellent condition, will be materially lower than when the installation was new. In order to insure that the illumination will at no time be inadequate, it is necessary to add a suitable amount to the intensity considered desirable and design for this larger amount initially.

How dust and dirt destroy the effectiveness of lighting units is strikingly shown in Fig. 1. A point which is not apparent from the curves but which should be mentioned in this connection is that a dirty installation is likely to be more objectionable from the standpoints of glare and density of shadows than one which is clean. Glare is somewhat a matter of brightness contrast, and a bright bulb against a dirty reflector or a bright unit against a blackened ceiling may appreciably accentuate glare. The density of shadows depends, among other things, upon the areas of the light sources, and where reflectors are dirty, their contribution of diffused light is lost and dark, sharp shadows result.

How large an amount should be added to the intensity considered adequate, or, what amounts to the same thing, by how large a factor the intensity considered adequate should be multiplied, to insure proper illumination at all times, depends upon the specific conditions surrounding any particular installation. The data presented in Table I, taken from the lecture course presented in 1916 under the joint auspices of the Illuminating Engineering Society and the University of Pennsylvania, give specific figures for depreciation due to dirty lamps and reflectors. In general, when installed in relatively favorable locations, open-reflector units show a depreciation which ranges from 10 to 25 per cent in four weeks' time. Where excessive smoke and dust are the rule, the depreciation over the same period may be as high as 40 per cent. The depreciation of ceilings and walls depends not only upon the characteristics of the location—*i.e.*, whether clean or dirty—but upon their original color as well. The only factor which is not affected by location is the depreciation of lamps with burning. Gas-filled lamps average about 95 per cent of their initial light output throughout life; the output at the end of rated life is usually about 92 per cent of the initial output, and where there are only one or two lamps in a room lamp depreciation must be based upon this figure rather than upon the average output. While the total depreciation of lighting systems over a given period will, of course, vary widely,

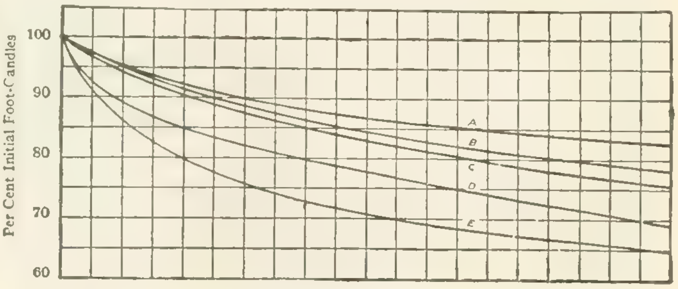


FIG. 2—EFFECT OF COLLECTION OF DUST ON LAMPS AND REFLECTORS

A—Dome enameled steel
B—Bowl enameled steel
C—Dense opal glass
D—Prismatic glass.
E—Light-density opal glass.

TABLE I—LOSS OF LIGHT BY ACCUMULATION OF DIRT *

Authority and Reference	Conditions and Surroundings	Lamps, Globes and Reflectors	Period Covered by Tests	Per Cent Total Decline for Period
Durgin and Jackson *Trans.* I. E. S., 1915, p. 707.	Downtown Chicago Office building dustiest rooms.	Semi-indirect dense bowls and tungsten lamps.	Three weeks	26
Aldrich and Maha, *Trans.* I. E. S., 1914, p. 112	Office building in Chicago stock yards.	Prismatic reflectors, satin finish, and tungsten lamps direct.	Twelve weeks	25
Aldrich and Maha, *Trans.* I. E. S., 1914, p. 112.	Office building in Chicago stock yards.	Mirror reflectors and tungsten lamps indirect.	Nine weeks	25
Edwards and Harrison *Trans.* I. E. S., 1914, p. 176.	Office corridor suburban district, Cleveland.	Inclosing prismatic.	Eight weeks	11

* "Illuminating Engineering Practice," 1916, Illuminating Engineering Society—University of Pennsylvania.

experience has shown that a factor of 1.2 for very clean locations and very clean operations (16⅔ per cent loss) and a factor of 1.5 for dirty locations and relatively dirty operations (33⅓ per cent loss) may be used with assurance of satisfactory results, provided, and this is of the greatest importance, that a schedule of regular and frequent cleaning be adopted and adhered to.

THE DIFFERENT PHASES OF MAINTENANCE

Cleaning.—The curves of Fig. 2 are of interest as showing the relative rapidity with which various systems of open-reflector units depreciate owing to dust and dirt. The values from which these curves are plotted were obtained by measuring the illumination intensity at the work. In this way the effect on the resulting illumination of deposits on the inside and the outside of the reflecting and diffusing surfaces is correctly weighted, a result not obtained when units are measured in a photometer for total light output.

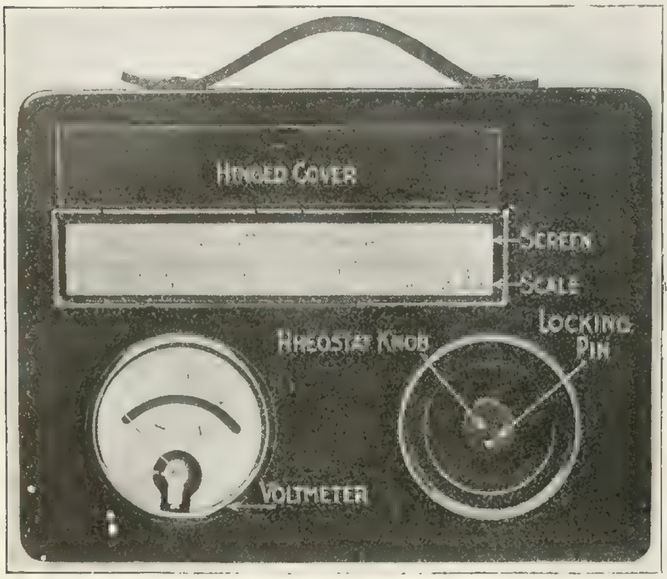


FIG. 3—FOOT-CANDLE METER

Reference to curve 2 of Fig. 1 will show that there is a great difference between merely wiping out a unit and washing it thoroughly. On the average, wiping out has about two-thirds the effect of a thorough washing. Obviously, in arriving at any cleaning schedule, the care with which the work is to be done is an important consideration.

A device has recently been developed which will be found extremely useful in the proper maintenance of a lighting installation. This device is known as a foot-candle meter, for it measures the illumination at the work directly in terms of foot-candles. The instrument is shown in Fig. 3. With it the illumination can be read directly from the scale without computations or adjustments. In one large establishment where the superintendent uses a foot-candle meter systematically as a check on his maintenance department, readings of illumination intensity are taken at regular intervals at fixed stations throughout the plant. These readings are recorded in such a way that the successive readings are readily comparable. When any inconsistency appears in the records an investigation is made and the proper remedy applied. The intensity in this establishment is never allowed to fall below 6 foot-candles without immediate correction. By measuring light actually delivered to the work the foot-candle meter automatically reveals the combined effect of all possible causes of depreciation. Ignorance of the magnitude of depreciation has often been the cause of inadequate maintenance.

As has been pointed out, the importance of the factors affecting the rate of depreciation of a lighting system is largely dependent upon local conditions, and it is difficult to formulate cleaning schedules which will be generally applicable. The schedules suggested in Table II may be used as a basis for formulating a schedule adapted to specific conditions; however, a man with a foot-candle meter is the best judge of individual requirements.

It is of the utmost importance that the responsibility for proper maintenance of the lighting system be definitely assigned. Experience proves that unless there is a clear understanding on this point the work is never properly handled. A definite schedule should be outlined and carefully enforced. In large industrial plants, large office buildings and the like a small maintenance department is necessary for accomplishing effective results. In smaller buildings one employee may be able to handle the work satisfactorily. It is significant that several of the more progressive window-cleaning companies have established the cleaning of lighting equipment as a part of their regular service, and this plan has the advantage that the work is done by trained men.

TABLE II—SUGGESTED CLEANING SCHEDULES

Where direct-lighting systems are used—*i.e.*, where there are no reflecting or diffusing surfaces concave upward to invite dirt accumulation—the interval of cleaning should be about as follows:

Characteristic of Location	Interval in Days if Units Are Wiped Out*	Interval in Days if Units Are Thoroughly Washed
Very dirty	3	5
Dirty	7	10
Average	15	20
Clean	30	40

Where open semi-indirect or totally indirect units are used:

Characteristic of Location	Interval in Days if Units Are Wiped Out*	Interval in Days if Units Are Thoroughly Washed
Dirty	5	7
Average	10	15
Clean	20	30

* Washing every third or fourth interval assumed.

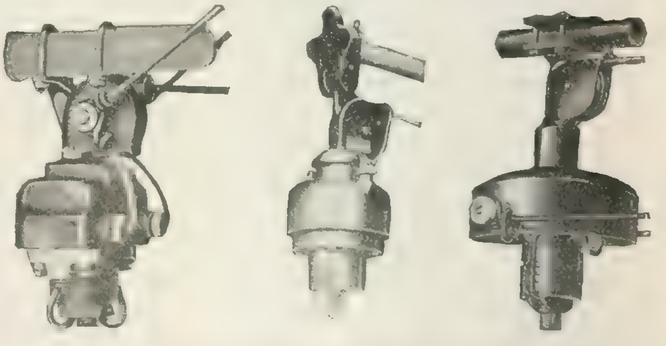


FIG. 4—CUT-OUT HANGERS FACILITATE CLEANING

It is unfortunate that in the design of lighting systems more attention is not given to accessibility for cleaning. Yet even where careful thought is given to this factor it is frequently necessary because of other considerations to place units where they are very difficult of access. In many industrial plants, such, for example, as steel mills, units can be reached for cleaning only from the traveling crane, and the fact that the crane is likely to be in service twenty-four hours a day six days in the week complicates the maintenance problem. Where such conditions exist, it is advisable to go over the system every week end rather than to attempt to operate a five-day or a ten-day cleaning schedule. In some cases it will be found practicable to substitute clean units for dirty ones throughout a section of a plant, clean the dirty ones, and substitute them for others in another section, etc. This can be done readily by using standard devices for connecting to and disconnecting from the circuit.

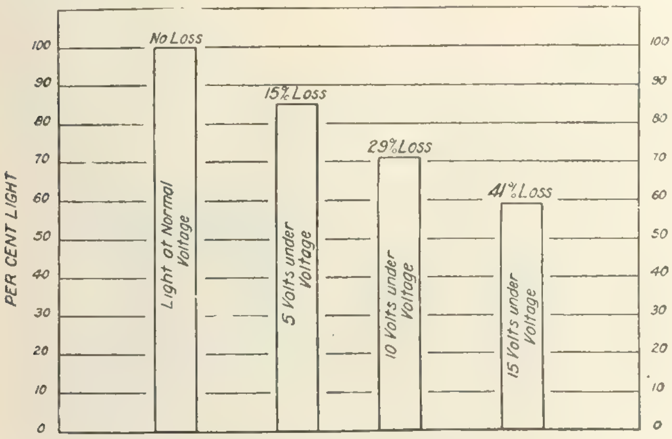


FIG. 5—LOSS OF LIGHT DUE TO LOW VOLTAGE
Based on 115-volt tungsten lamp

Where units are so placed that their proper maintenance involves considerable difficulty or perhaps danger to the one who looks after them, the investment in some form of disconnecting hanger which permits the units to be lowered to the floor is advisable. Several types of such hangers are available and their use will be found to go a long way toward insuring proper maintenance. Women, or men who are no longer able to work safely high above floor level can sometimes be employed advantageously where the work is simplified in this way.

Some units are, of course, easier to clean than others, but, with the exception of certain types built up of plaster* or composition and those employing polished metal, all require a thorough washing at least as often as every third or fourth cleaning period. A small stiff brush will often be found to expedite the work. Warm water and soap appear to be about as effective as the chemical cleaners for general use, although where the reflectors become stained, as by exposure to fumes, the latter facilitate the work. Any prepared cleaners which give satisfactory results in the bathroom of a home may be used without fear of their damaging the reflecting surfaces of lighting units. Where mirrored reflectors are washed, special attention should be given to avoiding injury to the backing.

Replacement of Lamps.—The manufacturers, through improvements in lamp making, have succeeded in producing lamps in which the candlepower is well maintained throughout life, and blackened bulbs are continually decreasing in number. However, individual lamps show considerable variation from the average performance, and where inspection shows a bulb to be considerably darkened the lamp should be replaced with a new one. Vacuum lamps require more careful inspection in this respect than gas-filled lamps.

While it can be shown that it is cheaper to replace a blackened lamp with a new one under most operating conditions, the consideration of greater importance is the fact that blackened bulbs absorb light which is needed upon the desk tops, machines or counters, as the case may be. The inspection of lamps for this cause of lighting depreciation is simple, and it should be done at each cleaning period.

The cleaning of any unit should not be considered complete until it has been lighted to insure that the lamp or lamps operate. Where several lamps are used in an indirect or dense semi-indirect bowl, one or more may fail without the effect in the illumination being at once apparent unless the maintenance man examines the fixture for this possibility. On the other hand, where a single large lamp is used in such bowls a lamp failure is at once observed. The cleaners should carry a supply of lamps of the proper size with them so that a burned-out bulb may be replaced immediately.

Voltage Rating.—Incandescent electric lamps are rated for a given light output at a certain voltage. On a lower voltage a lamp will give less light and on a higher voltage more light. This is generally understood, but few appreciate that the variation in light output is several times as great as the variation in voltage. The chart of Fig. 5 shows the relation between light output and voltage as obtained by exhaustive tests on many groups of lamps. A difference between rated voltage and operating voltage of a few per cent is accompanied by a percentage difference in light output about three and a half times as great.

Refinishing of Ceiling and Walls.—How frequently an interior requires refinishing depends upon: the type of lighting, whether direct, semi-indirect or totally indirect; the nature of the finish employed; the characteristics of the location, whether relatively clean or dirty, and, in less degree, upon the color of the finished surfaces.

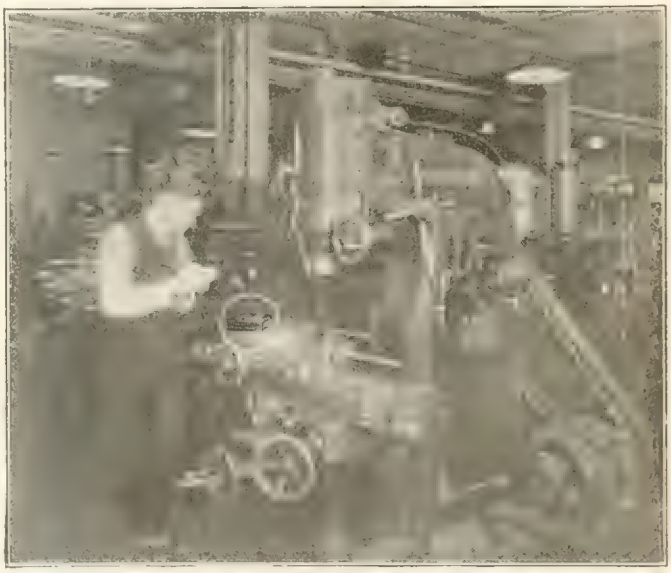


FIG. 6—FOOT-CANDLE METER REVEALS POSSIBLE CAUSES OF DEPRECIATION

Reflectors in a direct-lighting system themselves turn light into a downward direction and make the effectiveness of the system less dependent upon reflection from the ceiling and walls than where other units are used. Inclosing units amid light-colored surroundings produce a distinctly pleasant brightness; amid dark surroundings they furnish much less light and frequently are excessively glaring. Again, semi-indirect and totally indirect systems depend essentially upon good reflection from the ceiling, and to a less extent from the walls, for their effectiveness.

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*The reflecting efficiency of plaster or composition can best be renewed by rubbing with sandpaper or a stiff wire brush.

Fortunately, considerations of appearance often dictate the refinishing of a soiled and gloomy interior where the expenditure from a lighting standpoint alone would not have suggested itself. However, ceilings and walls, like other reflecting surfaces, lose much of their effectiveness before the accumulation of dust has reached the point where the surfaces appear badly in need of refinishing. For this reason it should be the duty of the maintenance department to ascertain the condition of the walls and ceiling and to see that they are kept in a good reflecting condition.

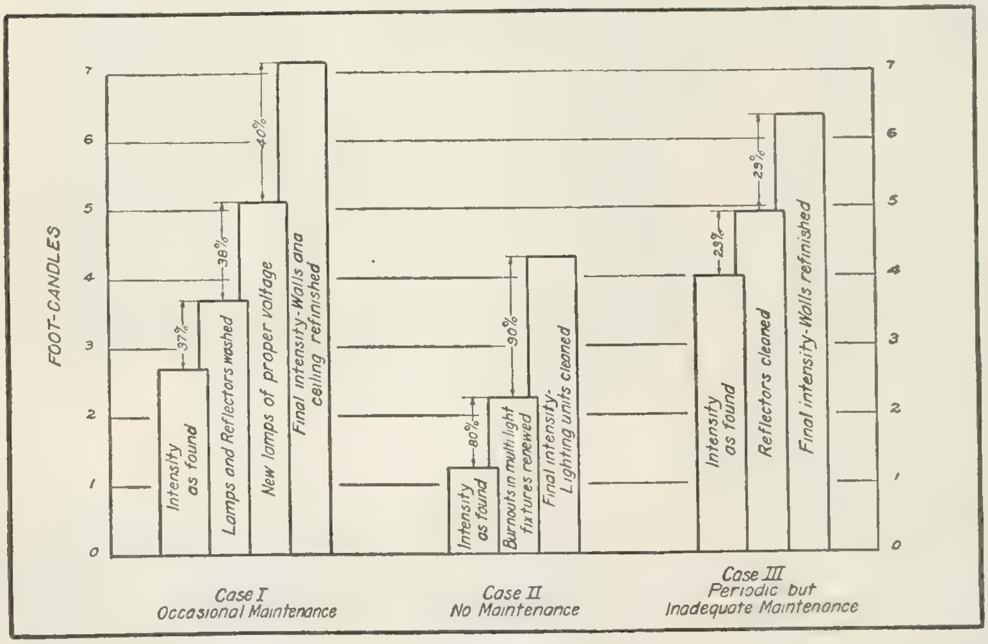


FIG. 7—TESTS OF SEMI-INDIRECT AND INDIRECT LIGHTING SYSTEMS ILLUSTRATE NECESSITY FOR REGULAR AND ADEQUATE MAINTENANCE

CONSIDERATIONS IN CHOICE OF COLORS

A white paint or plaster surface absorbs less light than any other interior finish. Yellowish or warm-toned paints are considered desirable in many cases on account of the cheerful, pleasant atmosphere created. Such tones reflect a larger proportion of artificial light striking them than blue tones, although the latter may appear at first glance equally light. The reason for this is that the light from the ordinary incandescent lamp contains a higher percentage of yellow and red rays than blue rays, and a surface of a tone other than white reflects a greater proportion of the rays of its own color than of another color. This is the basis of the common recommendation that where a white paint is not wanted a paint of light-cream tone may be used without bringing about a marked sacrifice in lighting effectiveness.

The mistake should not be made of using paints of a yellowish tone for ceilings with daylight lamps in indirect or semi-indirect fixtures, for the yellow tones would not only reduce the efficiency of the installation but would destroy largely the daylight effect sought. Experiments have shown, however, that the color of the portions of the side wall near the floor has no material effect upon either the color quality or the amount of illumination.

POSSIBILITIES OF ELECTRIC SMELTING IN FAR WEST

Low Energy Rates, Ore Deposits and Smaller Bulk of Product Give It Advantage in Smelting Ferro-Manganese

AT THE present time there are five plants smelting ferro-manganese on the Pacific Coast. The possibilities of success and the growth of the industry are based upon the chances for cheap power, as the cost of the power consumed is a very great proportion of the manufacturing cost. This may readily be realized when the consumption of from 600 kw.-hr. to 800 kw.-hr. per ton of steel is compared with the necessary consumption of from 7,000 kw.-hr. to 9,000 kw.-hr. per ton of metal in the production of ferro-silicon. Moreover, electric furnace steel sells for a higher price per ton than any of the ferro-metals. The presence of ore deposits in this region and the smaller bulk of the finished product give the West an advantage in freight rates. It has been stated by the industry that if power could be obtained at $18 per ton per kilowatt-hour per year the West might readily compete in the market.

It has been found that a three-electrode furnace is most efficient, and about 60 per cent of those in use are three-phase. The lower contact in a one-phase furnace gives trouble by burning off and letting the metal through the furnace. There is danger of an excess carbonization of the bath with two electrodes. The power factor of the induction furnace is low and losses from radiation are high. It has been found that the electrode loss of a three-phase furnace is about 8 per cent. Best results are achieved at a voltage of from 60 to 70, a higher voltage resulting in too much volatilization.

Electrodes may be made at the factory from calcined anthracite coal from which all the volatile material is driven and which is then ground fine and mixed with from 15 to 20 per cent of pitch of not too hard a consistency. The electrode is then pressed into shape and again calcined. A socket and pin joint makes it possible to conserve electrodes by attaching the new to the stub of the old.

The process of smelting goes on almost continuously, as the furnaces are fed from the top and tapped from the bottom without disturbance of the electric regulation. The load factor runs 95 per cent or better on 25 cycles and the power factor averages 95 or 96 per cent.

Present and Future of Line Insulators

Expansion of Metal Parts, Cement, Etc., Cause of Failure Combined Electrical, Mechanical and Porosity Test Should Be Substituted for Present Tests—Value of Grading High-Voltage Strings

BY F. W. PEEK, JR.
General Electric Company

AFTER a few years of more or less successful operation, insulators selected by the most careful or most severe electrical tests begin to fail rapidly. There are, of course, exceptions, but this has been the general experience.

The apparent deterioration of the porcelain is for the greater part due to one or the other of the following causes:

1. Gradual mechanical cracking due to the expansion of cement or tight-fitting metal parts, to internal strains caused by firing or to brittle porcelain.
2. Gradual absorption of moisture due to porous porcelain.

The greater part of the trouble has been due to cracking. Failure of porcelain insulators where tight-fitting or tightly cemented-in metal parts are used is not surprising when the poor mechanical characteristics of porcelain are considered. Cracks gradually develop under the mechanical stresses and are finally followed by electrical failure at the weakened parts.

The foregoing causes of deterioration are pretty well verified in practice because the types of insulators in which the porcelain units are strung together by loose fitting metal parts or cables have not failed. For instance, operating reports and electrical and mechanical tests made on one type of non-cemented insulator show no deterioration after ten years of service.

It has been suggested many times that porcelain be replaced by a more suitable material. Unfortunately no such material is available at the present time. Until such a material is developed porcelain should naturally be used to the best advantage.

PRESENT ELECTRICAL TESTS NOT CONCLUSIVE

Practical experience has shown that the most severe electrical tests do not solve the problem, but, on the contrary, may do a great deal of harm. Experience has also shown that an insulator mechanically constructed to avoid expansion and porosity troubles may survive even if made of inferior porcelain. High-voltage electrical tests made at the factory cannot be expected to anticipate mechanical failure due to expansion of metal parts or to the absorption of moisture after several years of service.

The solution seems to be to start with an insulator designed to avoid any possible cracking of the porcelain parts from expansion of cement or metal. Years of service have so far been the best criterion of design. The material should then be selected of uniform quality, reasonable toughness and freedom from porosity and firing strains. The terms "tough" and "non-porous" are relative terms, and the allowable safe variation will depend to some extend on the design. The electrical strength of the completed unit should, of course, be reasonable, but this is really secondary to the other characteristics, since the highest electrical strength vanishes when a crack appears.

The ends mentioned cannot be attained by applying excessive electrical tests to anticipate future cracking which is due to firing strains or brittle porcelain. The results can best be attained by testing a small percentage of the product to destruction from day to day after the usual electrical and inspection tests have been made, the object being to determine if the product is up to the standard and of uniform quality. Electrical, mechanical and porosity uniformity tests are necessary. Extremely accurate tests are not important, but it is important to have tests that can be very quickly made, in order to be able to find at once any trouble due to firing or poor materials. A check test should be made on the firing indicated as unsatisfactory by the uniformity test. If the repeat tests still show the material to be unsatisfactory either electrically or mechanically, or to be porous, the complete firing should be rejected. Such tests will insure a uniform product and success on a tried design, but will not of course correct a poor design.

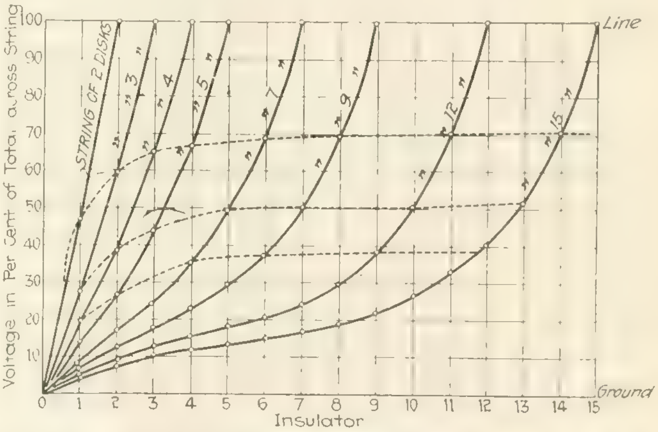


FIG. 1—VOLTAGE DISTRIBUTION ACROSS INSULATOR STRINGS OF TWO TO FIFTEEN DISKS (UNGRADED)

UNEVEN VOLTAGE DISTRIBUTION ACROSS INSULATOR STRINGS

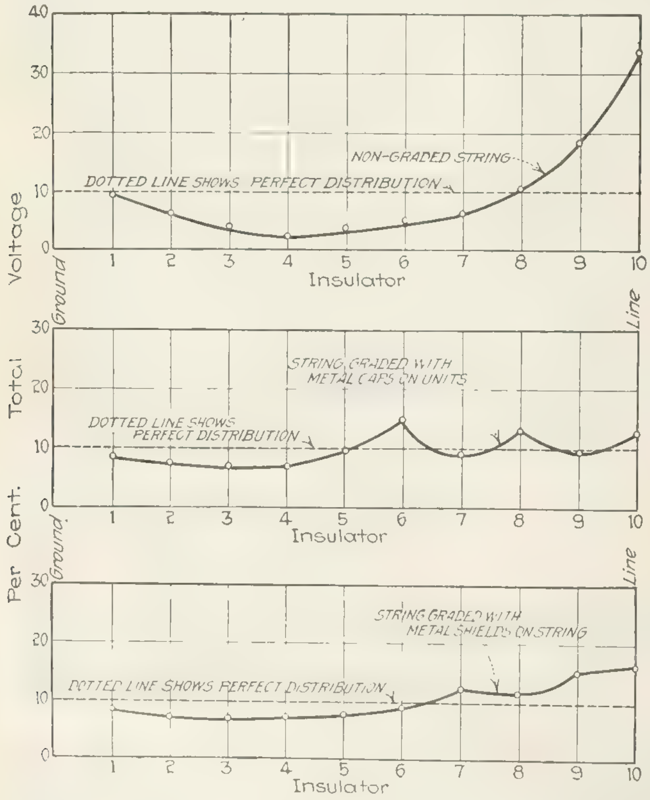
It is interesting to discuss at the prseent time the relative reliability of insulators for different line voltages and what changes from present practice, if any, are necessary for the very high voltages which are now being proposed. On low-voltage lines where only one unit is used the breakdown of that unit means a failure. At a somewhat higher voltage where two units are used the chances of complete failure at a given point are less, since one good unit will withstand line voltage and the probability of both units failing at once is small. The probable complete failure of a string decreases as the number of units in the string are increased.

The percentage of failures due to cloud lightning should decrease with increasing line insulation and, therefore, with increasing line voltage. This follows because for any given number of lightning storms there are many low-voltage surges, a less number of moderate-voltage surges and few extremely high-voltage surges induced on a transmission line. Both high-voltage and low-voltage lines are subjected to practically the same disturbances.

There is one factor of increasing importance with increasing voltage.[1] It has long been known that when insulators are placed in series in a string the arc-over voltage is not the sum of the arc-over voltages of the individual units, but much less. This is due to the uneven division of voltage on the different units. A very high percentage of the voltage is across the line unit. Typical curves for voltage distribution on strings of insulators of from two to fifteen units in length are given in Fig. 1.

GRADING IS HELPFUL ON HIGH-VOLTAGE STRINGS

It will be noted that for strings of from five to fifteen units approximately 30 per cent of the operating voltage is across the line unit. This is not especially serious for the lower voltages. For instance, at 100 kv. the voltage to neutral is 58 kv. and the voltage across the line unit is 0.30 × 58 = 17.4 kv., but for a 220-kv. line the voltage across the line unit is (220 ÷ 1.73) × 0.30 = 38 kv., which is higher than desirable.



FIGS. 2, 3 AND 4—VOLTAGE DISTRIBUTION ACROSS SIMILAR STRINGS OF INSULATORS EXCEPT THAT ONE IS UNGRADED WHILE TWO ARE GRADED

The uneven distribution of voltage is due to the capacity to ground. The insulator next to the line must carry the ground capacity current of all the other units whereas the second unit from the line must carry the capacity of all the units but one, etc. The distribution can, therefore, be corrected by increasing the capacity of the units near the line or by using plates or shields, especially on the line end. Figs. 2, 3 and 4 show the voltage distribution on a string of ten units. Perfect distribution is represented by the dotted line. It is unnecessary to get perfect distribution in practice; it is probably preferable to grade in steps to avoid too many parts. Figs. 3 and 4 show actual step-grading curves on the same string. In Fig. 3 the capacity of the units near the line was increased by variable metal caps, in Fig. 4 by a ground shield. Perfect grading can readily be obtained in the laboratory. In these strings grading was accomplished by very few steps.

On the non-graded string of insulators above it would be expected that the arc-over voltage would be 1/0.30 = 3.3 times the arc-over voltage of one unit, since the line unit would be at arc-over voltage if the above voltage were applied to the string. As a matter of fact it is much higher, because the conducting corona which first forms on the line units in effect increases the size of the caps and automatically grades and reduces the stress on the line unit as the arc-over voltage is approached.

RELATIONS OF WET AND DRY ARC-OVER VOLTAGES

Heretofore the main argument given for grading has been to reduce the string length by increasing the arc-over voltage for a given number of units. It is much more important to reduce the operating stress on the line-end units.

With certain types of units the wet arc-over voltage may be higher than the dry arc-over voltage for long strings.[2] This is because rain may assist in grading a badly unbalanced string. As a general rule, a string cannot be very greatly shortened in practice by grading because of the effects of rain, dirt, etc., on the perfectly graded string. There would be little gain in increasing the dry arc-over voltage if at the same time the wet arc-over voltage were decreased. Rain would not increase the arc-over voltage of a graded string. The wet arc-over voltage would generally be lower because of the decreased length of string.

It has been found that the lightning arc-over voltage may be relatively greater on the non-graded string than on the graded string and that the wet lightning arc-over voltage is usually as high as the dry lightning arc-over voltage.[3] The lightning arc-over voltage is to a great extent a question of string length.

The wet and dry arc-over voltage of insulators decreases almost directly with barometric pressure. The insulator problem for the extremely high voltages is therefore more difficult at the higher altitudes.

From the above discussion it may be concluded that:

Insulator troubles have been due mainly to cracking caused by expansion of metal parts, cement, etc., and to porosity.

Certain designs with loose-fitting parts have been free from deterioration.

The old method of basing all on the electrical test should be abandoned. Severe electrical tests are often harmful. The electrical strength is secondary to other characteristics. An electrical, mechanical and porosity uniformity test should be established in which a small percentage of the product is tested to destruction from day to day. If it is running porous or brittle or is weakened by firing strains, it should be rejected.

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[1] Peek, "Electrical Characteristics of the Suspension Insulator," *A. I. E. E. Transactions* 1912, Vol. XXXI, page 907.

[2] Peek, "Electrical Characteristics of the Suspension Insulator," *A. I. E. E. Transactions*, 1912, Vol. XXXI, page 902.

[3] Peek, "The Effect of Transient Voltages on Dielectrics," *A. I. E. E. Transactions*, 1915, Vol. XXXLV, page 1857. "Factors Determining the Safe Spark-Over Voltage of Insulators and Bushings," *G. E. Review*, June, 1916.

For the very high voltages that are at present being considered greater reliability may in some respects be anticipated. The lightning arc-over voltage will be relatively higher and induced lightning voltages sufficient to cause arc-over will be less than on the low-voltage lines. Increasing the number of units in series is an advantage. Uneven distribution of voltage on the string becomes more serious on the higher voltages because of the high stress on the unit near the line. For strings of more than four or five units this stress is practically a constant percentage of the operating voltage independent of the string length. Uneven distribution can be corrected by grading. It will also often be found necessary at the very high voltages to use shields to prevent excessive corona on the line-end units.

What the Goodwin Plan Is Accomplishing—II

How the New Trade Spirit of Co-operation and Recognition of Service Rendered by Retailers, as Advocated by the Goodwin Plan, Is Being Reflected in the Business, Profits and Functioning of All Trade Groups

BY O. H. CALDWELL
Editor *Electrical Merchandising*

IN THE section of this article which appeared in last week's issue the benefits from the Goodwin Plan already apparent to central stations were summarized. Paralleling these benefits in importance to the entire industry are those resulting from the re-creation of the electrical contractor into the "contractor-dealer." The new spirit of co-operation in the trade has been built up from the fundamentals, by establishing the service function of the installer of wiring and the retailer of electrical goods. With this service function acknowledged and supported by manufacturers and jobbers, electrical contractors everywhere are being encouraged to open new retail stores, improve existing stores and render the kind of service that the buying public and the electrical industry expect of them. Where co-operation of the central station has been added, the old-time destructive competition has vanished and a true spirit of "service first" to the customer has taken its place.

Contractor-dealer organizations, local and national, have been strengthened all over the country and are to-day operating actively, developing ideas for better business among their members and elevating the business standards of the retail electrical trade.

Hundreds of contractor-dealers have installed standard accounting systems, cost-keeping methods and regular inventories of stock, so that they now know exactly the status of their business at any time. This is resulting in fewer business failures, and contractor-dealers everywhere are becoming better credit risks on the books of the manufacturers and jobbers.

Contractor-dealers are benefiting from the helpful attitude of electrical jobbers, many of whom have instructed their salesmen first of all to help their contractor customers to become better business men, to display their merchandise attractively, to equip and maintain their stores in keeping with the best in retail practice, and to run a good set of accounts. In other words, the jobber's salesman to-day is encouraged to be a merchandising instructor rather than an order taker. As a result the contractor-dealers are doing more business and the salesmen are getting bigger orders than ever before.

HOW THE JOBBER HAS BENEFITED

Increased volume and new lines of electrical goods handled, resulting in a reduction in the percentage of overhead and an increase in net earnings, are among the benefits now coming to the jobber.

In addition, the position of the jobber in the distribution plans of the manufacturer has been strengthened and his status as the most economical distributer more firmly established than ever. Among both manufacturers and dealers a more appreciative understanding is being created of the definite service rendered by the jobber and the reasons why he should receive an adequate jobber's compensation.

Many new members have joined the Electrical Supply Jobbers' Association, strengthening that association and making better association members of those already affiliated.

Jobbers everywhere have benefited from the increasing tendency of contractor-dealers to buy locally instead of buying from houses outside their own territory, which give no service.

Jobbers all over the country report an improved credit situation on the part of their contractor-dealer customers. Three years ago the contractor-dealer was generally an unfavorable credit risk; to-day his credit rating is generally "good." Hundreds of new retail merchants and contractor-dealers have come into the industry, and these all become customers of the jobber. In addition, electrical jobbers are now handling and distributing—at a saving—products of a number of the manufacturers who formerly marketed their products direct to retailers.

The Jobbers' Association has been shown the advantages of publicity and has for the past year conducted an advertising campaign telling frankly before the electrical trade its story of the jobbers' service as an indispensable economic factor. And not only are the jobbers advertising collectively as an association but a great stimulus has been given to advertising and publicity work by individual jobbers. Many of these wholesale houses have begun aggressive campaigns, directed at their own present customers and to make new retailer customers.

The present movement has been responsible for numbers of jobbers giving up the retail end of their business, which they formerly thought profitable but which upon investigation they have found to be a source of expense, in this way increasing their net earnings.

The jobbers' association has thrown open its own national meetings—enabling manufacturers, contractor-dealers and the trade press to be present and to gain a more comprehensive idea of the jobber's own problems.

As a result the contractor has obtained a comprehensive knowledge of the jobber's problems and is more sympathetic. Manufacturers who were indifferent are now seeking jobbers as distributers. The jobbers, on the other hand, are also attending local meetings of contractor associations and themselves learning more of the problems of the contractor-dealer and the reasons why many contractors were "poor credits" in the past.

MANUFACTURERS HAVE IMPROVED THEIR DISTRIBUTION

With the increase in the number of retail stores, operating on the new merchandising service basis, there has come to the manufacturers of electrical devices and supplies not only an increase in demand for their fast-moving lines but also a substantial increase in their established lines at a reduced selling expense.

Distributing through jobbers, electrical manufacturers to-day can predict their quotas better, for by obtaining definite commitments from jobbers the manufacturer is able to plan his production properly in advance and arrange his processes of manufacture in the most efficient way.

Manufacturers have been able to tap new territories, for with the establishment of hundreds of new retail outlets in communities never before reached by the electrical trade, electrical products are now finding an ever widening and increasing public. Moveover, there is the tendency for the manufacturer to produce a higher quality of merchandise than ever before, for discriminating purchasers are now demanding quality goods.

Problems of both the jobber and the contractor-dealer are being better understood by the manufacturing company, which is coming to appreciate the requirements of the trade as to quality and nature of product, methods of promotion and the proper discount schedules of various lines.

The public to-day is being informed regarding the labor-saving convenience values of electrical appliances by the sales efforts and individual publicity of thousands of retailers and wholesalers, in this way further stimulating the demand for the manufacturers' goods. It is undoubtedly this educational publicity, coupled with the tremendous increase in the number and effectiveness of retail outlets, that has contributed to the present tremendously expanded condition of the electrical appliance market, in which the manufacturers have been virtually swamped.

Manufacturers to-day are also coming to appreciate better the magnitude of the appliance and merchandising end of the electrical business, and to realize that there is tremendous business in the field of electrical appliances and labor-saving devices—business which exists in unlimited quantities.

THE NEW SERVICE TO THE PUBLIC

From the improved distribution of electrical goods resulting from the proper functioning of all trade groups, the public is being served rather than exploited. The marked increase in the sales of electrically operated labor-saving devices is only one illustration of the readiness of the American public to adopt modern improvements in the home with the same consideration for economies and convenience as when adopting them in the office and the factory. This increase in the volume of appliance sales is helping to bring about economies in their production and marketing, resulting in more favorable prices to the public than could have been possible with restricted outputs and individual and direct sales efforts.

Furthermore, electrical appliances to-day have been made easier for the public to buy. The customer has no longer to hunt or to go out of his way to find an electric shop. New stores are being opened daily in ever increasing numbers where there are found not only complete stocks of electrical goods, electrical conveniences and electrical labor-saving devices, but a spirit of service and an eagerness to tell the story of the "electrical way." Where the central station has also adopted this spirit and told its customers that the misnamed "current-consuming device" is really a "labor-saving device," the expensive commercial department has been converted into one that pays its own way.

Lighting customers are no longer required to pay for lamps they do not use as they were under the so-called "free-renewal" plan, where the cost of lamps and renewals was actually added to the customer's bill as a kilowatt-hour charge. Eight hundred companies have already replaced this out-of-date "lamp-renewal" plan with a lamp sales policy worked out on a merchandising basis, and in those cities lamps can now be purchased in any electric shop.

Contractors, in explaining the possibilities of providing "100 per cent installations" to their customers, installing outlets for every possible appliance need, locating lighting for the best possible results and placing switches for the greatest convenience, are doing a real service in showing the customer how to get the best possible service from his electrical investment and from electricity.

Articles in the daily papers and the general and household magazines and the newspaper advertising by manufacturers, jobbers and dealers who have followed the new merchandising activity in the trade have thrown new light on electric service and helped the public to understand and use those appliances to which the application of the expression "labor-saving" has a real meaning.

This better understanding of electric service tends not only to make the American home of a family of moderate means more effectively lighted but creates a demand for a complete service, calling for a wiring installation planned for convenience and efficiency in doing housework through adequate outlets and provisions for the motor-operated and electrical heated devices which at small cost transform the kitchen and the laundry in keeping with the tastes and inclinations of the average housewife.

TAXES have to be paid by the public. They cannot be imposed on any class. There is no power that can prevent a distribution of the burden. The landlord may be the one who sends a check to the public treasury, but his tenants nevertheless make the payment. A great manufacturer may contribute a large share of his income, but still the money comes from the consumer. It is impossible to escape the conclusion that high taxes make high prices. So long as the cost of government is high the cost of living will be high.—*Calvin Coolidge, Governor of Massachusetts.*

Readers' Views and Comments

Need for the Measurement of Glare

To the Editor of the ELECTRICAL WORLD:

SIR: It has occurred to me that you might want to insert in your paper the fact that there is a need which is felt in the illuminating engineering field for glare measurement. Glare interferes with vision and, besides being the cause of eye strain, headache, etc., is also the cause of serious accidents. It is often of importance in connection with the industrial codes and other good lighting specifications to be able to designate a degree of glare as an upper limit in a measurable quantity. Some attempt has been made to describe such a limit in terms of equipment, but this does not seem practicable or equitable as between different types of lighting units and equipment.

The art and practice of lighting would be advanced very materially if we had a simple portable instrument comparable with a foot-candle meter which inspectors, engineers and others could use to measure and to assign at least approximately the degree of glare throughout the objectionable range encountered from any point of observation in a room lighted either naturally or artificially. There is a similar need, through perhaps different ranges, in connection with street lighting and railway or automobile headlighting. Such an instrument might be called a "glarometer," "diffusometer," "contrast meter" or "brilliancy meter," according to the principle that would be most practicable for ordinary convenience.

While Messrs. Nutting, Cobb and others have carried on considerable laboratory research regarding the elements of glare, there is still a need for further investigation, especially as regards the practical interpretation and application of the principles under actual installation conditions. Even after the general standards are established, there will be a need of a means by which a non-scientific inspector can assign values to the conditions as encountered in any particular room or installation.

As glare involves physical, physiological and perhaps psychological values, accurate determinations constitute a difficult laboratory problem. After a number of years of study, it is possible to give only a very rough and unsatisfactory glare specification, which, in the case of a state code, leaves altogether too much to the individual judgment of inspectors.

For example, the codes of the States of Pennsylvania and New Jersey simply require that lamps shall be properly shaded to minimize glare. The New York code applies this to lamps less than 20 ft. (6.1 m.) above the floor level. Wisconsin, which is experimenting with specifications a little more definite, provides that lamps suspended at elevations above eye level, less than one-quarter their distance from any position in which work is performed, must be shaded in such a manner that the intensity of the brightest square inch of visible sources will not exceed 75 cp. Lamps suspended more than 20 ft. above the floor are excepted. For local lighting this code provides that the brightest square inch in view from any position at which work is performed shall not exceed 3 cp. This provision in the code is supplemented by a number of explanatory notes.

From this you can see that a very vital welfare factor is involved. It is evident that a degree of glare which is a serious objection to one operation may be harmless for another. As a considerable economic factor is involved, it is important to avoid unnecessary hardships for industries in which large areas are employed for operations making only slight requirements as far as vision is concerned, and where the workers are otherwise safeguarded.

With these things in mind, I have made a few crude attempts at a design of an instrument for field measurements of glare, and several engineers of my acquaintance have worked on the problem, but I have seen nothing yet that looks practicable. I am sure that any useful development along these lines will be warmly welcomed by the illuminating profession.

G. H. STICKNEY.

Edison Lamp Works, Harrison, N. J.

Cost of Handling Ashes in a Small Plant

To the Editor of the ELECTRICAL WORLD:

SIR: In the Aug. 30 issue of the ELECTRICAL WORLD, page 458, an article appeared giving a comparison of costs of handling ashes by the old wheelbarrow method and a steam conveyor. The plant considered contained one 500-hp. and five 150-hp. boilers. The costs per day of the two systems were given as follows in the article referred to:

Old method:		
Two ash wheelers..........	$10.88	
One teamster	4.08	
One horse and feed.........	1.50	
		$16.46
After installing conveyor:		
One laborer (nine hours)..........		4.08
Saving in twenty-four hours......		$12.38

The figures for the old method include nearly everything entering into the cost of ash removal. The figures for the new method carried one item, namely, labor. What were the charges known as "overhead," which includes interest on investment, depreciation, insurance and taxes; the maintainance charges; the cost of steam?

The plant described would probably not have in constant operation more than five boilers, one being down for cleaning. Assuming that the average load is 1100 hp. and that a boiler-horsepower-hour is developed on 5 lb. of coal, then the coal consumed per hour is 5500 lb., or 132,000 lb. (66 tons) per day. If the coal contains 12 per cent ash, the amount of this per day is a little less than 8 tons. Dividing the cost, $10.88, by the 8 tons of ashes, we have $1.36 as the cost per ton for wheeling alone. The conditions of ash removal, pits to wagon, must be rather unusual to limit a man's efforts to 4 tons per day or shift. The total cost of ash removal is 16.46/8 = $2.06 nearly. Such a cost is very unusual even for wheelbarrow removal in a small plant.

Kansas City, Mo. C. O. SANDSTROM.

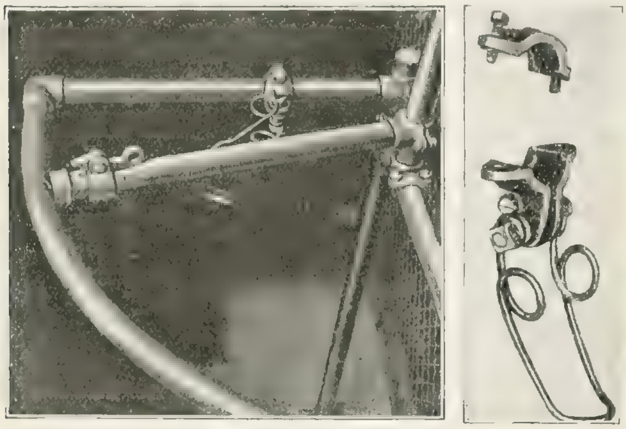
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

SPRING PREVENTS ARRESTER FROM REMAINING ON CHARGE

Pushes Charging Handle Back so that Carelessness on the Part of an Operator Cannot Result in Short-Circuited Arrester

To prevent an aluminum-cell lightning arrester from remaining directly connected to a line after it has been charged, a spring device clamped to the arrester frame has been designed by Alfred Herz, engineer of electrical tests of the Public Service Company of Illinois. When the handle is in the charging position the steel spring is under compression, and it is returned to normal position when the operator releases the handle. This device was thought necessary by the company because an aluminum-cell lightning arrester left on the line will become a hazard instead of a protection. The arrester will grow hot, dissolving the hydroxide film, and in about an hour's time the insulating oil will be hot enough to ignite. This burning oil will boil out of the tank, and in all probability it will set fire to surrounding objects and the cells will be short-circuited. Entire substations have been practically destroyed after short-circuiting of an arrester which was inadvertently left connected to the line.



STEEL SPRING RETURNS ARRESTER HANDLE TO NORMAL POSITION AFTER CHARGING

Arrester handle locked shut while photograph is being taken

PROTECTIVE MEANS FOR AN OUTDOOR BOILER BREECHING

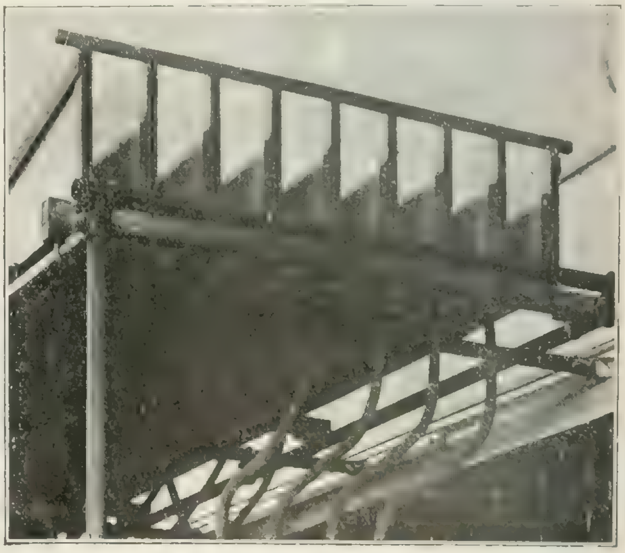
Insulation Placed Inside Breeching Protects Metal from Action of Gases and Permits Less Rapid Deterioration

The boiler-house design at the Moline plant of the United Light & Railways Company, Moline, Ill., made it advisable to put the boiler breeching on the outside of the plant. Heat insulation was therefore considered necessary to avoid excessive temperature drops in the breeching. A 2-in. (50-mm.) layer of "Vitrobestos" was fastened to the inside of the steel-plate boiler breeching by means of ¼-in. by 3-in. (8-mm. by 7.5 cm.) bolts staggered on 18-in. (45.7-cm.) centers. The joints between the sheets of insulation were "pointed up," and all exposed nuts or other metals were thoroughly coated and protected from the gases of combustion. Placing the insulation on the inside of the breeching did not affect its heat-resisting qualities, and besides it gave the additional advantage of protecting the metal on the inside surface of the breeching. With the inside surface of the breeching protected in this way and with its exterior properly painted it is felt that deterioration should be less rapid than with the usual design.

HOME-MADE BUS BARRIERS PREVENT SHORT CIRCUITS

Consist of Nine Asbestos Boards Spaced 6 In. Apart Above the Oil Switches—No Metal Used in Construction of Barriers

To prevent short circuits caused by birds or in some other such way the barrier structure illustrated here has been installed for the 2,300-volt, two-phase busbars at the Silver Lake generating station of the Pittsfield (Mass.) Electric Company. The structure consists of nine asbestos board panels ¼ in. (6 mm.) thick and 12 in. (30 cm.) high held in place by oak spacers. The vertical clamping pieces at the end are in pairs, with strips each ⅛ in. (3 mm.) thick by 1¼ in. (31 mm.) wide, with horizontal top tie bars ⅝ in. thick by 1 in. deep (16 mm. by 25 mm.) and horizontal base tie bars 1¼ in. by 1½ in. (31 mm. by 38 mm.) in section, mounted at their ends on blocks 1½ in. square clamped

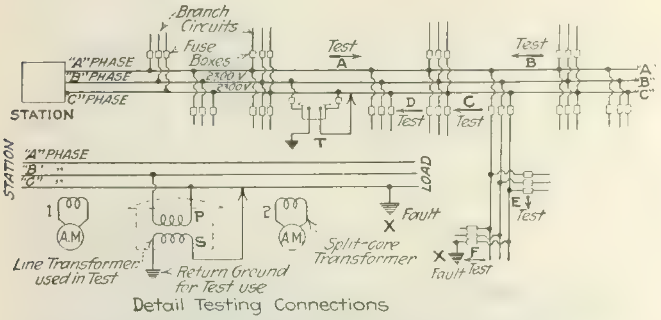


INSULATING BARRIERS PREVENT SHORT CIRCUITS to the pipe framing which supports the bus structure. The diagonal end piece shown is ⅛ in. thick and 1¼ in. wide. All the wooden framing was oil-treated before installation, and wooden dowel pins were used in place of nails to fasten the framing parts together.

LOCATING GROUNDS WITH PORTABLE TRANSFORMER

With Portable Current Transformer Position of Ground Is Determined from Direction of Current Caused by an Artificial Load

The customary procedure in locating a ground on a high-tension distribution feeder is to kill sections of the line by opening various main-line and branch-line fuse boxes until the station ground-detecting instruments show clearly when the defective section has been isolated. It is seldom possible to take these feeders out of service because of the number of small consumers, branch lines and transformers connected therewith. About the only way of testing for trouble on them has been to split the feeders into sections and isolate the defective part. Besides being slow and tedious, this process entails an interruption to the consumers fed from the section of the feeder on which the troubleman opens the fuse boxes, during the period required for him to descend the pole, telephone the station to ascertain if the ground has been cleared by the killing of that section of line, remount the pole and close the boxes. Furthermore, the fuse boxes frequently have broken down while being opened under heavy load, causing additional interruption.



METHOD OF TESTING TO LOCATE GROUND

The artificial circuit required is shown at *T*. *A*, *B*, *C*, *D*, *E* and *F* are the directions of test currents that will be observed at various points indicating the boundaries of fault.

One way in which grounds may be located without these objections is to establish an artificial circuit anywhere on the grounded phase, by means of the transformer shown at *T*, causing current to flow from that point to the ground. The direction of this current will indicate the relative direction from the testing point to the ground. From tests made at different parts of the feeder the boundaries of the artificial circuit may be determined and the ground fault located.

To illustrate the method used a typical 2300-volt distribution feeder with its main and branch lines is shown herewith. A ground somewhere on the "C" phase of it is indicated by the station ground detectors. The troubleman selects a distribution transformer fed from the grounded phase, of such size—15 kw. to 50 kw.—as will give him ample testing current, and which is not carrying load or only such load as may be cut to another transformer. The transformer is disconnected from the secondary distribution lines. One side of its secondary winding is connected to a known ground, a trolley-wire pole or fire hydrant; the other side is used as the test lead and connected to the grounded conductor of the feeder, as at *A* in the figure.

Full-load secondary current of the transformer will flow through the "C" phase conductor from the point *A* to the ground, shown at *X*. By connecting a split core or portable current transformer on the "C" feeder conductor on each side of the distribution transformer—as at 1 and 2 in the detail drawing—the current of the artificial circuit will be found to exist only in the direction of the arrow, or away from the station. A jump is made along the main line to, say, the point *B*, where the current transformer when put on the "C" phase registers only the normal current of the feeder, showing that the artificial circuit does not extend this far and that the ground lies back toward the station. Tests at points *C* and *D* give the same results as at *B*. The trouble therefore lies in the branch between *A* and *D*. At *E* the extra current is obtained, and the test at *F* definitely locates the fault in that spur.

Before establishing the artificial circuit the troubleman ascertains the load of the feeder at that point by means of his current transformer. For the return-ground connection to the distribution transformer a high-resistance connection must be obtained in order to limit the current and prevent an overload burning out the transformer. The ground connection to the transformer is made before the test-lead connection to the feeder conductor. Before making the latter the current transformer is placed on the test lead and that lead merely touched to the feeder conductor, while the ammeter is being observed to see if the transformer takes too much load. Should such be the case, the ground connection is changed to obtain greater resistance, and with the current transformer in place on the test lead this lead is flashed against the feeder conductor and the ammeter watched. When a suitable current has been obtained the test lead is permanently connected to the feeder conductor and so left until the troubleman has completed his tests at different points on the feeder and definitely located the trouble.

Philadelphia, Pa. FRANK GILLOOLY.

COMMUTATION IMPROVEMENT INCREASES EXCITER CAPACITY

Removing Shims from Behind Field Poles and Providing New Brush Equipment Offsets Reactive Kva. and Heavy Overloads

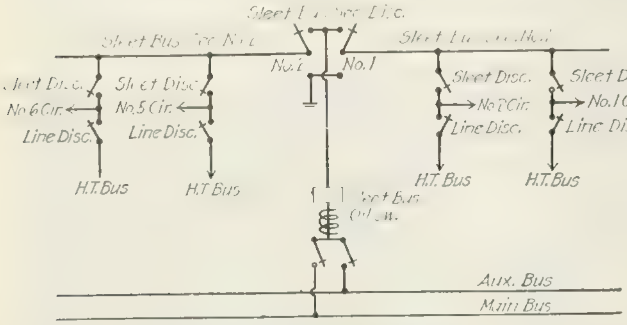
Owing to the heavy station loads and the very large proportion of the Baltimore reactive kva. thrown on the Holtwood plant of the Pennsylvania Water & Power Company steps had to be taken recently to provide additional excitation when the requirements approximately reached the limit of the installed apparatus. It was first thought that a new exciter set would have to be obtained, but a plan was worked out which obviated this expenditure. This consisted of removing the shims from behind the field poles of the waterwheel-driven set to improve the commutation and of replacing the original brush structure by a new type of improved design. By making these changes it is expected that the available direct-current capacity of the station for excitation will be increased by 800 amp.

At the time of this change switching equipment was tested for the higher rating, and with the exception of ammeter shunt the existing installation was found of sufficient capacity to operate safely under the increased loading. This additional excitation capacity at a nominal expense will take care of the excitation and direct-current requirements for some time to come.

MELTING SLEET FROM HIGH-TENSION LINES

It Disappears When the Cables Become Energized by Means of Current Flowing from Low-Tension Buses

In order to prevent sleet from forming on the high-tension lines and thus jeopardizing service, facilities are provided by the Consolidated Gas, Electric Light & Power Company for quickly connecting the Baltimore and Lancaster circuits to a low-tension bus. By this means it is possible to feed the proper amount of heating current directly from the low-tension bus into the high-tension circuit. The lines are short-circuited at the opposite end from the source of supply. Sleet will drop off the wires within a few minutes after they have been heated.



ELIMINATING LINE TROUBLE FROM SNOW AND SLEET

Ordinarily if high-tension circuits were paralyzed the telephone service would likewise be interrupted, although the supplying end of the line would not know of any trouble. This difficulty, however, is eliminated by means of a high-tension signaling system.

The installation at the Baltimore end consists of a short-circuit bus and the necessary disconnecting switches, series transformers and indicating instruments for each circuit. Most of this equipment was available for service during the last two winters and has been used with success on several occasions. It practically eliminates snow and sleet trouble as a source of service disturbance at a very negligible loss of capacity.

N. B. Higgins.

Baltimore, Md.

LIFE OF RECTIFIER TUBES USED WITH SERIES ARC LAMPS

Average Cost per Street Lamp for Tubes Needed for the Rectifiers from July 1, 1918, to July 1, 1919, Amounted to $3.29

During the year ended July 1, 1919, the average life of mercury-arc rectifier tubes used in connection with the series magnetite street-lighting system of the Southern California Edison Company was 754 hours. As there were 2275 arc lamps on the entire system supplied through these rectifiers, the average cost per lamp per year for tubes amounted to $3.29. The average life of tubes obtained in different substations or districts varied from 205 hours to 1852 hours, and the cost per lamp per year varied in a like proportion. This variation can be attributed to the operation and care of station regulator equipment and also to the condition of the circuits as regards freedom from grounds, etc.

The vacuum in these rectifier tubes is often restored by boiling them in water for about an hour. A little "Bon Ami" is used in the boiling water to remove the oil and clean the tube thoroughly. This process restores a good many tubes for additional use.

In stations where proper operating temperatures are not reached because of the local conditions, good results have been obtained by warming the oil to 65 deg. C. (149 deg. Fahr.) before starting the rectifier. This is easily done by inserting an incandescent lamp in the oil for a short time.

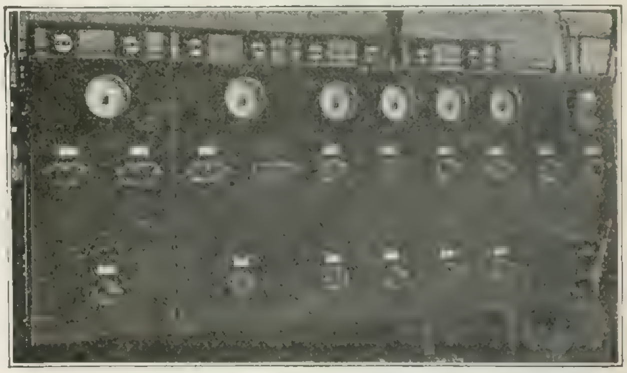
F. B. Lewis,
Superintendent Los Angeles District.

Los Angeles, Cal.

SERIES INCANDESCENT SWITCHBOARD HOME-MADE

Five-Panel Board Built by Pittsfield Electric Company for Substation Use Saves 50 per Cent of Purchase Cost

At the Renne Avenue substation of the Pittsfield (Mass.) Electric Company a five-panel switchboard for series incandescent lighting circuit control has recently been built by the company. The panels are of asbestos board, the standard size being 2 ft. wide, 3 ft. 8 in. high and 1 in. thick (60 cm. by 100 cm. by 2.5 cm.) mounted on 1¼-in. (31-mm.) pipe framing. At the top there is a row of jacks for testing or for pilot-light service, mounted on 6-in. by 8-in. (15-cm. by 20-cm.) fiber bases ¼ in. (6-mm.) thick, carried on 1¼-in. by ¼-in. strap iron. The lower switches control the energizing of the primaries of the regulators, installed on the floor behind the board, and the upper switches control the outgoing circuits. Those on the two left-hand panels are arranged so that if trouble occurs on either loop of a pair of outgoing circuits, one loop may be cut out of service and the other maintained. A totalizing watt-hour meter and main switch governing the supply of energy to the entire installation of regulators and rectifiers (used in connection with local street arc service) are provided on the right-hand panel. It is estimated that the company saved 50 per cent of the cost of a new board by building the one illustrated.



ASBESTOS BOARD PANELS SAVE 50 PER CENT OF THE COST OF A NEW BOARD

INDUSTRIAL APPLICATIONS

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

ELECTRIFIED OIL WELL PROVES TO BE ECONOMICAL

Allows a Saving of $3,665 in the Drilling of One Well and Requires Very Little Operating Attendance

Figures compiled by the engineers of the Empire Gas & Fuel Company at Bartlesville, Okla., show that the company saved $3,665 by the use of electric power, as compared with the cost of steam power, in the drilling of its No. 27 Stokes well in the Eldorado field. The report given out by the company showed the new method to be exceedingly simple. Except to have fuses replaced on two or three occasions, no serious trouble was encountered with the 75-hp. driving motor. The company figured the saving as being due in part to the motor, which cost $1,625, a saving of $237 over the cost of a boiler and engine, and in greater degree to the elimination of fuel oil, which with steam-driven equipment would have cost $2,160. Other small savings were obtained in the smaller depreciation per well, amounting to only $257.50, and in the cost of water, which was cut down from $480 to $60. In only one instance was the cost with electricity greater, and that was in installation. The excess here was due to the fact that the equipment was new and changes had to be made involving labor charges that it will not be necessary to figure in the future.

METHOD OF OBTAINING VARIOUS TEST VOLTAGES

Potential of Generator Made to Boost or Buck Line Voltage in Order to Provide Right Potential to Test All Motors

Motor repair shops are usually situated where only one source of energy is obtainable and some means must be devised to obtain both direct and alternating current energy at various voltages. Sometimes different-type generators are installed, but this method is obviously expensive and usually repair shops are not equipped with the means for wide voltage variation.

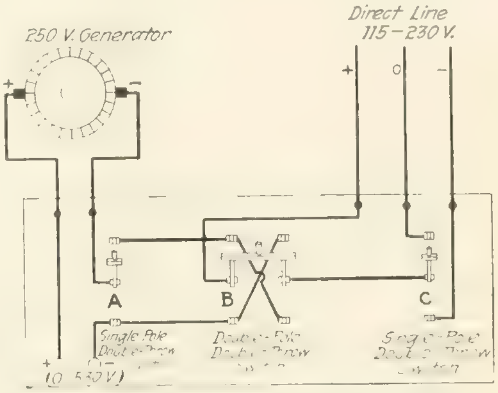
A rather wide range of voltages was obtained in a repair shop in the Middle West by the use of a 250-volt generator for bucking or boosting a constant potential of 115 volts or 230 volts. In this way a voltage range of zero to 500 volts was made available. Switches are arranged so they can be manipulated to get the range of voltages shown in the accompanying table. By adjusting the field rheostat small gradations of voltage can be obtained on account of the field being well saturated.

SWITCH CONNECTIONS FOR CHANGING VOLTAGE

Voltage At	Switch Position Switch A	 Switch B	 Switch C	Action of Generator
0–70	Up	Down	Down	Bucks line voltage of 230 v
35–185	Up	Down	Up	Bucks line voltage of 115 v
150–300	Down	Open		Works alone
265–415	Up	Up	Up	Boosts line voltage of 115 v.
380–530	Up	Up	Down	Boosts line voltage of 230 v

On alternating-current work voltage variation is obtained from a polyphase generator by varying the field in small steps. Two field rheostats are used in series. Both are of the same current capacity, but one has seventeen resistance steps of nearly 2 ohms each while the other has twenty steps of 0.1 ohm each, which makes the total resistance of the smaller unit equal to one step of the larger unit. The two rheostats are geared together with a twenty-to-one ratio so that with proper timing of the gears a step on the higher unit is cut in just after the lower unit passes from "all resistance in" to "short." Thus by continuous rotation of the handle on the smaller unit a resistance variation by the small steps of this unit is obtained throughout the wide range of the higher unit. E. E. GEORGE.

Chicago, Ill.



OBTAINING A WIDE VOLTAGE RANGE

METHODS USED IN TESTING FOR ALTERNATING CURRENT

Waving Stick in Front of Bulb—Touching Conductors to Carbon or Water—Lamp Bulb and Magnet Test

Waving a stick before an incandescent bulb, a very common test for alternating current, will present to the eye a series of images of the stick as it swings through the arc if the current is alternating, and merely a blur if the current is direct. If a piece of carbon is placed in series in a circuit, by simply resting conductors against it at two points a distinct buzzing sound will emanate from the carbon with alternating current but none at all with direct current. Practically the same effect will be noticed by touching the two conductors lightly to the surface of water.

A test that is not only excellent for detecting very slight alternations in a current but also a fair indicator of fluctuations in cycle and voltage may be performed as follows: Introduce an incandescent carbon-filament bulb, one with the simple loop filament, between the poles of a permanent magnet. The filament will oscillate rapidly in step with the cycle of the current. At first its movement may be rather erratic, but by careful adjustment of the bulb's position in the magnetic field it may be limited to a steady oscillation which will appear to the eye as a broad band of light, sometimes $\frac{5}{16}$ in. (8 mm.) across its widest point. A change in cycle will be indicated by a hesitancy in the oscillation of the filament until it regulates its movement again to the different cycle. Voltage increase or decrease is indicated by a corresponding increase or decrease in the breadth of the oscillation. This action of a filament carrying alternating current is produced regardless of the material or alloy of which the filament is formed. It is not advisable to use a tungsten bulb because this filament is not so rugged as the carbon filament and is strung so closely that short-circuiting of the filament along one or more points of its length would follow if the adjacent sides of a loop of the filament should oscillate only ¼ in. (6 mm.)

Joseph Braff.

New York, N. Y.

DATA SHEET EMPLOYED FOR TESTING INDUSTRIAL MOTORS

Lists Manufacturer's Guarantee of Both Machine and Motor and Records All Tests Since Machine Was in Use

When motor-driven machines have a constant and regular output, such as printing presses, automatic screw machines, etc., the record and test card produced here has proved extremely valuable. Each machine in the plant has an individual card on which the manufacturer's guarantee of both the machine and motor is listed. This in itself gives a fairly good idea of the suitability of the motor for the machine.

Every time the machine is tested the results of the test are recorded on the data sheet, and it is easy to make a comparison between the requirements and the actual operation. If the number of duty cycles (impressions) per hour is low, it can be readily seen what adjustments are necessary.

W. A. Harris.

New York, N. Y.

MACHINE										MOTOR											
Mach. No.	Size of Bed	Driving Wheel Shaft				Gear or Pulley Data	Impression per Hour			Motor No.	Type	H P.	Volts	Amps.	R.P.M.	Field	Size of Frame	H. P. Output	Rev. per Minute		
		Rev. per Impres.	Min.	Norm.	Max.		Min.	Norm	Max.										Min.	Norm.	Max.

TEST										REMARKS	
Controller Notch	Volts			Amps.	H.P.	Rev. per Min.		Impressio per Hour	Date		By
	Line	Arm	Field			Motor	Mach.				

ALLOWS EASY COMPARISON OF OPERATION AND REQUIREMENTS

COST COMPARISON FOR MAKING FOUNDRY STEEL

Operating Costs for Liquid Steel in the Ladle Under Favorable Conditions as Made by the Converter and Electric Furnace Processes

That the electric steel furnace is especially economical when operated twenty-four hours a day is shown in the two accompanying tables, which are included in a paper on electric furnaces read before the American Society of Mechanical Engineers recently by W. E. Moore. These figures are present-day comparative operating costs for liquid steel in the ladle under favorable conditions. The average cost per ton for two tons of converter steel, divided into per capita charges, amounts to $45.63, whereas the average cost per ton for a 3-ton acid-lined rapid-type polyphase electric foundry furnace steel amounts to only $21.59. This saving is made in spite of the fact that the fuel cost for the converter is considerably less than the electric furnace. Scrap steel can be utilized in the electric furnace whereas pig iron is necessary for the converter in most cases. In addition, the labor cost in the electric foundry is only one-third of that in the non-electric shop. With electrode cost figured at 7 cents per pound of steel, this cost amounts to $1.40 per ton of steel melted.

TABLE I—AVERAGE COST PER TON FOR TWO TONS OF CONVERTER STEEL DIVIDED INTO FOUR CUPOLA CHARGES

Two-ton Converter Charge	Cost per Ton of Liquid Steel
Low-phosphorous pig iron	$14.09
Bessemer pig iron	7.89
Steel scrap	10.14
Silicon and spiegel	5.55
Coke, 863 lb.	1.01
Cost of material per ton of liquid steel	$38.68
Additions per ton of steel:	
10 lb. 80 per cent ferromanganese at 6 cents	0.60
6 lb. 50 per cent ferrosilicon at 5 cents	0.30
2 lb. aluminum at 30 cents	0.60
Power for blower motors	1.25
Cost of materials and power per ton of liquid steel	$41.43
Average cost of cupola and converter linings	1.20
Labor costs	3.00
Cost of converter steel per net ton in ladle	$45.63

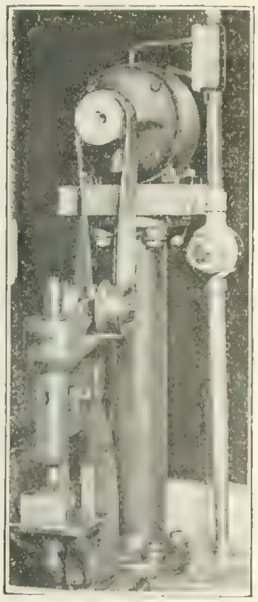
TABLE II—AVERAGE COST PER TON FOR THREE-TON ACID-LINED, RAPID-TYPE, POLYPHASE ELECTRIC FOUNDRY FURNACE STEEL

Three-ton Electric Furnace Charge	Cost per Ton of Liquid Steel
Axle turnings (included above 3 per cent losses, 200 lb.)	$12 40
Mill scale (included above 60 per cent losses, 60 lb.)	0 09
Electrodes at 7 cents	1.40
1650 kw.-hr. (550 per ton) at 1 cent per kw.-hr.	5.50
Losses in melting 260 lb.:	
80 per cent ferromanganese	0.40
50 per cent ferrosilicon	0.25
Aluminum at 30 cents	0.15
Cost of material per ton of liquid steel	$20.19
Average cost of linings and roofs	0.40
Labor cost on furnace attendance	1.00
Cost of electric steel per net ton in ladle	$21 59

MOTOR MOUNTING DESIGNED FOR RIVETING MACHINE

Compact and Simple Pedestal Support Provides Method of Mounting Motor Used for Short Belt Drive

By mounting the motor driving a small Grant riveter on a pedestal an unusually compact support has been obtained as shown here. The motor, a ¼-hp., 110-volt Westinghouse single-phase unit, is bolted to a 5¾-in. by 7-in. by 1½-in. (14.6-cm. by 18-cm. by 3.7-cm.) wooden base, which in turn is attached to a pipe flange mounted on a 2½-in. (6.2-cm.) pipe pedestal. Four ¼-in. (6-mm.) bolts attach the motor to its base, the motor shaft being placed with its axis at right angles to those of the main driving pulley and idlers. A smaller pedestal would serve the purpose fully as well, the size shown being used on account of its availibility.



The service for the motor and for a group of similar units mounted on the bench is carried downward from overhead branch feeders through a ½-in. (1.3-cm.) rigid conduit equipped with a snap switch and condulet fitting for the motor. Thus the control of the motor is within easy reach of the working center of the riveter without being an obstruction.

METHOD OF ASCERTAINING CORRECT BRUSH POSITION

"Kick" Method Is Thought to Be Best Procedure as It Depends Upon Transformer Action Between the Field and Armature Conductors

Because correct brush position is of great importance in the operation of interpole machines, this is usually marked on the rocker ring by the manufacturer before shipment. On some older machines the brush position is not marked or is marked wrong, and it is usually advisable to determine it correctly. This is also important after armature rewinding. The "kick" method is thought best as it depends upon the transformer action between the field and armature conductors. To set the brush position by the "kick" method the armature cables and equalizer are disconnected and insulated. After the resistance in the field rheostat is "cut in" in series with the field the brushes are set at what is thought to be the correct position on the commutator bars, which are connected to the coils of the slots directly under the centers of the interpoles. A low-reading voltmeter (3-volt or 5-volt scale) is connected to one positive and one negative brush stud, and the main switch is closed and quickly opened again. If the voltmeter needle "kicks" one way when the switch is closed and the other way when it is opened, the brush position is wrong. The brushes should be adjusted until the position is found where the needle does not "kick."

CONSUMPTION RECORDS OF ELECTRIC MINE HOISTS

Averages for One Year from Eight Mines Show from 2.2 Kw.-hr. to 2.9 Kw.-hr. per 1000 Ton-feet Hoisted Under Different Conditions

The maximum power demand of mine hoists may vary greatly with the choice of electrical equipment, but the energy consumption seems more nearly to approach to a constant value. Records taken over a period of twelve months from eight vertical-shaft iron mines on the Marquette range, Michigan, show an average energy consumption of 2.6 kw.-hr. per 1000 long ton-feet (310 t.m.) and a maximum variation from this figure of about 15 per cent. This average energy consumption is for hoisting more than 1,258,000 long tons (1,278,000 m.t.) from an average depth of nearly 600 ft. (180 m.). The annual tonnage hoisted by the different mines varied more than five to one, and the average depth had a range of more than three to one.

ENERGY CONSUMED PER 1000 TON-FEET HOISTED FROM VERTICAL-SHAFT MINES

Mine	Long Tons Hoisted	Average Depth Hoisted (Ft.)	Kw.-Hr. per 1000 Ton-Ft	Motor	Hp	Drive	Type of Hoist	Unbalanced Hoist Capacity in Lbs.	Maximum Rope Speed, Ft. per Min.
A	320,893	610	2.5	*A.C.	500	Geared	Balanced cage, men and material	7000	1000
B	82,675	300	2.9	A.C.	200	Geared	Balanced skip and cage, men and material	6000	750
C	98,021	885	2.4	A.C.	400	Geared	Balanced skips for material only	6500	1000
D	146,362	400	2.6	A.C.	400	Geared	Balanced skips for material only	7000	1000
E	63,305	800	2.6	A.C.	400	Geared	Balanced skips for material only	7000	1000
F	345,909	950	2.7	2 D.C. on one Ilgner M.G. set	200 500	One geared One direct-connected	One balanced gage and one balanced skip	8000	1500
G	74,297	360	2.2	A.C.	200	Geared	Balanced skips for material only	6500	600
H	126,901	435	2.6	A.C.	400	Clutch	Double-drum unbalanced skip and cage, men and material	6000	600
Total	1,258,363	....	...						
Average	157,295	592 5	2.6						

* All alternating-current motors are three-phase, 60-cycle, 2200-volt wound-rotor type.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

INSPECTION DEPARTMENT PROVES TO BE A SUCCESS

Metropolitan Edison Company of Reading, Pa., Is Obtaining Good Results from a New Part of Its Organization

The Metropolitan Edison Company of Reading, Pa., is obtaining good results from an inspection department which was added to its organization several months ago. This department obtains any information that may be desired about service, sees that customers are billed in accordance with schedules filed with the Public Service Commission, and looks after periodic inspection of customers' equipment.

The department has greatly improved the efficiency of the daily inspection routine, increasing the average inspections per day per man from four to fourteen. Information obtained and investigations made with reference to rates being charged for different kinds of service to customers have resulted in increasing the revenues of the company many thousands of dollars per year.

The department has also taken care of nearly 3,500 changes in rate authorizations made necessary by the filing of new schedules with the Public Service Commission which became effective Nov. 1, 1919.

THE H. L. DOHERTY SCHOOL FOR SECURITIES SALESMEN

How This Organization Is Conducting a Course of Study to Give Men Knowledge of Properties and Training to Sell Securities

BY L. F. FULD

Educational Director, Bond Department, Henry L. Doherty & Co.

The Doherty school for securities salesmen was established by Henry L. Doherty & Company in the autumn of 1919 for the purpose of furnishing instruction in the fundamentals of securities to ambitious young men and incidentally of increasing the available number of securities salesmen in this country.

The school was not established primarily for the employees of the Doherty organization, although such employees are admitted to the school on the same terms as applicants from other organizations. Nor was the school organized primarily for the purpose of recruiting securities salesmen for the organization, although it is now the policy of the organization to appoint as securities salesmen only men who have completed the course of instruction in the school.

The course of study in the school, which covers a period of two months, consists of discussion periods, inspection trips, collateral reading and written tests. Of the twenty discussion periods, seven are devoted to securities, five to utilities, four to salesmanship and four to the securities of the "House of Doherty." A written test is given to the students at bi-weekly intervals, each covering the work of two weeks of instruction.

The students are taken on field trips to afford them an opportunity to inspect public utility and industrial properties from the point of view of a prospective investor. The financial and operating conditions of the company are thoroughly explained to the students on these trips, and each student is required to submit a written report on a hypothetical investment problem connected with the property inspected. A street-railway property, a telephone property, a central power station, a water plant and an oil refinery are inspected during the course of the two months of instruction.

To each member of the class a reader's card in the New York Public Library is furnished and a list of seventeen books recommended for collateral reading. The New York Public Library furnishes these cards and these prescribed books to the students in the school free of charge. The students are, for purposes of instruction, divided into two sections, each of which meets on alternate mornings from 7:45 a.m. to 8:45 a.m. in an auditorium in the financial district. Instruction is given in the morning rather than in the evening because in the strenuous business life of the present day the man who is worth while is physically and mentally exhausted in the evening and the school is interested only in men of this type. By giving the instruction under the plan followed at present each student is able to report at the desk of his present employment every morning promptly at 9 o'clock.

As to method of instruction, neither the elementary school method of having the pupils recite from text books nor the free-lance method of entertaining the students with a lecture is followed. An effort is made by means of the discussion of investment problems to draw from each student the knowledge which he possesses or has obtained from his collateral reading and to supplement this with the knowledge which he should possess to become an efficient securities salesman. It is believed that this discussion serves as a stimulus to attention and as an aid to memory.

To each student who satisfactorily meets all of the requirements of the school the diploma of the school is awarded. For graduation each of the first three fortnightly reviews is given the weight of one, the final examination is given a weight of three, and the factor of salesmanship a weight of four.. In the subject of salesmanship each student is required to make a sale to at least three customers during the time he is in attendance at the school. For his sale to the first customer he is given a rating of 40 per cent, for his sale to the second customer 20 per cent, for his sale to the third customer 10 per cent, and for his sale to each additional customer 2 per cent, with a maximum of 100 per cent. For graduation, 70 per cent is required on the factor of salesmanship, 70 per cent in the final review, and a general average of 70 per cent. The organization tenders a graduation luncheon to the graduates at the conclusion of the course, and diplomas are distributed to the graduates at that time.

An effort is made to keep in touch with the alumni of the school and to assist them in every possible way in the realization of their individual ambitions. No graduate is offered a position in the Doherty organization unless he has maintained a satisfactory standing in the school and expressed a desire for such a position at graduation, nor is any graduate taken into the organization except with the knowledge and approval of his present employer.

Of the twenty-one men who successfully completed the first class in the Doherty school for securities salesmen, six were employees of the organization at the time of their enrollment, three expressed a desire to join the organization at graduation and were admitted into the organization, and of the other twelve graduates, two continued the practice of law, in which they were professionally engaged, and the remaining ten continued in the employ of the following financial and investment institutions, with which they were connected at the time of their enrollment: Manufacturers' Commercial Company, Newburger, Henderson & Loeb, Salomon Brothers & Hutzler (two); Merrill, Lynch & Company, Calloway, Fish & Company, C. D. Halsey, New York Trust Company, Noel, Berman & Langley and Stacey & Braun.

The balance sheet showing the cost of conducting the first class in the Doherty school for securities salesmen is illuminating. The gross expenses, amounting to $850, consisted of $779 for salaries and $71 for rent. Gross receipts of $913 were earned by the organization from the sale of securities by the students, and after deducting from these gross receipts the commissions paid by the organization to the students net receipts of $228 remained. By the deduction of these net receipts from the gross expenses the net expenses of the class were found to be $622. As there were twenty-one graduates in the first class, the unit cost of each graduate was $29.64.

When the commissions paid by the organization to the students are considered, it can truthfully be said that not only do the students in the Doherty school for securities salesmen receive their instruction without fee, charge or expense of any kind, but in addition the successful students are paid by the organization a liberal sum during their attendance in the school.

REPLACING COLLECTORS WITH FOLLOW-UP LETTERS

Letters Following Bills and Discontinuance of Service on Twentieth of Month Get Better Results than Two Collectors

The loss of two collectors who were called into the army during the war necessitated a new system of collecting from customers of the Indiana General Service Company, Muncie, Ind.

Under the new system bills are sent out on the first of the month. Discounts are allowed till the tenth. About the fifteenth a second notice is sent to delinquents stating politely that there has probably been an oversight but also saying that if the bill is not paid by some definite date (usually the twentieth) the service will be cut off. This is lived up to pretty strictly. To have power cut on again, a charge of $1 besides the gross charge on the bill must be paid.

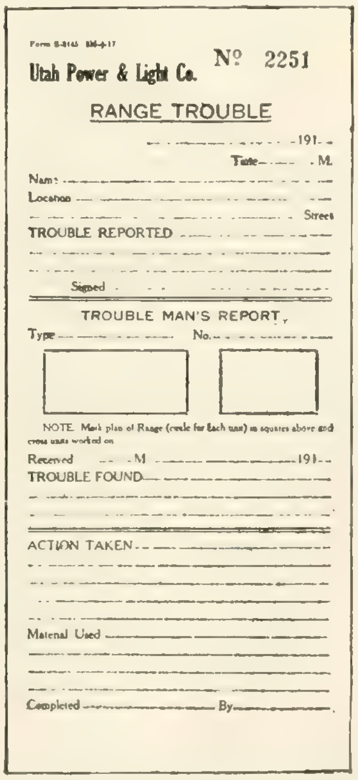
There was at first some fear of adopting this policy. There were many good accounts which had been allowed to run two, three or four months where the customers' personal relations with company officials were such that unfriendly feeling might otherwise result. However, when the customers realized that all were receiving the same treatment they were satisfied.

The number of delinquents has been reduced by 90 per cent to 60 per cent of what it used to be. Moreover, the cost of office work has not been increased and the salaries of two collectors are saved.

RECORDS IN HANDLING TROUBLES WITH RANGES

Question of How Maintenance Is to Be Handled Is Made Easier by Careful Records for Utah Power & Light Company

The question of how the maintenance department is to be handled is one of the most important which arises in the electric range business from the power company's standpoint. The Utah Power & Light Company has found that if the customer understands what has been done and what remains yet to be done, he is much less likely to become dissatisfied. Adequate records are valuable for the troubleman and the office. This company has worked out a complet set of tags, cards and office forms for its range business. The character of these is indicated by the one illustrated.



Utah Power & Light Co. Nº 2251

RANGE TROUBLE

191

Time M.

Name

Location

Street

TROUBLE REPORTED

Signed

TROUBLE MAN'S REPORT

Type No.

NOTE Mark plan of Range (circle for Each unit) in squares above and cross units worked on

Received M 191

TROUBLE FOUND

ACTION TAKEN

Material Used

Completed By

FORM ON WHICH UTAH CENTRAL STATION KEEPS CAREFUL RECORD OF CUSTOMERS' TROUBLES WITH ELECTRIC RANGES

A price, inspection and delivery tag is made out in duplicate. Twin tags are attached together so that they may be readily separated, one to go on the range to the customer, the other for the files, as a means of checking defects or damage which may develop after the range has left the storeroom. On this record is placed information on the amount of installments paid and due, if any. It is found that this obviates future controversy.

Information on inspection is transferred from this form to the card record kept of each individual range.

A duplicate form is used in handling range trouble reports. These are bound in book form and one copy is perforated. The trouble call is recorded in duplicate as it comes in and the original turned over to the range troubleman, who fills in the report on the work and returns it for filing. Record of the trouble is transferred also to the card for the individual range.

This general report is kept for each electric range customer. Date of installation, details of the range itself, inspection data and record of any trouble which may develop are kept. In addition the card contains space for such information as how the customer's house and kitchen are heated, what provision there is for hot water and whether the electric range displaces a coal or a gas range. This elaborate record also provides the necessary information for bringing about the sale of an electric water heater.

HANDLING RURAL BUSINESS IN STATE OF MINNESOTA

Company Collects $41,000 in Bonuses for Contracting Farm Lines in 1919 and Has Equal Prospects for 1920

One of the companies that have worked out a definite proposition to submit to farmers who wish transmission-line electric service is the Minnesota Gas & Electric Company of Albert Lea, Minn. Working under the program which the company has laid down, it has been able, according to H. L. Nichols, president, to take in something more than $41,000 in cash bonuses during the summer and fall of 1919. In that period it connected approximately 100 farms, and it has prospects of contracting with about as many more during the spring of 1920. The company's transmission-line proposition, as explained in one of its leaflets, follows:

Main transmission lines at 6,600 volts or higher from the company's generating plant in Albert Lea can be run to villages within a 20-mile (32-km.) radius from the generating plant. A proposition is made to the village at the end of such a line to vote the company a cash bonus toward the cost of the line on the basis that if a similar cash bonus can be raised from the farmers along the highway the company will proceed immediately to construct the line and furnish light and power service within a reasonable period thereafter at rates the same as would be made to these parties if they lived on Broadway in Albert Lea, plus about 10 per cent to cover losses in transmitting electrical energy to the villages and farms.

For example, a village located 10 miles (16 km.) from Albert Lea and large enough to furnish a substantial number of customers would be asked to pay a cash bonus to the company of approximately $7,000, about 30 per cent to 35 per cent of which would be returned to the village in the way of free service for street lighting, pumping, etc.

The farms within ¼ mile (0.4 km.) of the highway along this 10-mile (16-km.) line would be expected to advance a cash bonus of $250 each in case it was possible to obtain an average of three farms per mile. If only two farms per mile (1.6 km.) would contract, the average cost for the twenty parties would be $375. In either case the initial signers who made the line possible would divide equally the bonus to be paid by farmers who contracted after the line was built. Branch lines up to 5 miles (8 km.) in length can be constructed, and the farmers served would pay about $800 per mile toward the cost.

A ten-year contract would be made with each farmer specifying a minimum annual charge of $50 per farm, which would permit each farmer to use a total of 400 kw.-hr. during the year and all consumption over and above that amount to be billed at the end of the year at the rate of 8 cents per kilowatt-hour.

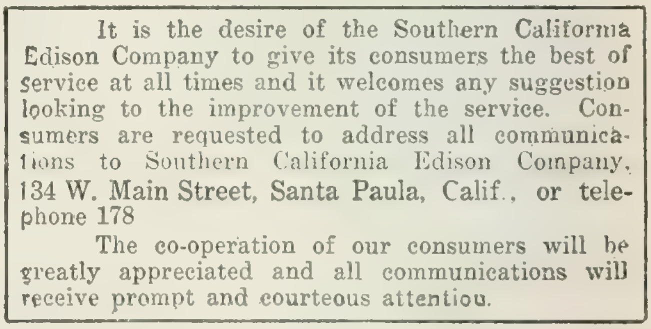
The initial bonus payment of $250, or more as the case might be, would be paid as follows: 25 per cent when the contract took effect, 50 per cent when the poles for the main transmission line were set, and 25 per cent when electric energy was available along the transmission line. Each farmer would further be required to advance about $120 toward the cost of transformers, lightning arresters, cut-out switches, service connections, etc., at the time they are installed, $50 of which would be returned to each in the way of free electric service up to the minimum charge for the first year.

The result of the above arrangement from the farmer's standpoint is that by making an investment of less than one-half the minimum cost of an individual light plant he obtains twenty-four-hour electric service not only for lighting but also for power up to 10 hp. in motors, and the total cost of electrical energy for both light and power is less than the depreciation item alone on an individual plant. At the same time the individual plant will not permit use of power for more than a 1-hp. motor, and then not with entire satisfaction. Farmers who have already contracted for this service have increased the value of their farms from $15 to $25 per acre and have obtained a commodity which not only greatly assists them in the labor problem but substantially increases the efficiency and progressiveness of their entire farm operations at a lower annual cost than could be obtained by any other method.

PUBLIC POLICY IN BILLS TO CONSUMERS OF ENERGY

How the Southern California Edison Company Uses Its Statements to Cultivate Public Feeling that It Seeks to Please

Very few customers are so perverse as to be annoyed at the mere receipt of their bill for the month's electricity, and yet in the receiving of every bill lie possibilities of misunderstanding. Possibly the amount is more than the customer feels just; possibly a mistake has been made in the past which he feels should have been rectified. The absence of all personal contact which must be part of the dealings of a large company with its subscribers is emphasized in the little printed slip which requests payment before such and such a day of the month.



It is the desire of the Southern California Edison Company to give its consumers the best of service at all times and it welcomes any suggestion looking to the improvement of the service. Consumers are requested to address all communications to Southern California Edison Company, 134 W. Main Street, Santa Paula, Calif., or telephone 178

The co-operation of our consumers will be greatly appreciated and all communications will receive prompt and courteous attention.

CULTIVATING GOOD RELATIONS WITH CUSTOMERS

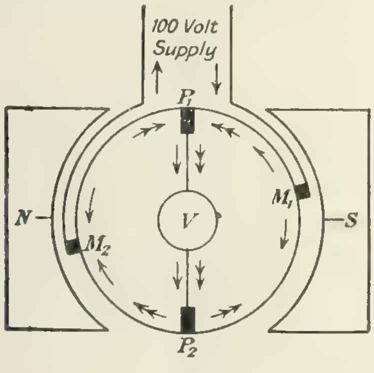
In order to forestall any feeling of annoyance, or the attitude of looking upon the electric utility as a cold-blooded corporation without any save a financial interest in customers, the Southern California Edison Company has adopted the custom of utilizing the reverse side of the bill for advertising purposes. Occasionally, of course, this involves the advertising of some one type of appliance or of a campaign which is being carried out, but more often it is a direct statement of good will toward customers.

DIGEST OF ELECTRICAL LITERATURE

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

A Back Emf. Booster.—G. BOWRON.—This paper is devoted to a description of a method by which the value of the back emf. can be made greatly to exceed that of the supply. Experiments were made with a 240-volt series fan motor, which was run unloaded on a 100-volt supply. An extra pair of brushes were provided as shown in the diagram. The two main brushes, M_1 and M_2, are connected to the supply. The normal position of these brushes is at the top and bottom of the diagram, but they are so arranged as to swing on either side of this position. In this way, any desired lead, forward or backward, can be given to the main brushes. The second pair of pilot brushes shown as P_1, P_2 are also adjustable, but unless otherwise stated they are used in the position shown in the diagram. They are connected to a voltmeter which indicates approximately the voltage generated in the armature by its rotation in the field. In the experiments brushes M_1 and M_2 were shifted in the forward direction from a position adjacent to P_1 and P_2 to a position of about 85 deg. lead. As the lead approached 40 deg. there was a rise in speed, accompanied by a rise in voltage at P_1 and P_2. As the brush lead was increased the speed still further rose until at 60 deg. the voltage was 160 and at 75 deg. the pressure reached its maximum at 190 volts. Beyond this point the speed and pressure dropped rapidly, and at 85 deg. the armature stopped. Similar results were obtained by giving the brushes backward lead. The author says that a large motor used as a step-up booster, as indicated in this article, should be efficient, but careful designing would undoubtedly be necessary in order to get sparkless commutation.—London *Electrician*, Oct. 24, 1919.



VARIOUS VOLTAGES PRODUCED AT *PP* BY MOVING BRUSHES *MM*

Lamps and Lighting

The Searchlight in the United States Navy.—RALPH KELLY.—The types and uses of searchlamps and signaling lights on naval ships are briefly described. A changed form of 12-in. (31-cm.) incandescent light is suggested which will insure the lamp-bulb filament always being at the focal point of the mirror and of the correct type for the application. The present type of low-power searchlight has many faults. These faults may be corrected by supporting the carbons rigidly near the arc, the positive carbon being held at the focal point by a simple automatic control. The best size and material of carbons should be used regardless of the burning ratio. There is room for a material reduction in the number and complexity of the parts in the high-power searchlamps in use at present. It is believed there is also a possibility of a considerable improvement in the electrodes. The use of the dome glass door enables a searchlamp to operate in close proximity to large-caliber rifles and makes it possible to build successfully even larger sizes of searchlamps than those at present in use. The star shell has great possibilities, but it is doubtful if it will ever supersede the high-power searchlight.—*Proceedings A. I. E. E.*, December, 1919.

Generation, Transmission and Distribution

Water Power in Iceland. — SAETERSMOEN and C. RABOT.—Iceland is, for its size, tremendously rich in water power, an estimate indicating 4,000,000 hp. available on the island, whose total area is a little bigger than Maine's. Upon initiative of the Norwegian engineer Saetersmoen, a power company with Norwegian backing has recently been formed for exploitation of a series of falls in the Thjorsà, about 60 miles (90 km.) from the capital Reykjavik on the south coast. The project calls for a total of six plants, aggregating about 700,000 hp. during five months, with over 1,000,000 hp. available during the rest of the year. Owing to the peculiar meteorological conditions the water supply is very steady. The estimated cost per horsepower and year in Reykjavik is 24.70 kr., or about $6. It is planned to utilize part of the energy for nitrogen fixation. An interesting project is said to be under way leading to importation on a large scale of grain from Canada over the Port Nelson route to Reykjavik, where powerful electric mills are to be erected, their product to be shipped to consumers directly through the main European ports.—*Tekn. Ukeblad*, Jan. 17, 1919; also *Revue Générale d'Electricité*, Sept. 20, 1919.

The Seattle-Spokane Transmission Line.—Regarding the recently completed transmission line to supply energy to the Western Division of the Chicago, Milwaukee & St. Paul Railway for electrified service it is said that about 28,000 hp. will be used, which will be divided between the Long Lake plant of the Washington Water Power Company and the Snoqualmie plant of the Puget Sound Traction, Light & Power Company. The transmission voltage is 100 kv. and the trolley voltage 3000 kw., direct current, which permits spacing of substations about 25 miles (40 km.) One interesting type of plant supplying energy to this system is a hydroelectric induction-generator plant operated without attendant and controlled from another generating plant on the Natches River. The accompanying table shows how power factor will be controlled at various loads, based on the potential at Long Lake remaining constant at 110,000 volts per phase and the potential at Snoqualmie remaining constant at 95,000 volts per phase:

	Load	Power Factor	Current
Snoqualmie	0	0 lag	78.25
Long Lake	834	69.8 lead	6.28
Snoqualmie	3,000	25.5 lag	71.30
Long Lake	3,636	80.4 lead	23.70
Snoqualmie	6,000	52.8 lag	69.00
Long Lake	6,765	85.7 lead	41.30
Snoqualmie	8,000	69.7 lag	69.80
Long Lake	9,015	87.5 lead	54.10
Snoqualmie	11,000	82.8 lag	80.70
Long Lake	12,738	95.8 lead	69.80

—*Stone & Webster Journal*, November, 1919.

Code Rules in High-Potential Systems.—G. S. Lawler.—The writer discusses the advisability of extending the rules on high-potential systems in the national electrical code.—*Electrical Review*, Nov. 15, 1919.

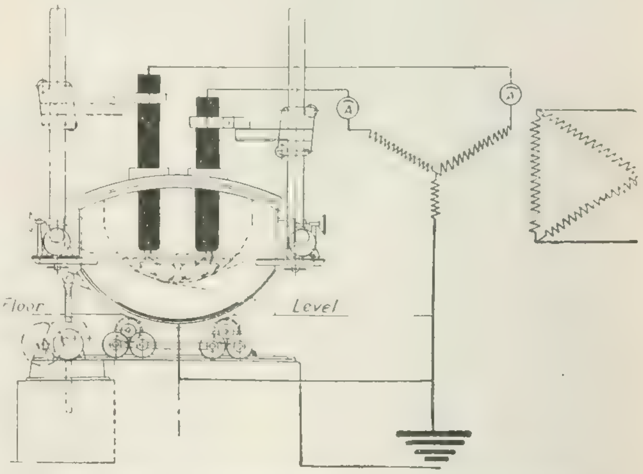
Standardization of Working Voltages of Electrical Plant in Germany.—Although standardization has been carried out to a considerable extent in Germany, there is still a great absence of uniformity in some directions. This is specially so in regard to terminal and long-distance line voltages. The Verein deutscher Ingenieure has therefore prepared a draft scheme proposing the following uniform working voltages: For direct current—220 and 440 volts as a rule for all cases; 550, 750 and 1,000 volts for railways only; 110 volts only for extensions. For three-phase current, 50 cycles—220 and 380 volts terminal voltage; further, 120 volts in new plants only where these are in damp and saturated rooms; also 500 volts for new plants operating with heavy-duty hoisting machinery. For high tensions, 6,000, 15,000, 35,000, 60,000, 100,000 and 150,000 volts as a rule; also in special cases, 3,000, 5,000, 10,000, 25,000 and 50,000 volts, particularly where connection with an existing feeder of the same voltage is probable. The Swiss Electrotechnical Society has also suggested uniform or standardized voltages which will take into account both existing and future progress. This will be helped by the fact that nearly 90 per cent of all motors in Switzerland are three-phase motors. The energy suggested for the standardization is therefore three-phase at 50 periods. It is assumed that the interlinked voltage will be used for motors and large consumers and the phase voltage mainly for lamps. For transformers three groups of standard voltages are suggested, in which, in addition to the ordinary star-delta connections (voltage ratio: 1:3), six equal collecting coils will be used, which will give three different voltages, in the ratio 1: 2: 3, according as the grouping is in delta, series, or parallel or zig-zag. The half-coils will have 125, 110 and 75 volts respectively in the three groups of voltages. With a half-coil voltage of 125 volts there would thus be standard voltages of 250/440 and the special groupings of 220/380 and 125/220 volts.—*Technical Review*, Oct. 28. (Abstracted from *Zeitschrift des Vereines deutscher Ingenieure*, Aug. 2, 1919).

Traction

Relationship of Items of Cost Under Pre-war Conditions and To-day.—F. W. Doolittle.—After giving hypothetical costs and incomes for a typical electric railway operation in 1914 and again for 1919 the author arrived at the following conclusions: (1) The tendencies toward higher cost of operation noted in studies made prior to 1914 have developed into revolutionary changes in price levels. (2) It is believed that these changes are permanent rather than transitory or temporary in character and affect all components of the cost of service, including return upon the investment. (3) The analysis of cost of service made for a typical property indicates that the increase in fundamental costs incurred can only be partially offset under the most favorable and economical conditions of handling traffic. (4) Because of the large influence of the cost of platform labor, the new level of costs results in far greater increases in those costs which vary with the miles traveled per passenger than in those costs which are fixed in their nature irrespective of the length of haul. This indicates that the discrimination which has always existed between long-haul and short-haul passengers is constantly becoming greater and that our previous ideas of the cost components in a zone system of fares must be modified. (5) The increased cost occasioned in complying with higher standards of service during rush hours is vitally affected by the recent additions to costs of labor arising out of the application of the minimum wage and the provision of higher unit pay for overtime work.—Toronto *Electrical News*, Nov. 1, 1919.

Installations, Systems and Appliances

Electric Furnaces in Metallurgy.—The object which the designers of the Greaves-Etchells furnace had in view was the arrangement of a furnace in which the intense concentration of heat around the arcs would be avoided. Such concentration leads to destruction of the refractory lining near the arcs. It also seemed desirable to secure a steady working load consistent with a reasonably high power factor. Better distribution of heat can be obtained by resistance methods. Consequently the furnace was built so that some of the heat had been generated in the lining of the furnace itself. Mechanically, the furnace does not differ much from others in the method of making connections and of detailed features which have been altered in the light of acquired experience. Electrically the furnace differs from others in the method of making connections and of grouping the transformer windings. Each electrode is independently regulated for the purpose of maintaining a good load factor. The furnace was therefore designed



ARRANGEMENTS FOR INDEPENDENT CONTROL OF THE TWO ELECTRODE CIRCUITS with a hearth connection which would act as an opposite terminal to each electrode entering the upper portion of the furnace so that an arc can be maintained on one electrode only quite independent of whether the other suspended electrodes are in connection with the bath. A brief reference to the figure will show that a lagging power factor is obtained on one-half of the system and a leading power factor is obtained on the other half of the Y so that, provided that each half of the system is evenly balanced, the over-all power factor is as near unity as is practically possible. A very efficient connection is obtained by cementing the hearth of the furnace to a large copper plate over the steel plate in the furnace bottom.—London *Electrician*, Oct. 17, 1919.

The Electric Control of Steel-Mill Auxiliaries.—C. HOWARD.—The choice of system, whether alternating-current or direct-current, requires careful consideration. So far the majority of installations have been carried out with direct-current motors. Automatic control, as against hand control, is particularly advantageous in steel works. With regard to types of control the author gives four classes and proceeds to give details of these. Certain items of plant require special forms of control, and, as examples, mention may be made of approach rollers, manipulators, screw-down gear, swinging table and skids. Reference is also made to hydraulic pumps and air compressors.—London *Electrician*, Sept. 26, 1919.

Telegraphy, Telephony and Signals

Applicability of Automatic Switching to All Classes of Telephone Service.—ARTHUR BESSEY SMITH.—The author deals with the advantages and general usefulness of automatic telephony. The subscriber's requirements are independent of the means used to satisfy them. Automatic switching is uniformly fast and involves reduced mental stress to the user because the passing of the number is positive and waiting time is reduced to the minimum. As viewed by the owner the apparatus has longer life, the service is very acceptable to the public, and but a tithe of the female employees are used. Automatic switching apparatus has increased greatly in margin of safety. Much progress has been made toward standardization of form and toward best methods of maintenance. A few changes in structure are described and data given to show margins of safety in operation. Present practice regarding party lines and measured service (cash and credit) is stated briefly. The durability of automatic equipment is illustrated by the fact that plants have not yet worn out. Maintenance routines are essential to successful operation. Girls do routine testing with marked success. Rural telephone lines present problems which have been solved in several ways, influenced by the greater number of telephones per line, the conditions of signaling subscribers, and the inferior insulation often encountered. Code ringing can be retained. Rural automatic service is only a little inferior to city automatic service. The community automatic exchange serves a small group of subscribers, either isolated or part of a telephone network. The rotary line switch is used because it is simple, reliable, quick-acting and provides twenty-five trunks. Toll switching in an automatic exchange gives the toll operator direct dealing to the subscriber, complete control over his line and periodic ringing. The toll network has also been improved by applying automatic switches to intermediate points, so that the originating toll operator can set up the complete connection herself. The experience of the past twelve years shows that this increases the business-carrying capacity of toll lines at least 50 per cent to 100 per cent.—*Proceedings A. I. E. E.*, December, 1919.

Determination of Rate of Deionization of Electric Arc Vapor.—HENRY G. CORDES.—After discussing the deionization and consequent loss of conductivity of mercury vapor carrying a momentary arc, the author considers an arrangement of circuits for determining the rate of deionization, and the effect of this rate on the voltage required for a subsequent reignition. The theory of the circuits shown is given and illustrated by numerical examples. It is suggested that the arrangements shown be experimentally carried out because of possibly important practical applications.—*Proceedings Institute of Radio Engineers*, October, 1919.

A Special Type of Quenched-Spark Radio Transmitter.—D. GALEN MCCAA.—A quenched-spark transmitter is so arranged that the capacity in the highly damped primary circuit is that between a special extra antenna and ground, and the primary and secondary circuits are partly inductively coupled through a common inductance in the ground lead and partly capacitatively coupled by the capacity between the special antenna and the usual secondary or radiating antenna. Quenching effects and normal mono-wave radiation are secured. Experiments are described and an oscillogram shown whereby the group frequency and radiation characteristics are indicated.—*Proceedings Institute Radio Engineers*, August, 1919.

Electrochemistry and Batteries

German Electrotechnics During the War: Electrometallurgy.—V. ENGELHARDT.—Electric blast furnaces were not started, but the steel production in electric furnaces increased from 89,336 tons in 1914 to 279,700 tons in 1917, the electric steel production of these two years making up 48.4 and 62.8 per cent of the special steel (crucible and electric). In Austria-Hungary the electric steel production rose in the same years from 15,844 tons to 47,152 tons, the proportions being very similar. Induction furnaces predominate in Austria, arc furnaces in Germany. Instead of deoxidizing the iron with ferromanganese fused calcium carbide is now successfully used. The copper of the driving bands of shells can be replaced by electrolytic iron. After experimenting on a large scale, two new electrolytic iron works, for 200 tons per month, were erected at Munich (Siemens-Halske) and Bitterfeld (Griesheim-Elektron). The latter plant is not yet complete. The process is that of Langbein-Pfanhauser and Fischer-Martin iron anodes in ferrous chloride, to which hygroscopic salts are added. For the refining of copper from brass (door brasses, picture frames, taps, crucifixes, etc.) and bronze (church bells) several refineries were built. The brasses are fused, the zinc is oxidized and the copper gained by electrolysis. In the electrolysis of the bronzes the stannic acid, passing into the anode mud and into the electrolyte, first caused difficulties. The bronze of old bearings is dealt with in special works, and a good tin is there obtained. As regards aluminium, bauxite deposits in Carinthia, Dalmatia and Hungary have been worked, and clays are said to have been purified. Particulars about the latter purification are not yet available.—*Science Abstracts, Section B*, Sept. 30, 1919. (Abstracted from *Elektrot. Zeits.*, May 8, 1919.)

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

News in Brief

Summary of Important Happenings in the Industry During the Week

Passage of the water-power bill by the Senate is a long step toward enactment, and the industry is awaiting the action of the conferees with keen anticipation of conditions which will permit real development. In advance of any facts as to the final terms it is impossible to estimate what amount of development will take place in the near future. Certainly any workable conditions which will invite capital investment or risk will be followed by prompt construction and the utilization of powers now wasted. The more encouragement there is to capital of small risk, safety of principal and sure return, the more readily will private investors advance funds.

The hydroelectric power bill urged by the conference of mayors of New York State cities last year has been introduced again in the Legislature. It provides for state development of water powers and for the sale of the energy to municipalities or private parties.

The lease of properties of the Sierra & San Francisco Power Company to the Pacific Gas & Electric Company for fifteen years has been approved by the California State Railroad Commission. The total rentals amount to $2,000,000.

The Pacific Gas & Electric Company has included in its budget for 1920 $15,000,000 for extensions and new capital expenditures, including $3,000,000 for the Pit River development.

The new-business co-operations committee of the Ohio Electric Light Association met at Akron on Jan. 21. H. C. Stephens of Akron spoke on "Electric Drive in the Rubber Industry from the Central-Station Viewpoint."

The Commonwealth Edison Company of Chicago and the Public Service Company of Northern Illinois have opened a permanent stock and bond department through which securities will be sold directly to the public. The securities of the Middle West Utilities Company will probably be added to the list of stocks and bonds handled.

A controlling interest in the Connecticut Power Company is to be purchased by the Hartford Electric Light Company, according to present plans.

President Maclaurin of the Massachusetts Institute of Technology died suddenly of pneumonia on Jan. 15.

Sir Oliver Lodge, the noted British scientist, who is to lecture in the United States and Canada on psychic and physical subjects, reached New York on Jan. 15.

An issue of $12,500,000 of two-year 6 per cent secured notes of the Philadelphia Electric Company, sold to bankers, is offered on a 7¼ per cent interest basis.

England's electricity supply bill, as finally passed, does not provide for compulsory nationalization of power supply, and the plan will be effected through voluntary action of the joint electricity authorities.

The Indiana Public Utility Association has been organized with Charles L. Henry as president to consider common problems of utilities of the various classes and to enlist public co-operation.

The wiring committee of the N. E. L. A. Commercial Section asks central-station appliance department managers for results of commercial experiences with portable cords for heaters.

At the annual meeting of the Engineering Institute of Canada, to be held at Montreal on Jan. 27 to 29, many subjects, including the water powers of Quebec, will be discussed.

The electric production and distribution sections of the Empire State Gas and Electric Association held meetings at Schenectady, N. Y., on Jan. 14 and 15 at which some very interesting discussions were presented on periodic apparatus inspection, meggers versus high-voltage insulation tests, application of relays, insulator practice and training linemen. The sections were presided over by L. C. Reynolds and W. C. Blackwood respectively.

The supply jobbers are enjoying a continued high rate of business, hampered to some extent by poor stocks of staples. This stocking feature is not improving any in general because transportation is holding up and lengthening shipments. Socket demand is heavy, but stocks are now in sufficiently good shape to allow lower prices. Frequently incoming shipments of pipe, loom and flexible armored conductor do not touch jobbers' storerooms but are transhipped from the terminal or from the sidewalk. Much of this material the jobbers have sold for three months ahead. Loom deliveries are reported a little better. Local transformer stocks are better, but local motor stocks are badly broken.

Central stations are ordering apparatus in better quantity than usual at this season. It is becoming more general for jobbers to order supplies for longer periods in advance than ever before. No chance of quicker deliveries is seen. Prices have advanced on several lines. High-tension porcelain insulators, bushings and accessories are up 5 to 10 per cent; a certain line of single-phase motors is up 10 per cent, and of fractional motors 5 per cent; sewing machines advanced 10 per cent, bells and buzzers 10 per cent, cross-arms 20 per cent, and in the West knife switches and safety switches went up 5 to 25 per cent, condulets 20 per cent and friction tape 15 per cent. Jobbers are asking more for flexible armored conductor, supply of which is very short.

A 50,000-kw. hydro-electric plant, known as the Tugaloo Development, will in all probability be started by the Georgia Railway & Power Company on the Savannah River near Tallulah Falls within a year. It will take from two to three years to complete it. The generating stations which this will supplement, as well as the system served, were indicated in the May 17, 1919, issue of the ELECTRICAL WORLD, page 1025.

Among the large projects contemplated throughout the country is the construction of a second transmission line between Athol Springs and Dunkirk, extensions to distributing systems in Brocton and Ripley and the towns of Hamburg, Eden and Brant, and for improvements and additional equipment in substations at Gardenville and Dunkirk by the Niagara & Erie Power Company of Buffalo, N. Y. The Public Service Commission has authorized the company to issue $685,000 in bonds and notes to pay for same.

The towns of Geneseo and Little River, Kan., have voted bonds to extend the transmission line of the United Water, Gas & Electric Company of Hutchinson, Kan., to a distance of about 14 miles north of the present terminus. Efforts are also being made in four other towns west of Geneseo to issue bonds to secure service from the company, and if the project goes through the transmission line will probably be extended another 40 miles west of Geneseo. Work has been started on the erection of a 35,000-volt line south from Hutchinson for a distance of 35 miles. When completed it will supply electricity to Arlington, Partridge, Langdon and Turon. Another line is under construction from Sterling to Alden. This line will eventually be extended to Great Bend and Kinsley.

WATER-POWER BILL IS PASSED BY THE SENATE

This Sends the Measure to Conference Between Members of the Upper and Lower Houses, and Important Changes Are Forecast

By a vote of fifty-two to eighteen the Senate on Jan. 15 passed the water-power bill. The measure now goes to conference. It is a foregone conclusion that important changes will be made in the bill by the conferees. The conferees on the part of the Senate are Senators Jones of Washington, Nelson of Minnesota, Bankhead of Alabama, Smoot of Utah, Fall of New Mexico and Myers of Montana, and those who will represent the House are Representatives Esch of Wisconsin, Sinnott of Oregon, Haugen of Iowa, Sims of Tennessee, Taylor of Colorado and Lee of Georgia.

The votes against the bill were fewer than had been expected. Senators voting against the measure were Borah of Idaho, Gore of Oklahoma, Gronna of North Dakota, Harris of Georgia, Harrison of Mississippi, Kenyon of Iowa, Kirby of Arkansas, Lenroot of Wisconsin, McCormick of New York, McKellar of Tennessee, Norris of Nebraska, Nugent of Oregon, Reed of Missouri, Shepherd of Texas, Stanley of Kentucky, Tramell of Florida, Walsh of Massachusetts and Williams of Mississippi.

COMPENSATION FOR PRIVATELY USED WATER POWERS

The amendment relating to compensation for the use of water powers utilized by private capital and not by the government, which had been lost by one vote in committee of the whole, was voted upon again in the Senate proper and was passed by a vote of forty-four to twenty. The amendment as adopted reads as follows:

> That the licensee shall pay for the license herein granted such reasonable annual charges as may be fixed by the commission for the purpose of reimbursing the United States for the cost of administration of the act in relation to water powers developed under its jurisdiction, in the proportion that the water power developed by the project covered by said license bears to the total water power developed by all projects licensed under the act, and for that purpose such charges may be readjusted from time to time, not oftener than once in two years; the licensee shall also pay for the use and occupation of any public lands and lands in reservations, except tribal lands embraced within Indian reservations, necessary for the development of the project covered by the license such reasonable annual charges based upon the actual value of the government lands used as may be fixed by the commission; but in no event shall the annual charge for the foregoing exceed 25 cents per developed horsepower: provided, that when licenses are issued involving the use of government dams or other structures owned by the United States or tribal lands embraced within Indian reservations the commission shall fix a reasonable annual charge for the use thereof, and such charges may be readjusted at the end of twenty years after the beginning of operations and at periods of not less than ten years thereafter in a manner to be described in each license.

The five provisions of the measure which were characterized by Gifford Pinchot as being anti-public and indefensible were not adopted except the one striking out the Senate committee amendment relating to joint approval of contracts and the one limiting to some degree the amount of severance damages. The Pinchot objections, which were pressed very strenuously by Senator Lenroot and others and which it is expected will receive consideration in the conference, are as follows:

1. Section 10 (e) gives the public water powers away for practically nothing by relieving licensees from paying the reasonable value of what they get from the public. It limits the possible charge to the reimbursement of the government for the expenses of administering the act, plus a small charge based on the value of government lands occupied, irrespective of their water-power possibilities. Thus it prevents any charge being made for the enormously valuable water-power rights to be granted under the bill. When a municipality is to develop and use the power for its citizens a nominal charge is right and just, but when a corporation or individual is to be given publicly owned rights and make a profit from them it is clear beyond question that a reasonable charge, based on the value given, should be made.

The right to make such a charge is clear. To abandon it for the profit of the corporations would be wholly unjustifiable. The water-power commission should be given a free hand to charge what the rights granted are actually worth. This grave defect in the bill can be remedied by striking out the Senate committee amendment.

2. Section 22 gives the public service commission of a state the power to decide alone that a contract may extend beyond the end of a license, apparently with the intention that the national government, or its new licensee, shall be saddled with obligations as to the making of which it will have had no voice, no matter how unfair, disadvantageous or costly to the public interest they may be.

This provision is absurd on its face. Merely to set forth its apparent intention condemns it. Again the fault can be cured by eliminating the Senate committee amendment.

3. The provision for "severance damages" in Section 14, page 25, lines 1 to 5, is without justification and should be omitted from the bill. The taking over of the property after fifty years of notice has nothing analogous to that in which the owner is suddenly deprived of a part of his property against his will, and in justice requires no severance damages at all. No valid argument can be made for damages based upon anything more than the loss of use for some short period of not more than three years while necessary changes are being made.

4. At the end of Section 15 the bill contains provisions which are calculated to make a license perpetual. These are contained in the words "on reasonable terms" and "which is accepted," line 20, all of which should be stricken out. The word "shall" in line 20 should be changed to "may." The rights of a licensee will then surely and automatically terminate at the end of fifty years, as they should, and no collusion or other device will avail to make them indefinite. Of course, the typographical error in line 20 must be corrected by changing "license" to "licensee."

5. The bill provides that certain items, if any, shall be deducted from the legitimate original cost of a project in order to determine the price to be paid therefor when taken over by the United States or another licensee. But it fails to provide that these proper and necessary reserves shall be made at all. This omission would mean the unjustifiable loss of millions of dollars to the government. It can be cured by striking out the words "reserves for such purposes" in line 3, page 17, and substituting therefor the words "amortization, sinking fund, and other similar reserves, if and as required by the commission, but such reserves shall not be so made as to prevent a fair return upon the net investment."

THE GREAT FALLS DEVELOPMENT

As finally passed by the Senate, the bill contains the authorization for a $25,000,000 power development on the Potomac River at Great Falls and gives to the federal Power Commission all the authority vested in the Newlands commission. It is regarded as not improbable, however, that both of these provisions of the bill will be stricken out in conference. The Newlands commission was empowered to study development and control of waterways and water resources and subjects relating thereto and to study the matter of bringing into co-ordination and co-operation the engineering, scientific and constructive agencies of the governmental departments so as to make recommendations as to irrigation, drainage, forestry, reclamation, clarification of streams, regulations of flow, control of floods, utilization of water power, prevention of soil erosion and waste, storage and conservation of water.

The matter of development of water power on Indian reservations called forth considerable debate, but an amendment by Senator Nugent prevailed after determined opposition on the part of Senator Walsh of Montana. Among other things the amendment agreed to provided that "in the case of tribal lands embraced within an Indian reservation which said lands were ceded by the Indians to the United States by treaty, no license shall be authorized except by and with the consent of the council of the tribe."

An effort was made by Senator Nugent to amend the bill so that it would not take effect until the expiration of three years after its approval by the President. This amendment had the support of only a few votes.

EMPIRE STATE ASSOCIATION SECTIONS MEET IN SCHENECTADY

Periodic Inspection, Insulation Testing, Application of Relays, Testing Insulators and Training Linemen Among the Topics

Two days of very lively and interesting discussion on timely operating subjects developed from the meetings of the production and distribution sections of the Empire State Gas and Electric Association on Jan. 14 and 15. Both sections held their sessions at the Mohawk Hotel in Schenectady, L. C. Reynolds being chairman of the production section and W. C. Blackwood chairman of the distribution section.

At the first day's session the principal topics discussed were periodic inspections of station apparatus, meggers versus high-voltage testing of insulation, stoker operation and relay application. Testing of insulators, outdoor substations, fusing of transformers and training linemen were among the subjects considered at the second day's session.

G. M. Parsons, Syracuse Lighting Company, outlined a very comprehensive plan of periodic inspection which his company follows. In the discussion which followed it was the consensus of opinion that inspection should not be put off as a rainy-day job, but that it should be carried on systematically and periodically, giving particular attention to auxiliary apparatus which might be overlooked otherwise and making arrangements whereby the equipment can be thoroughly inspected without interrupting service. It was also brought out that the frequency of inspection should depend on the importance of the service and the frequency with which different kinds of defects occur. The frequency with which different inspections are made was cited by men representing various New York companies.

Among the persons who took part in this discussion were E. P. Peck, Utica Gas & Electric Company; C. S. Van Dyke, Schenectady Illuminating Company; V. Poston, New York & Queens Electric Light & Power Company; D. B. Taylor, Troy Gas Company; H. W. Morreall, Utica; W. C. Pearce, Syracuse Lighting Company; Sydney Alling, Rochester Railway & Light Company, and W. C. Blackwood, New York & Queens Electric Light & Power Company.

Sydney Alling, Rochester, presented a paper on "Meggers Versus High-Voltage Testing," in which he pointed out that a megger may be suitable for determining insulation resistance but that it is not indicative of dielectric strength.

In line with this subject K. V. Farmer, Syracuse, W. C. Blackwood, Long Island City, E. P. Peck, Utica, and L. C. Reynolds referred to the conditions under which the induction or "woodpecker" method of locating faults and the slide-wire bridge methods give satisfaction.

I. E. Powell, Rochester, cited some experiences with burning coke breeze and anthracite screenings.

O. C. Traver, General Electric Company, emphasized the importance of applying relays properly, discussed time setting and compared induction and plunger-type inverse and definite time relays as to proper field of use. Different methods of protection such as in reverse power, balanced and differential relays were considered.

Troubles with relays and methods of avoiding them were touched on in the discussion by E. P. Peck, W. C. Blackwood and Mr. Lyon of Buffalo. Mr. Peck urged manufacturers to make relays more rugged and even sacrifice efficiency if necessary. Complicated relay connections should be strenuously avoided. Mr. Blackwood said that differential relays on transformers have tripped during heavy loads on the secondary side without any failure in the transformers or apparent faults in relay connections. It is possible that excessive increase of transformer losses with great loads may have caused the relays to trip. Mr. Lyon had had trouble in securing protection on lines with the neutral grounded through a relatively high resistance.

L. N. Crichton, Westinghouse Electric & Manufacturing Company, explained in some detail the manufacturing of insulators and discussed the causes of insulator failure, mechanical tests for flows, methods of reducing failures and relative advantages of various electrical testing methods.

This subject was discussed quite extensively by E. P. Peck, Utica, and A. M. Perry, ELECTRICAL WORLD. Details of their remarks will be presented, with features of other discussions, in later issues of the ELECTRICAL WORLD. In general Mr. Peck referred to the oscillator, and the hot-and-cold water tests, use of the "buzz stick" and telephone-receiver method for detecting faulty insulators and protection of insulators from flash-overs. Mr. Perry referred to an extensive investigation which the ELECTRICAL WORLD has made of operating companies' practices in using insulators, testing and inspecting them, costs of testing, causes of failures, methods of avoiding them, etc.

C. M. Rhoades referred to an 18,000-kva., 66,000/6,600-volt outdoor substation at Nashua, N. H. (see ELECTRICAL WORLD, Jan. 17, page 139), constructed of concrete poles, channel irons, rigid buses and pin insulators. This contains 28 tons of steel, and the poles cost $60 apiece. Without transformers and switches, the substation costs 95 cents per kva.

The construction of outdoor substations was discussed by E. P. Peck, B. E. White of Utica, L. N. Crichton, K. V. Farmer and C. S. Van Dyke. Mr. Peck referred to the practice of the Georgia Railway & Power Company, with which he was formerly connected, saying that it has standardized on a few types of industrial substations to avoid the delay often occasioned by designing each station separately, to permit keeping stock parts in readiness, and to facilitate assembly. Such substations can be erected within ten days after receiving a request for service.

B. E. White called attention to the opportunity for co-operation between electrical and mechanical or civil engineers in designing such stations, saying that more attractive stations with 50 per cent of the steel ordinarily used have been constructed through such co-operation. The use of stock pipe parts and fittings for constructing outdoor substations was referred to by Messrs. Crichton and Farmer. To indicate the possible life of concrete poles Mr. Van Dyke said that some have been in service in Schenectady since 1893.

T. S. Spates mentioned a training school that has been established by the New York & Queens Company for developing linemen needed because of the labor scarcity. The Public Service Electric Company of New Jersey has a similar school.

ENGINEERING INSTITUTE OF CANADA TO MEET IN MONTREAL

Three-Day Meeting to Be Held in Conjunction with Montreal Branch Provides Opportunity for Discussion of Many Subjects

The annual meeting of the Engineering Institute of Canada will be held at Montreal on Jan. 27 to 29, inclusive. A professional meeting of the Montreal branch of the Engineering Institute will be held at the same time at which a number of papers will be presented dealing with water powers and other development.

The program for the three days is as follows:

Tuesday, Jan. 27

9:00 a.m.—Opening of registration at headquarters, 176 Mansfield Street.

10:00 a.m.—Reception of reports.

1:15 p.m.—Luncheon at Windsor Hotel for members and ladies and invited guests.

1:50 p.m.—Formal welcome and greeting.

2:00 p.m.—Address, "Modern Highway Problems," by F. W. James, assistant chief engineer Bureau of Roads, Washington, D. C.

2:45 p.m.—Resuming of business session.

4:20 p.m.—Address of retiring president.

5:00 p.m.—Inauguration of incoming president.

9:00 p.m.—Reception and dance, Rose Room, Windsor Hotel.

Wednesday, Jan. 28

10:00 a.m.—"The Training of the Chemical Engineer," by R. F. Ruttan, professor of chemistry, McGill University; "The Importance of Physics in Engineering Education," by A. H. Eve, Macdonald professor of physics, McGill University; discussion by four authorities on technical education.

1:10 p.m.—Visit to Northern Electric Company's works.

1:30 p.m.—Luncheon, as guests of the president of the Northern Electric Company.

7:45 p.m.—Annual banquet of the Institute, Rose Room, Windsor Hotel.

Thursday, Jan. 29

10:00 a.m.—"Quebec's Water-Power Policy and the Work of the Quebec Streams Commission," by Olivier Lefebvre, chief engineer Quebec Streams Commission; "The Operation of the Quebec Public Health Act," by Theo. J. Lafrenière, chief sanitary engineer to the Superior Board of Health of the Province of Quebec; "Quebec Highways," by Alex. Fraser, assistant chief engineer Quebec Department of Roads.

2:30 p.m.—"The Pulp and Paper Industry," by Fred van Bruyssel; "The Policy of the Air Board of Canada," by Lieut.-Col. O. M. Biggar, vice-chairman of the Air Board of Canada; "The Forests of Quebec," by G. S. Piche, chief of Forests Service, Quebec Lands and Forests Department.

8:30 p.m.—Smoker, Windsor Hotel.

PRESIDENT MACLAURIN OF M. I. T. DIES SUDDENLY

Distinguished Scientist and Executive Rebuilt Great School of Engineering for a Future of Increasing Service to Civilization

Dr. Richard Cockburn Maclaurin, sixth president of the Massachusetts Institute of Technology, mathematical physicist, lawyer, educator and executive of world-wide reputation, died suddenly on Jan. 15 at his home in Cambridge, after less than a week's illness from pneumonia. Overwork on behalf of the great endowment drive which was concluded on Jan. 10 amid much rejoicing by friends, alumni and others affiliated with the institute is believed to have cost the life of "Boston 'Tech's" self-sacrificing head, and his unexpected passing was the greater shock because of his active concern for the success of the endowment campaign and the joy which he felt in its full accomplishment. Dr. Maclaurin was at his office in the institute on Jan. 9, and at the jubilation banquet on Jan. 10, when the success of the campaign and the identity of "Mr. Smith," Technology's most notable benefactor, were announced, the regretted absence of the institute's president was believed to be due only to a temporary indisposition.

THE LATE PRESIDENT MACLAURIN

President Maclaurin was born at Lindean, Scotland, in 1870 and was the son of a distinguished mathematician, Robert Campbell Maclaurin. His family went to New Zealand when he was a boy, and there he received his grammar-school education. His preliminary education was completed in the English schools, and in 1892 he entered the University of Cambridge, where he took the degrees of B. A. and M. A. As an undergraduate he displayed proficiency in mathematics and won the Smith prize for excellence in this study. After his graduation he was elected a Fellow of St. John's College. For ten months after receiving his M. A. degree he toured the United States and Canada, studying the educational institutions of the two countries. He then returned to England and took up the study of law at Cambridge, where he was awarded the McMahon studentship, the most highly esteemed honor of its kind at the university. For six months, on leave of absence, he studied in Germany, and shortly after his return to Cambridge he won the Yorke prize for his thesis on

"The Title to Realty," which gained worldwide attention. The *Law Quarterly*, commenting upon this thesis, said: "It gives promise of a real school of legal history which may flourish and bear fruit, notwithstanding the general apathy of the profession toward anything not of obvious utility in practice."

Leaving the law school at Cambridge in 1898, Dr. Maclaurin went to New Zealand to take the chair of mathematics at New Zealand University, a post which he filled for seven years, contributing notably toward the development of scientific education in the colony. He became dean of the faculty of law and served until 1907, when he accepted the chair of mathematical physics at Columbia University, succeeding Dr. Robert S. Woodward, who had resigned to become president of the Carnegie Institution at Washington.

On June 7, 1909, Dr. Maclaurin was inaugurated president of the Massachusetts Institute of Technology. Here he faced the problems of conserving the fruits of the institute's noble past, planning for its larger continuance and establishing the school in a new home in which it might expand into higher and broader planes of usefulness to the world of applied science. The old quarters had been outgrown, and Dr. Maclaurin early realized the necessity for removal to a new and unhampered site. He devoted much time and energy to building up loyalty to the institute among its alumni, and one of the first fruits of this policy was the gift of half a million dollars by T. Coleman du Pont toward the purchase of a new site in Cambridge. The alumni backed up the president with enthusiasm in the campaign for building funds, and under his direction the splendid new plant at Cambridge was erected.

Through Dr. Maclaurin's efforts the interest of some of the country's leading philanthropists has been attracted to the institute, notably that of George Eastman of Rochester, N. Y., not an M. I. T. graduate, but whose benefactions, under the pseudonym of "Mr. Smith," have brought the institute $11,000,000 in the past seven years. Dr. Maclaurin came to the presidency of the institute at a time when the industries of the world were being enlarged and enriched by the discoveries and applications of science and when there was a more pressing demand than ever before for the best technical education. The institute was brought more and more into line with the demands of the industrial world for aid in research, and the so-called "Technology plan," by which many industrial plants, public utility organizations and engineering firms will "retain" and use the special organization of the institute now being created for this purpose, was recently declared by Dr. Maclaurin to be probably the most important step the institution has taken since its foundation.

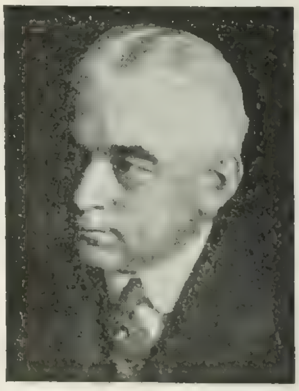
During the war Dr. Maclaurin performed great services for the government. He turned the entire plant and personnel over to the United States authoritites, thousands of young men were instructed in the theory and mechanism of aviation, and the institute also furnished the men and the influence which dominated the United States Shipping Board in its establishment of maritime schools throughout the country. He also advised the government upon many matters relating to the intensive training of military engineers and other auxiliaries to the fighting forces. After the close of the war he devoted himself heart and soul to placing the institute in a position from which its existing and potential resources may be developed to their maximum usefulness, unhampered by the severe financial limitations which threatened to retard its work and prevent its expansion.

Dr. Maclaurin was the holder of numerous degrees from institutions of learning and was a member of a wide range of scientific and philosophical societies. He was the author of many scientific theses, including "The Theory of Light" and other treatises. Cambridge (England), Wesleyan, Harvard, Denison and Dartmouth have borne witness to his distinction by degrees conferred. He was an able executive, extremely popular with the student body of the institute, and loyally supported by the faculty. His influence as a citizen and educator was recognized in tributes by Governor Coolidge of Massachusetts and many others.

DR. WALKER HEADS M. I. T. INDUSTRIAL DIVISION

Strong Organization for Industrial Co-operation and Research Created Which Holds Contracts Aggregating Nearly $1,000,000

Dr. William H. Walker, formerly head of the research laboratory of applied chemistry at the Massachusetts Institute of Technology, has been appointed head of a new division of industrial co-operation and research. Dr. Walker has been on the staff of the institute for over twenty-five years and head of the applied chemistry research laboratory for the past twelve years. The success of this laboratory has been noted in many parts of the country, its facilities being used extensively by such concerns as the General Electric Company, National Tube Company, Vacuum Oil Company and Goodyear Tire & Rubber Company. During the war Dr. Walker served as a colonel in the Chemical Warfare Service and was in command of the Edgewood Arsenal, where 15,000 men were manufacturing poison gas for use against the Germans. He was awarded the distinguished-service medal with a citation for his technical ability, industry and zeal.


DR W. H. WALKER

By the institute's new plan all its resources are placed at the service of American industry and already 120 large concerns have contracted for co-operative and research work designed to bridge the gap between the institute and the world of business by making it possible for the clients of the school to consult the institute staff and utilize laboratories and libraries in the solution of their problems. The program also includes putting clients in touch with sources of information and other scientific libraries and institutions the world over. It is understood that the annual retainers now agreed upon range from $1,000 to $25,000.

Of the work of the new division Dr. Walker said:

"Whenever a manufacturer runs upon a problem that requires research or information not at his disposal, he can consult our division. We can give him all the information on his problem which we have at hand. This means all the information which any member of our great staff may have at hand.

"If we do not have it here, we can tell him where he will be most likely to find it, whether in other institutions and libraries of this country or abroad. If he requires special service in an experimental or research way, we will arrange consultations, investigations, tests or research with our technical staff. Or, if necessary, we can put him in touch with outside sources. This means, of course, that we must maintain records of the qualifications, experience and special knowledge of our alumni as well as of men now studying at the institute. The significance of this departure by the institute is evident to any one who has observed the difficulties of big concerns in hunting out special knowledge which they require; and its significance for Technology is just as great, for we appreciate how much it will mean to us to be brought in closer touch with the practical problems of the industrial world. We want to meet the industries more than half way. It means, too, a large field for new income for the support of the institute. There could be no more legitimate way for a great scientific school to seek support than by being paid for the service it can render in supplying special knowledge where it is needed. Already contracts we have signed total between $900,000 and $1,000,000."

Among the clients of the institute are the Edison Electric Illuminating Company of Boston, Stone & Webster, the American Telephone & Telegraph Company, the General Electric Company, Arthur D. Little, Inc., the Pierce-Arrow Motor Car Company, the American International Corporation, the United States Steel Company and the United States Rubber Company.

PHILADELPHIA ELECTRIC COMPANY SELLS NOTES

Issue of $12,500,000 Secured Two-Year Notes Purchased by Bankers and Offered to Public on 7¼ per Cent Interest Basis

An issue of $12,500,000 of two-year 6 per cent security notes has been sold by the Philadelphia Electric Company to Drexel & Company, Harris, Forbes & Company and Brown Brothers & Company. It was offered for sale by the bankers at 97¾ and interest, yielding about 7¼ per cent. It is part of an authorized issue of $15,000,000 notes, dated Feb. 1, 1920, and is subject to call in amounts of not less than $500,000 on four weeks' notice at 101 and interest, at any time prior to Feb. 1, 1921, and on or after that date at 100½ and interest.

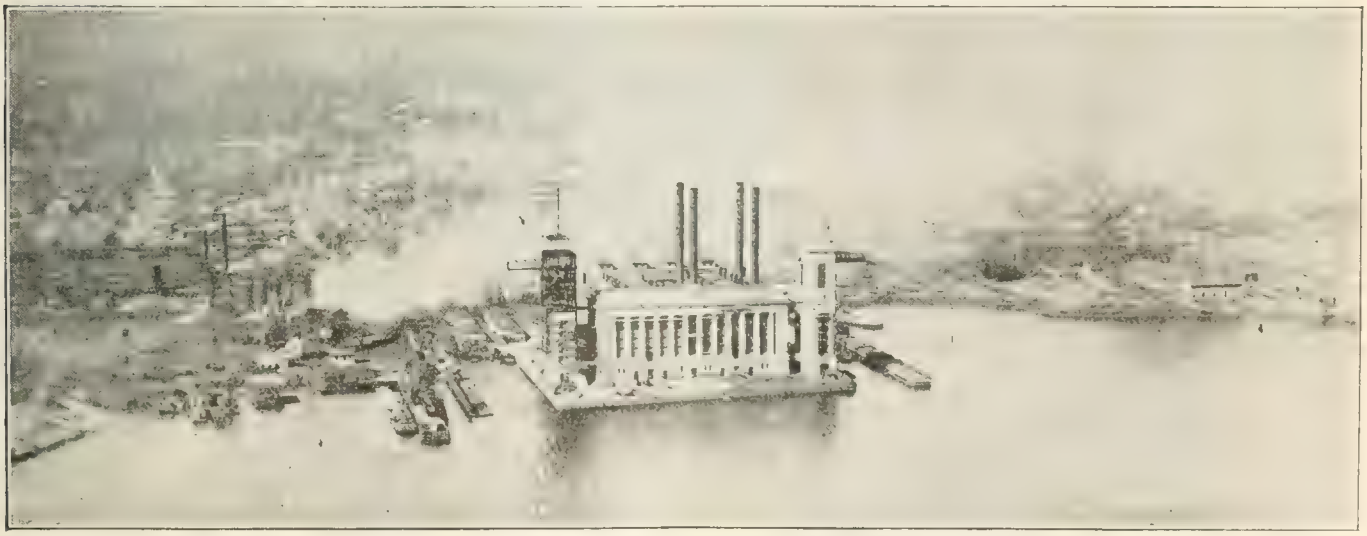
In describing the physical property of the company to the bankers, President Joseph B. McCall says:

The Philadelphia Electric Company system includes nine generating stations, having installed an aggregate rated capacity of 263,118 kw. Energy is distributed through seventy-nine substations (forty-one of which are privately owned industrial substations) over 11,180 miles of electrical conductors. The underground system comprises 2,044 duct miles of conduit. There are now in service 139,724 meters and energy is supplied to 124,808 customers.

The Philadelphia Electric Company, in order to increase its power-generating facilities and to enable it adequately to meet the present and prospective heavy demands for central-station service, is now constructing on the Delaware River at Beach and Palmer Streets, Philadelphia, a large new steam-power station. This power station is designed for an ultimate installed generating capacity of 180,000 kw., of which it is anticipated that the initial 60,000 kw. will be in operation about October, 1920. This station is being built of reinforced concrete.

The Delaware County Electric Company, to increase its power generating facilities and to augment the power supply of the Philadelphia Electric Company system, recently constructed on the Delaware River at Chester, Pa., a large steam-power station. The Chester power station is designed for an ultimate installed generating capacity of 120,000 kw., of which the initial 60,000 kw. has been in operation since October 1, 1918. This station is built of reinforced concrete and steel and in accordance with approved standards.

The Philadelphia Electric Company's Chester Station from the Air



This is a novel view of the large new Chester station of the Philadelphia Electric Company, which houses some of the great generating units providing energy for that busy industrial center.

APPARATUS COMMITTEE DECIDES ON TENDENCIES

N. E. L. A. Group Has Reviewed Progress and Troubles in All Apparatus from the Generator to the Consumers' Premises

When the National Electric Light Association convention is held in Pasadena, Cal., members will receive an exceptionally thorough report from the apparatus committee. This body, which met at Louisville, Ky., on Jan. 15, 16 and 17 to discuss its report, has completed all of its work with the exception of editing the various sections to be turned in by the sub-chairman of the committee.

The topics which will be covered this year are generators, switchgear transformers, motor rules, substations and the Bureau of Standards safety rules. In the Louisville discussion the major portion of the time was devoted to the discussion of experience and tendencies in the use of oil switches and auxiliary oil-switch apparatus.

N. E. L. A. COMMITTEE TESTS OF PORTABLE CORDS FOR HEATERS

Wiring Committee Will Measure Laboratory Tests by Commercial Experience—It Asks Co-operation from Central-Station Officials

The wiring committee of the Commercial Section of the National Electric Light Association in planning to investigate portable cords for heaters is arranging for laboratory tests, but it believes that the laboratory tests, or at least the first that will be made, will not give the practical or commercial values of the cords. In fact, what it is really aimed to do is to test the tests by comparing the results of the first tests with commercial experience, and then, by devising and arranging for other tests, finally to get a form of tests which shall as nearly as practicable conform to commercial and practical experience. For this purpose the wiring committee hopes to get the managers of some of the appliance departments of central stations to give the results of their experience.

The wiring committee will prepare sheets in which the various cords to be tested will be described according to their trade name and specifications. The manager will then be asked to rate the different cords, as No. 1, No. 2, etc. The average of the ratings of a number of different appliance department managers will be computed, with the idea that such averages will give the best information at present available as to the commercial value of the different cords.

Six men have volunteered to rate the cords, but in addition the wiring committee would like to have others, and if any central-station man who is familiar with the cords on the market will volunteer to do this the wiring committee will appreciate his offer. If he will send his name to R. S. Hale, chairman, 39 Boylston Street, Boston, Mass., the list of cords, trademarks, etc., will be sent. The six who have already volunteered are C. E. Greenwood of Boston, C. Michel of St. Louis, Dorsey Smith of Baltimore, Mr. Lewis of New York, A. G. DeClercq of Chicago, and H. Calvert of Philadelphia. By adding to these representative names those of other central-station officials in all parts of the country the committee hopes to achieve ratings that will be accepted by all as authoritative.

ALL ELECTRICAL INTERESTS CO-OPERATE IN CANADA

Convention of Manufacturers, Jobbers, Dealers and Utility Operators Terminates in Banquet Attended by 600 Persons

The largest gathering of Canadian electrical men and interests ever held in Canada overflowed the great banquet hall of the King Edward Hotel, Toronto, on Jan. 16, to hear the addresses by W. L. Goodwin and Samuel Adams Chase which closed a busy two days of meetings and sessions participated in by the Canadian Associated Manufacturers of Electrical Supplies, the Canadian Electrical Supply Jobbers' Association, the Ontario Municipal Electrical Utilities Association, the Ontario Association of Electrical Contractors and Dealers, the Toronto Section, A. I. E. E., the Toronto Electric Club and the Canadian Electrical Association (Canadian Section, N. E. L. A.). More than 600 electrical men of Canada—utility operators, manufacturers, jobbers, contractors and dealers—were present at the closing banquet, having as their guests to hear Mr. Goodwin many distinguished Canadian public officials, including the Lieutenant-Governor and the Prime Minister of Ontario and several Cabinet members, the Mayor of Toronto, Senator Nicholls and others.

Following toasts by ex-Premier Hearst of Ontario, Lieut.-Col. Carmichael of the Ontario Hydro-Electric Commission and Mayor Church of Toronto, Mr. Chase, special representative of the Westinghouse company, told of the results that come through co-operation and mutual understanding.

MR. GOODWIN'S ADDRESS

Mr. Goodwin, referring to the present power shortage in Ontario caused by the tremendous new load of household appliances which has replaced and now exceeds the former 100,000-kw. munition-plant load on the "Hydro" system, declared that every possible resource for electric power on the American continent will have to be developed as rapidly as plants can be built if electrical utilities are to keep up with the tremendous demands for electricity for homes, farms and factories. He urged that private as well as public enterprise be encouraged and safeguarded to provide the power facilities which will be needed as railroads are electrified, farms served with electricity and electric service standardized for popular use. Facing this wonderful opportunity for serving mankind in the immediate future, Mr. Goodwin called for earnest, harmonious co-operation of all interests in the electrical field, under the leadership of men who have an understanding of the commercial magnitude of the problems and opportunities now before the industry.

H. Munro Grier, K.C., president of the Canadian Section, N. E. L. A., who followed Mr. Goodwin, paid an eloquent tribute to the latter's "educative, expositive and extremely excellent address" and to his "tremendous capacity of mind and heart as revealed in his vision for the electrical industry of the future." "The power of co-operation," continued Mr. Grier, "is well illustrated by those tiny drops of water tumbling over Niagara, which, isolated, are swept aside by the wind in spray or wasted in the thunders of the cataract, but when harnessed and made to co-operate furnish light, heat and power, enriching the community life of whole states and provinces."

SIR OLIVER LODGE HAS ARRIVED TO LECTURE

Noted British Scientist Reaches New York and Will Talk on Psychic and Physical Subjects in this Country and Canada

Sir Oliver Lodge, the noted British scientist, reached New York on the steamship Lapland on Jan. 15. He is here to make a short lecture tour in the United States and Canada, speaking on psychic and physical subjects. The lectures announced for New York City between Jan. 22 and Feb. 8 are as follows: "The Reality of the Unseen," "The Evidence for Survival," "The Destiny of Man," "The Structure of the Atom" and "The Ether of Space."

ENGLISH ELECTRICITY SUPPLY BILL IS PASSED

Radical Changes Made in the Measure as Originally Submitted by the Government—Nationalization Abandoned

After many changes from the original draft the electricity supply bill prepared by the British government has been passed by the House of Commons and the House of Lords and has received the royal assent.

The effect of the radical changes made in the measure before it was enacted into legislation was to take away compulsory powers under which, it was contended, complete nationalization of the generation and distribution of electric power would have taken place. Instead of compulsory powers whereby the government would have dominated the industry the plan of national electricity supply will be carried out on a voluntary basis by joint electricity authorities.

HARTFORD COMPANY TO BUY CONNECTICUT POWER COMPANY

Stockholders and State Commission to Be Asked to Approve New Arrangement, Which Will Facilitate Interconnection and Development

Arrangements are being made by the Hartford Electric Light Company for the acquisition of a controlling interest in the Connecticut Power Company, and it is planned to bring the matter to a formal vote at a meeting of stockholders of the former organization Feb. 10, after which the approval of the Connecticut Public Utilities Commission will be sought. It is planned for the Hartford company to issue 7,500 shares of stock, of par value $750,000, in exchange for $1,000,000 common stock of the Connecticut Power Company.

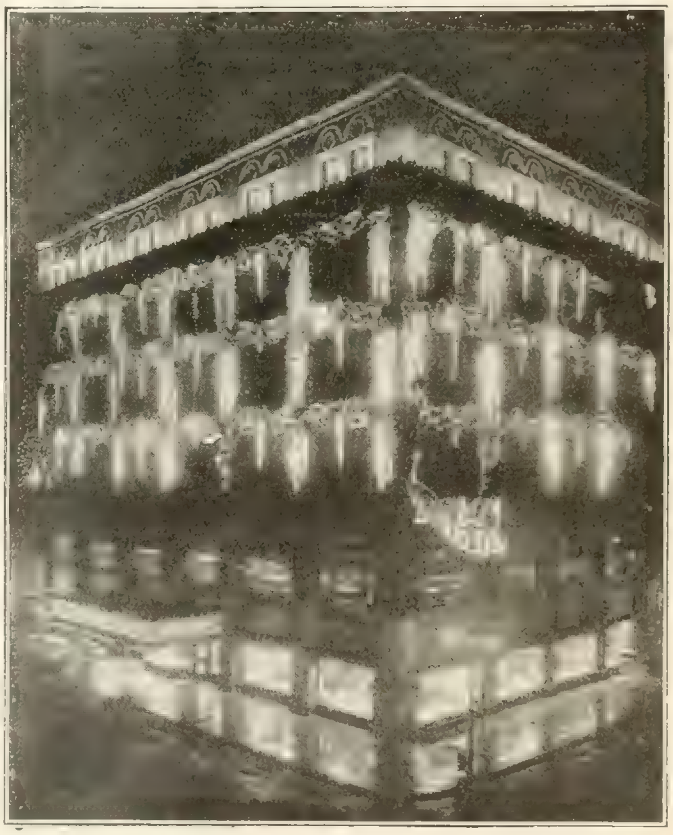
The Connecticut Power organization is managed at present by Stone & Webster, and conferences with the Hartford company have shown that a transfer of control will be advantageous to a broad policy of interconnection and system development. The Connecticut Power Company supplies the entire gas, electric lighting and commercial power business in New London, the entire electric lighting and commercial power business in Middletown, and serves numerous other manufacturing communities in Connecticut, including Canaan, Norfolk and Thomaston. A 12,000-hp. hydro-electric plant at Falls Village furnishes energy at 66,000 volts to a transmission line running from northwest to southeast across a considerable portion of the state and connected with the Hartford, Torrington and Bristol systems. Neither company is to change its name, a representative of the ELECTRICAL WORLD is informed.

GENERATING CAPACITY OF THE LARGE SYSTEMS

Returns of Narragansett Electric Lighting Company Add 80,000 Kw. to Totals of "Electrical World" Compilation

In addition to the returns on the generating capacity of large central-station systems printed in the ELECTRICAL WORLD of Jan. 17, page 164, statistics have been received from the Narragansett Electric Lighting Company, Providence, R. I. The steam generating capacity of this company on Jan. 1, 1919, was 80,000 kw. No additions were made during 1919 and none are contemplated during 1920. Inclusion of this company would make the steam generating capacity of the large systems as of Jan. 1, 1919, 3,309,986 kw. and as of Dec. 31, 1919, 3,815,556 kw.; and it would make the total hydro-electric and steam capacity of the large systems 5,889,965 kw. on Jan. 1, 1919, and 6,715,195 kw. on Dec. 31, 1919.

Toledo Company's New Building



The Toledo Railways & Light Company has formally opened its new building and display rooms. The new headquarters were formerly occupied by a large department store. The building was remodeled completely and artistically. With the night illumination the building appears to be covered with a climbing and clinging Japanese wistaria vine, while butterflies in natural color and in motion flutter among the leaves. Huge peacocks complete this unusual picture. Floodlighting of the roof and brilliant electric signs over the canopy complete the illumination. It was conceived by George Williams, head of the new-business departments of the Henry L. Doherty companies.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., Philadelphia Section.—"Electric Furnaces" are to be discussed at the Feb. 9 meeting of this section of the American Institute of Electrical Engineers.

A. I. E. E., Los Angeles Section.—"The Engineer in Industry" will be the topic for discussion at the Feb. 17 meeting to be held by this section of the American Institute of Electrical Engineers.

American Society of Heating and Ventilating Engineers. — The annual meeting of this society will be held at the Hotel McAlpin, New York City, Jan. 27, 28 and 29.

A. I. E. E., Fort Wayne Section.—The subject of "Autogenous Welding" will be taken up at the Feb. 19 meeting to be held by this section of the American Institute of Electrical Engineers.

A. I. E. E., Indianapolis-Lafayette Section.—At the Feb. 20 meeting held by this section of the American Institute of Electrical Engineers the subject of "The Problems Confronting Electric Railroads" will be taken up.

Franklin Institute and Philadelphia Section, A. I. E. E., Joint Meeting.—The Philadelphia Section of the American Institute of Electrical Engineers and the Franklin Institute will meet jointly on March 17 to hear G. H. Clamer's paper on "Induction Electrical Furnaces."

Tri-State Water and Light Association of the Carolinas and Georgia.—The tenth annual convention of this association will be held at Atlanta on May 19, 20 and 21. Headquarters will be at the Piedmont Hotel. Manufacturers will be given necessary space for exhibits free of cost.

A. I. E. E., St. Louis Section.—The annual election of officers held by this section of the Institute resulted in the unanimous choice of G. A. Waters, chief engineer of the Wagner Electric Manufacturing Company, as chairman and Stanley Stokes of the Union Electric Light & Power Company as secretary-treasurer.

Philadelphia Section, Association of Iron and Steel Electrical Engineers.—At the Feb. 7 meeting, to be held at the Engineers' Club, R. B. Gerhardt, superintendent of the electrical department of the Bethlehem Steel Company, Sparrows Point, Md., will present a paper entitled "Electrical Features of a Modern Mill."

New York Electrical League.—At the January luncheon of the league the following were elected officers for the ensuing year: President, James R. Pollock; first vice-president, Walter Neumuller; second vice-president, F. H. Leggett; treasurer, L. L. Strauss; secretary, J. Wynne Jones; directors, James M. Wakeman, Joseph Forsyth and Harry B. Logan.

American Institute of Electrical Engineers.—On March 12 a meeting of the Institute will be held in Pittsburgh under the auspices of the traction and transportation committee and the subject of "Electric Traction" will be discussed.

Western Society of Engineers.—The men who will guide the electrical engineering section of the Western Society of Engineers during 1920 are: A. F. Riggs, chairman; C. A. Keller, vice-chairman, and T. Milton, director. The new officers of the society itself are: President, F. K. Copeland; first vice-president, C. F. W. Felt; second vice-president, J. L. Hecht; third vice-president, Linn White; treasurer, F. F. Fowle; trustee, J. H. Libberton.

I. E. S., New York Section.—Meeting jointly with the New York division of the National Council of Lighting Fixture Manufacturers, the section discussed the relations between the fixture manufacturer and the illuminating engineer. Two papers were presented, one by W. R. McCoy on "What Can the Illuminating Engineer Do for the Fixture Manufacturer?" in which he made a plea for co-operation, and the other by Bassett Jones on "Brightness, The Fundamental in Illuminating Engineering." Mr. Jones stated that engineers should give more attention to the painting of walls, ceilings and floors than they have heretofore if the best lighting is to be obtained. Among those who took part in the discussion were G. W. Cassidy, Norman MacBeth and W. B. Anderson. Herman Plaut of the fixture manufacturers and F. M. Feiker of the illuminating engineers jointly presided over the meeting.

A. I. and S. E. E., Philadelphia Section.—At a meeting of this section of the Association of Iron and Steel Electrical Engineers held on Jan. 3 J. D. Wright, electrical engineer of the General Electric Company, read a paper on "Electric Mill Drives." He discussed the subject from the standpoint of steel-mill electrical engineers and presented figures on the power consumption of motor drives per ton of metal handled by steel-mill rolls and on the flywheel weight per motor horsepower, advocating a moderate policy in flywheel design. In the discussion of the paper reference was made to the question of a wider tendency to adopt 60-cycle induction motors for steel-mill uses with geared connection so as to make possible higher driving speeds and thus to secure improved power factor. Mr. Wright referred to the importance of adjustable-speed motors for some cases of steel-mill work, but discouraged the thought of employing synchronous motors in many of the cases for power-factor correction owing to the usual condition of very large starting torque.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Condition of Transmission Line Construction.—The Pennsylvania Public Service Commission in the case of J. Morris Horst et al. vs the Metropolitan Edison Company of Reading ordered the respondent to furnish electric service to the complainants upon execution by the complainants and delivery to the respondent of a written agreement guaranteeing from the transmission line made necessary to furnish such service the payment of an annual return of $100 for five years.

"Wholesale" Rates Beneficial to All.—In a decision upholding an increase in artificial gas rates by the Philadelphia Suburban Gas & Electric Company the Pennsylvania Public Service Commission remarks that "the practice of public service companies selling large quantities of gas, water and electricity at what might be termed wholesale rates, whereby the unit of cost to the consumer is lessened, has long been recognized by both commissions and courts as being beneficial alike to the companies and all their consumers, and does not constitute unjust discrimination."

Household Appliances in Cooking and Power Rates.—Increased rates for electric service by the Moab Light & Power Company were authorized by the Utah Public Utilities Commission with the provision that the cooking or power rate should apply on electrical household appliances when used on cooking or power meters. The commission said in discussing the schedule filed by the company: "The wisdom of excluding household electrical appliances from the benefits of the cooking and power rates may be open to question. The future growth of the company's business will apparently depend largely upon the development of the small power load. The use of electrical household appliances and utensils, such as ranges, washing machines, irons, sewing machines, fans, vacuum cleaners, etc., is increasing, under the stimulus of active sales campaigns conducted by power companies. Inasmuch as most of such power is used during the daytime, and, therefore, serves to bridge a daily recurring period of minimum power demand, this company, as well as others, can probably afford to lend encouragement to the fullest use of such appliances and devices, by applying to them rates for service similar to rates accorded users of small motors. This is being done with satisfactory results by other power companies operating in this state."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Cheap Power in Pennsylvania.—The cheapest electrical power in Pennsylvania is at Mount Union, the War Department states, in announcing that it will sell its sulphuric-acid plant located at that point. Mount Union draws its coal supply from a mine within the town limits.

Narragansett Company Has Employees' Club.—The Nelco Athletic Club has been formed by employees of the Narragansett Electric Lighting Company. The object of the club is to promote good fellowship among the employees by a series of interdepartment athletic contests and social gatherings. Both men and women employees are included.

Iowa Engineers Must Register.—Any unregistered professional engineer or land surveyor practicing in Iowa after July 4, 1920, will be subject to a fine of not less than $100 nor more than $500 under a new law. This requires practicing engineers and surveyors to register upon their professional requirements without examination up to Jan. 4, 1920, and thereafter until July 4, 1920, a technical examination is required before a board of examiners. K. C. Kastberg, Des Moines, Iowa, is secretary of the board of examining engineers, and the other members of the board are Seth Dean, L. M. Martin, F W. Stubbs and Alvin LeVan.

N. E. L. A. Educational Courses.—The educational courses which were arranged by the Commercial Section of the National Electric Light Association, covering practical electricity, commercial engineering, elementary accounting and advanced accounting, were offered to employees of the Southern California Edison Company during the early part of the present winter. At present there are approximately 300 employees enrolled as follows: 280 in practical electricity, eight in commercial engineering, ten in elementary accounting, and two in advanced accounting. These courses are being supplemented by classes arranged by the company. Already classes have been held in several of the districts with an attendance of from twenty-five to seventy-five, depending upon the size of the district and the number of students enrolled therein. In the promotion of this work it was found advantageous and effective to invite all of the employees in a district to the first meeting, in order that they might gain a better idea of the purpose and worth of the course. The enrollment in one of the districts was more than doubled following the first meeting. F. B. Lewis, superintendent of the Los Angeles district of the Southern California Edison Company, is in charge of these classes.

Research Graduate Assistantships in University of Illinois.—To assist in the conduct of engineering research and to extend and strengthen the field of its graduate work in engineering, the University of Illinois maintains fourteen research graduate assistantships in the engineering experiment station. Two other such assistantships have been established under the patronage of the Illinois Gas Association. These assistantships, for each of which there is an annual stipend of $500 and freedom from all fees except the matriculation and diploma fees, are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering, physics or applied chemistry. An appointment to the position of research graduate assistant is made and must be accepted for two consecutive collegiate years, at the expiration of which period, if all requirements have been met, the degree of master of science will be conferred. Nominations to these positions, accompanied by assignments to special departments of the engineering experiment station, are made from applications by the director of the station each year not later than March.

J. E. Aldred Lectures at Johns Hopkins.—The dates for the J. E. Aldred lectures on engineering practice before the department of engineering of Johns Hopkins University, Baltimore, for 1919-20 have been announced. Through the generosity of Mr. Aldred this course of lectures on engineering practice was founded. The course of lectures is one feature of a general plan, made possible by Mr. Aldred's gift, for furthering and improving undergraduate instruction in the methods and problems of the practice of engineering. During the year three lectures each will be given in the general subjects, civil, electrical and mechanical engineering. Engineers or others who may be interested in the topics will be welcomed. The lectures announced are: Jan. 28, "Common Sense in Engineering," J. E. Aldred, New York; Feb. 11, "The Development of Long-Distance Electric Power Transmission," P. M. Lincoln, Cleveland; Feb. 18, "The Purchase and Erection of Engineering Equipment," A. S. Loizeaux, Baltimore; Feb. 25, "City Planning and Its Relation to Municipal Development," Nelson P. Lewis, New York; March 3, "Reinforced-Concrete Design and Construction, Past and Present," Ernest P. Goodrich, New York; March 10, "Railroad Grade Crossing Elimination," Samuel T. Wagner, Philadelphia; March 17, "The Commercial Side of Engineering," Commander Walter M. McFarland, New York; March 24, "Engineering and Construction Organization for Rapid Work," I. W. McConnell, New York.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Negligence from Mode of Constructing Trolley Wires.—Since a defendant traction company in using an overhead trolley is in the lawful exercise of its franchise, negligence cannot be imputed to it because it used the overhead wire system (125 N.E. 93).

Trade Marks and Trade Names.—A trade name, separated from the business to which it belongs and in which it is used, is not a species of "property" and cannot be sold and transferred as such, but can only pass with some property or business with which it has become identified (125 N.E. 73).

Binding Receiver of Telegram.—The receiver of a telegram is not, in the absence of an agreement by him to that effect, bound by a contract between the sender and the company, and his failure to present his claim within sixty days as required by the regulations of the company is not a defense (125 N.E. 45).

Invalid Sale of Trade Name.—Contracts between S and Y, both using the trade name "Bankable" in connection with their product, whereby Y sold his trade name to S and agreed not to use such trade name under his prior right in a given territory can be enforced as to the negative covenants not to use the name, the invalid stipulation relative to the sale of the trademark apart from any property or business being separable (125 N.E. 73).

Injury to Boy from Live Trolley Wire.—Where a trolley wire of defendant traction company running under the bridge of a railroad company was so placed that no one standing on the bridge or even bending over the parapet could reach it, the Court of Appeals of New York has held that the defendant was not liable for injury to a boy who in crossing the bridge swung a wire about eight feet long, bringing it in contact with the trolley wire (125 N. E. 93).

Damages for Personal Injuries.—According to the Supreme Judicial Court of Maine, in the case of Nadeau vs. Caribou Water, Light & Power Company (108 A. 190), a verdict for $2,512.50 in favor of one who received a severe electric shock, burning his hand so badly that it was totally disabled for four months and causing the amputation of one of his fingers, as well as impairing his income, part of which had been gained by playing the violin, was not so excessive as to warrant the conclusion that it represented anything but the honest judgment of the jury.

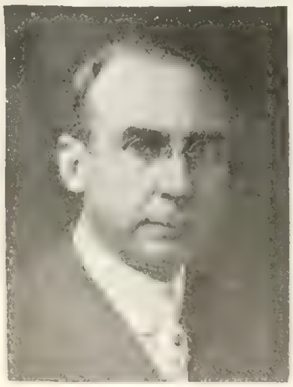
John T. Hutchinson of the Quakertown (Pa.) municipal electric light plant has resigned to become superintendent of the municipal plant at Souderton, Pa.

R. B. Woolley, who has been director of publicity of the Society for Electrical Development, Inc., for the past two years, has resigned to become associated with the Thos. F. Logan, Inc. Advertising Agency, New York City. Mr. Woolley will specialize in electrical merchandising accounts.

Thomas L. Small, formerly assistant treasurer of the Savannah (Ga.) Electric Company and for the last few months connected with the Stone & Webster properties at Brockton, Mass., has recently taken charge as manager of the properties of Stone & Webster at Baton Rouge, La.

Walter Neumuller, who has just been appointed assistant secretary of the New York Edison Company, has been associated with that company since 1900. Mr. Neumuller's progress in the company has been rapid. He started in a clerical position, advancing to the position of private secretary to Arthur Williams, general commercial manager. In 1918 he was placed in charge of all retail business of the company, which position he has held since that time. He is an active worker in a number of electrical organizations, including the National Electric Light Association.

S. M. Kennedy, general agent of the Southern California Edison Company, has been appointed a committee on public relations by President R. H. Ballard of the National Electric Light Association. Mr. Kennedy, the sole member of this important committee, will make a comprehensive report to the national convention at Pasadena in May. Because of his practical success in the field of relations with the public, Mr. Kennedy has become known generally throughout the industry. The keen study which he has made in his special province assures the high value of his report to the convention.


S. M. KENNEDY

Men of the Industry

Changes in Personnel
and Position—
Biographical Notes

H. W. Reilly, heretofore superintendent of the Oklahoma Gas & Electric Company at Oklahoma City, Okla., has been appointed vice-president in charge of operation, succeeding W. R. Molinard, who has recently resigned to give his entire attention to private interests in California. Mr. Reilly assumed his new duties on Jan. 1 of this year.

H. S. Brooks, who on Jan. 1, 1920, was appointed assistant vice-president in the department of accounts and finance of the American Telephone & Telegraph Company, has been in the continuous service of that company since 1892, when he started in the canvassing department. He has since held the following positions in the long-lines department: district superintendent, assistant general superintendent and general commercial superintendent. Mr. Brooks' new duties are in connection with the financial work of the company, in which he will assist Vice-president Walter S. Gifford.

G. E. Armstrong, protection engineer for the Southern California Edison Company, has joined the editorial staff of the McGraw-Hill Company as associate editor of the *Journal of Electricity*, San Francisco, Cal. In this capacity Mr. Armstrong will also assist Robert Silbley, the Pacific Coast editor of the ELECTRICAL WORLD and *Electrical Merchandising*. Since leaving the University of California, which he attended as a member of the class of 1914, Mr. Armstrong has been engaged in various engineering activities of the Southern California Edison Company and has acquired a wide experience in matters pertaining to hydro-electric generation of long-distance transmission of electrical energy.

Richard H. Rice, acting manager of the Lynn (Mass.) Works of the General Electric Company for the past year and a half and one of the best known steam engineering experts in the country, has been appointed manager of the Lynn plant, succeeding Walter C. Fish. Mr. Rice was born at Rockland, Me., in 1863 and was graduated in mechanical engineering at the Stevens Institute of Technology in 1885. After a short term of service in the institute laboratories and in the Dennison (Ohio) shops of the Pittsburgh, Cincinnati, Cleveland & St. Louis Railroad he entered the employ of the Bath (Me.) Iron Works as a designer of marine engines. From 1887 to 1891 he was designer and chief draftsman for the late E. D. Leavitt, consulting steam engineer, Cambridgeport, Mass., and from 1891 to 1894 he was superintendent and engineer of the William A. Harris Steam Engine Company, Providence, R. I. For the next nine years he was treasurer of the Rice & Sargent Engine Company, Providence, R. I., and in 1903 he was appointed consulting steam engineer for the General Electric Company, in charge of the steam-turbine department of the Lynn Works, which post he held until his appointment as chief executive of the Lynn factories. Mr. Rice has taken out about fifty patents on steam, air, water and other machinery, and he is a member of the American Society of Mechanical Engineers and has contributed to various engineering publications. The employee representation plan at Lynn has been developed largely under his administration.

R. H. RICE

Donald I. Cone, who took an important part in research work for the joint committee on inductive interference, whose valuable report has just been published by the California State Railroad Commission, is one of the energetic younger electrical engineers in the West. The labors of the committee with which he was associated are particularly important because of the necessity for solving complex problems arising from the long-distance transmission of high-voltage electrical energy on the Pacific Coast. Mr. Cone, through his experience with the transmission and protection engineering staff of the Pacific Telephone & Telegraph Company, San Francisco, was highly qualified to assist in laboratory and field work connected with the investigation. Mr. Cone was born at Eureka, Cal., July 30, 1891. He received his technical training at the University of California, where he was graduated from the College of Electrical Engineering in 1913 with the degree of B. S. Entering the employ of the Pacific Telephone & Telegraph Company, he has had charge of much of the study of interference and protection work for that system.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber
of Electrical Equipment and Supplies—
Notes on Industrial Activities and Business Methods

WHAT HAPPENS WHEN INCREASES ARE PASSED ON

Where Discounts Are in the Neighborhood of 50 per Cent to Jobber List Prices Must Be Advanced by Twice the Net Advance on the Part

Advances in the price of raw materials are not always reflected in proportionate or equal amounts in the higher prices of the finished products. An interesting case of this came to notice just recently. The fractional-horsepower motors used in washing machines advanced in the neighborhood of $2.50 apiece. The manufacturer, in order to pass this increase on without making a cent of profit himself, found it necessary to advance the list price of his machine $5. In other words, the jobber gets his discount from the list price of the entire machine. Inasmuch as most discounts on socket appliances sold to the jobber are in the neighborhood of 40 to 50 per cent, it is apparent that any increase in the price of raw materials passed on must raise the list price at least double the amount of increase of the parts. Where the discounts are smaller, as in the case of equipment and certain supplies, then of course the increase in the price of the finished products is only a little more than the increase in the price of the raw materials or parts.

YEAR'S LIGHTNING-ARRESTER BUSINESS SHOWS INCREASE

Season Has Been Prolonged by Heavy Fall Buying While Shipments Are Made in Reasonably Short Time

Regardless of the time of year, reports from manufacturers of lightning arresters indicate that during the past fall sales have been rather large. Current business is increasing, while sales for the month of October were especially high. In one case sales during that month were almost equal to those during the past spring and summer months and were about 100 per cent greater than for the same month in 1918. Another manufacturer sold at least 50 per cent more in October than in any previous month of last year.

Although it has not been possible to get figures from all manufacturers, it is generally agreed that 1919 sales will exceed those for 1918. Some reports have been received showing increases in sales of from 17 to 32 per cent over the previous year. In one case this increase has come entirely in the last six months.

Deliveries are good and run from stock to six weeks. In one case they are given as good or bad, depending on the kind of product, with the expectation that in 1920 they will be good. Where stock cannot be accumulated, shipments are running up to six weeks, depending upon the requirements of the customer and the voltage ratings of the arresters. Even six weeks is considered rather short time for filling orders. One manufacturer who can fill orders in from ten days to two weeks has been materially assisted in this by the standardization of the product and a large stock of raw materials.

It is not expected that any increase in price will come into effect within the near future. Advances in the neighborhood of 15 per cent in the past six months have been reported on account of increasing prices of labor and materials.

Increased business is looked for in view of the general business outlook and some new power and line developments. The future seems much brighter than the immediate past because it is believed that most companies now have more time and more money to devote to the question of lightning arresters than under conditions prevailing a year ago. At the same time, one manufacturer finds that the smaller utilities are buying more equipment. Taken all in all, the lightning-arrester season has been extended beyond normal, and increased business for the whole year has been satisfactory.

TO GATHER CURRENT SUPPLY DATA FOR EXPORTERS

Commercial Agents of Bureau of Foreign and Domestic Commerce Will Collect Answers to Questionnaire Just Drafted

Because of the numerous inquiries from exporters regarding the characteristics of current supplied by power plants in various parts of the world, the Bureau of Foreign and Domestic Commerce, through the American consuls and commercial attachés, is undertaking to gather such information so that it may be available for American exporters.

P. S. Smith, electrical trade commissioner for the Bureau of Foreign and Domestic Commerce, has drafted a questionnaire which, when filled out, will supply the exporting electrical goods trade of this country with necessary information regarding electricity-supplying companies in all parts of the world. Among the data which will be available will be whether the current supplied in any foreign city is direct or alternating, the frequency of the current and the voltage.

The questionnaires will be forwarded to the commercial agents of the bureau, who will collect and return the information to the bureau in Washington, where it will be collated and classified.

FOREIGN EXCHANGE RATES AFFECTING ELECTRICAL EXPORTS

Record for Month Is Below That of October, but Total for Eleven Months Is 50 per Cent Over 1918 Period

Electrical exports for the month of November, amounting to $6,704,184, fell below the figure for October by $500,000, and in only two months of 1919 were total exports lower. High exchange rates undoubtedly have had considerable to do with this condition of the last few months. The figures are only half a million above those for November, 1918.

Total exports for the eleven months ended November amounted to $82,424,051, which, however, exceeded the same period of 1918 by an amount totaling just in excess of $27,600,000.

In no instance does any item exceed that of any other month in 1919, although exports of dynamos or generators and of carbon lamps in November were exceeded in only one month. On the other hand, fewer carbons were exported, and tungsten lamps, meters and transformers were next to the lowest of any month of 1919. Motor exports held up very well. The amount of insulated wire which left the country has been increasing steadily for the past three months.

Canada, France, England, Argentina and Japan have bought well throughout the month, and Italy, Cuba and Norway purchased in rather fair amounts.

Figures in the following table were computed by the Bureau of Foreign and Domestic Commerce:

	November		Ten Months Ended November	
	1918	1919	1918	1919
Batteries	$350,162	$406,722	$2,945,116	$5,521,235
Carbons	211,191	61,971	1,461,573	1,290,819
Dynamos or generators	300,230	617,981	3,019,315	5,216,860
Fans	35,307	68,298	758,649	1,388,512
Heating and cooking apparatus	54,617	117,772	611,545	1,469,182
Insulated wire and cable	398,956	535,746	5,138,426	8,315,897
Interior wiring supplies, including fixtures	153,310	174,640	1,328,345	2,074,064
Arc lamps	274	1,904	14,011	15,805
Carbon-filament lamps	14,845	41,501	89,063	185,912
Metal-filament lamps	423,533	253,963	3,139,289	4,363,009
Magnetos, spark plugs, etc.	260,796	237,604	2,431,700	2,802,013
Meters and measuring instruments	219,620	156,655	1,765,614	2,663,352
Motors	925,171	1,003,864	7,561,981	9,857,437
Rheostats and controllers	63,048	40,655	260,907	478,924
Switches and accessories	206,828	229,941	2,043,514	3,348,752
Telegraph apparatus, including wireless	51,767	37,147	310,716	789,120
Telephones	188,429	373,610	2,565,548	3,453,175
Transformers	554,116	157,381	3,333,493	3,489,982
All others	1,765,052	2,186,829	16,015,740	25,700,001
Total	$6,177,252	$6,704,184	$54,794,545	$82,424,051

STOCKS OF INDUSTRIAL LIGHTING REFLECTORS LOW

Activities Are Increasing in This Market, the Field for Which Offers Great Possibilities to Electrical Distributers, According to a Recent Survey

That the industrial reflector business has a favorable outlook for the new year is shown by the increasing demand, particularly in the Middle West and New England, and the growing interest of the jobbers, who are adding to their sales staff men to specialize in general and industrial lighting. The field open to this branch of the industry is covered in a report of a recent survey of industrial lighting carried on by the National Lamp Works.

Purchases of standard R. L. M. reflectors have increased this fall and winter, with more attention to the sizes from 100 watts through 200 watts. In consequence, stocks of these sizes in manufacturers' and in disbributers' hands are extremely low. This condition has been accentuated by the steel and coal strikes. The supply of sheets is low and deliveries are delayed in reaching the reflector producers. This is putting off shipments of the finished reflectors as far along as the first of March, or six weeks, although in general three to four weeks is ruling on a large order. Some manufacturers have small stocks and can ship two hundred or so in less than three weeks. These periods are about double those required early in the fall. In the last two weeks there has been more activity in the larger sizes around 400 to 750 watts.

Prices showed an increase during the first half of November of from 10 to 15 per cent.

One of the heaviest shortages in steel at the present time is in sheets. The automobile trade presents a factor which must not be overlooked when thought is taken on the supply of sheets. Unfilled steel orders at the end of December were the heaviest of the year, but it is expected that sheet capacity will be increased in 1920. Nevertheless, the necessity is apparent for anticipating sheet needs in 1920 and placing orders sufficiently in advance of requirements to insure delivery.

In connection with the work to be done in this industrial lighting field, the report previously mentioned brings to light some interesting figures. The average proportion of work done under artificial light is from 25 to 30 per cent, and the general manager was shown to have the greatest interest and authority in lighting changes. Of particular interest is the attitude of industrial manufacturers toward their present lighting. Although 30 per cent of the 446 manufacturers interviewed have not changed their lighting within five years, 85 per cent were more or less satisfied with their present lighting conditions. The latest change in 60 per cent of the plants was in lighting equipment and lamps, while in 31 per cent it was in lighting system. New Mazda B lamp installations predominated over Mazda C lamp installations in the ratio of 70 to 54 in these changes.

No reflectors were used in 19 per cent of the plants, and only 31 per cent were partly equipped. The size of plants concerned is indicated in the average number of lamps used, namely 1250. Renewals were slightly under a year. A small majority ordered lamps in less than 100 lots, 28 per cent in lots from 100 to 200 and 20 per cent in quantities over 200. Apparently plants do not know how to order lamps. When they do purchase they go to the lamp manufacturer for 8 per cent, to the electrical jobber for 43 per cent, to the electrical retailer for 34 per cent and to the central station for 18 per cent. Hence is shown the importance of the electrical jobber and retailer in the distribution of lamps to industrials, and the opportunity of those agencies of working with the plants which they serve in illumination matters.

The industrials state that they would seek information regarding lighting changes from the electrical retailer, jobber, architect or engineer, central station, their own electrician and the lamp manufacturer in that order, so that approximately 70 per cent would go to the electrical distributer or to their own organization. And they are keen to the advantages to be derived from efficient industrial lighting when 79 per cent figure it would increase production, 71 per cent believe it would decrease spoilage, 60 per cent hope for prevention of accidents, 51 per cent believe it would improve discipline and 41 per cent see an improvement in hygienic conditions. The lamp distributer and the service to be rendered by efficient lighting conditions in the factory seem to go so closely hand in hand that an especially bright outlook appears in the industrial reflector market.

UNDERWRITERS' APPROVAL OF FARM-LIGHTING PLANTS

Manufacturers Decide, After Weighing Advantages and Disadvantages, that Decision to Submit Plant Must Rest with Individual Concern

There has been more or less discussion recently relative to the advisability of obtaining from the Underwriters' Laboratories approval of farm-lighting plants. In order to arrive at a decision on this matter a committee of manufacturers gave it consideration and as a result stated that approval is advantageous on the grounds that it is a guide to perfect design and makes the product as safe as possible; that it prevents increase in insurance rate with stock companies in some districts, though it does not decrease rates as much as should be the case with a device that eliminates the dangers of lighting systems of the flame type, and that, besides, it offers some sales advantages. On the other hand, the committee thought there were numerous disadvantages, among them being that to obtain the underwriters' approval retards the development of original ideas and encourages extreme requirements in construction which tend to increase the cost beyond commercial limits. It is a disadvantage, the committee held, to have fire underwriters' requirements cover structural details instead of confining them to fire-prevention principles.

As a result the Association of Farm Lighting Plant Manufacturers, at its recent meeting, concluded that the individual manufacturer must decide for itself whether or not it shall submit its plant for approval by the Underwriters' Laboratories.

METAL MARKET SITUATION

Copper Situation Strong in Market of Light Trading—Lead Again Higher

Producers of copper are holding spot and first-quarter deliveries at 19.25 cents and, in the main, second-quarter at 19.50 cents a pound. At the same time, some of these producers are willing to pull first-quarter quotations over into April and even May for regular customers on large orders. The market is much quieter than during the first two weeks of the month, and spot and nearby requirements of the large consumers are well taken care of. Producers, considering this situation, see no reason for letting down the bars to encourage the little spot and nearby business that is coming through. It is felt that only a few weeks will pass before the big consumers will be in the market again. Meanwhile there is an intermittent flow of orders for small amounts of the metal. At present there are no signs in the market of a lower copper price in the near future.

The outside market, on the other hand, will shade 19.25 cents, even to 19 cents a pound, but the amount of business done at this figure is small. Traders are buying and selling among themselves at this figure, in many cases to fill obligations. If sales should continue as they did in December and early January, producers' stocks of refined metal and their capacity for refining would be severely taxed to meet the demands. Refiners have lowered their capacities and are still running at a good rate, but if customers as a whole begin to send in orders on a big scale for rather nearby shipment, refining capacity would be unable to handle the business. With no evidence of a drop in sight, customers knowing their requirements over the next few months gain nothing by holding off till the last minute, tending to clog up refining capacity on a specified shipping schedule.

Export demand has quieted down considerably, the ruling price being 20 to 20.25 cents. Of the copper exported from the United States in 1919, it is estimated that Japan took 40 per cent. The outstanding fact is that Japan is becoming an importer of copper rather than an exporter. This is an entire reversal of her policy of a few years ago. Much of her copper has been turned into brass goods for the Eastern market, while at the same time she has been drawing bar into wire for the modernization of her factories and for hydro-electric developments.

Lead shows an advance over the previous week. The main producer's price is 8.50 cents, while the outside market has small supplies at 8.75 cents.

Zinc for early shipment is not very plentiful. Better inquiries are around from the galvanizers. Sheet zinc is higher to 12.50 cents.

Steel-mill conditions are not very favorable in light of short coal supplies and lack of sufficient labor. Finished and semi-finished material producers are unable to secure adequate supplies of raw materials and are consequently limited in their output. This has a distinct bearing on the supply of sheet steel and other kinds of steel and iron needed by electrical manufacturers.

NEW YORK METAL MARKET PRICES

	Jan 13	Jan. 20
Copper:	£ s d	£ s d
London, standard spot	119 15 0	116 5 0
	Cents per Pound	Cents per Pound
Prime Lake	20.00 to 20.50	19.50 to 20.00
Electrolytic	19.25 to 19.50	19.00 to 19.25
Casting	19.25	18.50 to 18.75
Wire base	22.25	22.25
Lead, trust price	8.25	8.50
Antimony	10.25	10.62½
Nickel, ingot	42.00 to 43.00	42.00 to 43.00
Sheet zinc, f.o.b. smelter	12.00	12.50
Spelter, spot	9.50	9.50
Tin	65.00	64.00
Aluminum, 98 to 99 per cent	31.50 to 32.50	31.50 to 32.50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	17.75 to 18.25	18.00 to 18.25
Brass, heavy	10.50 to 11.00	10.50 to 11.00
Brass, light	8.50 to 8.75	8.75 to 9.00
Lead, heavy	6.75 to 7.00	7.00 to 7.12½
Zinc, old scrap	5.25 to 5.50	5.25 to 5.50

THE WEEK
IN TRADE

A HIGH rate of buying continues in all localities but the Northwest, in which section the midwinter lull has not yet been overcome. Here, however, business is picking up. Building is progressing at a great rate, several returns showing improvement over the same period a year ago.

Complaints on slower and more unsatisfactory shipments are coming in, and jobbers' stocks are suffering, particularly in the West and New England. Deliveries on sockets are so much better that competition is lowering prices a bit. Loom is in a little better shape, too, as far as deliveries are concerned.

Greater activity is reported in the central-station market for apparatus. In Chicago jobbers are adding salesmen, principally to handle appliances, and are increasing their office and storage space. Appliance sales are still extremely heavy, and no let-up is foreseen. More attention is being paid to orders far in advance of those ever placed before. Collections are, in general, good.

Price advances are shown on high-tension porcelain insulators and accessories, some lines of single-phase and fractional motors, one type of pole lightning arrester, sewing machines, bells and buzzers and cross-arms. In the West knife switches and safety switches, condulets and friction tape are up. Jobbers' prices are higher on flexible armored conductor.

NEW YORK

Continued heavy buying keeps a large volume of material constantly on the move. There is no sign of a let-up on wiring supplies to afford any accumulation of stocks. Jobbers' pipe stocks are long and short, depending on the jobber and whether or not shipment has just come in. Frequently pipe stocks never reach the warehouse but are routed from terminal to customer. The same can be said of non-metallic flexible conduit and flexible armored conductor. Much of this material is booked for three months ahead. Shipments of loom are said to be coming through a little better. One jobber has a good stock of open wiring porcelain and little call for it, but the general market for this is much undersupplied.

Central stations are ordering transformer voltage and feeder regulators, meters and lightning arresters in better volume than is customary at this season. Distribution-type transformer stocks are better than a month ago, but motor stocks in local warehouses are badly broken up.

As for recent price advances, high-tension insulators, bushings and accessories went up 5 and 10 per cent, depending on type. Certain single-phase and fractional motors went up 5 and 10 per cent, one class of pole-type lightning arresters advanced 17 per cent, and some jobbers' prices on flexible armored conductor are higher. Shipments of material from factories are expected to become longer rather than shorter.

One jobber reports a small shortage on nearly all recent incoming shipments. In some cases part of the shipment is missing while in other cases a component part of the apparatus never was packed originally.

MOTORS.—Westinghouse type AR single-phase motors advanced 10 per cent in price on Jan. 12 and General Electric fractional-horsepower motors advanced 5 per cent on Jan. 15. New York stocks of motors are spotty, and incoming shipments are quickly absorbed. Ability to ship is clinching the orders.

TRANSFORMERS.—Local stocks are in better condition than a month ago. Central stations are ordering well.

LIGHTNING ARRESTERS.—Sales are in good volume. Certain pole types have advanced 17 per cent because of increase in price of porcelain parts used in their make-up. One manufacturer reports better ordering of arresters with transformers, as a component accessory of every distribution pole-type transformer.

METERS.—Heavy ordering is the characteristic note in a normally rather quiet market at this season. No relief to present shipments is offered by manufacturers.

LAMPS.—Stocks are reported somewhat below normal, especially on the 120-volt size.

RIGID CONDUIT.—Jobbers' stocks are spotty, running from one-half carload in warehouse up. Manufacturers' local stocks are likewise, as a rule, poor. Black pipe in $\frac{1}{2}$-in. size is selling for $68 to $74 for 1,000 ft.

FLEXIBLE ARMORED CONDUCTOR.—Jobbers' prices are higher in several cases. For 1,000 ft., No. 14 double strip is up to $95, while other quotations are as low as $88, with virtually no stock. Some jobbers' allotments are booked ahead for three months.

NON-METALLIC FLEXIBLE CONDUIT.—Somewhat better deliveries are coming in, but orders are taking up the goods so fast the loom is frequently transshipped without touching the stockroom. From list to 25 per cent off is being quoted, depending on amount—the latter figure for coil lots.

WIRE.—No. 14 rubber-covered is commanding $12.50 to $13 for 1,000 ft., while 5,000-ft. lots can be had for $11.50. Stocks are in fair condition.

PORCELAIN.—High-tension pin-type insulators and suspension insulator accessories advanced 10 per cent in price Jan. 17. Suspension-type insulator bushings and hardware advanced 5 per cent. The market is strong with heavy buying and many inquiries and shipments are long. From sixty days to twelve weeks is being quoted, depending on type wanted, and the tendency is toward still longer shipments.

CHICAGO

Jobbers in the Middle West are in general putting on more salesmen and taking more office and storage space. Many of them are enlarging their forces in order to push the sale of household appliances, particularly washers. On account of poor factory deliveries in many lines large increases in sales are not expected immediately. Central stations all over this section of the country are planning or building new plants, substations and lines. The Commonwealth Edison Company has drawn plans for a large new plant to serve the Calumet district.

Prices have advanced approximately 10 per cent on high tension insulators and electric sewing machines.

WIRE.—Base prices on weatherproof are lower, averaging about 28 cents. Rubber-covered still holds 29 to 30 cents. Shipments are improving, but stocks do not get a chance to build up much.

ARMORED CONDUCTOR.—There is a very short supply to meet the existing big demand. Prices are stiff. No. 14 twin is quoted at from $87 to $95 per 1,000 ft.

SOCKETS.—A big demand is noted and stocks are fair with the exception of pulls, which are still low. In standard package lots these are quoted at 54 cents, keyless at 27 cents and key and push at 30 cents.

BUZZERS AND BELLS.—A price increase of approximately 10 per cent has been put into effect. The difficulty of getting small wire is probably accountable for the shortage of buzzers.

HIGH-TENSION INSULATORS.—At least two large manufacturers of insulators have increased their prices approximately 10 per cent. Quotations from one maker at the increased prices are as follows: 15,000-volt, pin-type, 91 cents; 32,000-volt pin, $2; 45,000-volt pin, $2.30. The pins for the insulators cost 25 cents, 85 cents and 90 cents respectively. The link type of suspension insulator sells for about $3.25, and the regular type, 10 in., at $2.60.

SEWING MACHINES.—Price increases have been made on several electric sewing machines, amounting to about 10 per cent of the list. A Wilson machine advanced $7 to $72 Jan. 1, and one Westinghouse model increased about a month ago $7.50 to $72.50.

BOSTON

Great activity characterizes trade. Building and engineering construction permits are running far ahead of last year. Jobbers' stocks are hampered by rather poor deliveries, but regular customers are being well cared for by individual houses. Collections are holding up well. A number of central stations have been in the market for high-voltage cable during the past week, and a fair amount of extensions of lines for ordinary service is expected this spring. Prices are steadier this week than for some time, and a decided softening is noted in socket quotations, owing to competition. Domestic appliance sales are a continuing feature of the market. In the main, supplies of the staple character are harder to obtain than specialties. The New England Telephone & Telegraph Company has begun the erection of a three-story exchange building with provision for machine switching in Boston.

WIRE.—Prices are fairly steady, tending toward firmness, with varying discounts under close competition. Three central-station orders placed within a few days for three-conductor, 13,000-volt to 17,000-volt cable totaled about $75,000. Base prices range as follows: Bare, 23.5 to 24 cents; rubber-covered, 26 cents net; weatherproof, 28 to 28.5 cents. Stocks of smaller wire are much improved, and not much complaint is heard about deliveries.

FLEXIBLE ARMORED CONDUCTOR.—Jobbers are serving their "regular" customers better than for some time, though not much of this material is lying around loose. No. 14 single-strip was quoted at about $90 per 1,000 ft. Monday.

METALLIC FLEXIBLE CONDUIT.—The demand is great but the supply is very low. In the small lots available list prices are being quoted on both single and double strip.

NON-METALLIC FLEXIBLE CONDUIT.—Scattering shipments are coming in, and the "old line" customers are being cared for fairly well by small-lot sales. The $\frac{7}{32}$-in. size brings about $30 per 1,000 ft.

SOCKETS.—Prices reflect close bidding, with improved supplies. Pulls are running lower at 45 cents, keys at 25.5 cents, and keyless at 23.5 cents in case lots. A healthy demand continues.

SNAP SWITCHES.—Trade is good, with fair supplies and discounts of about 15 to 17 per cent off list.

STORAGE BATTERIES.—Business is very active, but supplies are well maintained by advance ordering. Prices are steady, notwithstanding recent upward quotations in lead. A demand is arising for the use of storage batteries in improved truck lighting and ignition work. Deliveries are quoted from two to three weeks for this service.

STARTING, LIGHTING AND IGNITION SYSTEMS.—A tremendous business is being handled. One manufacturer is reported to have sold his entire year's production within the first eight days of January and to have closed his books on further orders at present.

MOTORS.—Deliveries on moderate-sized and small single-phase and three-phase motors are quoted at 12 weeks, f.o.b. factory. Local stocks of motors are hard hit. Even concerns which do not cater to appliance trade are approaching the point of overtaxed facilities. Confectionery plants are buying heavily in motors at present.

DRY CELLS.—The demand is falling off somewhat, with steady prices. No. 6 cells are quoted at $32.90 per 100, and the igniters at $33.90, in barrel lots.

RIGID CONDUIT.—Local stocks are relatively small in the smaller sizes and could be quickly cleaned out if released to the general trade. One jobber reported 50,000 ft. of $\frac{1}{2}$-in. galvanized pipe in stock Monday, with scheduled shipments of two carloads a month to September.

ATLANTA

Jobbers report a continued increase in activities after the inventory period. Unusually large orders are being received from all parts of this section, and there is a tendency on the part of some purchasers to place orders for their 1920 fall requirements. One jobber reports that parties who formerly ordered a dozen articles at a time are now placing orders for a gross of the same, not with the idea of getting a pro rata share of the gross but with the hope of receiving all of their order.

January building permits started off with a tremendous rush, the first ten days of the month smashing all previous January records. Building permits for the city of Atlanta amount to $986,390 and cover such construction as large department stores, apartment houses and warehouses. The week ended Jan. 8 showed in the six principal cities in the South an average increase in building of 60 per cent over last year. Jobbers report collections unusually good.

CONDUIT.—No improvement is to be noted in stocks or shipments.

WIRE.—Stocks and shipments of weatherproof continue to improve, and jobbers are making good shipments on all of the large sizes, while Nos. 6, 8 and 10 are reported in sufficient quantities to take care of present demands. There is a shortage, however, in No. 12 and No. 14 rubber-covered. Prices are quoted steady; rubber-covered, 28 cents; weatherproof, 29 cents base.

CROSS-ARMS.—An advance of 20 per cent in price is noted. Local stocks are in fair shape and shipments good.

HEATING DEVICES.—Jobbers report the receipt of large orders, many of which are placed for the retailers' 1920 holiday trade. Orders for all lines are phenomenal, flatirons, as usual, showing the strangest demands. On account of the anticipation of their future requirements jobbers seem to feel that they will be able to take care of the coming summer and fall without difficulty.

DESK FANS.—The spring activity is somewhat late this year, no orders of moment yet being received. In anticipation of the demand beginning about Feb. 1, jobbers are accumulating large stocks so that they will be in a position to make prompt shipments when the trade begins.

SEWING MACHINES.—The popularity of the portable machine is on the increase. A brisk movement is being reported by the principal jobbers. Fair shipments and good local stocks account for their ability to fill orders.

WASHING MACHINES.—The demand continues to exceed the supply, and slow shipments indicate that no improvement is to be expected.

EXHAUST FANS.—Contrary to the usual custom, the movement of exhaust fans is continuing throughout the winter. The spring demand, however, is not yet in evidence, but jobbers anticipate considerable activity in this line in the next few months. They are therefore making every effort to accumulate sufficient stocks.

ELECTRIC HOISTS.—A temporary slump in demand since Jan. 1 is noticed. Numbers of inquiries are beginning to come in, and as soon as manufacturers have completed their 1920 plans this item will become active.

SEATTLE-PORTLAND

Business in Seattle and the Puget Sound district last week was at low ebb, in spite of the fact that building showed a slight spurt. The small volume of sales is directly attributable to the decline in steel-ship building, which also affects smaller allied industrial plants, such as machine shops, boiler shops, tin and copper shops, etc. Sales to lumbering and logging industries also are at a minimum, because many plants are closed or will close on account of the continued car shortage. Jobbers' stocks in many lines, especially motors and heavier power apparatus, are hard hit, and chances for immediate replenishment are slight. Stocks of schedule material are in fair shape and are improving, owing primarily to the light demand since before the holidays. Shortage of household appliances, particularly washing machines, vacuum cleaners, hot plates, etc., according to several larger jobbing houses, is causing considerable alarm, as promised shipments are not coming through. Prices, with but few minor exceptions, remain comparatively firm. Collections both in the city and rural districts are good, though not up to the standard of last year at this time. The Seattle school board recently decided to postpone the issuance of $4,500,000 in bonds for proposed new schools until costs are lower. The City Council is considering a bond issue of $1,750,000 for completion of the Cedar Falls hydro-electric project. Machinery and equipment for this project would cost $500,000 and would increase the capacity of the plant to 18,000 kw. The Kane Pneumatic Shock Absorber Company, Centralia, Wash., plans the erection of a 500-kw. power plant.

Portland district reports business showing a gradual increase following the holiday lull, particularly in appliances, small motors, house-wiring devices, etc. Shortage of stocks in many lines of household devices is acute with no immediate relief. Building both in Portland and in the smaller towns is increasing noticeably. Prices have shown no recent advances. Collections throughout the state, and in Portland particularly, are considered good.

ELECTRIC PADS.—Several of the largest Seattle retailers report stocks sold out. The local factory is unable to keep up with orders and Eastern shipments are coming through very slowly.

WIRE.—In spite of the light demand of recent weeks, stocks as a whole are poor.

FLEXIBLE ARMORED CONDUCTOR.—Slight increase in demand is noted, occasioned primarily by minor increase in apartment-house construction, which is scheduled to show further increases. Despite poor shipments, stocks are in fair shape.

SAN FRANCISCO

There is plenty of building going on, but few new jobs. Credits are being extended on a shortened basis because the sale of devices, which necessitated longer credit for a time, is now firmly established and dealers no longer need extra time on washing machines and the like. Collections average forty-five days' time, which is considered a good showing.

RECEPTACLES.—The sale of baseboard receptacles is being stimulated by the remarkable demand for portable stand lamps, and dealers are encouraged to believe that this long-pending demand will now relieve the much overloaded socket.

SWITCHES.—The call for knife switches is increasing, and especially for double-throw switches, which are needed in range and water-heater installations. Rumors are in circulation that several range campaigns are to mature, requiring the use of double-throw switches. Standard knife switches have increased 20 to 25 per cent in price in various quantities, and externally operated safety switches have jumped from 5 to 15 per cent in various quantities.

CONDUIT FITTINGS.—Condulets, taplets and parallel lines have increased in price 20 per cent right down the line through the various quantities. Several jobbers report that their 1919 sales showed a big increase over 1918, one which was even greater than the proportionate increase on outlet fittings.

INSULATING MATERIAL.—Commercial grade friction tape has increased 15 per cent in various quantities, the ¾-in. size now selling for about 47.5 cents per pound in 100-roll lots. There is a bigger demand for higher grade friction tapes, no doubt occasioned by the steady increase in the price of commercial grade which has brought the two grades almost together on a price basis.

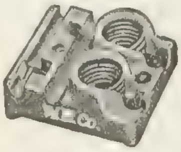
RANGES.—It is reported that a big range campaign will shortly be staged by one of San Francisco's power companies. It is a fact that without any special effort the demand for ranges has continued without regard to increase of prices, showing that the public has acquiesced in the factory contention that high labor costs have justified these increases.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Cut-outs

A line of cut-outs with white porcelain bases and heavy copper current-carrying members has been recently developed by the Ward Electric Company, Philadelphia Stock Exchange Building, Philadelphia, and approved by the Underwriters' Laboratories. The line includes catalog numbers 2569, 2965, 2587, 2199, 2165, 8042, 2135 and 1935. The last-named is illustrated, being a two-wire single-branch cut-out.


TWO-WIRE SINGLE-BRANCH CUT-OUT

Mechanical Milk and Cream Producer

For producing cream and milk mechanically from their component parts the Sharples Separator Company of West Chester, Pa., is manufacturing a 200-gal. (757-l.) motor-driven emulsifier.

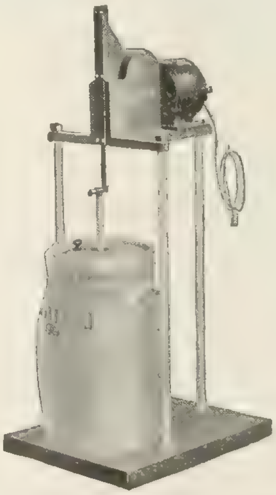
A 3-hp. motor with a speed of 3500 r.p.m., equipped with a 9-in. (23-cm.) steel pulley, drives the emulsifier bowl by means of a canvas belt at a speed of 16,000 r.p.m. Where the emulsifier is to operate on direct current an "Eck" motor, equipped with a Cutler-Hammer rheostat, is supplied, and where alternating current is available a three-phase, 60-cycle motor, rated at 220 volts, is used without a controller.

SUPPLIED WITH HEATER TANK, BRINE TANK AND COOLER

Besides the emulsifier proper a copper water-jacketed heater tank with a propeller agitator, a brine tank and pump and a cooler are supplied with the outfit; the brine pump and agitator are operated from a line shaft.

Butter Churn with Inclosed Mechanism

Sanitation, safety, silence and ease of operation, portability and simplicity are characteristics which the Holland Manufacturing Company of 129 North Wells Street, Chicago, states have been built into its motor-driven household-size churn. This churn consists of a $\frac{1}{12}$-hp. electric motor and driving mechanism mounted above a double-glazed 5-gal. (18.9-l.) stone jar in which a rod and dasher of the familiar hand-churn type is operated. The wood base of the churn supports three iron uprights to hold the motor and gear case and also keeps the earthenware container in place.

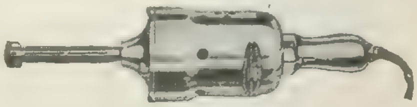

HAS ROD AND DASHER MOVEMENT

This new outfit for home butter-making, which operates on 110 volts alternating current or 32 volts or 110 volts direct current, weighs 60 lb. (27 kg.).

Electrically Operated Automobile Valve Grinder

An electrically operated grinder for automobile valves has been placed upon the market by the Eclipse Valve Grinder Company, Sub-Freight Station Building, Twentieth Street at Oak, Kansas City, Mo. It is designed to give a positive and rapid back and forward, or oscillatory, movement to do the grinding and a slow rotary movement to turn the valve continually to a new position. The motor, which is controlled by a trigger switch in the handle, operates on either alternating current or direct current from the ordinary 110-volt lighting socket.

One feature of the new valve grinder is its light weight, which is but 6½ lb. (2.9 kg.). Other features of the tool pointed out by the maker are simplicity of operation and limited number of parts.

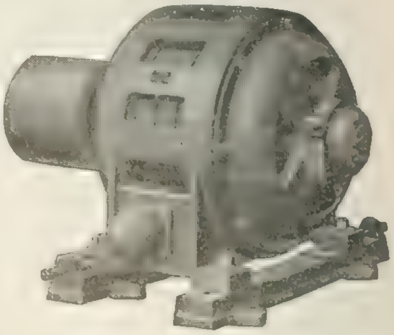

MOVEMENT OF VALVE GRINDER IS BOTH OSCILLATORY AND ROTATING

The motor housing is constructed of tough aluminum alloy made in two compartments, thus separating the grease-packed mechanism from the motor.

Constant-Speed, Ring-Oiling Induction Motors

Standard horizontal type, constant-speed, ring-oiling induction motors for operation on two-phase and three-phase circuits on 110, 220, 440, 550 and 2,200 volts and 60, 50, 40 and 25 cycles are now being marketed by the U. S. Electrical Manufacturing Company of Los Angeles, Cal., and are known as type "ST."

The frames of the new motors are cast and of shell-type construction with openings to allow air circulation. End brackets protect the windings and may be rotated for wall or ceiling mountings. Oil wells are protected from dirt and dust, and the inside of the bearing housings are enameled. Oil-well level indicators are provided with hinged self-closing covers. Large replaceable bearings are used. Provision is made to keep accurately machined oil rings in place. Oil is dis-


SHELL-TYPE FRAME USED

tributed over the entire bearings, and double grooves on the end with multiple drains prevent surplus oil creeping along the shaft.

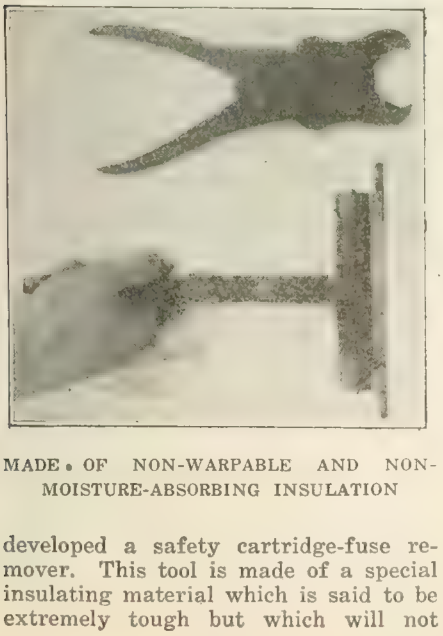
The stator, the manufacturer states, is made of non-aging electrical sheet steel, japanned, baked and stacked in a hydraulic press between heavy keys end flanges. End fingers and spacers are welded to heavy disks to prevent teeth bending in removing the rotor. The slots are practically all of open type.

The coils are form-wound, taped and in most sizes of either square or rectangular wire, cotton-covered. By removing specially treated wedges which hold the coils in place, these can be removed and readily replaced in case of burn-out. The insulation in the slot is laminated varnished cambric and fiberoid and is reinforced at the ends. In the 220-volt motors mica is used for slot insulation. Phase insulation is laminated varnished cambric in the small sizes of motors and specially insulated and treated phase coils in the larger sizes. The leads are extra-flexible double-braid brush cable extending through rubber bushings in the terminal plate.

The shafts of the rotor are stated to be of high-carbon open-hearth spindle steel and of large size. The bars are of drawn copper of rectangular cross-section. The rotor slots are overhung and the bars act as fans, providing forced air circulation. The end rings, it is claimed, have liberal cross-sections and radiating surface and are brazed to the bars, making an indestructible construction which, it is said, cannot be burned out. The rotor flanges are keyed to the spiders, which are used on all sizes of the motors.

Safety Cartridge Fuse Remover

For removing and replacing cartridge fuses ½ in. (12.7 mm.) to 1½ in. (38 mm.) in diameter the Bush Electric Company of Cleveland, Ohio, has developed a safety cartridge-fuse remover. This tool is made of a special insulating material which is said to be extremely tough but which will not warp or absorb moisture. The construction of the fuse remover resembles that of a pair of pliers, except that the movement of the handles is multiplied in the gripping jaws, resulting in simplicity of operation, only one hand being required.



MADE OF NON-WARPABLE AND NON-MOISTURE-ABSORBING INSULATION

Quick-Make and Quick-Break Safety Switches

A compact externally operated quick-make and quick-break safety switch known as type BG and designed to possess all the safety features essential for maximum protection to both operator and the circuit which it controls has been placed on the market by the V. V. Fittings Company, 1910 North Sixth Street, Philadelphia, Pa.

The inclosing cabinet used in the new switch is made of sheet metal with electrically welded joints. The switch proper is toggle-spring-actuated, thus producing a positive "on" position and a positive "off" position. The springs are at rest when the switch is in either the "on" or "off" position. The knife blades, it is claimed, make and break contacts simultaneously. The fuse compartment of the new switch cannot be opened until the switch mechanism is in the "off" position, nor can the switch be thrown to the "on" position while the fuse compartment door is open. The switch compartment can be opened, if locked, only by authorized parties. This permits the inspection of the switch even while in the "on" position.

SWITCH IN "OFF" POSITION AND FUSE COMPARTMENT OPEN

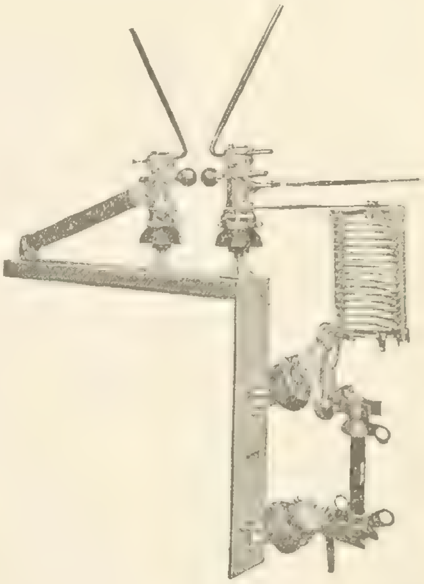
Provision is made for the use of from one to three locks on either the "on" or "off" positions of the switch, and both the switch and fuse compartment doors are fitted with hasps for attaching padlocks.

These safety switches are obtainable in both fuseless and fusible styles for 250 volts alternating or direct current and also for 500 volts alternating current. All of these switches are obtainable in 30-amp. or 60-amp. styles, two or three poles. In the 30-amp. size, it is stated, the regular 60-amp. switch is used with a 30-amp. fuse cut-cut to guarantee strength.

The finish of all switch boxes is baked black enamel.

Farm Line Switch and Arrester Unit

A farm-line unit combining an expulsion-fuse disconnecting switch, a sixteen-turn choke coil and a lightning arrester complete with horn and ball gaps is being marketed by the Electrical Engineers' Equipment Company of Chicago, Ill. The entire equipment is mounted on two steel plates at right angles, ready for bolting to the cross-arms. It is made for a voltage of 13,200 in the "L" size and for higher voltages in the combination "G." All steel members are hot-dip-galvanized, while pins, bolts and nuts are sherardized. The outfit includes a switch stick and six extra fuse links.



CONSISTS OF DISCONNECTING SWITCH, CHOKE COIL AND LIGHTNING ARRESTER

Improved Outlet Plate

An improvement has been made by the Sterling Manufacturing Company, Erie, Pa., in its outlet plate whereby the new hickeys will be provided with a set screw so as to hold securely the fixture stem, especially when used to support a wall bracket.

FIXTURE STEM HELD FAST

Manufacturers' Activities

THE BUSSMAN MANUFACTURING COMPANY, St. Louis, Mo., states that Buss renewable fuses from 3 amp. to 600 amp. at 250 volts and from 3 amp. to 60 amp. at 600 volts have been listed as standard by the Underwriters' Laboratories.

THE WOLVERINE TUBE COMPANY has moved into its new plant at 611-625 Central Avenue, Detroit, Mich. The new plant, comprising two and one-half acres of land with 30,000 sq.ft. of floor space in the factory, will afford greater facilities for producing brass and copper tubing.

THE SPERO ELECTRIC COMPANY announces that it has bought a building at East Thirty-third Street at Woodland Avenue, Cleveland, Ohio, and has remodeled it to suit requirements. The three floors and basement will be used for the manufacture of a full line of switchboards, tablet boards, fuse boards and cabinets. No new products are being manufactured. The personnel of the company consists of B. E. Spero, Leon Spero, S. W. Spero and A. F. Cibs.

THE FORT WAYNE (IND.) BATTERY MANUFACTURING COMPANY will as of Jan. 1, 1920, begin the manufacture of storage batteries for automobiles and lighting systems. The company is completing a two-story building, 54 x 196 ft., and a boiler house, 50 x 57 ft. The company has taken options on several vacant lots surrounding the plant for future expansion. Among the directors are S. A. Lehman, J. C Sherer and George Houser.

NEW VICE-PRESIDENT FOR WESTINGHOUSE INTERNATIONAL — Edward D. Kilburn, who since March 15, 1917, has been New York district manager of the Westinghouse Electric & Manufacturing Company, was recently elected vice-president and general manager of the Westinghouse Electric International Company. Mr. Kilburn was graduated from Cornell University, and immediately after leaving college he entered the employ of the Westinghouse company, being for a number of years with the Syracuse office of the company. Subsequently he was transferred to the Westinghouse Machine Company, with headquarters at New Haven, Conn. In 1915 he returned to the Electric company as manager of the power division of the New York office. A year later he was also made manager of the railway and lighting divisions, subsequently becoming manager of the office. Maurice Coster, who has been engaged for more than thirty years in handling the foreign interests of the Westinghouse company, continues as vice-president of the International company with advisory duties. The Westinghouse Electric International Company was formed in the spring of the present year to succeed the Westinghouse Electric Export Company. It handles the Westinghouse foreign business and is worldwide in its scope, exclusive of the United States and Canada.

E. D. KILBURN

THE JANETTE MANUFACTURING COMPANY, Chicago, announces that it has moved into its new factory at 556-558 West Monroe Street.

F. O. CREAGER has been placed in charge of the Chicago office of the Adams-Bagnell Electric Company, which will in the future be at 1511 Heyworth Building, Chicago.

B. J. SHULSINGER has resigned his position with the McGraw-Hill Company, publisher of the ELECTRICAL WORLD, to become advertising manager of the National Metal Molding Company, Pittsburgh, Pa. Mr. Shulsinger was at one time a member of the advertising department of the Western Electric Company.

THE CHANDLER SERVICE CORPORATION, 74-76 Ashland Place, Brooklyn, N. Y., announces that the service formerly rendered by the Chandler Engineering Corporation will be continued under conditions affording the organization greater resources, more extensive facilities and broader scope for progressive, enterprising expansion along new lines in the industrial field. Its undertakings embrace the electrical art through its engineering and industrial divisions in connection with industrial projects, and it is equipped with laboratories, drafting rooms and experimental shops.

GENERAL ELECTRIC COMPANY TO OPERATE GLOUCESTER FACTORY—Plans of the General Electric Company to acquire the three-story Rowe building on Duncan Street, Gloucester, Mass., and utilize it as a factory for motors and generators were made public last week after a conference between company officials and the Municipal Council. The company holds a seven-acre tract in the city which will probably be developed, and at the end of three years, if plans mature, about 5000 persons will be employed in Gloucester.

THE ARNOLD ELECTRIC TOOL COMPANY, INC., 902 Chapel Street, New Haven, Conn., has recently increased its capital stock from $25,000 to $300,000 in order to provide funds for its greatly increased business. Until recently the company had its tools assembled, but the old Brown Street school has been purchased and converted into a manufacturing plant, to which an addition must be erected to meet the company's requirements. Over 200 mechanics will be employed to fill outstanding orders and to care for the 1920 business, which the company feels will be heavy.

PACENT ELECTRICAL COMPANY, INC., 150 Nassau Street, New York City, has been incorporated. Louis G. Pacent, radio engineer, who for the past five years has been manager of the radio department of the Manhattan Electrical Supply Company, Inc., is president. The new company will carry a full line of dependable electrical and radio apparatus for experimental work, and will also maintain a laboratory where such equipment, including the latest types of vacuum tube apparatus, can be treated under actual working conditions. All the most modern equipment will be sold through the various jobbers and dealers under full guarantees, and the company will co-operate with the American Radio Relay League in the testing and promotion of new developments in radio apparatus.

CHANDELIER SHOW AND FIXTURE MARKET IN DETROIT.—The National Council of Lighting Fixture Manufacturers will hold its chandelier show and fixture market at the Hotel Statler in Detroit, Mich., Feb. 9 to 14. After the preparation of displays and opening of registration booth on Feb. 9, the joint meeting with the Glassware Guild and National Lighting Fixture Dealers' Society will be held at 9:30 a.m. Feb. 10. At 10 o'clock that morning and thereafter each morning at 9:30 the National Council will meet, the session on Feb. 11 being given to design protection, E. N. Caldwell chairman; on Feb. 12, topic, standardization, chairman to be selected; on Feb. 13, election of officers, report of committees and selection of convention city, and on Feb. 14, executive and other committee meetings. The 10 a.m. session on Feb. 10 will be given over to cost accounting, Robert M. Biddle chairman. The 2 o'clock session each afternoon will be given over to the chandelier show and fixture market. The chandelier show at 7:30 p.m. on Feb. 11 will be architects and builders' night, and the one on Feb. 13 will be public night.

THE ODIN COMPANY, 325 West Ohio Street, Chicago, which has been manufacturing motor-driven electric washing machines for some time, is now under the direction of H. H. Lyche, president; W. H. Kenealy, vice-president, and J. J. Kenealy, secretary-treasurer.

THE GENERAL ELECTRIC COMPANY'S Windsor (Conn.) factory is to have its floor space doubled by the addition of about 40,000 sq.ft. The factory was purchased about fifteen years ago from the Eddy Electric Company, then in bankruptcy. About 150 employees will be added. Small motors and other supplies of lighter character are produced at Windsor, with Arthur A. Bailey as general manager.

FAIRBANKS TO DISTRIBUTE LINCOLN MOTORS.—A contract recently signed between the Fairbanks Company and the Lincoln Electric Company of Cleveland, Ohio, gives this company the exclusive distribution of Lincoln electric motors for industrial applications. This line includes alternating-current motors for two-phase and three-phase circuits in capacities from ½ hp. to 500 hp., for all commercial voltages and frequencies, and direct-current motors from ½ hp. to 150 hp. The Fairbanks Company will also co-operate with the various Lincoln district offices in connection with the sale of the manufacturer's other products. The Lincoln Electric Company is one of the largest manufacturers of alternating-current industrial motors in the United States.

THE AMERICAN STEAM CONVEYOR CORPORATION, Chicago, announces that the Atlas Machinery & Supply Company is now handling the sales of the American steam ash conveyor in its St. Louis territory. This company has offices at 1416 Syndicate Trust Building, St. Louis, Mo., and is a new sales organization in that vicinity. It is headed by William H. Patton, who recently returned to the United States after two years' service in the army. Associated with Mr. Patton is his brother, W. R. Patton, who for the last twenty years has traveled the Central West, engaged in the sales of power plant equipment. During the past four years he has represented several of the large manufacturers as district manager. N. B. Stewart, who has been identified with the power-plant machinery business at St. Louis for twenty-five years, has also associated himself with this company.

CANADIAN HEATING DEVICE COMPANIES CONSOLIDATE.—The Canadian Edison Appliance Company, Ltd., has been formed in Toronto, Canada, as of Jan. 1, 1920, to consolidate the manufacturing departments of heating devices of the Canadian General Electric Company, Ltd., and the organization of the Canadian Hotpoint Electric Heating Company, Ltd., and the Hughes Electric Heating Company, all of Toronto, Ont. This new Canadian enterprise will continue to manufacture the complete line of heating and cooking devices that have been manufactured in the past by the above-named companies. The new company states that its purpose is to sell all the complete lines and carry on the policies of the above companies in the broadest possible manner. J. R. Richardson is managing director, F. M. Dusenberry sales manager, F. R. Goldsmith working manager, R. S. Morgan secretary and treasurer, and W. P. Young purchasing agent. Early in 1920 the Canadian Edison Appliance Company, Ltd., will open its new works in Stratford, Ont. The general offices are now at 25 Brant Street, Toronto, Ont.

Supply Jobbers' Notes

THE HATFIELD ELECTRIC COMPANY, Indianapolis, Ind., dealer and contractor enlarged its activities on the first of the year to include those of supply jobber. Three salesmen will be put on the road to cover the Indiana territory, handling appliances and other electrical materials.

THE REVERE ELECTRIC COMPANY, electrical supply jobber, which was started recently in Chicago, has Van M. Marker as president and F. R. Eiseman as secretory and treasurer. Both of these men have been active in the Chicago electrical trade for a number of years. Mr. Marker was for ten years in charge of the Adams-Bagnall Electric Company's Chicago office, and Mr. Eiseman was city sales manager for the Electrical Appliance Company, Chicago, for fifteen years. The new concern has 13,000 sq.ft. of floor space at 439 Plymouth Court and is distributer of Buckeye lamps.

W. W. WILLIAMSON has been appointed general manager of the Alpha Electric Company, 151 West Thirtieth Street, New York City, vice J. H. Hughes, resigned. Mr. Williamson was formerly sales manager of the Alpha company.

JAMES H. HUGHES, who resigned as general manager of the Alpha Electric Company, Inc., has become secretary of Crannell, Nugent & Kranzer, Inc., 110-112 West Thirtieth Street, New York City. His long experience in the electrical supply field, covering a period of more than a score of years, has brought him in contact with the trade generally. The company has already outgrown its present location, finding it necessary to store its surplus stock in nearby lofts. Crannell, Nugent & Kranzer, Inc., sells only at wholesale, says Mr. Hughes.

JAMES H. HUGHES

Foreign Trade Notes

COMBINE IN BRITISH MOTOR INDUSTRY.—Harper, Bean, Ltd., has been formed in London to include A. Harper & Sons & Bean, iron founders; Vulcan Motor & Engineering Company, Swift, the British Motor Trading Corporation, Steel Manufacturers of Sheffield and a number of subsidiary manufacturers of electric lighting and starting sets.

INSTALLATION MATERIAL IN SWEDEN.—A meeting of manufacturers of and merchants in the electrical installation and lighting glass branches was held in Stockholm a short time ago, when the scarcity of materials in these departments was discussed. The scarcity was attributed partly to the dearth of fuel which prevented the production of porcelain and glass, and partly to the non-arrival of imports which were expected from other countries.

CHARLES H. CHAMPION, 347 Fifth Avenue, New York City, purchasing agent for some British houses, announces that a large company in England, with a branch office in the United States for the purpose of looking after shipments and completing purchasing transactions, etc., desires to be placed in touch with manufacturers of electrical labor-saving appliances, with a view to their sale in the United Kingdom. It is particularly interested in washing machines, electrical clothes driers, vacuum cleaners, dish-washing machines, motor-driven sewing machines, electrical water heating apparatus, electrical automobile accessories, electrical fixtures and fittings and good salable novelties suitable for trade in the United Kingdom. Articles of the higher class and in large quantities are wanted.

VICKERS, LTD. - BROWN - BOVERI ARRANGEMENT LIMITS EUROPEAN COMPETITION.—It is understood that the working arrangements recently made between the firm of Vickers, Ltd., and Brown, Boveri & Company, Baden, Switzerland, covers not only British business but also the British colonies and certain European countries. The Vickers company has acquired the sole British and colonial rights in all the patents of Brown, Boveri & Company, Ltd., and the latter firm undertakes to conduct no direct business in any part of the British Empire. In addition, direct combination is to take place between the subsidiary undertakings of both companies in France and Italy. Vickers, Ltd., has also purchased shares in the Brown, Boveri Company to the amount of £280,000. The arrangement will lessen the risk of competition of continental firms, as there are now only two neutral manufacturers who are capable of building large generating sets such as those required by the Edinburgh Corporation.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A company in Greece (No. 31,217) desires to secure agencies from manufacturers for the sale of electric motors and other electric machinery and appliances, telephones, etc.; plain and insulated electric cables and wires.

A company in England (No. 31,166) desires to purchase electrical fittings and appliances, steel-enamel conduits for electrical wires, and teak blocks for mounting switches. Quotations should be given c.i.f. English port.

A business man in Spain (No. 31,196) desires machinery for making filament electric lamps. Quotations should be given c.i.f. Spanish port. Payment preferably by irrevocable credit in any Spanish bank. Correspondence may be in English.

The general purchasing agent of a firm in Spain (No. 31,190) desires to purchase and secure an agency for electrical measuring instruments (meters), and electrical equipment of all kinds. Quotations should be given c.i.f. Spanish port. Correspondence should be in Spanish.

Riera, Toro & Van Twistern, Inc., manufacturers' agents at 82 Beaver Street, New York City, and Havana, Cuba, having an established trade in Cuba, are desirous of making connections with reliable manufacturers of all types of electrical table, boudoir and floor lamps, fixtures and lighting specialties.

An electrical goods merchant in Spain (No. 31,146) desires to purchase and secure an agency for the sale of raw and insulated materials for electrical construction and repair shops, high-tension apparatus, telephones, porcelain insulators, copper wires, and copper in bars and sheets. Quotations should be given c.i.f. Spanish port. Payment, cash against documents. Correspondence may be in English.

Trade Publications

INDICES.—The General Electric Company has issued indices to its descriptive bulletins and sheets and to its supply part bulletins, dated October, 1919.

ELEVATORS.—The Warner Elevator Manufacturing Company of Cincinnati, Ohio, is issuing, in loose-leaf form, a bulletin covering its electric equipment for traction elevators.

ENTRANCE SWITCHES.—The Trumbull Electric Manufacturing Company of Plainville, Conn., has published circular No. 46 to tell about its "Circle T" externally operated entrance switches and meter protective trim.

INDUCTION FURNACE.—Bulletin No. 9, entitled "Some Results Obtained in Electric Heating with High-Frequency Induction," has been issued by the Pyrolectric Instrument Company, 636 East State Street, Trenton, N. J.

RADIANT HEATERS.—The Majestic Electric Development Company, 1705 Allegheny Avenue, Philadelphia, is circulating a folder describing its new radiant automobile radiator and engine heater, its current determinator, and several styles of its radiant electric household heaters.

WINDING MACHINES.—Bulletin No. 1214 on winding machines and coil winding apparatus has been issued by the Belden Manufacturing Company, Twenty-third Street and Western Avenue, Chicago, in advance of its catalog No. 8. New machines not previously listed are shown in the new bulletin.

VENTILATING FANS.—"Scruplex" electric ventilating fans and exhausters are covered in a sixteen-page bulletin No. 58, which has been published by the L. J. Wing Manufacturing Company, 352 West Thirteenth Street, New York City.

HOUSEHOLD APPLIANCES. — The Western Electric Company of New York City has issued an illustrated booklet entitled "The Eight-Hour Day in the Home," showing how time and labor may be saved in the home through the use of electrical household appliances.

FARM EQUIPMENT.—A thirty-two-page illustrated booklet entitled "The New Farm Help," is a recent publication of the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., and sets forth more than seventy uses to which electric power may be put on farms.

ELECTRICALLY HEATED STEAM DEVICES.—The Bennage Company, 322 Euclid Avenue, Cleveland, Ohio., has issued a bulletin describing the Sepco system of electrically generating steam for heating devices. This system is made by the Steam Electric Products Company of Cleveland, Ohio.

RADIO EQUIPMENT. — The Wireless Specialty Apparatus Company, Boston, has issued an eighty-three-page catalog of its products. The catalog includes a valuable series of tables bearing upon the relation of natural wave-length, frequency and inductance-capacity product in condenser circuits, prepared by Greenleaf W. Pickard, consulting engineer of the company, and formulas for the calculation of radio phenomena, collected by William H. Priess, chief engineer.

ELECTRIC STEEL FURNACES.—Two-phase two-electrode furnaces are discussed in a new bulletin entitled "The Improved Booth-Hall Furnace" issued by the Booth Electric Company, 53 West Jackson Boulevard, Chicago. This bulletin discusses the two-phase furnace as a general pitless furnace, taking up its special shell, the shallow bath, the hearth construction, the auxiliary electrode, speedy melting, mechanical features, electrical features, cost of operation, and rating.

New Incorporations

THE WILDER (MINN.) RURAL ELECTRIC COMPANY has been incorporated with a capital stock of $20,000 by Henry Keffler and others.

THE NEEDVILLE (TEX.) GIN & LIGHT COMPANY has been incorporated with a capital stock of $45,000 by Edward Rinsinger, Henry Banker and M. E. Cloud.

THE MASON-BRACKEN ELECTRIC COMPANY of Germantown, Ky., has been organized to supply electricity for lamps and motors in Brooksville. H. L. Corliss is president.

THE WYNONA (OKLA.) LIGHT & POWER COMPANY has been incorporated by Frank Watson of Wyonna, William Watson of Lometa, Tex., and F. M. Overless of Bartlesville. The company is capitalized at $50,000.

THE NATIONAL INSULATING COMPANY of Parkersburg, W. Va., has been incorporated by J. Marshal, C. D. Forrer and M. E. Hiehle. The company is capitalized at $40,000 and proposes to manufacture insulating equipment.

THE NORTHWEST ELECTRIC APPARATUS COMPANY of Minneapolis, Minn., has been incorporated by John A. Clark, 1806 Park Avenue, Minneapolis. The company is capitalized at $30,000 and proposes to deal in electrical supplies.

THE STEINMETZ ELECTRIC MOTOR CAR COMPANY of Baltimore, Md., has been incorporated with a capital stock of $2,000,000 to establish a large assembling plant for electric trucks and light motor cars. Dr. Charles P. Steinmetz of Schenectady, N. Y., is interested in the project.

THE BROADALBIN (N. Y.) SUPPLY & CONSTRUCTION COMPANY has been incorporated with a capital stock of $25,000 to do general contracting and wiring work, and to deal in electrical fixtures, appliances and machinery, doing business under the same management and in the same offices in Broadalbin and Northville as the Broadalbin Electric Light & Power Company. The officers are: William Pierson Judson, president; Henry C. Finch, secretary and treasurer, and Thomas D. Drought, manager, all of Broadalbin

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

New England States

DAMARISCOTTA, ME.—The Lincoln County Power Company is installing a 750-hp. wheel and a 500-kva. generator at Damariscotta Mills to replace the 100-kva. generator now in use. L. S. Lincoln is treasurer and manager.

OLD TOWN, ME.—The local electric light plant and water-pumping station of the Bangor Railway & Electric Company was recently destroyed by fire, causing a loss of about $75,000. The company, it is said, is making arrangements to rebuild same.

CLAREMONT, N. H.—The W. H. McElwain Company is contemplating building an addition to its shoe plant at Claremont and the construction of a power house at Newport.

PORTSMOUTH, N. H.—Preparations are being made by the Rockingham County Light & Power Company for a hydroelectric development on the Lamprey River in the town of Durham. It is proposed to raise a present dam 18.5 ft. high to a height of 35 ft. and by means of canal and headworks to gain 15 ft. further, locating a plant just below Parkers Falls. The Rockingham company has built a tie line from the Portsmouth station which will be used in connection with the Lamprey River development. It is planned to install two water wheels taking 550 cu.ft.-sec. each and in the dam two Tainter gates, each 22 ft. long by 14 ft. high, capable of caring for from 7,000 to 8,000 cu.ft.-sec. The present development in Durham was formerly owned by the Newmarket Electric Company.

NORWOOD, MASS.—Orders have been placed for two 2,000-kw transformers to replace two 1,000-kw. now in use in the municipal lighting system. F. S. Barton is superintendent.

TAUNTON, MASS.—The installation of a new 4,000-kw. turbo-generator in the municipal electric light plant is under consideration. Warren B. Lewis is manager.

Middle Atlantic States

ARCADE, N. Y.—The Village Council is contemplating the installation of a 250-hp. water-tube boiler, pumps and heater in the municipal electric light plant; also the erection of a transmission line to Sandusky and some rural lines. L. A. Mason is clerk.

BATAVIA, N. Y.—The Genesee Light & Power Company has petitioned the Public Service Commission for permission to erect electric transmission lines to South Byron and Byron to supply electricity for lamps and motors in those towns.

COOPERSTOWN, N. Y.—Contract has been placed by the Southern New York Power Company for a 500-kw., 60-cycle, 2,300-volt turbo-generator for its Walton plant. C. L. Stone is vice-president and general manager.

DANSVILLE, N. Y.—The Dansville Gas & Electric Company is contemplating changing its system from 133 cycles to 60 cycles. Not yet decided when the change will be made. C. H. Mason is superintendent.

FRANKLIN, N. Y.—The Delaware & Otsego Light & Power Company contemplates installing an auxiliary steam plant to furnish power through the dry season; also the erection of from 6 to 10 miles of new transmission line and rebuilding the present transmission system as far as possible. E. A. Mackay is president and manager.

HILTON, N. Y.—Plans have been completed by Peck & Pratt, Inc., for the erection of a new power plant to be used for operation of its proposed cannery works.

NEW YORK, N. Y.—The Interborough Rapid Transit Company contemplates the construction of a substation for its Westchester branch at Westchester Avenue, near St. Peters Avenue, to cost about $50,000.

NORWOOD, N. Y.—The Norwood Electric Light & Power Company contemplates the installation of a generator and water wheel and construction of new wheel pits. Cortes F. Vance is manager.

NUNDA, N. Y.—The Nunda Electric Light Company contemplates increasing its power plant (for standby service only) from 125 kva. to 250 kva. Orders have been placed for transformers for substation which will double the present capacity. A. J. Woodworth is president.

PORT LEYDEN, N. Y.—The Port Leyden Electric Light & Power Company contemplates the installation of a new generator. Louise E. Wilson is owner.

WATERTOWN, N. Y.—Plans have been prepared by the Northern New York Utilities, Inc., for an addition to its local electric plant. The company has applied to the Public Service Commission for permission to extend its line to Clifton and for an approval of a franchise granted by that town.

WELLSVILLE, N. Y.—The Water and Light Department is contemplating the installation of a 300-kva. turbo-generator in the municipal electric light plant. C. F. Schermerhorn is superintendent.

BELVIDERE, N. J.—The Warren Wood Working Company contemplates the installation of a new generator in its hydro-electric plant. Paul E. Widener is superintendent.

CHATHAM, N. J.—The installation of a 180-kva. generating unit, directly connected, in the municipal electric light plant is under consideration. Theodore T. Haldeman is superintendent.

LAKEWOOD, N. J.—The Lakewood & Coast Electric Company contemplates the installation of a 1,500-kva. General Electric three-phase, 2,200-volt turbine and increasing its transformer capacity. A. S. Phelps is manager.

WEEHAWKEN, N. J.—Large quantities of electrical and mechanical equipment will be required in connection with the proposed dry dock and ship repair plant of the Weehawken Dry Dock Company, foot of Baldwin Street, on property recently acquired on the Hudson River at North Bergen and Guttenberg.

BOILING SPRINGS, PA.—The Boiling Springs Electric Light & Water Company contemplates the installation of a 100-kva. Westinghouse three-phase, 60-cycle, 2,400-volt generator. J. C. Bucher is owner and manager.

DUSHORE, PA.—The Sullivan County Electric Company will install a new generator and boiler and will erect 30 miles of transmission lines. H. L. Troxell is general manager.

FORD CITY, PA.—An additional electric generating unit will be installed in the municipal electric light plant. J. H. Mintgens is superintendent.

GROVE CITY, PA.—The installation of an electric generating unit, consisting of a 125-kw. generator directly connected to an oil engine, in the municipal electric plant is under consideration by the municipal electric department; also the erection of a three-phase, three-wire, 2,200-volt transmission line, ¾ mile long. Frank H. Poehlman is superintendent.

ORRTANNA, PA.—The Orrtanna Electric Light & Power Company contemplates the erection of an electric transmission line to Biglerville. The company is now building a line to McKnightstown. S. Z. Musselman is manager.

PHILADELPHIA, PA.—Arrangements have been made by the Philadelphia Storage Battery Company, Ontario Street, for the erection of a three-story addition to its plant, to cost about $50,000.

PITCAIRN, PA.—The Council is considering the installation of a gas-engine-driven electric generating unit of about 200-kva. capacity in the municipal electric light plant. M. H. Stout is secretary.

PITTSBURGH, PA.—Plans have been completed by the Spang Chalfant Company of Etna for the construction of a new substation at its plant. Henry Chalfant is president.

WILLIAMSTOWN, PA.—The Lykens Valley Light & Power Company contemplates the erection of 5 miles of three-phase transmission line. J. B. Whitworth is manager.

CLAYMONT, DEL.—Plans have been perfected by the Worth Brothers Steel Company for extensive additions to its plant, to cost about $2,000,000. The work will include the construction of a new rolling mill, the installation of furnaces, shear equipment, rolling-mill machinery, electrically operated traveling cranes, etc. Norman R. Entrekin is general superintendent.

NEW CASTLE, DEL.—The Wilmington & Philadelphia Traction Company of Wilmington contemplates the installation of additional equipment at its local station.

OCEAN CITY, MD.—The Delmarvia Utility Company contemplates the installation of a 125-kw. generator and the erection of 1 mile of 2,400-volt, three-phase transmission line. Henry T. Moore is manager.

OXFORD, MD.—The Town Council has approved a bond issue for $18,000 for the construction of a new municipal electric light plant.

ELKINS, W. VA.—The Elkins Power Company contemplates the installation of a new generating unit. C. C. Bosworth is manager.

HUNTINGTON, W. VA.—The Ohio Valley Electric Railway Company is making a new survey for its proposed 11,000-volt transmission line from Kenova to Huntington and a 11,000-volt line from the Third Street substation to the Eighteenth Street East station. W. R. Power is general manager.

KANAWHA CITY, W. VA.—Plans are being considered by the Libby-Owens Sheet Glass Company for additions to its local plant, to be equipped with glass-making and general operating machinery, to cost about $2,000,000.

LOGAN, W. VA.—The Kentucky & West Virginia Power Company is now enlarging its local plant and will install this year one 15,000-kw. turbine and two additional boilers of 1,000 hp. each. F. R. Weller of Washington, D. C., is chief engineer.

MORRISVALE, W. VA.—The Royal Block Coal Company, it is reported, will rebuild its power house, recently destroyed by fire. The loss is estimated at $20,000.

PHILLIPI, W. VA.—The installation of an 800-hp. steam turbine in the municipal electric light plant is under consideration. A. D. Poling is manager.

BASIC, VA.—The installation of additional power equipment in the municipal electric light plant is under consideration. J. F. Rhodes is chairman of finance committee. M. E. Swontzel is manager.

North Central States

BROOKLYN, MICH.—A special election will be called to submit to the voters the proposal to issue bonds for the construction of an electric distribution system, to include ornamental lamps for the village square. The Village Council has approved a tentative contract for a franchise to the Hydroelectric Development Company of Liberty Mills to supply electricity for lamps and motors in Brooklyn.

EAST JORDAN, MICH.—Plans are being considered by the East Jordan Electric Light & Power Company for rebuilding its power dam on Deer Creek.

ARCANUM, OHIO.—The installation of a boiler in the municipal electric light and water plant is under consideration. C. C. McCool is superintendent.

DAYTON, OHIO.—The Dayton Power & Light Company is reported to be contemplating the installation of a 30,000-hp. steam turbine and two large boilers at its Millers Ford plant. The cost of the proposed work is estimated at about $800,000.

GREENVILLE, OHIO.—The Greenville Electric Light & Power Company contemplates the installation of a 2,000-kw. generator, condensers, two 600-hp. boilers, etc., and also the erection of transmission lines to Hollansburg, Glenkarn and Palestine. W. S. Meeker is secretary.

MARYSVILLE, OHIO.—The Marysville Light & Water Company contemplates the erection of an electric transmission line to New Dover. Mayne Mackan is superintendent.

CARROLLTON, KY.—Bonds to the amount of $25,000 have been voted for improvements to the municipal electric light plant and waterworks system.

MURRAY, KY.—The installation of a 200-kw steam-driven generating unit in the municipal electric light plant is under consideration. J. W. Stitt is manager

OWINGSVILLE, KY. — The Electric Light Company contemplates the installation of a 50-kw. direct-current generator E. V. Brother is secretary and manager

PARIS, KY.—The Paris Gas & Electric Company contemplates the erection of 9 miles of 6,600-volt transmission line. C. L. Steenbergen is manager.

AUBURN, IND.—The Public Service Commission has authorized the city of Auburn to issue $50,000 in bonds, the proceeds to be used for improvements to the municipal electric light and water plant ordered by the commission.

PERU, IND.—The installation of a new 500-hp. boiler in the municipal electric light plant is under consideration. G. C. Anderson is manager.

DECATUR, IND.—Plans are under consideration for building an entire new municipal electric plant, including the erection of a new power house, the installation of a 1,000-kw. turbine, three new boilers, switchboard, spray pond, stokers, ash conveyors and condensers. M. J. Mylott is manager.

CHICAGO, ILL.--The Lincoln Park Commissioners are contemplating installing a new substation, 12,000-volt transmission, three-phase, 60 cycle; two 3,000-gal. centrifugal pumps driven by a 1,800-r.p.m., 4,000-volt, three-phase induction motors; two 300-kva. 12,000/4,000/2,300-volt, three-phase transformers; one three-phase, four-wire, 2,300/400-volt circuit; three single-phase, 2,300-volt regulated multiple lighting circuits; twelve 7.5-amp, 5,000-volt circuits; storage battery; motor-generator unit; local power and lighting panels and transformers, and probably large flood-lighting installations and concrete post drive lighting. C. H. Shepherd is electrical engineer in charge.

SAVANNA, ILL.—The People's Gas & Electric Company is considering the installation of an additional boiler and generating equipment, the erection of 10 miles of transmission lines and installing substation apparatus. F. P. Bowen is manager.

GREENWOOD, WIS.—The Municipal Light and Power Department contemplates extensions to its high-tension line and the erection of 16 miles of rural lines to furnish electricity to the farming districts. G. V. Rork is superintendent.

KAUKAUNA, WIS.—The Municipal Electric Light and Water Departments are considering the construction of a new dam and a 7,000-hp. hydroelectric plant. A transmission line to connect with the system of the Wisconsin Traction, Light, Heat & Power Company is now under construction. J. O. Posson is manager.

LOWELL, WIS.—The Lowell Light & Power Company contemplates the installation of a vertical alternator. W. F. Pease, Jr., is secretary and treasurer.

MANITOWOC, WIS.—The Public Utilities Commission is contemplating the purchase of an additional generator for the municipal electric light plant within the next year or two. W. C. Steaffler is secretary and purchasing agent.

MILWAUKEE, WIS.—The Public Sewerage Commission is planning to build a steam-driven electric generating plant in connection with the Jones Island sewage disposal plant project. The plans provide for a development of 11,700 np., at an estimated cost of $1,250,000. Specifications are being prepared for three types, coal-burning boilers, oil-burning boilers and internal-combustion engines. T. Chalkley Hatton is chief engineer.

OSSEO, WIS.—The property of the Osseo Electric Company has been purchased by the Augusta (Wis.) Light & Telephone Company. The new owner will erect a transmission line from Augusta to Osseo. Energy will be obtained from the Wisconsin-Minnesota Light & Power Company. S. E. Lee is manager of the Osseo company.

COLUMBUS JUNCTION, IOWA.—The Louisa County Power Company contemplates the erection of about 40 miles of transmission lines. R. L. Van Meter is president and manager.

DUBUQUE, IOWA.—At an election to be held Jan. 26 the proposal to establish a municipal electric light plant in Dubuque will be submitted to the voters.

HAWARDEN, IOWA.—The installation of a 200-kva. generator and engine and boilers in the municipal electric light plant is under consideration by the Electric Light and Water Department; also the erection of rural lines and lines in streets not now served. Otto Pyles is manager.

PERSIA, IOWA—The local electric light plant, owned by J. G. Cave, was recently destroyed by fire, causing a loss of about $7,000.

GREENFIELD, MO.—The water, electric light and ice plants, controlled by Lee Brothers of Kansas City, were recently destroyed by fire, causing a loss of about $20,000.

HUNTER, N. D.—The Hunter Light & Power Company is considering the installation of an 80-hp. oil engine-driven generating unit. As yet nothing definite has been decided upon. J. B. Hockridge is president.

MAYVILLE, N. D.—Plans are under consideration for improvements to the municipal electric light plant. Estimates will be submitted by R. W. Richards of the Western Equipment Company, 63 East Sixth Street, St. Paul, Minn.

ANSLEY, NEB.—The installation of an additional 100-hp. generating unit in the municipal electric light plant is under consideration by the village of Ansley. J. A. Barker is chief engineer.

AUBURN, NEB.—The Intermountain Railway, Light & Power Company contemplates the installation of one 310-hp. Nordberg Corliss engine with a 200-kw. General Electric three-phase, 60-cycle generator. N. H. Coit is local manager.

CHANUTE, KAN.—Extensive improvements are contemplated to the municipal electric light plant, including the erection of new engine room, a spray pond for cooling water and the installation of a 500-kw. turbo-generator and one 250-hp. Heine boiler. H. R. Williams is superintendent.

KANSAS CITY, KAN.—Plans are under consideration by the Kansas City (Mo.) Railways Company for the construction of a power plant on James Street, Kansas City, Kan., to cost about $27,000.

ONAGA, KAN.—Plans are being prepared for the installation of an electric lighting system at the County Home. Bids, it is understood, will soon be asked by the County Comissioners.

Southern States

HOBGOOD, N. C.—Plans are under consideration by the town of Hobgood to erect an electric transmission line to the town of Scotland Neck, a distance of about 7 miles, to secure electricity from the municipal electric plant there to operate the proposed local municipal lighting system. The cost of the distributing system and transmission line is estimated at about $20,000.

JACKSONVILLE, N. C.—Bids will be received by the town of Jacksonville until Feb. 17 for construction of sewer system and waterworks, consisting of 11,000 ft. of sewer pipe, and 12,000 ft. of water mains, together with a 60,000-gal. tank on tower, a 60,000-gal. reservoir, steam-driven electric generating and pumping equipment and appurtenances. Plans and specifications are on file at the office of the town clerk, Jacksonville, and the Carolina Engineering Company, Southern Building, Wilmington, N. C.

ZEBULON, N. C.—Improvements and extensions are contemplated to the municipal electric lighting system, including the installation of a complete generating unit and erection of a transmision line to Wakefield. R. E. Ward is manager.

SMITHVILLE, GA.—The Council is considering calling an election to submit to the voters the proposal to issue bonds for the construction of an electric light, water and sewer systems.

WAYNESBORO, GA.—Improvements to the municipal electric light plant and waterworks system, to cost about $25,000, are under consideration.

PALM BEACH, FLA.—Extensions and improvements are contemplated by the City Council to the electric lighting system, to cost about $10,000.

SPRUCE PINE, ALA.—The Spruce Pine Sand & Gravel Company is planning to install a generating plant, boilers and pumping equipment in connection with its proposed works, consisting of a hydraulic gravel washing and screening plant. James A. Barr of Mount Pleasant, Tenn., is construction engineer. Charles B. Crow is treasurer and general manager.

BUNKIE, LA.—The Bunkie Ice Company contemplates the installation of a 150-hp. crude-oil-engine-driven unit. C. J. Pope is vice-president and general manager.

BROKEN ARROW, OKLA.—The Public Service Company of Oklahoma, Tulsa, contemplates the erection of an electric transmission line from Broken Arrow to Tulsa.

GRANDFIELD, OKLA.—The Grandfield Light & Power Company is making improvements to its plant, including the installation of a 225-hp. Skinner engine, one 200-kva. General Electric alternating-current generator, ten transformers, from 5 to 15 kva. Contract has already been awarded. Fred Dorse is engineer in charge of the work. J. S. Green is manager.

HOBART, OKLA.—Plans are being prepared by the V. V. Long Company, engineer, Colcord Building, Oklahoma City, for a municipal electrict light plant. An election will soon be held to vote on the proposal to issue $35,000 in bonds for project.

LUFKIN, TEX.—The City Commissioners are considering asking for bids for the installation of an ornamental lighting system in the business district.

Pacific and Mountain States

OLYMPIA, WASH.—Plans are being prepared by Wilder & White, architicts for the new Capitol group of buildings, for a power house, to cost about $183,000. Bids for the new building, it is understood, will be opened early in February.

ASTORIA, ORE.—Bids will be received by the State Highway Commission, Multnomah County Court House, Portland, Ore., until Feb. 5 for construction of one double-leaf trunnion bascule bridge with approaches and appurtenant works, including miscellaneous electrical and other equipment, on the Columbia Highway across Young's Bay, near Astoria. Plans and specifications may be obtained at the office of the State Highway Commission and the State Highway Engineer, State House, Salem, upon deposit of $10. Herbert Nunn is state highway engineer.

ASTORIA, ORE.—The Pacific Power & Light Company is planning to install additional equipment at its Youngs Bay station, including one 3,759-kva. General Electric steam turbine, switchboard to control turbo-generator and feeder panels, three 1,000-kva., single-phase 24,000/2,200-volt Westinghouse transformers, the erection of one substation, also the installation of three 150-kva., 6,600/11,400/220/440-volt transformers and three 333-kva., 6,600/22,000-volt transformers at Port Dock. The Phoenix Utility Company is contractor. H. H. Schoolfield, 409 Gasco Building, Portland, is engineer in charge.

ONTARIO, CAL.—Plans are under consideration by the Edison Electric Appliance Company for extensions to its plant. The company manufactures Hot Point electric heating and cooking appliances.

ROSEVILLE, CAL.—The Pacific Fruit Express Company is planning to utilize electricity instead of steam for operating the ice-manufacturing machinery for its refrigerating plants.

SAN JOSE, CAL.—The Security Warehouse & Distributing Company of San Jose is planning to erect an ice and cold storage plant, to cost with equipment about $500,000.

Canada

MILLTOWN, N. B.—The Canadian Cottons, Ltd., will construct a new dam and hydroelectric power house, equipped with three vertical units, replacing its present plant. R. S. Kelsch, Power Building, Montreal, Que., is consulting engineer.

ST. JOHN, N. B.—Preparations are being made by the Cornwall & York Cotton Mills Company, Ltd., of St. John for the construction of a new power house and engine room, which will be equipped with water-tube boilers, turbo-generator, switchboard, cooling pond, etc. Two units of 750 kw. will be installed. R. S. Kelsch, Power Building, Montreal, Que., is consulting engineer.

CORNWALL, ONT.—The Canadian Cottons, Ltd., will construct a new hydroelectric power house in Cornwall, immediately west of its Stormont Mills. The power house will be equipped with three vertical shaft units of 1,000 kw. capacity. The company also contemplates installing a new unit consisting of water-tube boilers steam turbine and necessary auxiliaries in its new steam turbo-generator plant. R. S. Kelsch, Power Building, Montreal, Que., is consulting engineer.

HAMILTON, ONT.—Arrangements are being made by the Ontario Mills of Hamilton for the installation of a new 12,000-hp. steam-boiler plant, equipped with water-tube boilers, coal and ash-handling machinery, heaters, pumps, piping, etc. R. S. Kelsch, Power Building, Montreal, Que., is consulting engineer.

DESCHAMBAULT, QUE.—The Portneuf Hydraulic Company will install two units of 1,000 kw. each at its plant this year. Henri Paré is manager.

Miscellaneous

PETERSBURG, ALASKA.—At an election held recently the proposal to issue $75,0000 in bonds to establish a municipal electric light plant was carried.

PANAMA—Bids will be received at the office of the general purchasing agent of the Panama Canal, Washington, D. C., until Jan. 30 for steel tubing, sheet copper, copper ferrules, cable thimbles, platform scales, pulleys, bilge pumps, electroplating supplies, etc. Blanks and further information relating to this crcular (1335) may be obtained from the above office.

Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 30, 1919)

1,326,791. METHOD AND MEANS FOR THE UTILIZATION OF THE THERMIC EFFECT OF CATHODE RAYS; Alf Sinding-Larsen, Vestre Aker, near Christiania, Norway. App. filed Oct. 30, 1918. Focuses cathode rays at small opening heating chamber, and heating object in chamber beyond focus rays.

1,326,861. SELECTIVE CONTROLLING APPARATUS FOR ELECTRIC CIRCUITS; Henry F. Herman, Pleasantville, N. Y. App. filed March 7, 1916. Adapted to electromagnetically operated mechanism.

1,326,882. APPARATUS CONTAINER; Harry F. Stratton, Cleveland, Ohio. App. filed May 3, 1917. Casing with cover and set of eye bolts and ring bolts.

1,326,891. ELECTROPLATING AND ELECTRO-CLEANING APPARATUS; Andrew Ness, Glasgow, Scotland. App. filed Nov. 22, 1919. Rotating drum with concentric aperture.

1,326,895. TIMING APPARATUS; Daniel S. Holt, Mittineague, Mass. App. filed Feb. 5, 1919. Indicates proper time for ejection of charge from receiver.

(Issued Jan. 6, 1920)

14,787 (reissue). DYNAMO-ELECTRIC MACHINERY; Leigh J. Stephenson, Chicago, Ill. App. filed Dec. 10, 1919. Produces dynamical braking effect.

1,326,912. METHOD OF WELDING; Spencer C. Cary, Brooklyn, N. Y. App. filed April 6, 1916. For box strapping.

1,326,924. LAMP-LOCKING CONSTRUCTION; Edgar H. Freeman, Trenton, N. J. App. filed July 2, 1918. Locking mechanism concealed.

1,326,952. OZONIZING APPARATUS; Payton J. H. Moore, Chicago, Ill. App. filed March 1, 1917. High voltage passed through coils on glass plates.

1,326,955. MUSICAL INSTRUMENT; Elmer F. Mueller, Chicago, Ill. App. filed May 21, 1917. Combines features of piano and phonograph.

1,326,962. SECTIONAL NON-ROTATIVE INSULATING KNOB FOR SUPPORTING ELECTRIC WIRES; Alfred M. Poindexter, Denver, Col. App. filed May 1, 1917. Frictional engagement with bulged sides of nail.

1,326,964. WATER HEATER; Fred Poole, Jewell, Kan. App. filed Feb. 9, 1915. Resistance wound within closed-loop pipe.

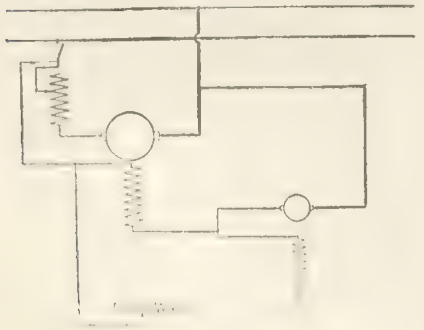
1,326,968. PROCESS OF EXTRACTING OILS FROM FATTY SUBSTANCES; George D. Rogers, Gloucester, Mass. App. filed March 7, 1919. By electrolytic action.

1,326,972. ANODE FOR ELECTRIC VACUUM APPARATUS; Moritz Schenkel, Charlottenburg, Germany. App. filed Sept. 13, 1916. Annular anode built up from a number of sections.

1,326,983. PORTABLE ELECTRIC LIGHT; Frederick G. Spiers, Jamaica, N. Y. App. filed Nov. 29, 1918. Casing with heavy layer of fiber insulation.

1,326,994. TELAUTOGRAPHIC APPARATUS; George S. Tiffany, Summit, N. J. App. filed Dec. 15, 1917. With receiver-selecting mechanism.

1,327,009. ELECTRIC SWITCH; William E. Andree, Chicago, Ill. App. filed June 7, 1916. Two telescoping members both reciprocable along a line.



14,787—Dynamo-Electric Machinery

1,327,017. ELECTRIC POCKET LAMP; Conrad Boltshauser, Zurich, Switzerland. App. filed Oct. 23, 1917. Flat cylindrical shape with carbon and zinc button.

1,327,023. ELECTRICAL APPARATUS FOR THE ELECTROCHEMICAL TREATMENT OF LIQUID HYDROCARBON AND OTHER COMPOUNDS; Louis B. Cherry, Kansas City, Mo. App. filed Feb. 26, 1916. Avoids cracking and destructive distillation.

1,327,046. ELECTROMAGNETIC BRAKE; Henry V. James, Radlett, England. App. filed Sept. 18, 1917. For material feed reels; used with textile, paper-making and printing machinery.

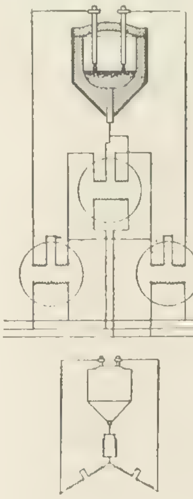
1,327,050. STAMPING MACHINE; Bernard S. Lee, Beverly, Mass. App. filed Sept. 6, 1917. Power-driven shoe-marking machine.

1,327,094. ELECTROLYTIC CELL; Alvah M. Griffin, Kansas City, Mo. App. filed Aug. 24, 1918. Maximum volume of gas generated in given time.

1,327,102. SHERARDIZING APPARATUS; Charles J. Kirk, New Castle, Pa. App. filed March 1, 1919. Rotary retort with both external and internal heating units.

1,327,121. SELF-FILLING STORAGE BATTERY; Norman D. Sturges, Bellerose, N. Y. App. filed Aug. 6, 1919. Storage tank above battery.

1,327,124. SIGNALING DEVICE FOR MOTOR VEHICLES; Milton Tibbetts, Detroit, Mich. App. filed Feb. 18, 1916. Varies degree of vibration in horn.



1,327,174—Three-Phase Electric Furnace

1,327,129. DRIVE GEARING; Fay M. Wolff, Louisville, Ky. App. filed Aug. 23, 1918. For self-propelled chairs.

1,327,132. ENGINE STARTER; Vincent Bendix, Chicago, Ill. App. filed Sept. 25, 1916. Hollow armature shaft with driven shaft within.

1,327,135. RHEOSTAT; William L. Bliss, Niagara Falls, N. Y. App. filed May 13, 1918. Manual adjustment.

1,327,160. ELECTRICALLY DRIVEN SPINDLE; Josef Hurtig, Rochester, N. Y. App. filed Jan. 8, 1919. For woodworking machines.

1,327,174. THREE-PHASE ELECTRIC FURNACE; Frederick T. Snyder, Oak Park, Ill. App. filed March 11, 1918. Has only two carbon electrodes and a bottom contact.

1,327,185. TELEPHONE SYSTEM; Donald F. Whiting, New York, N. Y. App. filed Dec. 28, 1918. For high-frequency signaling currents.

1,327,207. METHOD OF CONTROLLING TEMPERATURES; Tiodolf Lidberg, Chicago, Ill. App. filed Jan. 9, 1919. For bacteriological research work and orificial surgery.

1,327,234. STORAGE-BATTERY ELEMENT; Eugene Handler, Newark, N. J. App. filed May 5, 1916. Spacing prevents buckling.

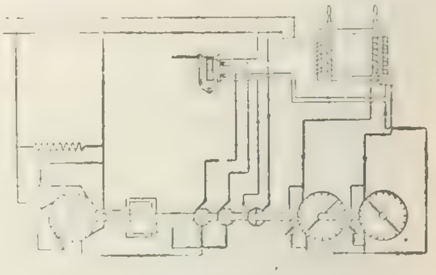
1,327,267. PROCESS OF WELDING; Leon B. Brewster and Frank Weisehan, Cleveland, Ohio. App. filed Dec. 7, 1917. For filling blow-holes.

1,327,274. STREET INDICATOR FOR TRAMCARS; Henry S. Evans, East Chicago, Ind. App. filed April 18, 1916. Operates by contactor engaging with trolley.

1,327,279. ELECTRICAL RADIATOR HEATER; William Hurst, Winnipeg, Manitoba, Canada. App. filed Jan. 17, 1918. Pipe containing resistance.

1,327,280. PICTURE-PROJECTING APPARATUS; Charles F. Jenkins, Washington, D. C. App. filed Oct. 17, 1916. Carbon arc and distance from condensing lens adjustable.

1,327,282. HERMETIC UNIT SMELTING SYSTEM; Woolsey McA. Johnson, Hartford, Conn. App. filed Feb. 18, 1915. Multiple-stage system for smelting and transporting zinc ores.



1,327,521—Rectifier System

1,327,284. CIRCUIT BREAKER FOR MAGNETOS; Paul Labrosse and Felix Esteve, Lyons, France. App. filed May 9, 1918. Provides fiber insulating sleeve between the axle of lever and disk.

1,327,340. ELECTRIC BELL; William D. Lutz, Allendale, N. J. App. filed July 27, 1917. For high-voltage circuits.

1,327,341. METHOD OF DEVELOPING DEFECTS IN METALLIC OBJECTS; Angus S. MacDonald, Great Neck Station, N. Y., and Harry P. MacDonald, Montclair, N. J. App. filed April 13, 1918. Flaws detected by passing current through samples.

1,327,344. INTERRUPTER FOR IGNITION DEVICES; Charles T. Mason, Sumter, S. C. App. filed March 27, 1918. Produces current in secondary circuit for sparking.

1,327,349. HOMOPOLAR MAGNETIC CIRCUIT; Robert V. Morse, Ithaca, N. Y. App. filed Sept. 13, 1917. Light and compact filed magnet structure with uniform flux distribution.

1,327,350. COOLING SYSTEM FOR HOMOPOLAR MACHINES; Robert V. Morse, Ithaca, N. Y. App. filed Sept. 13, 1917. Ventilated field, armature and coils.

1,327,352. TELEGRAPH RECEPTOR; William E. Peirce, Newark, N. J. App. filed Jan. 17, 1917. Telephone receiver with amplifying lever.

1,327,361. IGNITION DEVICE; Harry R. Van Deventer, Sumter, S. C. App. filed Oct. 13, 1917. Generator support removed without disturbing electrodes.

1,327,375. IGNITION GENERATOR; William W. Dean, Stamford, Conn. App. filed Aug. 22, 1916. Rotor provides large magnet without increasing diameter.

1,327,409. CONDUIT OUTLET BOX; August H. Schneider, Syracuse, N. Y. App. filed Feb. 7, 1916. For outdoor use.

1,327,412. TELEPHONE; William C. Ude, West Haven, Conn. App. filed Aug. 1, 1917. Adjustable transmitter.

1,327,421. ELECTRIC ELEVATOR-CONTROLLING SYSTEM; Carl S. Brown, Portland, Ore. App. filed Nov. 16, 1915. Push-button control for dumb waiters.

1,327,463. SECTION SWITCH; Harry W. Davis, Edgewood Park, Pa. App. filed June 3, 1918. Automatic safety switches for mine trolleys.

1,327,496. ELECTRIC LAMP SOCKET; Garnett Snider, Bruce Mines, Ontario, Canada. App. filed Sept. 22, 1917. Lamp thrust into socket and twisted to give firm contact.

1,327,500. TELEPHONE SET; Henry Symes, Dunedin, New Zealand. App. filed Nov. 9, 1916. Automatic calling device, transmitter and receiver mounted.

1,327,502. IGNITION DEVICE; Harry Randolph Van Deventer, Sumter, S. C. App. filed Oct. 13, 1917. Including ignition electrodes, a generator and a trip-operated spring mechanism.

1,327,507. INTERNAL-COMBUSTION-ENGINE WATER HEATER; Fred Walther, Omaha, Neb. App. filed Dec. 5, 1918. Heater operated from control board.

1,327,521. RECTIFIER SYSTEM; Henry E. Burket, Kansas City, Mo. App. filed March 29, 1917. Prevents "kick-back" on main commutator.

1,327,542. ELECTRIC CONDUCTOR; Peter F. Frey, Niagara Falls, N. Y. App. filed May 27, 1918. Prevents creepage in storage batteries.

Electrical World

The consolidation of Electrical World, Electrical Engineer *and* American Electrician

Volume 75 New York, Saturday, January 31, 1920 *Number* 5

The Wage Earner's Effect on Business

MUCH has been said recently regarding the daily wage earner's prosperity as compared with bygone times. Extravagance has been rather a fetish with the American public of late, and to this state of things the wage earner has naturally contributed his share. However, there is at least one healthy sign in conditions as they are at present, that being the remarkable growth of all business that helps to lighten the burdens of the household. No doubt, much of the tremendous increase in the electrical appliance trade is due to the growing acuteness of the servant problem, but when one stops to consider that most American households have always been operated without servants it seems evident that the whole answer is not there. This willingness of labor to let its unusual prosperity make the ordinary burdens of the family lighter is commendable, and while extravagance in the purchase of luxuries will eventually decrease, it is very doubtful if the housewife will ever again be content with the old methods. It is, therefore, to be expected that legitimate lines of business dealing with necessities will continue to flourish, and the electric appliance trade is now in that class.

The modern electric central station is a monument to the engineering skill and foresight of the engineer, but the quality and continuity of service rendered to customers depend largely on the training, efficiency and fidelity of the men who constitute the operating organizations of the industry.

Utilizing Poor Coal

WE HAVE published from time to time various papers dealing with the utilization of low grade fuel, a subject which is daily growing in importance, as the miners are subject to more and more dissension and transportation grows more difficult and uncertain. In the issue of the Electrical World for Jan. 10, page 68, a study by E. H. Bull gave characteristics of the coal mined in Montana and Wyoming. These mines are of the sub-bituminous class, rather high in ash and in moisture and rather low in calorific value. In mining these coals quick ignition is needed and the matter of ash discharge demands great attention. The earlier attempts were only moderately successful owing to failure properly to meet these conditions. In going into the matter in a practical way, Mr. Bull finds that excellent results can be obtained by the use of a rather fast running chain grate with a long and steeply pitched arch to obtain the concentration of heat at the stoker gate used for quick and thorough ignition.

As in burning other low-grade fuel, a combustion chamber of liberal size seems to be highly desirable. The necessary thickness of fuel bed and speed of chain grate vary somewhat from coal to coal as might be expected, but the same general principles hold good for all. In trying out on experiments three varieties of this sub-bituminous coal, Mr. Bull found it possible to get an over-all efficiency of approximately 75 per cent with development of roughly from 175 to 200 per cent of the builder's rating of the boilers. This overload capacity seems to be limited by the volume of the furnace as might be anticipated from the nature of the fuel. These results are highly satisfactory as pointing the way to successful use of these valuable but rather troublesome forms of coal. The secret seems to be in skillful adjustment of the combustion and liberal room for completing it. Given these, a properly constructed chain grate will do the rest, and the fuel proves economical in many situations where the cost of high grade steam coal would be well nigh prohibitive.

The inefficiency of labor is due not so much to the deliberate loafing of employees as to their unfamiliarity with the particular work they are doing. Many workmen have been too unsettled to stay long enough at any one job to become skilled.

Extra-High-Voltage Lines

THE interconnection of the San Joaquin Light & Power Corporation's system with that of the Pacific Gas & Electric Company now in the process of construction at Newman, Cal., involves a 20-mile (32-km.) tie-in at 60,000 volts with a capacity of 10,000 kw. Although insignificant in the amount of power to be transferred from one system to the other, the event is nevertheless one of great importance as representing the actual metal connection which binds together the electrical systems from Oregon to the Mexican border, an actual stretch of copper of more than 1,400 miles (2,250 km.), the distance between New York and Omaha.

The splendid success of the now considerable number of long transmission lines of 100 kv. or more has given rise to much speculation concerning further advances. The very valuable results achieved through interconnections of neighboring electric supply systems in meeting the heavy demands of the war emergency furnish the incentive for study to determine the possibilities of large benefits from more extensive interlinking of electric power sources over wider areas. It has been authoritatively stated that for one large California power company the sole means by which it was practicable to meet the urgent demand upon it was the interconnection with a neighbor company having surplus capacity.

The earnest and broad discussion at the recent convention of the Pacific Coast Section of the American

Institute of Electrical Engineers at Los Angeles of a paper proposing a 220-kv. "busbar" from the northern end of California to Los Angeles served to indicate the large advances already made toward extensive interconnection. It appears settled that there are no excessively serious technical obstacles to be overcome. The possibility of utilizing small power sources not otherwise capable of economical development and of obtaining the advantage of diversities of water-power supply, as well as load, emergency service and other like benefits, is suggested. Questions of ownership, control and operation loom large and will naturally require much study.

The beginnings of such extensive extra-high-voltage lines are already in existence. The 150-kv. Big Creek-Los Angeles line and the long 100-kv. systems supplying the Chicago, Milwaukee & St. Paul Railway electrifications in Montana, Idaho and Washington are perhaps the most notable examples. With the completion of such additional lines as those now contemplated in northern California the vision will come near to reality.

In view of such considerations the question of the future interrelations of existing and proposed extra-high-voltage circuits deserves the most careful study of engineers of electric power supply.

Incomplete construction cost data are a thorn in the flesh of the engineer trying to determine the reasonableness of subsequent estimates and later outlays. The practice of "lumping" various bulky equipment into single expense items may satisfy the banker, but it is only an annoyance to the engineer seeking definite and classified information.

Life of Poles

WHEN one thinks of the vast aggregate length of the pole lines standing in this country, supporting conductors for power, railroads, lighting, telegraph and telephone and of the number of forest trees that have to be cut down in order to provide them, it is evident that the steady perennial depreciation and decay of all these poles mean a heavy drain upon the forests of the country. Eventually, we may be forced economically to the general adoption of reinforced-concrete poles instead of wooden poles; but until that time comes we should do what may be commercially practicable toward diminishing the rot and depreciation of the pole lines in service on our highways. An instructive article on this subject is presented this week by Page Golsan. Mr. Golsan's article is not specifically directed to chemical impregnation of the poles but to a study of the rate of their depreciation by exposure to the weather and to a consideration of the causes of breakdown. It would appear that, at least in the region where these tests were made, the rate of decay does not depend materially on the nature of the soil. Moreover, the statistical data presented go to show that the percentage rate of decay with time is roughly according to a straight-line law, after the first three years have passed. In those first two or three years, the depreciation is relatively small. On the whole, the pole strength falls to one-half, on the average, in about eight years. After the poles have weakened unbalanced lateral stresses are much more dangerous than simple vertical stresses, toward bringing about their collapse. The conclusion is that wooden pole lines should be carefully guyed and braced, in order to remove and cancel all lateral stresses or forces tending to break the stubs at the ground line. This is, of course, no new doctrine, but the simple and clearly expressed mathematical reasoning emphasizing the doctrine is timely and serviceable.

The electric central-station industry as a whole has little reason to regret its work in financing, but it is well to realize before the day of reckoning comes that if the potentialities of customer ownership are good, the possibilities of serious injury to local good will are very great where dubious methods are employed to market securities.

Keeping Up the Illumination

IT IS a comparatively simple thing to lay out an installation for the proper illumination of almost any room. It is quite another thing to insure that the standards shall be kept up under the various circumstances of every-day use. Ward Harrison and J. R. Colville gave in last week's issue of the ELECTRICAL WORLD a striking study of the situation found in an office installation which had been neglected. The results are especially to the point because they involved all the elements of depreciation which one is likely to encounter. The system consisted of indirect units which had been in operation more than two years. The ceiling was flat white and the walls light buff, both originally having good reflecting power. The reflectors had been wiped out with fair regularity, but the lamps had been in service for two years, and the ceiling and walls had been gradually soiled by the smoke of the city, so that the reflectors had fallen far below their standard quality. The average illumination actually found on the desks was 2.7 foot-candles—decidedly too little.

The first step was to take down the reflectors and wash them thoroughly. The result was an increase of 35 per cent in the measured illumination, an illustration of the difference between perfunctory dusting and real cleaning which is much to the point; for where lighting units are exposed to soft-coal smoke, as they often are, a deposit forms which does not yield to anything but thorough cleaning. Next the lamps received attention, with the result that they were found to have been intended for a voltage higher than the average voltage of the circuit and to have depreciated considerably. The former difficulty may have arisen from sheer misinformation as to the real voltage at the outlets, or possibly from carelessness in purchasing the lamps. Whatever the reason, the result, complicated by too long usage, was rather disastrous. When replaced by new lamps at a proper voltage the illumination rose by nearly 1.5 foot-candles. Finally, the ceiling and walls of the office were refinished in the original tones, and the illumination then jumped up about 2 foot-candles. The net result was that an installation of entirely adequate design, giving more than 7 foot-candles when in proper condition, had dropped to 2.7 foot-candles through depreciation caused by neglect. Perhaps indirect lighting, because of its up-turned reflectors, with their interior condition concealed from the eye, and its dependence on the widespread diffusing surfaces of walls and ceilings exposed to smoke, suffers to an exceptionally great degree from negligence; but semi-indirect and direct systems are far from immune, and examples could be found of either system little less bad than the one here cited.

From a practical standpoint, the efforts of the engineer should be directed toward allowing a factor of safety in the original design to take account of good ordinary conditions of use, and then to insistence that these good conditions be kept up. In a month of ordinary city service depreciation from dirt is likely to range from 20 to 40 per cent. The plain moral is that glassware or other reflectors should be thoroughly cleaned every two or three weeks if under ordinary city conditions, and if there is reliance on the ceiling and walls as reflecting surfaces, the condition of these surfaces must be carefully watched and they should be freshened whenever necessary. As this is a rather serious job, it is important to allow a larger factor of safety in the use of indirect and semi-indirect installations than in the case of plain reflectors. Aside from this, the lamps must be replenished, or there certainly will be trouble from lack of light.

All things considered, the authors recommend a factor of safety of from 1.2 for favorable conditions to 1.5 for very unfavorable ones. If an illumination is in first-class condition at the start, an occasional inspection with a foot-candle meter affords extremely valuable information as to what is going on; but in any case foresight is preferable to hindsight, and persistent cleaning is the obvious way out of the difficulty.

Customer ownership of public utility securities is a wise policy if sound values are maintained by upright and progressive management. Great care is essential, however, in marketing such securities, to avoid policies which threaten the reduction of dividends or loss of interest, or which throw discredit upon shares or bonds as collateral acceptable by conservative banking institutions.

Protection for Branch Circuits

A BRIEF paper by H. C. Horstmann and V. H. Tousley in the current issue gives some valuable subgestions regarding the protection of branch circuits in industrial plants. It is usual in such cases to run the main conductors near the ceiling, often on open cleat work, and to tap from these mains the conductors for individual motors or groups of lights. To carry out this construction according to the insurance rules, one must either drop down with conductors of the same capacity as the mains or install fuses at the tap. The first procedure is expensive, the second is extremely inconvenient, especially in the case of blowing a fuse, because fuses at the ceiling are not easy to reach and considerable delay is likely to intervene before they are properly replaced. The tendency therefore in such cases has been to fuse the wires pretty liberally, perhaps much too liberally as compared with ordinary rules and precedents.

The purpose of the writers of this discussion is to point out to what extent safe conditions can be met while still making the tap of moderate size and fusing it only within easy reach. In order to secure safety the tap wire must be able to stand heating up to the point where it will blow the fuse or open the circuit breaker back of it, and the total resistance of the tap line must therefore be low enough to allow the current and short circuit to rise to this point. The authors give details of the temporary current capacity of wires such as would be used for taps, by which sufficient protection against over-heating can be insured while still allowing time enough for the circuit to be opened further back. With proper installation of tap circuits in conduit a considerable economy could be effected by working in this way and the proposition is well worth consideration.

If managers of electric central stations keep a close watch upon their coal supply situation, the present tendency to get "jumpy" over irregularities of shipments and variations in quality will be considerably relieved. The time is ripe for a cool-headed study of fuel requirements over a long period, including the never-ceasing pursuit of economy in coal consumption.

An Industrial Lighting Survey

ONE OF the papers before the recent convention of the Illuminating Engineering Society, which we take pleasure in presenting this week, deals with a somewhat comprehensive investigation of the lighting conditions actually found at the present time in industrial plants. The survey covered representative cities in fifteen states, including in all 446 plants. The striking feature of the report is that, in spite of the obvious need for good lighting to maintain the best working conditions from the standpoint of output, 60 per cent of the total number required some measure of improvement, not infrequently large. On the whole the big plants were better lighted than the little ones, and their managers took a more intelligent interest in the matter. Apparently the chief difficulty has been lack of interest in lighting from failure to appreciate what it means in production. Only about 60 per cent of the responsible men interviewed during the inquiry knew anything about the modern gas-filled lamp, to say nothing of having a realization of its possibilities.

Just why the average manufacturer should be so relatively indifferent is hard to say, although probably the growing importance of artificial lighting has not yet forced itself on the attention of managers who think of their plants in terms of daylight rather than darkness. An interesting revelation of the same attitude of mind was, that of the men interviewed about half said that they would go to the electrical retailer or jobber if they wanted to do anything in the matter, and only about one man in five was disposed to turn to the architect, the engineer or central station for help. The meaning of this situation is threefold. First, the average manager would go to the contractor if to anyone and consequently would not seek his aid until he had fairly definitely made up his mind that changes were necessary, and that he was ready to consider buying equipment. This puts the burden of improvement, so to speak, on the introspection of the busy manufacturer. Second, it is equally clear that the electrical dealer has a large and comparatively unworked field before him. There are not a few dealers who have rather keen interest and plenty of knowledge regarding illuminating matters, and they evidently can do a large amount of good in industrial lighting. Third, by this same token it is very clear that electrical dealers ought to specialize in illuminating matters more than they generally do. There is certainly need of very much missionary work, especially for the accumulation of convincing data as to the improvement of operating conditions due to good illumination.

The Economy of Static Condensers

Most Advantageous in Sizes of 500 Kva. or Less, Making Them Particularly Suitable for Power-Factor Correction in Industrial Plants—Experiences of Two Electric Service Companies

By **FRANK HERSHEY**
General Electric Company

THROUGHOUT the last year static condensers assisted to a marked degree in improving the power factor on the lines of electric service companies. Inasmuch as the adavntages of the static condenser compared with the synchronous motor or condenser are more pronounced for capacities of 500 kva. and below, the demand for this type of apparatus, as was expected, was greatest among industrial consumers who purchased equipments in accordance with recommendations from the central stations supplying them with power. At the same time, a number of equipments were ordered by utility companies for installation at substations and at outlying points on some of their feeders supplying power to a large number of small consumers. It was because the individual requirement of each customer was comparatively small that it was more economical to consider group rather than individual correction.

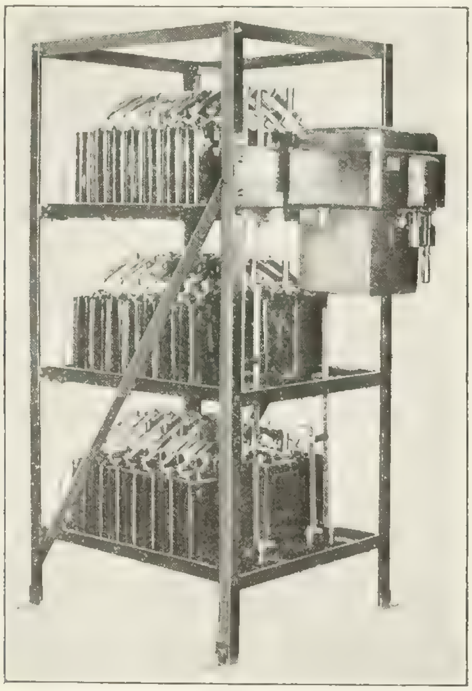


FIG. 1—THREE-PHASE, 60-CYCLE, 2,300-VOLT STATIC CONDENSER WITHOUT REACTOR AND DISCHARGE RESISTANCE

Static condenser equipments for 2,300-volt service consist of a number of condenser units, a reactor for dampening out the higher harmonics in the voltage wave which would affect the corrective capacity of the units, a discharge resistor for draining the condenser charge when disconnected from the line, and an oil circuit breaker for the control of the equipment. For 220, 440 and 550-volt service an auto transformer is also provided designed to step up the supply voltage to 1,200 for the condensers in order to provide for more economical use of the active material. The number of condenser units included in an equipment is directly proportional to the capacity required, each unit having a capacity at 60 cycles of 5 kva.

Condensers of the type under consideration have been standardized for installation on circuits ranging in frequency from 40 to 125 cycles, in voltage from 220 to 2,300, and in capacities from 30 kva. to 300 kva., the smaller sizes being 30 kva. and 60 kva., and then increasing in steps of 60 kva. to 300 kva. For the correction of power factor on circuits exceeding 2,300 volts transforming apparatus consisting of either a transformer or an auto-transformer is furnished, the choice depending on the ratio of transformation required to step the voltage down to 2,300 volts, and a suitable oil circuit breaker is provided to control the equipment from the line side of the transforming apparatus.

RELATIVE ADVANTAGES AND DISADVANTAGES

The advantages of the static condenser as compared with other forms of apparatus for power factor correction are as follows:

The cost is comparatively low in small sizes.
No special location or foundations are required.
The losses are extremely low.
Practically no attendance is required.
There are no moving parts to wear out.
The condenser is noiseless in operation.

The disadvantages are:

The capacity is less easily adjusted than that of the synchronous condenser.
No lagging correction is obtainable.
The cost is high in large sizes as compared with the synchronous condenser.

A comparison of the costs per kva. between static and synchronous condensers is given in Fig. 3. It will be noted that the static condenser costs less than synchronous apparatus below the ratings tabulated.

Volts	Kva.	Volts	Kva.
220	130	550	210
440	175	2,300	475

More important than first costs, however, are the annual costs of operation. Assuming that the full corrective capacity is required for a period of ten hours per day, or 3,500 hours per year, a charge for energy at ½ cent per kilowatt-hour and capital charges of 15 and 20 per cent respectively, without attempting to include an installation and maintenance charge, a comparison of annual operating costs, shown in Fig. 2, will indicate that marked economies can be obtained by using static condensers of much higher capacities than the limits determined on the basis of first cost.

That static condensers have affected economies in plant operation is evidenced in the following report from W. A. Forbush, superintendent of the Edison Electric Illuminating Company of Brockton, Mass., summarizing the results obtained by the installation of two 200-kva., 2,300-volt condenser equipments at the Stoughton substation*:

The loads varied from 700 kw. to 780 kw. Without the condenser the average power factor was 70 per cent, giving 1,057 kva. with a voltage of 12,400. The connection of the condenser raised the power factor to 90 per cent, giving 822 kva. with a voltage of 12,850. That is, the kva.-load was reduced over 20 per cent and the delivered voltage improved nearly 4 per cent. These results check very closely with the original calculations, and continued service has verified them.

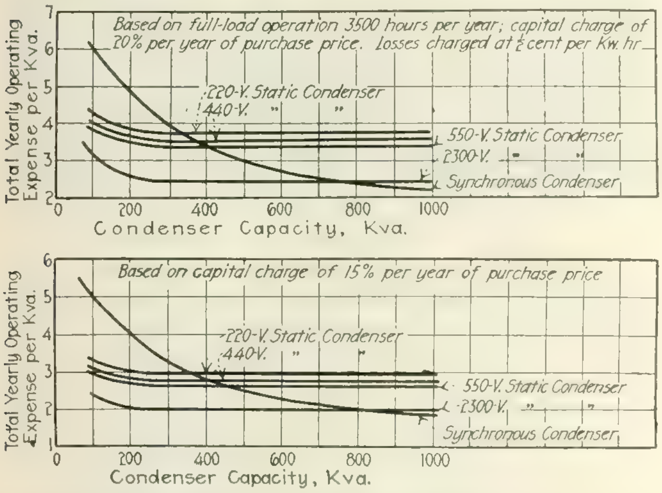


FIG. 2—TOTAL YEARLY OPERATING EXPENSES PER KVA. FOR STATIC AND SYNCHRONOUS CONDENSERS

Approximate calculations were made to see what the annual savings would be. The average day load was assumed to be 607 kw. for a twelve-hour period. For the other twelve of the twenty-four hours the load was taken as 390 kw. This, for a twenty-five-day month, that being an average number of working days, gave an annual reduction of transmission losses of 205,000 kw.-hr. This represents a substantial saving.

While the above results were valuable and would of themselves have justified the installation, the primary object here was increased capacity. This was accomplished, as previously shown, to the extent of about 20 per cent and permitted the Stoughton district to care for its growth over a critical period.

The financial aspect may be shown roughly as follows:

Cost of 400 kva. capacity	$7,500.00	
Expense of transportation and installation	300.00	
Cost of set installed		$7,500.00
Annual fixed cost, 15 per cent		1,125.00
Increased capacity made available in Stoughton, 300 kw. Value of capacity, 300 kw. at $50 per kw. ($50 per kw. taken as the cost of transmission and conversion investment)		15,000.00
Annual fixed cost, 15 per cent		2,250.00
Reduction in losses, 225,000 kw.-hr. 225,000 kw.-hr. at $0.0075 per kw.-hr.		1,687.50
Annual saving		$3,937.50
Annual cost		1,125.00
Net annual saving		$2,812.50

We believe that these figures show the value of the installation to us. They might be made even more impressive by taking the savings on the greater load which will soon be carried, but every attempt has been made to be conservative.

We can say without qualification that we are most satisfied with the results as they have shown themselves. This is true with regard to improved voltage regulation, better power factor, decreased losses and increased capacity.

Static condensers have also been used effectively to relieve an overloaded distributing system and have made it unnecessary to install additional transformer capacity. An example of this was given in the Feb. 2, 1918, issue of the ELECTRICAL WORLD, by J. F. Dubois, manager electrical department, Lynn Gas & Electric Company, Lynn, Mass. The results obtained are summarized as follows:

Early in 1915, two static condensers rated at 100 kva. each were installed and connected to the secondary network. Space not being available at the factory first mentioned, one unit of 100 kva. was located in a machine shop across the street. At another point a portable galvanized-iron building was erected to house the other condenser. The company found itself able to take on this factory of 160 hp. in motors without the addition of a single transformer or the changing of the circuit in any way except in the installation of the condensers. The power factor of the circuit at the station was raised to about 78 per cent. The results were so satisfactory that in the present year another unit, of the subway type, was installed in an ordinary transformer manhole on Monroe Street, Lynn. This equipment is working perfectly at present, and in a recent test it raised the power factor of the circuit at the station from 60 per cent with the condensers all off to 90 per cent with all the units in, the present load being about 440 kva.

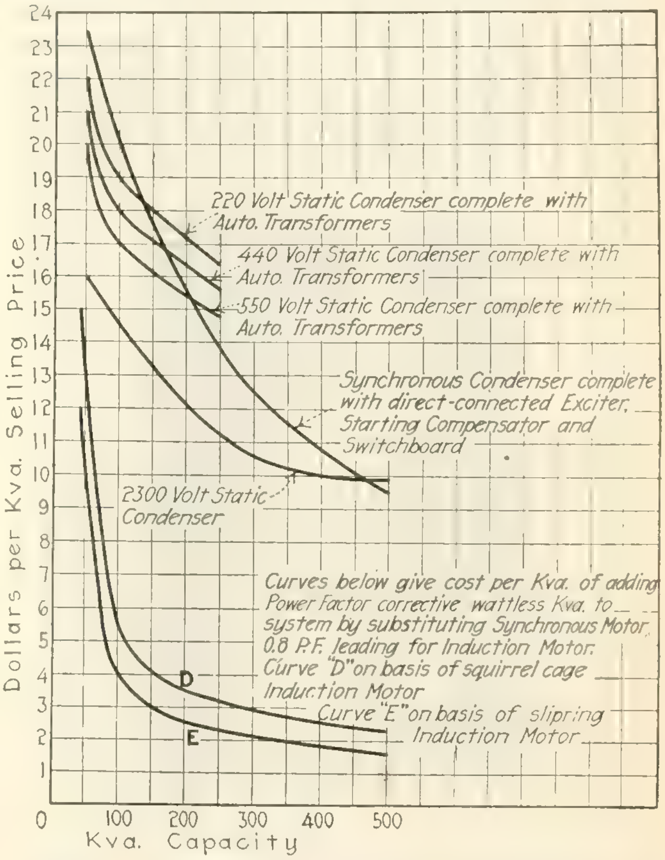


FIG. 3—COMPARISONS OF FIRST COSTS OF STATIC AND SYNCHRONOUS CONDENSERS

INDUSTRY *must be humanized, not destroyed. It must be the instrument not of selfishness but of service. Change not the law but the attitude of mind. Let our citizens look not to the false prophets but to the Pilgrims.*—CALVIN COOLIDGE, *Governor of Massachusetts.*

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*Excerpt March issue *Stone & Webster Journal.*

Researches in High-Voltage Insulation

Extensive Tests of Suspension Insulators Show that Temperature Changes Are the Most Serious Causes of Failure — Promising New Types of Insulators Are Undergoing Test of Actual Service — Extra High-Voltage Lines Seem Assured

By **HARRIS J. RYAN**
Professor of Electrical Engineering, Leland Stanford Jr. University

THE existing conditions in recent years have served to emphasize the importance of vast extensions of the high-voltage power networks for the reclamation water powers, the conservation of fuel and to enhance the economic use of existing power plants. Power engineers have, therefore, been engrossed in comprehensive studies of all essentials that relate to a nation-wide extension of electric power service. In these studies power transmission engineers who know the status of high-voltage transformers, switch gear and line insulators have acquired the conviction that a decided increase in line voltage may now be undertaken with safety in new projects when warranted by economic considerations. Projects of this sort are new power developments, as such, wherein 75,000 kw. or more per circuit must be transmitted over distances ranging from 200 miles (320 km.) upward and 220,000-volt buses for the economic exchange of power over state-wide or even greater areas. The advent of this conviction had been delayed in part by the lack of durability of the general run of high-voltage line insulators. It is natural, therefore, that a return should have been made to the difficult study of all factors that relate to insulator durability and of means for the improvement of the duty service to be had from the insulators available in the present state of the art.

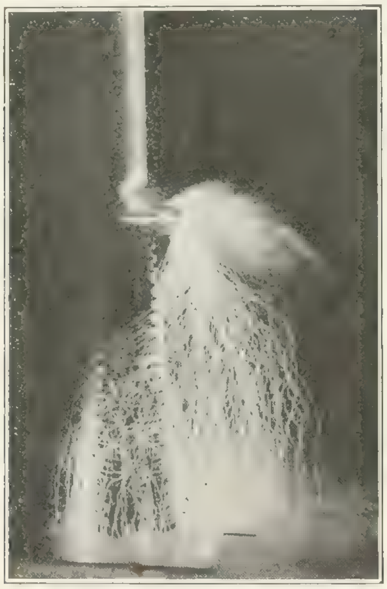
FIG. 1—DISCHARGE OVER POST INSULATOR AT RADIO FREQUENCY

Insulator manufacturers have displayed enterprise in the improvement of factory ceramics, insulator assembly and factory tests, in making improvements in old designs, in courageously producing new designs and in trying them out in practice.

Many insulator durability studies were interrupted by the war and were renewed during the year now closing. In one instance cap and pin suspension insulators of various makes undergoing natural daily temperature cycles by yard treatment in 1917 were left for the duration of the war as follows: one-half in the yard to continue the daily and seasonal temperature cyclic treatment and the other half in even temperature storage for control. After 750 days all were returned to the laboratory and tested for failure by 1000-volt direct-current megger, the "buzz stick," "spark stick," under flash-over voltage and ten seconds spark-over voltage. These insulators were of the 1911-14 vintages that lack durability. Those left in the yard continued to fail at an accelerating rate as was expected, while but few failed among those left for control in even temperature storage. Beyond all doubt, therefore, inability to withstand temperature changes is almost the total cause of deterioration in this type of insulator after it has passed the factory and acceptance tests.

A batch of eighteen cap and pin "high-temperature" glass suspension insulators had also been subjected to natural daily temperature cycles for a year in the yard prior to the war period. One only had failed. They too were continued in the yard for 750 days through and beyond the war period and were then retested. Nine out of the seventeen were found to have failed—a far higher rate than that occurring for the poorest cap and pin porcelain insulators. The higher rate of failure of these glass suspension units must be attributed to their physical properties compared with those of porcelain. Glass is amorphous, vitreous and brittle, while good porcelain is cellular, non-porous and tough.

Having come to a clear understanding that the chief cause of the excessive deterioration of cap and pin porcelain insulators has been their inability to withstand indefinitely natural temperature changes, many transmission engineers have renewed their faith in their ultimate dependability. To this manufacturers have reacted by making improvements in construction and in factory technique for minimizing effects due to temperature that promise greater durability henceforth.

NEW TYPES OF INSULATORS UNDER TEST

Long high-voltage circuits were equipped with a comparatively new type of suspension insulator. Therein the cap of the porcelain disk is replaced with a stout porcelain core. The metal linking-up pieces have tines that are anchored in the end faces of the porcelain core with a special alloy cast in. No cement is used. A radical departure in the structure of the suspension insulator has thus been introduced. In the aggregate the circuits carried by these core and tine insulators are being subjected to wide variations in climate. They will have to endure the extremes of temperature and other elements encountered at high altitudes in the southern Sierras, in the lower hot and dry areas of the far South-

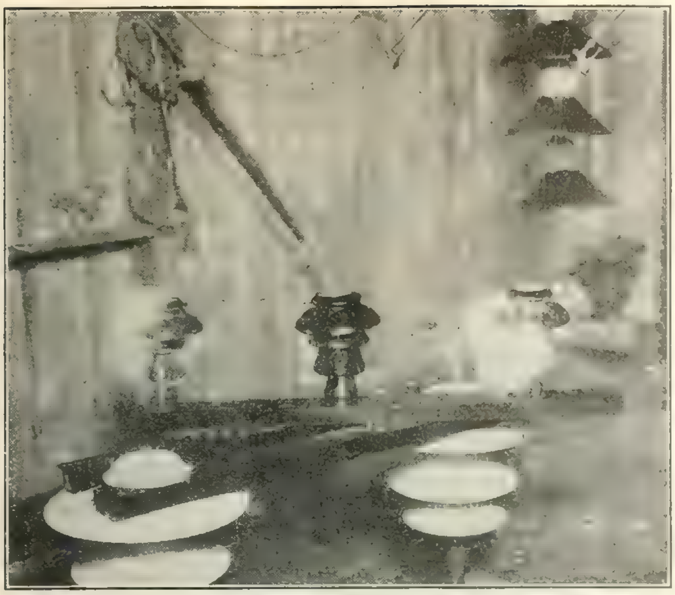

FIG. 2—RAIN TEST FOR PIN INSULATORS

west and the more humid areas of the far Southeast. There is, therefore, in progress a great practical durability test that can be reproduced and foreshortened in no laboratory as yet. The durability returns from these core and tine insulators will be received and studied with care during the ensuing five years.

Interest is being revived in the pioneer type of suspension insulator wherein the porcelain disk has a bomb-shaped center pierced to receive links which constitute the connecting-up hardware. This may be designated as the bomb and link type. Many transmission engineers are renewing their studies of the advantages and disadvantages of this type of suspension insulator. The manufacturers thereof have undertaken to extend their facilities for its production. Its present-day electrical, mechanical and durability factors are being studied through records and in the field and outstanding laboratories. To some it seems highly probable that a general return to the use of this type of insulator will result in a material advance in suspension insulator durability.

The technical paper treating the probability factor in the make-up, use and maintenance of strings of suspension insulators that was read at the Los Angeles convention of the American Institute of Electrical Engineers is of lasting importance. It deals with some of the outstanding factors that must always be understood and relied upon for the successful use of this form of insulator.

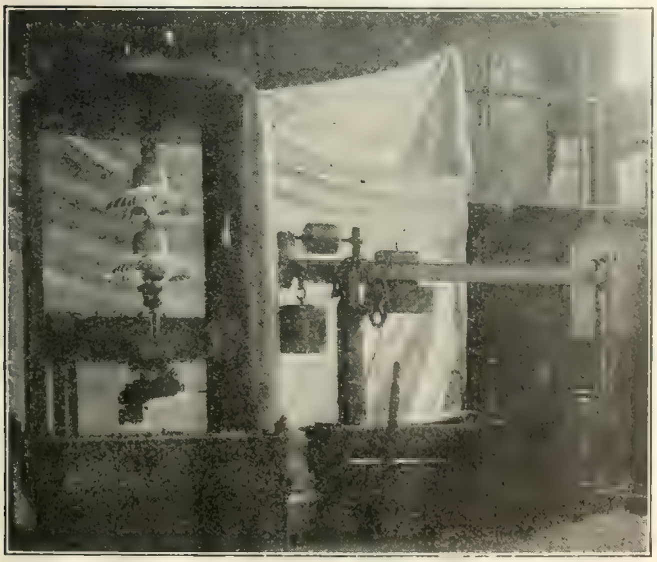

FIG. 3—COMBINED RAIN AND TENSION TESTS OF SUSPENSION UNITS

Pin-type insulators for the support of 22, 33, 44 and 66 kv. circuits have been given further study in the factory and field with the result that some real advances have been made. Substantial designs have been reformed so as to raise materially the ratio of wet to dry flash-over voltages. So far as is known such result can only be obtained by the avoidance of overstresses of the air adjacent to the insulator surfaces at substantially all voltages below flash-over.

FIG. 4—SUBJECTING SUSPENSION INSULATORS TO DAILY TEMPERATURE CYCLES AT STANFORD HIGH-VOLTAGE LABORATORY

Transmission engineers in the field have continued with success their efforts to discover and to use means for locating on live circuits porcelain parts in suspension and pin-type insulators that have failed. The best results have been obtained by the use of suitable means for gaging the voltage duty carried by each individual porcelain part of the insulator.

One such method consists in the use of a U-shaped metal discharger mounted on the end of an insulating rod of convenient length. The implement is called the "buzz stick" by its engineer advocate. The discharger is placed in the stray electric field about the insulator formed by the line voltage. The observer notes the character and location of the noises that occur because of the overstresses thus produced in the atmosphere. By experience he learns to judge of the presence of one or more defective parts in the insulator. Unless there are too many defective parts present, rendering the procedure unsafe, such parts are then identified by shorting all of the parts, one at a time, with the discharger. Those defective will deliver weak spark discharges or none at all.

In another method the insulator part is shunted with suitable tine-like electrodes through an adjustable spark gap in series with a condenser having a capacitance of about one-quarter that of each of the insulator parts. These things are made light and are carried on the end of a conveniently proportioned insulating rod. The spark gap is inclosed and sound therefrom is carried to the ear of the test man by a listening tube. The insulation strength of the condenser is made sufficient to withstand an ample portion of the total line voltage. This outfit is called the "spark stick." The voltage duty carried by each of the insulator parts under test on the circuit while in service is then gaged by shunting it and noting the maximum length of gap through which sparks are passed. A part that has failed or is near to failure will pass sparks through an abnormally short gap only, if at all. It is thus quickly and definitely located. In employing the spark stick one engineer has used a glow bulb in lieu of the adjustable spark gap.

In the tests referred to earlier it was found that the buzz and spark sticks were just about equally dependable in locating defective insulator parts. Only practice can determine which is ultimately to be preferred. In the long run each will locate more defective parts than the 1000-volt megger, particularly after a long dry season. The megger has the disadvantage that the section of the circuit wherein insulators are being tested must be put out of service. However, many transmission engineers are unwilling as yet to have their insulator test men work on live circuits. The use of the megger will, therefore, likely be continued to a considerable extent during the immediate years to come.

INSULATION STUDY AT 500,000 VOLTS AND 60,000 CYCLES

Modern high-powered radio-telegraph stations radiate hundreds of kilowatts from antennae at 100,000 volts or more. Because of the high frequencies employed, huge, wasteful and destructive coronas are formed from any conducting electrodes when atmosphere adjacent thereto is permitted to be overstressed and ionized to the slightest extent. The higher voltage duties which the suspension insulator units placed next to the line conductor must sustain because of electric flux leakage present a difficulty in the use of this form of insulator for the radio engineer, just as they do for the power engineer when the voltage to ground approaches 100,000. To study these difficulties and to find their remedy a 500,000-volt, 60,000-cycle laboratory source was provided by one manufacturer. With it many important studies of a variety of remedial expedients, such as metal guards, graded parts and electrodes that are continuously and tightly covered with porcelain, have been tried. It is to be hoped that the results obtained thereby will be published soon for the benefit of all.

Progress was made in knowledge of the fundamentals requisite for the successful insulation of underground cables and armature conductors for moderately high voltages. Such insulations must be continuous sheaths built up of dielectric sheets, fibers and binders. They have attained ranking importance. In most of these sheaths air is present in films or filaments. Such films are weaker dielectrics than the sheath-forming materials. Heretofore little has been known of the dielectric strength characteristics of these films. Within the year the results of a valuable and extensive research in regard hereto have been reported. They have demonstrated the positive necessity for reducing to the utmost the thicknesses of the air films that tend to form in this class of insulation.

In dielectrics perhaps the most interesting items of the year have been the limited reports of piezoelectric motor phenomena. These were studied by many during the war and some remarkable results were obtained. They should have a considerable peacetime application. Certain crystal dielectrics were made to function electromechanically at radio frequencies with high efficiencies and at more watts per pound of active materials than occurs correspondingly in the best known synchronous motors operated at 60 cycles under full load. It is to be hoped that when peace is finally and fully established, complete reports of the work done in piezoelectrics may be published.

Public Utilities of Indiana Organize

Indiana public service companies have organized the Indiana Public Utility Association, the purposes of which are to consider common problems of the members and to enlist public co-operation in a movement to improve standards of service, despite the high cost of living. The officers of the new organization are: President, Charles L. Henry, Indianapolis & Cincinnati Traction Company; vice-president, Harry Reid, president Interstate Public Service Company; treasurer, Charles C. Perry, Indianapolis Light & Power Company; secretary, Thomas Donohue, manager Lafayette Electric, Gas & Heating Company and secretary of the Indiana Electric Light Association. The membership includes gas, traction, light, heat and power, water and telephone service.

The organization issued the following statement outlining its purposes subsequent to its organization:

> Public service companies throughout the United States are facing a critical situation because of the continually advancing costs of material and labor. The situation in Indiana, where it is almost impossible to advance rates in step with increasing costs, is typical of the national situation. Rates for public service are more or less static. They are fixed and they stay fixed until such time as, after much legal procedure and necessarily slow financial investigation, they can be shown to be insufficient. Service is frequently impaired, and the companies suffer losses while the public suffers inconvenience until rates can be readjusted.
>
> The public is usually in no mood to put up with poor service or with facilities outgrown since war days, and because all other service and commodities have been and are increasing in price, the public is resentful of new increases. On the other hand, public service companies provide common service and rightfully expect some measure of co-operation from the public.
>
> They must, therefore, find sufficient income to meet increasing labor and material costs to maintain and improve pre-war standards of service. At this period their problem is especially difficult because maintenance and replacement materials, as well as operating materials, such as coal for example, have increased in price. In nearly every phase of utility service, replacement and maintenance work lapsed during the war, with the result that the companies are now taking it up again under a severe handicap.

Natural Life of Cedar Poles

Quantitative Study of Butt Rot Shows that Cedar Poles Should Last from Fourteen to Seventeen Years—Mechanical Strength Is Determined Largely by Side Pull and Poles Should Therefore Be Well Guyed

By **PAGE GOLSAN**
Consulting Engineer, San Francisco, Cal.

FOR the appraisal made by the Southern California Edison Company several years ago it proved to be necessary in the determination of depreciation annuities to assign an average useful life to round cedar poles. While inadequacy for service, action of public authority and other factors cause the early removal or replacement of many poles, the largest number are not replaced until the time when rot brings about the end of their natural life. Results can, therefore, be reached more intelligently if the average natural life of an undisturbed pole be known and such life be tempered with the probabilities of functional depreciation as determined by local experience. In carrying out this investigation the average rate of rotting at the pole but was determined and the life calculated from the change in diameter at the butt. Since the greatest danger is that poles may fail near the butt due to sidewise pull, they should be guyed when subjected to such stress. It is also economical to use poles of large butt diameter because the pole strength varies as the cube of this diameter.

In connection with this appraisal, two crews were sent into the field at Los Angeles, and 1021 poles of varying ages up to ten years were examined. The soil was dug away for a depth of 12 in. to 18 in. (30 cm. to 45 cm.) and the rot chopped off with hatchet and pick. The original unrotted diameter and the diameter of firm wood at the rotted section were averaged from five or six measurements in each case, and the character of soil was noted.

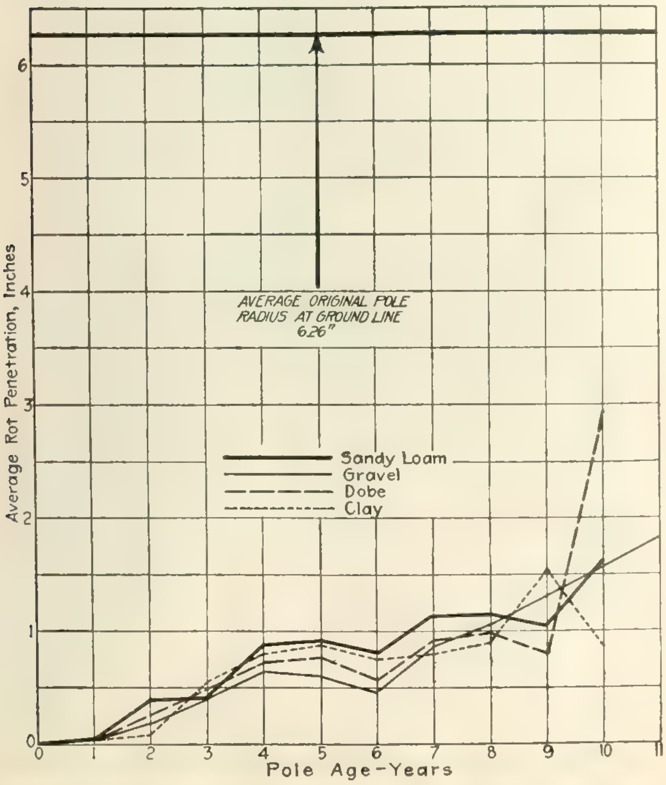

FIG. 1—EFFECT OF POLE AGE ON ROT PENETRATION; DATA FROM WHICH SAFE LOAD OF POLES MAY BE DETERMINED

Almost invariably it was found that the rot was confined to a small cylindrical portion near the ground surface only. While it has been held that such rot is caused by microscopic organisms, the author is of the opinion that it is largely caused by an intermittent wetting and drying of the pole, the outflow of water gradually carrying the soluble matter away until only the unsupported cellulose fibers remained. Except for knots and certain favorable settings, the depth of penetration of rot was usually found to be uniform around the circumference of the pole.

An investigation of the records before starting field work showed that a large number of the poles had been treated by brush application with a coating of a thin carbolineum paint. To divide the results between poles so treated and poles not treated, an attempt was made to note this fact during the field observation. With the exception of settings under two or three years, however, practically no traces of the treatment could be found. Evidently cold brush treatment does not give deep enough penetration for thorough waterproofing, and the paint was soon washed out. Whether the chemicals reduced the attack of insects in the early years cannot be said. The results of this field investigation are shown in Fig. 1, treated and non-treated poles being averaged together.

It will be seen that the type of soil had not a very definite effect on the rate of rot, and to smooth out the results an average of these curves was compiled and

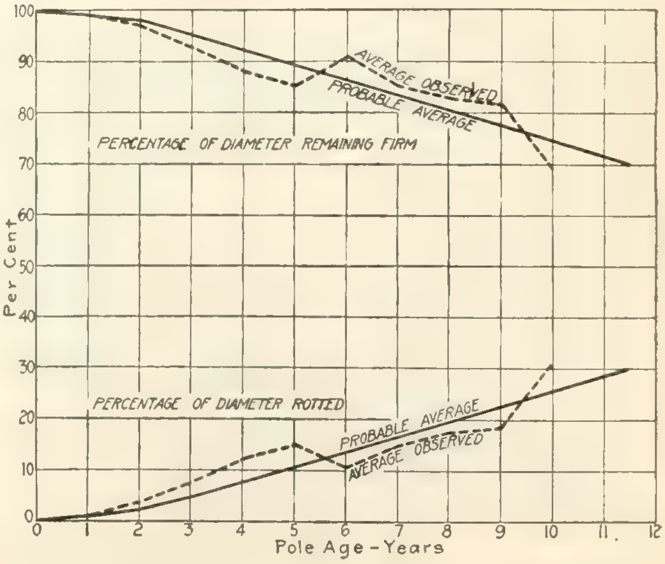

FIG 2—PERCENTAGE OF POLE DIAMETER REMAINING FIRM AFTER DIFFERENT PERIODS OF SERVICE

transferred to Fig. 2 as the percentage of the average pole diameter rotted away at each year of its age. This curve was then further smoothed out by drawing a probable average rate of rot. Deducting these curves from 100 percent produces the "percentage of diameter remaining firm" for each year as shown.

Obviously the replacement of a pole from natural causes is a matter of safety. It cannot be left to stand until it falls over, and safety is a matter of its structural strength. A study of natural-pole life must take the structural strength into account.

Fig. 3 shows diagramatically a pole projecting out of the ground a distance l, with forces W and X, acting upon it. If it may be assumed that the ground is rigid, the greatest stress caused by W is practically at the ground line. Force X, consisting of the weight of wires, cross-arms, transformers, etc., is also at a maximum slightly below the ground line when the weight of the pole is added. We may assume the maximum stresses due to these forces to be at the ground line.

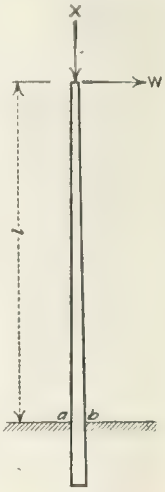

FIG. 3
ERECTED POLE

If D = the pole diameter at the ground, then the moment of inertia of this section is: $I = \pi D^4/64$.

Let f = maximum unit stress in extreme fibers of the firm wood surface at this section,

Then $f = MD/2l$ (where D = pole diameter and M = moment acting on the section).

The moment at the section due to W is: $M_w = Wl$; whence f_w (maximum unit stress due to W) =

$$\frac{M_w D}{2I} = \frac{WDl}{2\,\pi D^4/64} = \frac{32\ Wl}{\pi D^3}. \tag{1}$$

At a point a this stress is tension or negative, at b compression or positive.

The area of the section at the ground line is

$$A = \pi D^2/4$$

Let $Y = X$ plus the weight of pole above ground. Then f_y (maximum unit stress due to Y) =

$$\frac{Y}{A} = \frac{Y}{\pi D^2/4} = \frac{4\ Y}{\pi D^2}. \tag{2}$$

This stress is positive at both a and b.

The maximum unit tensional stress is, therefore: (2) — (1), or $f_t = f_y - f_w = 4Y/\pi D^2 - 32Wl/\pi D^3$. (3)

The maximum unit compressional stress is, therefore, (2) + (1), or $f_c = f_y + f_w = 4Y/\pi D^2 + 32Wl/\pi D^3$. (4)

Since in ordinary cedar the ultimate limit of resistance is about $f_t = 10{,}000$ lb. per square inch, $f_c = 6{,}000$ lb. per square inch.

And since in our equations f_c is always greater than f_t owing to the plus sign of equation (4), a pole will fail on its compression side and we are limited to equation (4).

If $Y = 0$, then the strength of a pole is proportional to the *cube* of its diameter.

If $W = 0$, the strength of a pole is proportional to the *square* of its diameter.

The question arises as to which factor controls.

Equation (4) may be written:

$$f_c = \frac{4}{\pi D^2}\,(8l\ W/D + Y). \tag{5}$$

For a given pole this shows that each pound pull of W is $8\ l/D$ times more important than a pound pull at Y.

For a 40-ft. (12-m.) pole, 12-in. (25-cm.) butt, with 35 ft. (10.5 m.) out of the ground $8l/D = 280$.

If the pole, cross-arms, wire transformers and all weigh a total of 5000 lb. (2268 kg.), the effect of this weight is equal to an unbalanced pull at W of only $5000/280 = 18$ lb. (8 kg.), which may be exceeded many times over. This will bring home to the utility engineer the importance of strong and frequent guying.

The great effect of D^3 may be further clearly shown in determining the amounts of W or Y required to break a pole. Assume a pole of 15-in. (37.5-cm.) butt with 40-ft. (12 m.) out of ground. To break under W :

$$6000 = \frac{4}{\pi (15)^2}\left(8 \cdot \frac{40 \times 12}{15}\ W + O\right)$$

$$W = 4140 \text{ lb.}$$

To break under Y :

$$6000 = \frac{4}{\pi (15)^2}\,(O + Y)$$

$$Y = 1{,}060{,}000 \text{ lb.}$$

Of course, the pole would buckle under column action long before force Y could be fully applied, but it merely shows that practically we may state that:

$$\text{Pole strength} = KD^3.$$

This being the case, we may replot the "remaining firm diameter" of Fig. 2, cubing the percentage of remaining diameter in each instance. The result is shown in Fig. 4.

This curve shows the rapid decrease in the strength of a pole as rot at the ground line proceeds and affords a tangible basis on which to judge natural life as based on factor of safety. A pole should certainly come out when its breaking resistance to a horizontal pull or to a non-centered dead-weight load has decreased to but 15 to 25 per cent of its original strength. Such a life, as determined by these observations, is found to be between fourteen and seventeen years. Of course, a large number of poles may exceed this life, also a great many may rot out sooner. We have merely dealt with the average.

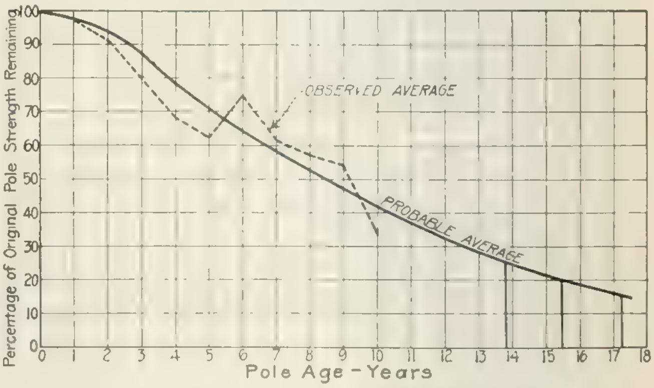

FIG. 4—CHANGE IN POLE STRENGTH DURING LIFE

The formula, Strength = KD^3, also brings ou the fact that large butts are more economical than small butts. The cost of a pole by no means increases as the cube of the butt diameter, and it can therefore be readily shown that large butts, because they last longer in proportion to the investment, decrease renewal costs.

As pointed out at the beginning, many poles must be removed because of load changes, underground work and other functional elements before their natural life has been reached.

The Real Functions of the Engineer

Common Understanding of Social and Industrial Conditions Necessary so that the Human Factor Shall Not Be Overlooked in Engineering Design

By GEORGE W. BACON
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ENGINEERING may well be regarded as the most aggressive of the professions; it thrives on change, on the new application of an old principle, the adaptation to the job of to-day of a new union of materials and mechanisms. In its broader aspects it must equate and relate the thing to be done to the social relations and conditions it aims to benefit. In other words, the engineer has a social as well as a technical function.

The bridge should be designed and located not only with due regard to the origin, direction and degree of the immediate traffic and the physical characteristics of the site, but with even greater consideration to the part it can be made to play in the development of the areas thus joined through inviting service.

The street or subway car with narrow exits or entrances or misplaced seats not only fails to serve the public effectively, but in like degree to return to the investor his just due. The expense of running the misfit is just as much as that of the car engineered to meet the traffic conditions, and the difference in the earning power of the two represents the difference, with adequate fare rates, between success and failure.

The plant designed without adequate provision for growth is no less fortunate than the one that disregards in its construction attractive and hygienic living conditions for its employees. Engineering has failed too much to insist on the significance of these facts.

The steamship whose dead weight is not properly related to the business of the route can prove a less desirable investment than one that is underpowered, poorly cuisined or improperly ventilated, if not a less desirable form of service.

Engineering gave eyes to the army and ears to the navy, and it stopped, as it enabled the start of, the Great War.

In helping to guide the correct solutions of the problems of peace, the technical as well as the broad economic talents of the engineer will be required.

Never has the engineer faced such opportunities for conserving resources or creating economies as are now presented to those who are equipped with that experience and that fearless regard for facts out of which grows sound vision—the man who does things and the men who back him.

Twenty-five years or more have passed since most of the engineers who are now deciding issues left the curriculum which has, to a greater or less degree, since become their background. At that day, and since, too little regard was had for the commercial and human factors with which engineering must function. Insistence on technique too frequently obscured tolerance for simple business principles.

To-day few businesses would incur the risk of eventual capital impairment through failing to reckon in the design and conduct of its plant and organization with the changing social conditions.

My point is that to-day, more than ever before, the engineer, be he old or young, who looks above and beyond mere technique and is able to visualize in terms of productivity to society the plant machine mechanism or application of principle upon which he is engaged, to work with and to really lead men in the mass, is the kind of engineer that will put on the map work that is worth while by applying sound practices to present-day needs.

On these broader phases of the problems of the engineer the attention of technical men is focusing more and more. Our political and economic organization rests on the use of mechanical devices in industry; that is to say, the production and distribution of finished products is fundamentally an engineering problem.

At the same time, so far as the main purpose of industry is the satisfaction of human wants, the control and management of mechanical processes involved in the production of finished products is in addition a social problem.

To an increasing degree must the schools of the country realize the importance of the social function of the engineer. In New York, for instance, the New School for Social Research, a school of graduate standards for business and professional men and women, has recently invited Guido H. Marx, professor of mechanical engineering at Stanford University, to offer a series of lectures and conferences designed to initiate discussion among technical men, with the object of developing some common understanding of industrial and social conditions. The idea is worthy of emulation in other important educational centers.

The social function of the engineer might be summed up as such disposition of the technological factors in industry as to eliminate waste from which the community now suffers, to increase production and to provide for more adequate distribution. Upon such broadly trained engineers is the direction of the country's industry today coming largely to depend.

The Effect of Lighting on Accidents

A chart published by the California Industrial Accident Commission gives the record of the number of accidents which occur in different months of the year. It is apparent that the ratio is inversely proportional to the length of the daylight period, the highest number of accidents being somewhat beyond the middle of December. The new industrial lighting law which has recently gone into effect in that State is expected to reduce the number of winter accidents at the same time that it increases the output of factories which have hitherto been inadequately lighted. This definite relationship between light and safety is the strongest argument for the rewiring of industrial establishments.

Central-Station Operating Ratio Decreasing

In Spite of the Increasing Costs of Labor and Materials, Manufacturing and Distribution Costs per Kilowatt-Hour Are Now on the Decline

THE review of the central-station industry for the past few years gives some very significant comparisons. In connection with its monthly survey of central-station output and revenue the ELECTRICAL WORLD has undertaken an investigation of the relation of operating expenses to revenue of central stations, in order that an accurate idea may be obtained of the distribution of the gross income of central stations between manufacturing and distribution expenses and income available for interest and dividends, or, in other words, to obtain the operating ratio. In this survey operating expenses covered all expenses up to but not including interest on funded and floating debt. About 41 per cent of the industry responded to the questionnaires sent out, but the figures obtained were well balanced as to location, and as to capacity and character of stations.

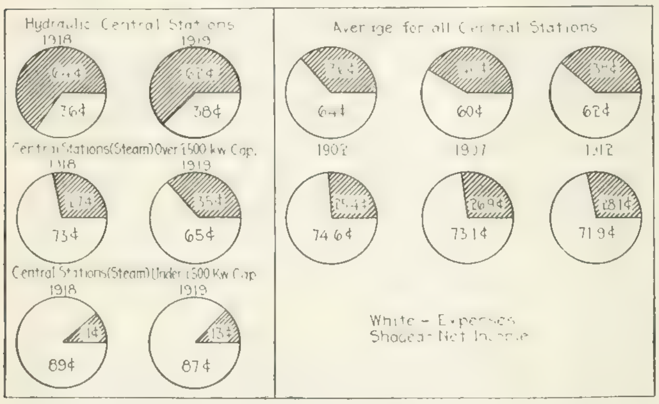


FIG. 1—MANUFACTURING AND DISTRIBUTION COSTS AND NET INCOME AVAILABLE FOR INTEREST AND DIVIDENDS PER DOLLAR OF INCOME FROM SALE OF ENERGY.

In a consideration of the central-station industry, stations naturally fall into the following classes: Hydraulic, steam and gas plants of more than 2500 kw. rating, and steam and gas plants of under 2500 kw. rating. Tables I and II and Fig. 1 give the operating ratio for these three classes of stations, and also for the industry as a whole. The operating ratio of the hydraulic stations increased slightly during 1919, but the ratio of the steam stations both large and small, showed a decrease, especially the larger stations. The low operating ratio of the hydraulic stations is more apparent than real, for the original cost of a hydraulic plant and the interest of the funded debt is often more than enough to overcome the low cost of operation for several years.

The most significant result of this investigation is to be found in the average operating ratio curve for all central stations as shown in Fig. 3. After almost ten years of gradual increase the average ratio between income and operating expenses for the whole central-station industry has taken a downward turn. In the case of the larger steam and gas plants this downward tendency is very noticeable. A higher degree of scientific management, higher rates and a more efficient use of fuel are probably the direct causes of this bettered condition. Whatever the cause, however, it is apparent that the net income available for interest, amortization and dividends of central stations per dollar income are increasing after some ten years of decrease and that this branch of public utilities is, as a consequence, entering upon a new era of prosperity as a market for utility bond investors. This is all most gratifying to the electrical industry at large, for the central station is the mirror which reflects the prosperity of the entire industry.

THE YEAR 1919 SHOWS INCREASE OF 600,000,000 KW.-HR. PRODUCTION OVER 1918

Figures on output and revenue of central stations in the United States are available through October 1919. An estimate for the months of November and December, taking into consideration the coal strike and its resulting curtailment of electric power by orders of the Fuel Commission, gives an output for the year 1919 of approximately 30,300,000,000 kw.-hr. and a revenue of approximately $601,000,000. This is an increase of 600,000,000 kw.-hr., or 2.1 per cent, in output, and $70,000,000, 13 per cent in income over the year 1918. In the past three years the output has increased over 7,000,000,000 kw.-hr., or 32 per cent, while the income has increased $186,000,000, or 45 per cent. During 1918 the output increased 11 per cent, but this was during a period of intense war activity in all lines of industry, and the fact that after such a period a material reaction has not taken place is a clear indication of the healthy condition of the entire industrial life of the country.

Fig. 5 gives curves showing the revenue, manufacturing cost and net income available for interest and dividends per kilowatt-hour of central stations. The revenue per unit gradually dwindled from 3.42 cents in 1902 to 1.79 cents in 1918, when a decided turn for the better took place, the revenue per kilowatt-hour in 1919 being 1.99 cents. The net income available for interest

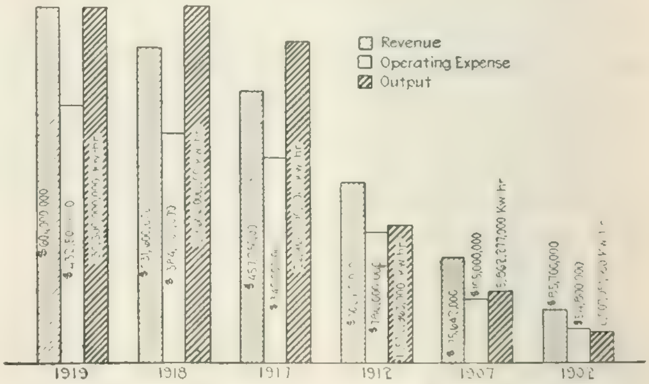
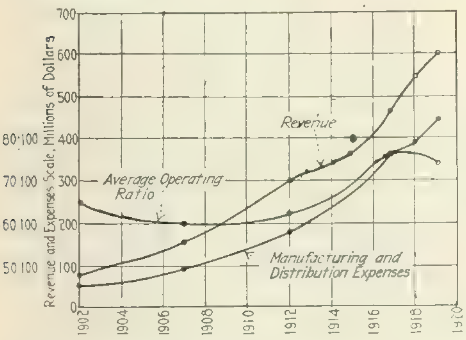


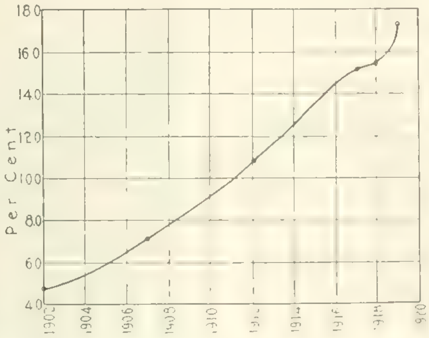
FIG. 2—REVENUE, OPERATING EXPENSES AND OUTPUT OF CENTRAL STATIONS, 1902-1919

TABLE I—OPERATING RATIO AND PROFITS PER KILOWATT-HOUR OF CENTRAL STATIONS

Year	Revenue from Sale of Energy		Manufact'g and Distribution Expenses	Operating Ratio, Expenses to Income	Output of Central Stations		Revenue per Kw.-Hr.		Manufacturing and Distribution Cost per Kilowatt-Hour		Net Income per Kw.-Hr. Available for Interest and Dividends	
	Million Dollars	Av. % Yearly Increase	Million Dollars		Million Kw.-Hr.	Av. % Yearly Increase	Cents	Av. % Yearly Increase or Decrease	Cents	Av. % Yearly Increase or Decrease	Cents	Av. % Yearly Increase or Decrease
1902	85.7	. . .	54.8	64.0	2,507	.	3.42	. . . . . .	2.19	. . .	1.23	. . . . .
1907	176.6	21.2	105.0	60.0	5,862	26.8	2.99	—12.5	1.79	—18.2	1.20	—2.4
1912	302.1	14.4	186.1	62.0	11,533	19.4	2.63	—12.1	1.62	— 9.5	1.01	—15.8
1917	457.2	13.2	345.0	74.6	26,960	26.8	1.86	29.3	1.29	—20.4	0.57	—43.5
1918	531.6	16.2	384.0	73.1	29,686	11.0	1.79	— 3.7	1.29	0.0	0.50	—12.3
1919	601.0*	13.2	432.5	71.9	30,300	2.1	1.99	+11.0	1.43	+10.8	0.56	+12.0

* Estimated.





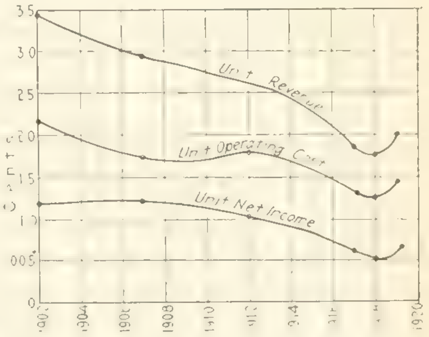


FIG. 3.—REVENUE, MANUFACTURING AND DISTRIBUTION EXPENSES, AND AVERAGE OPERATING RATIO OF CENTRAL STATIONS, 1902-1919. FIG. 4—RATIO OF VALUE OF ELECTRICITY GENERATED TO VALUE OF ALL MANUFACTURES, 1902-1919. FIG. 5—REVENUE, MANUFACTURING AND DISTRIBUTION COST AND NET INCOME AVAILABLE FOR INTEREST AND DIVIDENDS PER UNIT OUTPUT OF CENTRAL STATIONS, 1902 to 1919.

TABLE II—OPERATING RATIO OF CENTRAL STATIONS BY CLASSES OF STATIONS

Year	Hydraulic Stations		Steam Stations Over 2500 Kw. Rating		Steam Stations Under 2500 Kw. Rat'g		Entire Industry	
	Operating Ratio	Per Cent Increase or Decrease	Operating Ratio	Per Cent Increase or Decrease	Operating Ratio	Per Cent Increase or Decrease	Operating Ratio	Per Cent Increase or Decrease
1918	36.2	. . . . .	72.6	. .	89.2	.	73.1	. . . . .
1919	37.8	+1.6	64.4	—8.2	87.6	—1.6	71.9	—1.2

and dividends per unit reached the lowest ebb in 1918—at 0.5 cent per kilowatt-hour. However, a gain of 12 per cent in this item during the past year should do much toward reinteresting the investing public in public utility securities.

Considered as a manufactured product, electricity is fast assuming a foremost position in this country. Table III and Fig. 4 clearly indicate the rapid rate at which the value of electricity generated is growing as expressed by the income derived from the sale of energy. In 1902 the ratio of the value of electricity generated to the value of all manufactures was 4.8 per cent, while in the short space of seventeen years this ratio has increased to about 17.2 per cent. It is doubtful if many other industries can show anything like such a comparative increase.

THE CENTRAL-STATION INDUSTRY BIDS FAIR TO BECOME ONE OF NATION'S VITAL ELEMENTS TO PROGRESS

In general these statistics indicate a wonderful growth of the central-station industry. From a mere cog in the industrial wheel it has grown in a very few years into one of the most important elements of that wonderful intricate machinery which has placed America first industrially among the powers of the world. With the immense undeveloped water powers of the West and the rapid conversion of prime movers from steam to electric, the central station bids fair to become, if it has not already become, the heart of the nation, from which flows the red blood that makes our industrial life the wonder and envy of the foreign world. All production, revenue and net-income curves point to a still further increase, while the unit cost of operation, seems to be relatively on the decrease. If this condition continues, and every available fact points in that direction, the electrical industry is destined for an immediate era of prosperity undreamed of heretofore.

TABLE III—VALUE OF ELECTRICITY GENERATED AND VALUE OF MANUFACTURES IN UNITED STATES

Year	Value of Electricity Generated (Gross Income)		Value of Total Manufactures in United States		Ratio Value of Electricity Generated to Value of All Manufactures in per Cent
	Million Dollars	Average per Cent of Yearly Increase	Million Dollars	Average per Cent of Yearly Increase	
1902	85.7	. .	1,766.6	. .	4.8
1907	175.6	21.2	2,415.0	7.4	7.3
1912	302.1	14.4	2,814.2	3.4	10.7
1917	502.1	13.2	3,295.4	3.4	15.3
1918	531.6	10.6	(Estimated) 3,417.7	3.8	15.6
1919	601.0 (Est.)	13.2	(Estimated) 3,540.0	3.8	17.2

Power for Copper Refineries

Problems of Designing and Operating Two Large Plants, One Steam and Other Hydro-electric, in South America Outlined by Percy Thomas

SOME of the engineering problems involved in designing two South American power plants and some of the difficulties encountered in operating them after their erection were discussed by Percy Thomas in a very interesting lecture given before a meeting of the Association of Mining Engineers recently in New York. One of the plants is a steam station operated by the Chile Exploration Company, and the other is a hydro-electric development serving the Braden Copper Company. Experiences at the mines with electrical appliances such as electric shovels, were also related.

Both of the plants considered are situated on the west coast of South America, one at Chiquicamata and the other at Braden. Because of the unusual scarcity of water inland near Chiquicamata and the fact that fuel has to be imported, the Chile Exploration Company's station was erected on the seashore, where plenty of condensing water should be obtained, and the boilers, which are equipped with steel-tube economizers in the same casing, are provided with mechanical atomizers for burning fuel oil. To obtain pure make-up water for the boilers evaporators using live steam from the boilers are used, although Mr. Thomas said that he would advocate using exhaust steam from the auxiliaries if the plant were being built over. In this case, however, the auxiliary turbines exhaust into an early stage of the main turbines.

Owing to the ground swells on the Pacific Coast considerable seaweed accumulated in the condensing water tunnels at first so that a breakwater and revolving screen had to be installed. The transformers, which are rated at 110,000 volts, are equipped with head tanks full of oil so that there is no air space over the oil inside the transformer case and consequently no absorption of water. The oil is externally cooled in sea water, a plate of zinc being attached to the coils to prevent corrosion thereof by the seawater.

Duplicate 110,000-volt transmission lines are employed to convey energy to the copper refinery over the first 10 km., but the remainder of the line is single-circuit. A double circuit is used near the coast to permit washing off the insulators on one line every two or three weeks the salt that has been deposited by spray blown from the ocean. Although two-piece disks were employed, the insulators began to break down three or four years after being installed, and the "buzz-stick" method is now being employed to detect faulty insulators. From investigation it has been concluded that the principal insulator trouble is due to moisture.

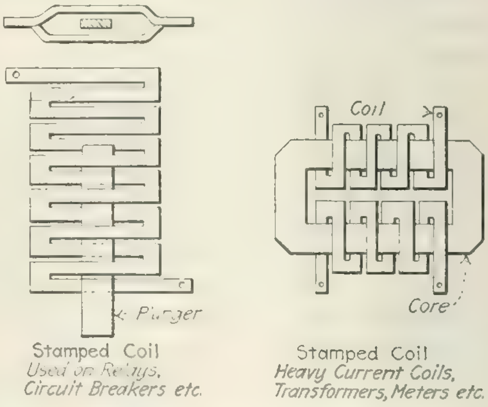
Electrolytic processes at the copper mine require that direct current at 120 to 290 volts be supplied, so 3,500-kw. converters with alternating-current boosters forming an integral part of them are used and fed from adjustable transformer taps. There are also two other converters which are fed from one transformer having two secondary windings. Alternating current is used for the five electric shovels which are now being employed, and they have been found very successful. Ten will be in operation shortly. To prevent an excessive overdrawing of current when a dipper takes too big a "bite," jamming relays are employed to insert resistance automatically. The cost of operating these electric shovels is much less than that of steam, according to Mr. Thomas, and they do all that the latter can do.

Electric power is also used for operating car dumpers, electric furnaces, electric crushers and magnetic separators, the most successful type of magnet used being the mushroom type. However, there is need of a more satisfactory magnetic head-end pulley.

Compared with the plant just described the station of the Braden Copper Company is a big contract. It is in a territory where there is plenty of water but too far from the coast to receive oil or fuel of any type economically. Therefore power is developed hydro-electrically. Development was very difficult, however, because of the shifting formation of the rock that makes it difficult to keep ditches clear of débris washed down with the water. Owing to the suspended matter in the water or to some peculiarity in the water itself the waterwheels are eroded very rapidly so that the replacement expenses of the plant are very high. In the plant just completed by the Braden company 80,000 cu.yd. (61,000 cu.m.) of gravel passed through the dam in one week so that the operating problem encountered should be obvious. Because of this condition a roller gate had to be employed in the dam instead of the ordinary type used in this country. To prevent excessive strains in the penstocks at the new plant, which operates under a head of 1,500 ft., a surge tank of two concentric cylinders is employed, the inside one communicating with the penstock. Between the two cylinders are small holes which restrict the flow of water from the inner cylinder to the other one, although they relieve the pressure in the penstock. The water flowing in the outer cylinder can be saved and utilized if desired. Although the operating conditions on the Chile Exploration Company's transmission line inland are very favorable, the Braden Company's lines are subjected to frequent lightning.

Solenoid Coils Are Made from Stampings

A COIL or solenoid formed by stamping or punching out of sheet metal strips which are alternately bent upward and downward is covered in United States patent No. 1,184,536, issued to Morris B. Kassel and Albert Finkenberg of New York City. It is especially intended for use as the coils of heavy-current or overload relays. Since it does not require any insulation or soldering of terminals it can very readily withstand heat. Being of rigid construction part of the stamping which forms the new coil can be used to mount insulating block containing contacts and supports for the plunger.



COILS PUNCHED FROM ONE PIECE OF METAL

Possibilities of Industrial Lighting

A Survey Shows Practically No Effort to Teach Executives the Benefits of Good Lighting—85 per Cent Satisfied, but Only 40 per Cent Have Good Illumination—Nearly One-third Made No Change in Five Years

By R. O. EASTMAN*

THAT productive lighting intensities are seldom found in factories is because about 90 per cent of the executives consider lighting as an expense, instead of an instrument of production. This condition was revealed in a very comprehensive investigation of representative industrial lighting conditions. In every case an effort was made to interview only executives, who it was found had been almost entirely neglected as far as lighting was concerned by the central stations and manufacturers. It was found that lighting improvements were in the largest measure dependent upon the advice and selling ability of the electrical retailers and jobbers.

According to the Illuminating Engineering Society's code 26.6 per cent of the plants visited required 0.4 to 0.6 watts per square foot (1000 sq.cm.), 34.6 per cent of the plants required from 0.6 to 1 watt per square foot, 33.2 per cent required from 1 watt to 1½ watt per square foot, and 5.6 per cent required a higher illuminating intensity. Compared with these requirements 40 per cent of the manufacturing plants had good lighting, but better illumination was needed by the other 60 per cent.

SCOPE AND METHOD OF INVESTIGATION

In conducting such a survey as this it was realized that the universal adaptability of the results depended more upon the proper selection of the plants visited than upon their number. The investigation actually covered 446 industrial plants in 57 different towns and cities throughout fifteen states in the chief industrial belt of the country. In order to make the investigation free from bias, non-technical investigators were chosen, and taught what they would be required to know about industrial lighting and the lamp business. Questionnaires were carefully prepared and committed to memory by each investigator so that the facts would come out in conversation with people interviewed rather than by direct questioning. The investigators were then tested on trial investigations before they were sent out on the survey.

An executive officer of the company was interviewed in forty-six per cent of the plants; the superintendent supplied the information for twenty-one per cent of the companies, and the electrician was the informant on twelve per cent of the calls. It was not found difficult to get the information, in fact the executives were very interested and seemed surprised that their lighting conditions could be discussed in non-technical terms.

The distribution of the interviews by population strata was as follows: Cities having a population of 100,000 or more, 47.4 per cent; cities of from 25,000 to 100,000 people, 31.2 per cent, and cities between 4500 and 25,000 people 21.6 per cent.

Plants in medium-sized towns were much more backward as a whole in their lighting installations than the plants in either the large cities or smaller towns. This is attributed to the fact that the large towns are obviously more actively canvassed by progressive lighting men, and many of the small towns are near the large cities, and profit by the lighting activity there. It is the medium sized towns some distance from the large cities, that seem to be especially neglected.

Dividing the plants according to their size, 14.4 per cent were classified as very large; 21.9 per cent large, 36.8 per cent medium, and 24.5 per cent were considered small. The larger plants were found to be better lighted than the smaller ones, and the executives of the larger plants were also better informed on lighting matters.

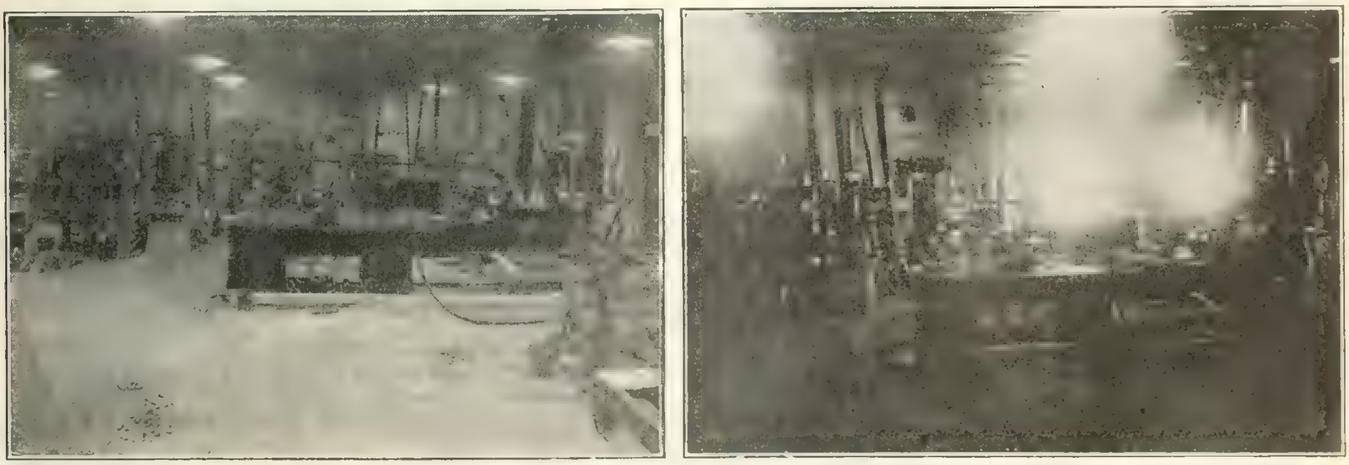


FIG. 1—THE GLOOM AND DANGER OF LOCALIZED LIGHTING ARE BANISHED BY ADEQUATE GENERAL ILLUMINATION

One of the most important revelations of the entire investigation is the overwhelming importance of the electrical retailer and jobber in industrial lighting matters, and the comparatively insignificant position occupied by the central station, the architect, the building engineers and lighting equipment manufacturers. Nearly 50 per cent of those interviewed said they would seek advice regarding lighting changes from an electrical retailer or jobber; 13 per cent would go to a consulting engineer or architect; about 9 per cent to the central station, about 15 per cent to some one in their own employ, and only about 6 per cent would ask the manufacturers for advice. Eliminating some others who were doubtful it was found that 72 per cent would go to the electrical distributor, or some one in their own organization for advice on lighting problems.

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*Presented before thirteenth annual convention of Illuminating Engineering Society.

Another salient point brought out by the investigation is the widespread knowledge of the general benefits to be derived from better factory lighting as compared with the very little effort that has been made to improve conditions. The superintendents and chief electricians were very much interested in better lighting, and the plant electricians were surprisingly well informed. The interest of the executive officers, however, may be said to be of a latent or potential quality, and as a general rule the plant electrician did not seem capable of impressing his ideas upon the plant executives. This seems to indicate that too little effort has been expended in showing the possibilities of productive lighting intensities to the executive officers of industrial companies. The importance of taking up such matters with an executive of the company is shown by the fact that in two-thirds of the plants visited the president, treasurer or general manager of the company authorized changes in the lighting system, and the purchase and installation of new lighting equipment. This lack of attention to the executive officers of industrial corporations may account for the fact that the largest percentage in table No. 7 is for plants which have not made any changes in their lighting installations for more than five years.

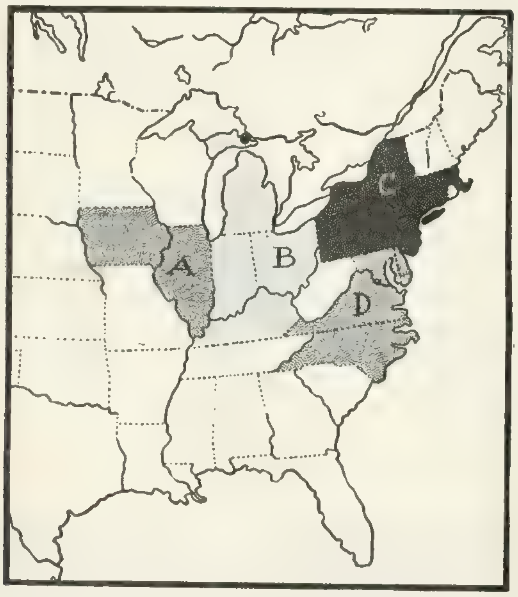


FIG. 2—TERRITORY COVERED BY THE INDUSTRIAL LIGHTING SURVEY

Reference to table No. 6 shows that only 11½ per cent of the manufacturers were dissatisfied or anxious to improve their lighting conditions, while over 30 per cent had either poor, partly poor or very poor illumination. About 85 per cent of the companies called upon were

TABLE I—MEN WHO AUTHORIZE PURCHASE INSTALLATION AND CHANGES OF LIGHTING EQUIPMENT

	Per Cent
President	22.3
Treasurer	8.5
General manager	36.4
Purchasing agent	20.4
Superintendent	10.7
Others	1.7

TABLE II—WEIGHT GIVEN BY INDUSTRIAL PLANTS TO ADVANTAGES OF GOOD INDUSTRIAL LIGHTING

	Per Cent
Increased production	8
Decreased spoilage	7
Prevention of accidents	6
Improvement of discipline	5
Improvement of hygienic conditions	4

TABLE III—WHERE INDUSTRIAL PLANTS SEEK ADVICE ABOUT LIGHTING CHANGES

	Per Cent
From electrical retailer	24.7
From electrical jobber	20.7
From consulting engineer or architect	13.2
From central station	9.2
From own electrician	7.1
From own engineer or architect	5.9
From own superintendent	1.6
From lamp manufacturer	6.1
From other manufacturers' engineer	0.5
From no one	1.9
From other sources or doubtful	9.1

TABLE IV—ATTITUDE OF INDUSTRIAL PLANTS TOWARD THEIR PRESENT LIGHTING

	Per Cent
Well satisfied	34.4
Fairly well satisfied	50.6
Disinterested	1.5
Doubtful	2.2
Dissatisfied	3.3
Anxious to improve	8.0

TABLE V—OBSERVED LIGHTING CONDITIONS COMPARED WITH I. E. S. CODE

	Offices Per Cent	Factories Per Cent
Excellent	19	.7
Good	36	32.1
Only fair	31	29.1
Poor	13	18.8
Very poor	1	3.5
Partly good and partly poor		7.8

TABLE VI—WHY NO CHANGE WAS MADE IN 30 PER CENT OF THE PLANTS IN PAST FIVE YEARS

	Per Cent
Satisfied	70.8
Best lighting not required	7.9
Slow getting started	6.7
Intended to move	4.5
Never thought of it	3.4
Miscellaneous	6.7

TABLE VII—TIME OF LAST LIGHTING CHANGE 39 PER CENT OF WHICH WERE PLANNED BY LOCAL DEALERS

	Per Cent.
Within one year	14.6
One year ago	13.4
Two years ago	20.2
Three years ago	10.6
Four years ago	11.1
Five years ago	5.9
More than five years ago	24.2

more or less satisfied with their existing lighting conditions, although only about 40 per cent of the plants visited were adequately illuminated.

It was found that 69 per cent of the plants purchased their light and power service, and that 37 per cent produced all or part of their own light and power requirements. This shows that 6 per cent of the plants produced some service and purchased part of their requirements. In spite of the fact that central stations supply service to over two-thirds of the plants investigated, the utilities are anything but a potent factor in the development of industrial lighting, as will be shown by referring to table No. 3. Only 9.2 per cent of the manufacturers seek lighting advice from the utility, while 45.2 per cent go to jobbers and retailers. There were many empty sockets in fifty plants, a few in 136 plants and no empty sockets in 103 plants. Central station service was used by 62 per cent of the plants which had many empty sockets, 71 per cent of those with a few empty sockets and 70 per cent of those with none.

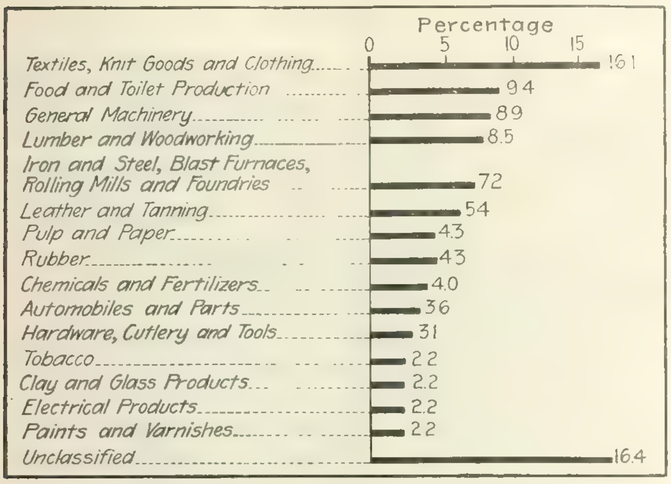


FIG. 3—DISTRIBUTION OF INTERVIEWS OF KIND OF BUSINESS

Of interest to manufacturers is the report that only about 60 per cent of the men interviewed knew anything about the gas-filled incandescent lamp, and only 15 per cent had heard of the "daylight" lamp. The vacuum-tungsten lamp was known to nearly 90 per cent of the men called upon.

Dividing the plants on a basis of the extent to which reflectors were used, one-sixth used reflectors throughout, and a slightly larger percentage used none at all. About one-third used reflectors extensively, and almost the same number used them to some extent.

Water-Power Development Appropriations in Norway

United States Consul General Marion Letcher writes from Christiania that the Norwegian budget for 1918-1919 contained an item of 22,250,000 crowns ($5,963,000) to be expended by the government in the development of water power, in addition to 1,000,000 crowns ($268,000) appropriated under special acts for the improvements of the Norefaldene. Of the above amount 15,125,000 crowns ($4,053,500) was expended in the acquisition of the Glomfjord waterfall. The corresponding appropriation in the budget for the present fiscal year is considerably larger, totaling 29,972,000 crowns ($8,032,496).

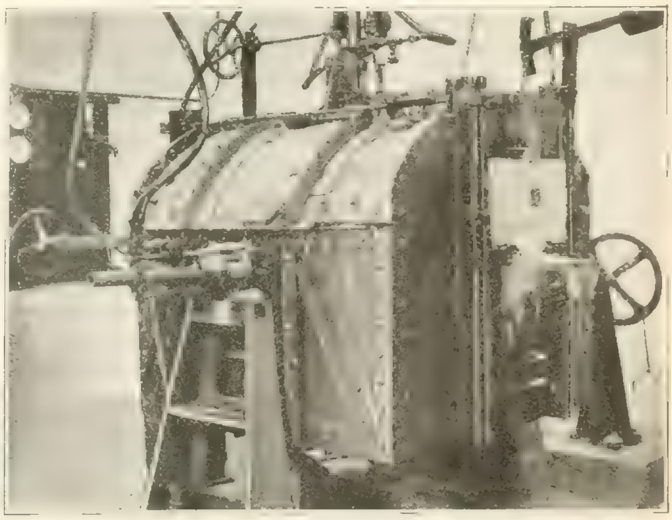
Electric Furnace for Experimental Use

Hand-Fed Carbon-Arc Furnace Utilizes Scrap Otherwise Non-Usable, Producing Steel with 2.8 per Cent of Carbon

THERE is considerable demand for special grades of cast iron—for instance, iron which is resistant to acids—and the necessity of experimentation to produce these results is so constant that the Pacific Foundry Company of San Francisco has found it expedient to install an electric furnace for this purpose alone. Cupola furnaces have hitherto been depended upon, but it was found that the two-phase Rennerfelt furnace of 750-lb. (340 kg.) capacity, which has been installed, is capable of using bits of iron scrap which could not be utilized in the other furnaces.

Even with the bits of waste, iron nails, borings and the like which are used as a base, it has been found that an iron of very desirable qualities is produced. The electric furnace burns out some of the carbon, resulting in a lesser quantity in the cast. A typical iron has about 2.8 per cent carbon and varying amounts of other elements.

The furnace is provided with three electrodes, the top one of the three-wire two-phase system of power supply, while the two side electrodes are connected to outside wires. A hand wheel is provided at the side, by which the electrodes are fed in at need. Electrodes are made in sections, so threaded that the new section may be screwed onto the old—a significant item in the economy of carbon. A large hand wheel controls the dumping, which pours through a gate at the end, and water connections keep the jacket cool. Power is used at 11,000 volts from the Pacific Gas & Electric Company's system.



CARBON ELECTRODES ARE FED INTO FURNACE BY MEANS OF HAND WHEELS

The electric furnace has hitherto been used largely for steel, but recent experiments performed at Columbia University on iron castings made in the electric furnace, confirm the satisfactory results here indicated. The strength of these castings was found to range from 40,730 lb. to 45,030 lb. per square inch, (2,850 to 3,152 kg.), a result considerably higher than records achieved with ordinary cast iron.

Fuse Protection for Branch Conductors

A Less Troublesome and Less Expensive Yet Safe Method of Installing Branch Line Fuses in Large Industrial Plants Is Recommended—Curves for Short Time Rating of Conductors Are Worked Out

By HENRY C. HORTSMANN and VICTOR H. TOUSLEY

THE common method of installing mains and branch conductors for electric light and power in such places as steel mills, foundries and large machine shops is to run conductors of heavy capacity near the ceiling, where they are as far as possible out of the way of mechanical injury. These wires are often run open, and some insulation other than rubber is often used. The majority of such installations are subject to more heat than rubber insulation is supposed to stand very long. From these mains, installed in a more or less inaccessible place, taps for individual motors or groups of lamps and motors are brought down in conduit, either along the side wall or along some column within the building.

In order to bring this method of construction within the rules of the National Electrical Code it is necessary either to drop down with conductors of the same current-carrying capacity as that possessed by the mains or to install fuses where the size of wire is reduced. To drop down with such heavy wires to supply only a small motor, is very troublesome and also is expensive. To install a set of fuses high up above the floor at the junction is also troublesome and is in addition conducive to much loss of time in case the fuse blows. In the vast majority of cases where such fuses have been installed they are so large as to be entirely useless. In places where hot metal is handled it is customary to place heavy penalties in the way of demerits on those responsible for delay in the proper operation of machinery. For this reason alone, if for no other, the man responsible will often make sure that a fuse in an awkward location—above all, one which he considers absolutely unnecessary—will not blow under any circumstances. He thereby succeeds in dodging the question of fuse protection for the conductor but still lives in dread of loose contacts or screws in the fuses or terminals, or in "jumpers" he has perhaps installed.

From the point of view of the operating engineer in charge of such places, permission to connect taps of considerably smaller capacity than the main and without fuse protection until the translating device is reached is a great boon, and it is the purpose of this article to show how far this may perhaps be granted.

Fig. 1 is a diagrammatic sketch of the manner in which branch conductors are usually installed. The taps leave the mains and enter the conduit through porcelain protection which gives assurance that no trouble will occur at this place, or at least none that would not exist as well if the fuses were installed there. The wires are then led down in conduit to a metal cabinet within easy reach of the floor. At the present time this cabinet often takes the form of one of the well-known safety switches, which make it impossible to gain access to the switch or any live parts inside without first disconnecting the whole line. In all modern shops of the type referred to, automatic remote control is usually provided so that this switch is used as a rule only in an emergency. Even in cases where it is disconnected every evening it is seldom called upon to break any current, and therefore it may be expected to last a very long time and to cause a minimum of trouble.

It can be seen from the sketch that there is little chance of trouble occurring on the tap line as far as it is in the pipe, and that practically the only chance of trouble is found at the lugs which connect the conductors to the switch terminals. Here there is a possibility of short circuits being made, either through the loosening of screws or by workmen changing a switch while the line is alive. It must be borne in mind that a fuse is always installed in connection with the safety switch and that this fuse is ample protection against any overload due to the motor on the branch wires, so that the only condition that really needs to be guarded against is a short circuit. The chance that a ground of such a nature as to put a limited overload on the circuit ahead of the motor fuses may come on and thus overload the lines, say 200 or 300 per cent, is too small to be seriously considered.

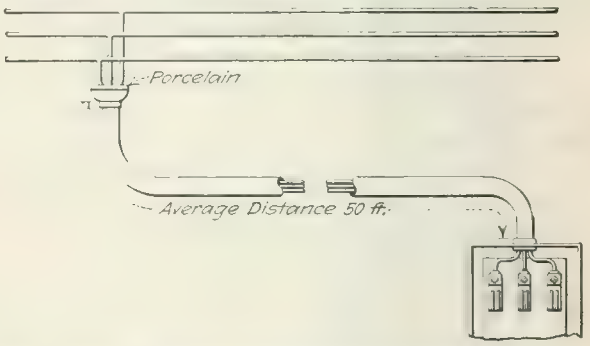


FIG. 1—USUAL METHOD OF INSTALLING BRANCH CIRCUITS

CONSIDERATIONS IN OMITTING FUSES

In order to make it safe to connect a small wire as a branch conductor to a larger one without providing fuse protection at the point where the change in size is made, two points must always be considered—first, the small wire must be able to stand the heating due to a short circuit which will draw enough current to blow the fuse or to operate the circuit breaker in the larger conductor; second, the total resistance of the line must also be low enough to allow the current to rise to this value in case a short circuit is made. The chief danger lies in the possibility that the current following a short circuit may not be strong enough to open the main circuit at once. Thus a long line or a long branch of small wire is at a disadvantage in this respect. This fact has been taken into consideration in Table II, and no branch circuits have been considered unless the current that would result from a short circuit made at the terminals of the small wire would exceed the normal current of the larger circuit by about 500 per cent. In this case, however, the calculations were based on a line voltage of 220 and a run of mains 1000 ft. (304 m.) long [2000 ft. (609 m.) of wire], while the taps were assumed to be 100 ft. (30 m.) long [200 ft. (61 m.) of wire]. This represents probably the hardest conditions that will be encountered.

SHORT TIME RATING OF CONDUCTORS

In Table I are given the current values which the various conductors listed there can carry for five seconds, ten seconds, fifteen seconds and thirty seconds.

TABLE I—CARRYING CAPACITY OF WIRES FOR VARIOUS LENGTHS OF TIME

Wire, B. & S. Gage	Time in Seconds				
	5	10	15	30	i
14	220	155	125	90	45
12	270	192	155	112	60
10	410	285	235	168	75
8	560	400	330	235	105
6	775	540	440	318	150
4	1130	800	660	520	210
3	1510	1060	875	615	240
2	1630	1140	945	670	270
1	1940	1370	1125	795	300
0	2580	1820	1485	1050	375
00	3015	2120	1740	1230	450
000	3780	2675	2175	1540	525
0,000	4250	3030	2450	1750	675
300,000	6350	4535	3435	2600	825
400,000	6930	4950	4000	2840	975
500,000	9240	6600	5350	3800	1200

These carrying capacities were estimated in the following manner: A curve depicting the temperature rise due to a heavy overload appears practically as a straight line assuming the temperature does not approach the steady or final value; temperature being plotted vertically and time horizontally as at the left in Fig. 2.

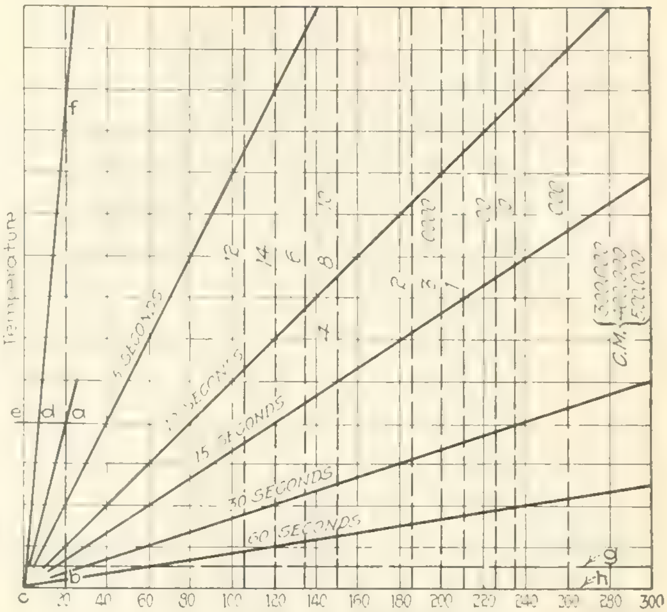


FIG 2—TEMPERATURE-TIME CURVES

For the determination of currents a conductor of given size will carry for short periods with a temperature rise of 40 deg. C.

The rise in temperature is, furthermore, approximately proportional to the square of the current used, and where heavy overloads are considered it is also almost independent of the surrounding conditions; *i. e.*, it matters very little whether the conductors be incased in conduit or run open. It follows from these considerations that if *c a* be a "curve" of temperature rise due to some current *i* it is possible to find the curve corresponding to any greater current *I* by laying out a length *b f* proportional to I^2 along line *b a* and then drawing the line to *c f*. Since the time necessary for *i* to cause the temperature rise from *c* to *e* is that represented by the line *e a* ?, it follows that the line *e d* will indicate the length of time required by *I* to cause the temperature rise *c e*. It is possible to use the same construction also to find the current that would cause a certain temperature rise in any given time by first laying out the time along *e a* and drawing a line from *c* through this point until it intersects *a b*. The current in question, *I*, will then be equal to the square root of the term T/t multiplied by *i*, where *T* stands for the length of the projected line as *b f*; *t* for the length of the line *c e*, and *i* for the current required to cause the temperature rise represented by *c e*.

TABLE II—SIZES OF WIRE FOR BRANCH CIRCUITS THAT MAY BE CONNECTED TO LARGER MAINS WITHOUT FUSE PROTECTION

Small wires will stand 400 per cent overload of large wire for time given at top of column and not exceed a temperature of 40 deg. C.
Data are for rubber covered branch wires in conduit.

Size of Main	Mains of Rubber Insulation					Mains of Other Insulation				
	Amperes	5 Sec.	10 Sec.	15 Sec.	30 Sec.	Amperes	5 Sec.	10 Sec.	15 Sec.	30 Sec.
2,000,000	1050	0000	300,000	500,000	....	1670	400,000	600,000	.	.
1,750,000	950	0000	300,000	400,000	......	1520	300,000	500,000	..	.
1,500,000	850	000	300,000	400,000	500,000	1360	300,000	500,000	.....	...
1,250,000	750	000	300,000	300,000	500,000	1185	300,000	400,000	500,000	....
1,000,000	650	00	0000	300,000	400,000	1000	0000	300,000	500,000	.....
750,000	525	0	000	0000	300,000	800	000	300,000	400,000	500,000
500,000	400	1	00	000	0000	600	00	0000	300,000	400,000
400,000	325	2	0	00	000	500	0	000	0000	300,000
300,000	275	3	1	0	00	400	1	00	000	0000
0000	225	4	2	1	0	325	2	0	00	000
000	175	4	3	2	1	275	2	1	0	00
00	150	6	4	3	2	.		.		.
0	125	6	4	4	3	.				.
1	100	6	6	4	4					.
2	90	6	6	6	4					.
3	80	6	6	6	4					
4	70	6	6	6	6					.
6	50	6	6	6	6					..

Now, in order to apply this method of determining the carrying capacity of conductors for heavy overloads of short duration to all conductors, the diagram may be reconstructed in more convenient form, as shown at the right side of Fig. 2. In this illustration the distance between the lines *g* and *h* represents a temperature rise of 40 deg. C. The time along the bottom is plotted in seconds and the diagonal ascending lines are drawn for five seconds, ten seconds, fifteen seconds and thirty seconds in accordance with the principles explained before. The various vertical lines represent conductor sizes, the gage number of each being given on the diagram. The distance from the point *c* along *c h,* is in each case proportional to the time which is required, according to tests, to reach a temperature of 40 C. deg. above the surrounding air in the corresponding conductor. The currents used in the various conductors to reach this temperature are given in Table I, (in column under *i*) as are also the results obtained by the calculations outlined above. Thus it takes 120 seconds for 45 amp. to raise No. 14 wire 40 deg. C. The formula is based on the assumption that the temperature rise is correctly represented by a straight line. This is not true. It is well known that any curve representing the values obtained in tests is in itself an interpolation of data, and that no one point on the curve can be taken as absolutely correct. This is especially noteworthy with curves representing very rapid rises in temperature. Therefore, in order to safeguard against all possible errors of this kind the time plotted along the bottom in seconds is taken as just half of that actually found in tests for the rise from 0 deg. to 40 deg. C. This, it is believed, will make the results given quite safe to apply in practice.

AN EXAMPLE OF POSSIBLE SAVING

As an illustration of the saving that may be effected by the use of the smaller wire in place of the larger the following actual case may be considered. In a certain large manufacturing plant there are four runs of 500,000-circ. mil. cables of two wires each operating at 220 volts direct current. The insulation is weatherproof and, according to the National Electrical Code, the cables have a carrying capacity of 600 amp. each. The nature of the business at this plant is such that a demand factor of 50 per cent is permissible according to the rules of the power company so that the connected load may be equal to 1200 amp. This is equivalent to 320 hp., and that load therefore could be connected to the mains through eight runs of No. 00 cable, each good for 40 hp.

Rubber-covered wire in conduit is used for the branch circuits. The circuit breaker in this case might allow the current to rise to more than 3000 amp. before operating and still protect the No. 00 wire. It is customary in installations of this kind to set the circuit breakers so that they will not operate very often. If one should open twice in one month, it would probably be set for a greater current strength.

Each run of branch circuits in this installation is about 100 ft. (30 m.) in length, and the cost of installing two conductors of 500,000-circ. mil. capacity in 3-in. (7.5-cm.) conduit is given as $250 each, while the No. 00 cables may be placed in 2-in. (5-cm.) conduit at a cost of only $115. Thus it is possible to effect a saving of $135 per branch, or $1,080 on each set of mains, or $4,320 on the whole installation. Moreover, the fuses would be more conveniently located and the installation can be reasonably safe.

Operation of the Meter Department in Scattered Territory*

Each Division Responsible for Testing, Installing and Maintaining Meters, but Central Standardization Laboratory Is Maintained

WHERE the area served by a central station is large and where the consumers are widely scattered, the meter department cannot be operated efficiently from a single location. For this reason several well-defined divisions must be established, each with its meter department to be responsible for testing, installing and maintaining the meters within its division boundaries. These meter departments should operate as a single unit, however, to avoid duplication of expensive equipment and men with specialized training, to obviate keeping stocks of large-sized meters, instruments and repair parts at a minimum, to give all division departments the services of a meter laboratory with an operating force adequate for their needs, and to standardize methods, equipment and policy.

To carry out this method a supervisor should be appointed and a standardization laboratory created. The supervisor should have complete supervision over all meter work. The standardization laboratory should be independent of any division department operated directly under the meter supervisor and should include standardizing facilities, a repair and construction department and a stock department for meters and instruments. The standardizing laboratory should be equipped with all primary, secondary and precision standards, with auxiliary apparatus necessary to perform its duties efficiently. The repair and construction department should be equipped with a complete outfit of precision tools, coil-winding machines, coil-baking ovens and other equipment necessary for making, repairing and tuning-up instruments and meter parts or coils. The stock department must carry an adequate stock of repair parts of all kinds.

Power-house and substation meters and instruments, meters of all customers having over 750 kw. load and all indicating instruments in customers' substations should be tested and maintained by a tester and assistant reporting to the standardization laboratory. This is necessary on account of the special instruments and equipment required.

The division departments should obtain instruments and transformers from the laboratory for their immediate needs by means of requisitions, but the stock department must be prepared to make immediate shipment upon receipt of these requisitions. Emergency requirements can be suitably met by accepting telephone orders. This method not only insures the division departments against issuing inaccurate or otherwise unsuitable instruments and transformers but enables the entire system to be served from a much smaller stock.

Requirements for meter locations, methods of testing, periods of tests of meters in service, methods of investigating complaints, training and instructing new men, forms of meter record and other standards necessary in meter work, system of filing, etc., should all be standardized by means of general instruction orders issued by the meter supervisor.

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*Excerpts from paper presented by E. H. Tyson of the Lehigh Valley Light & Power Company, Allentown, Pa., before the twelfth annual convention ofthe Pennsylvania Electric Association.

The division departments, each operating under its meter superintendent or foreman, conduct periodic tests according to a standard schedule and standardized methods and make repairs on meters and instruments which can be accomplished by ordinary meter testers or demand maintainers without special equipment or training in repair work.

The division meter rooms should be located in the largest cities and towns with locations as central as possible to division territory and with best transportation facilities to surrounding towns.

Where meters are situated a considerable distance from the division meter rooms district meter rooms must be established in order to reduce transportation costs and the possibility of injuring testing meters in transit. In other districts, where there is not enough work to require the continuous services of either a tester or an installer, one man should be trained to do both classes of work and also to maintain the few recording demand instruments in the district. District meter rooms must be provided with test boards for testing meters according to standard methods and should maintain an adequate stock of new low-capacity meters and such repair parts as may be required to replace parts which are worn during the course of ordinary test.

Meters scattered along the distribution lines outside of any district should be tested periodically by meter men using automobiles and who can report at the beginning of each work day to the division meter room.

Readers' Views and Comments

Method for Determining Customer's Average Power Factor

To the Editor of the ELECTRICAL WORLD:

SIR: Lack of reliable data is no doubt in a measure responsible for the deficiency of cost figures relating to high percentages of reactive kva. in consumers' installations; that is, with respect to tabulations obtainable of conditions as they exist in cases of average and extremely low power factor.

A means is suggested by a well-known fact in connection with metering polyphase loads that seems to offer a method quite inexpensive for determining the consumer's average power factor. When two single-phase watt-hour meters are used on a three-wire, three-phase system the readings of the two meters must be added algebraically in order to arrive at the total kilowatt-hours registered. In a case of power factor as low as 50 per cent, meter *A* would not register, while meter *B* would register the entire amount, and at less than 50 per cent, meter *A* would rotate backward and would have to be deducted from meter *B*. This at once suggests that the ratio of the readings of the two meters would be an index of the average power factor prevailing during the period of registration, and the use of a relatively simple calculation would readily give the result desired.

It is true that this method would not give the hour of the day that high reactive factors prevailed, but it is argued that diversity would be found eventually to take care of this matter. Moreover, in the case of relatively large consumers, individual surveys would be justifiable such as are the practice in the case of maximum demand determinations if it is desired to arrive at effects produced on the central station at any particular time of day. This method also is applicable to three-wire, three-phase systems only; but it is believed that the great majority of cases are of this type.

B. H. FREELAND,

Attica, Ind.

Supporting Educational Institutions

To the Editor of the ELECTRICAL WORLD:

SIR: I have read with interest the leading editorial in the Jan. 10 issue and feel that you have done a great service in calling attention to the service situation confronting our educational institutions because of lack of financial support.

The effects of the insufficient salaries of our college instruction staffs should be cause for serious alarm to the industries of the country. An insidious process of deterioration is taking place in our university faculties. Able teachers are leaving for more remunerative work outside, and able and ambitious men are not attracted by the rewards promised by the profession. At some period not so far in the future we shall find ourselves a nation whose universities do not rank better than third rate.

The universities put on the market a human product that is essential to industry—essential not only in positions of leadership but in an infinite number of positions of responsibility. Though it may be argued that many self-trained men have reached the top of the engineering profession, still it must be admitted that their number would soon fall short of the requirements of the age. More efficient methods of producing engineers are imperative.

The colleges endeavor to train men to think correctly, to work logically, to use as the basis for their work fundamental truths, to apply these in proper sequence, to make intelligent assumptions for supplementing exact data, to leave nothing untried in the effort to reach the correct solution, to be unprejudiced, critical, accurate. That the universities fail to do this in many instances is undeniable, but that this is their ideal is also undeniable.

Men of such training will solve the problems brought about by competition, intensive production, the ever-increasing needs of the human race. They will apply their training to produce greater efficiency and greater economy in present methods and to devise new processes that must come to further our civilization. They will grasp the new problems and will solve them.

The engineer is a necessity of modern life. His method of thought leads the way to progress. We must equip him with the inspiration of the best teachers. Can we afford to intrust our engineering apprentices to inferior workmen and equip them with inferior tools? It is the part of the industries of this country and of their leaders to see to it that something be done immediately to make the teaching profession in our universities desirable to the present incumbents and attractive to our ablest young men.

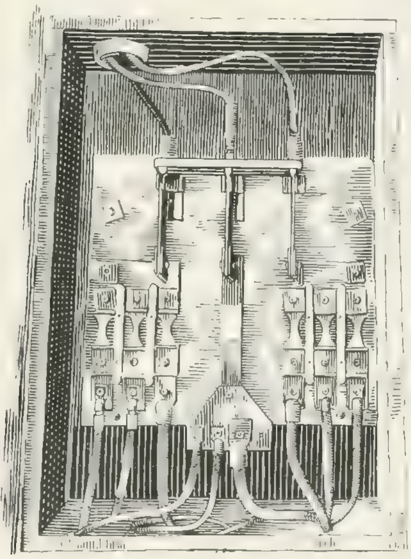
Detroit, Mich. P. O. REYNEAU.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Special Switch for Several Sets of Service Mains

IN THE illustration below a special design of switch as far as the fuses are concerned is shown which has been developed by a Middle West company and so arranged that four sets of service mains may be connected to it. Such mains are run to busbars which are protected by fuses. In this way in case of trouble all customers depending on the service switch will not be inconvenienced, for the particular mains which are involved can, by means of the fuses, be disconnected and the trouble remedied.



SERVICE SWITCH WHICH PERMITS EASY LOCALIZATION

These switches, which are installed in galvanized-steel cabinets of No. 12 U. S. gage, act as the service switch for all customers connected on a particular set of a company's service cables. They are made in three sizes, 100 amp., 200 amp. and 400 amp.

Stippled Globes Improve Incandescent Street Lights

THE use of stippled or rippled outer globes with dome refractor lends sparkle to the pendent incandescent street lighting units at Niagara Falls. In describing this application in a paper read before the Illuminating Engineering Society's thirteenth annual convention A. D. Cameron and C. A. Halvorson pointed out many other advantages of the combination.

Compared with the bowl refractor, the stipple globe and dome refractor combination gives about 15 per cent more lumens and has only one surface exposed to dust and smoke instead of three. Its distribution curve shows that the combination gives 200 per cent more light directly under the light, 100 per cent more light at an angle of 45 deg. and only 15 per cent less light at an angle of 10 deg. The stippled globe alone was said to give an efficiency of 15 per cent to 30 per cent higher than the ordinary diffusing globe and to permit the use of a dome reflector for street lighting which will give three times the light at points midway between lamps.

Dispatching Method for Operating Boiler Plant

WHEN the quantity of steam needed varies greatly from time to time, the rate of production cannot be changed quickly enough in a plant with numerous large boilers to insure an adequate supply at highest boiler efficiency. Furthermore, steam required for any load curve can be produced by various combinations of boilers at different ratings, and the selection of the best combination is important.

To enable advantageous operation of boilers on a load which is subject to wide differences in daily requirements for energy, a plan has been developed for the Ashley Street plant of Union Electric Light and Power Company, of St. Louis, which is as follows:

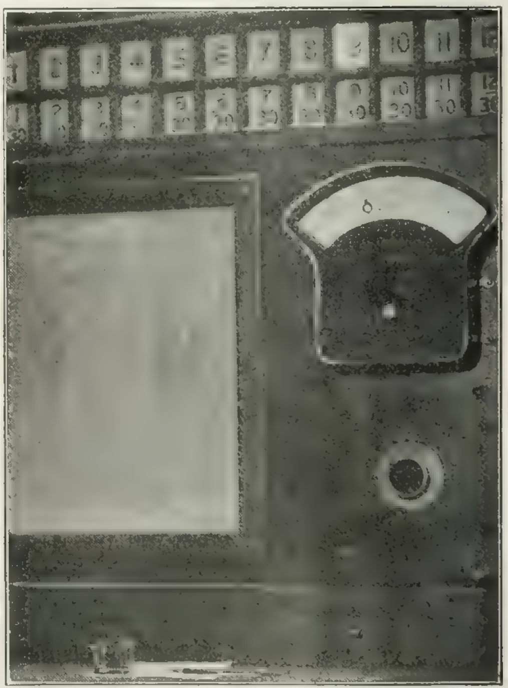


FIG 1—BOILER ROOM DISPATCHING BOARD AT OPERATOR'S CONTROL DESK

The number of "kilbers" shown on the "kilberscope" here and on the one in the boiler room is regulated by the handwheel under the instrument. The illuminated figure near the top of the board gives the time when the "kilbers" will be required. The framed tabulations to the left give the number of "kilbers" required for any load with different turbo-generator combinations.

The need was felt for a unit which was common to both prime movers and boilers and the name "kilber" was devised to stand for 1000 lbs. of steam per hour (450 kg. per hr.). It is a combination of "kilo"—one thousand, and "lb."—pounds, with the euphonic abbreviation "er" representing "per hour". Since the adoption of this name, the terms "kilowatts" and "boiler-horsepower-hours" are seldom heard in the boiler room. The steam flowmeters are now calibrated to read directly in "kilbers."

The system load dispatcher forcasts the load requirements and instructs the steam plant operator what load, in kilowatts, will be required from that plant one half hour later. The quantity of steam in "kilbers" which will be needed for that load with different combinations of turbo-generators is shown by a glance at the chart at the left in Fig. 1. The operator then orders from the boiler room the proper number of "kilbers" for delivery at a designated future time.

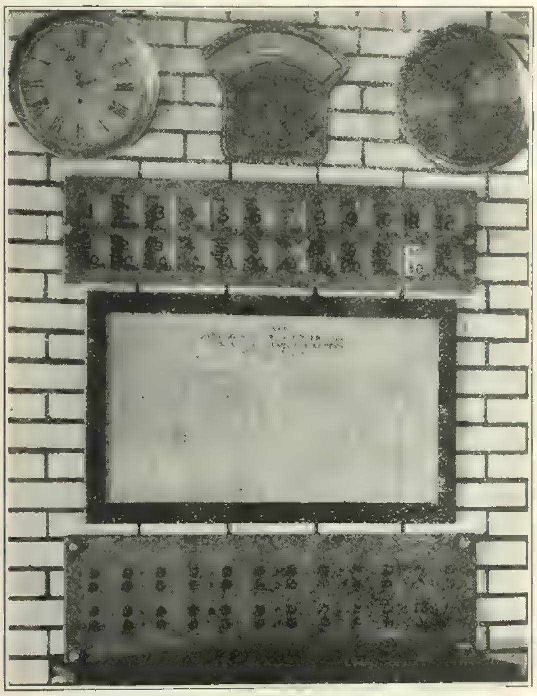


FIG. 2—SIGNALING BOARD IN BOILER ROOM

The "kilberscope" and time indicator are similar to those in Fig. 1. The chart here gives the output in "kilbers" from boilers in each of two groups when operated at different percentages of their rated capacity.

The apparatus for signalling orders and acknowledgments between the switchboard gallery and the boiler room is simple and effective. A circuit, containing a rheostat, runs from the operators control desk to the boiler room and connects two illuminated dial voltmeters graduated in "kilbers." These "kilberscopes," as they are called, are mounted near time indicators which have 24 separately illuminated compartments numbered to correspond with the hours and half-hours.

The operator's control desk, the rheostat wheel below the kilberscope, and the time indicator above this instrument are shown in Fig. 1. When this photograph was taken 340 kilbers had been ordered for nine-o'clock. Having set the "kilberscopes" at the desired reading, the operator closes a circuit which illuminates a compartment of the distant time indicator and actuates a claxon alarm in the boiler room. The alarm continues to sound until the boiler room attendant closes a circuit which illuminates a corresponding compartment for the time indicator at the control desk, thus acknowledging the order. The apparatus shown in Fig. 2 is installed in the boiler room. The illustration shows that 265 kilbers will be required at 11.30. The chart shown in the illustration gives the "kilber" output of the boilers in each group when operating at different percentages of their rated capacity.

This system eliminates the use of an unnecessary number of boilers under bank or operating at reduced capacity. It reduces the probability of misunderstanding between boiler room and turbine operators, and is a convenient means of placing the load dispatcher in more effective control of results. The economies produced have been important and have stimulated the plant employees to greater efforts to add to their bonus earnings by effecting further economies with the use of this new tool.

Automatic Ship Hoist Conveys Coal to Bunkers

COAL for the plant of the United Light & Railways Company, Davenport, Iowa, is brought into drop-bottom cars which empty into two track hoppers 14 ft. (4 m.) wide by 28 ft. (8 m.) long. A motor-driven apron conveyor with a capacity of 70 tons per hour delivers the coal either to the crusher or direct to cross-conveyor belts, which in turn discharge to another belt, carrying the coal to a 2-ton skip hoist at the end of the boiler house. The hoist is a standard passenger elevator type driven by a 35-hp., two-phase, 400-volt motor. It is so arranged that its control can be either automatic or manual. The skip car travels from the loading position to the dump position, a vertical distanct of about 108 ft. (33 m.) with full load at a speed of 225 ft. (69 m.) per minute, and with an ultimate capacity of 80 tons per hour.

In the loading position the skip bucket rests on a compression spring adjustable for different loads. When the spring compresses to the desired point a contact is made actuating a relay which closes the cut-off valve controlling the coal feed from the hopper supplying the bucket. On closing, the valve actuates the starting relay for the hoist. The bucket is elevated to the dumping position, empties and returns to its original position, automatically opening the hopper valve to refill the bucket with coal. It repeats the same cycle as long as the coal-handling operator desires automatic operation.

Some of the Practices of a Transmission Company

ON ITS system, which has 100,000 kva. back of it at a distance of 15 miles (24 km.) from the generaing station, the West Penn Power Company of Pittsburgh, Pa., has found that the horn gap is adequate to break the current on the line when transformers are short-circuited. Branch lines are not fused. It has been found that the use of core-type transformers is an advantage in case of trouble because they enable voltage to be applied to the line so that the defective apparatus can be traced through the burning which will result.

On certain circuit-breaker-protected transformers there was a failure which could not be located without applying almost full voltage to the transformers. The transformer was simply out of oil, and the experience proved rather costly.

In addition, it is difficult to obtain the lesser voltage at points where transmission voltage is available. With

the fuse, however, the coil which is in trouble is easily found and the replacement made in the field. In wet weather when repairs are made in the field a tarpaulin in the form of a circular tent with readily removable sides which snap into place is thrown around chain blocks used for lifting the core and main parts of transformers. This covering protects the transformer and the men that work on it. Field-repair work can be done on core-type transformers only, the shell type being too intricate. A. W. CARTWRIGHT,
Superintendent of Construction.
West Penn Power Company,
Pittsburgh, Pa.

Cable-Pulling Device Made from a Ford Car

BY SIMPLY attaching a pulling winch to a Ford car and connecting it to the driving shaft of the engine the Buffalo General Electric Company has obtained a dependable and speedy cable-pulling apparatus. The trouble sometimes experienced with apparatus which uses a one-cylinder or two-cylinder gas engine for motive power and the limitations of storage batteries when electric motors are used have been obviated. To pull the large cables which are in service in Buffalo only 4 hp. to 7 hp. is needed. Thus ample power is provided, because the Ford engine develops 12 hp. when operating at 1,000 r.p.m.

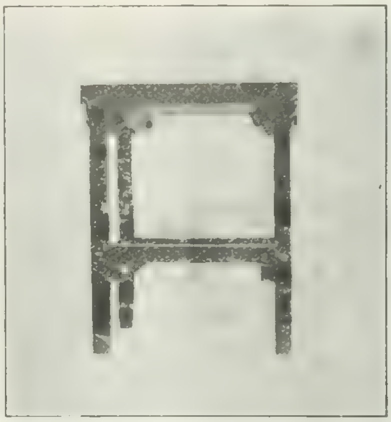
The cable-pulling winch is connected to the driving shaft of the motor by means of a 2-in. (5-cm.) Morse chain. When the engine is operating at 1,000 r.p.m. the cable will be pulled at 60 ft. (18 m.) per minute. Of course the speed control of the car is fully utilized for cable pulling. The winch and pulling rope weigh about 700 lb. (300 kg.). By placing blocks under the frame as shown in the illustration the wheels or chassis are not subjected to undue strain. The blocks of this motor have been in a Ford car which has traveled over 100,000 miles (150,000 km.). In fact, everything entering into this apparatus with the exception of the winch and rope was taken from the scrap pile. The cost of the pulling device complete was only $300.

FORD CAR UTILIZED TO PULL UNDERGROUND CABLE

Already this apparatus has pulled about 50,000 ft. (150,000 m.) of cable. A section has been pulled in twelve minutes which previously took ten men on a hand winch four hours. WILLIAM HEMPHILL,
Assistant Superintendent of Distribution.
Buffalo General Electric Company,
Buffalo, N. Y.

Light-Weight Wooden Insulating Stand

PORTABLE insulating stands fill a variety of needs in a substation or power house. Such stands are frequently made by supporting a small platform on inverted insulators, but they are extremely heavy. A good stand should first of all possess the necessary insulating qualities. The next requisite is mechanical strength, and the third is to secure the first two without the sacrifice of easy portability. The stand should not be so heavy that one will be tempted to "take a chance" in preference to using the stand.



WOODEN INSULATING STAND WEIGHS ONLY 15½ LB.

A stand that meets these requirements is shown in the accompanying illustration. It is made of wood that has been thoroughly dried. The legs and braces are of maple to which four coats of shellac have been applied, and the top is of white pine painted black. The stand is 19½ in. (50 cm.) high, the top is 15½ in. (38 cm.) square, and the legs form a base 14¾ in. (36 cm.) square. The stand weighs 15½ lb. (6.8 kg.) and has a flashover value of 210,000 volts when dry.

Prior to building this stand one was made by cementing a porcelain insulator on a casting that formed four supporting legs. Compared with this the wooden stand now being used has a 50 per cent higher flashover value, will stand more hard usage, weighs half as much and is cheaper to construct. HARRY RESTOFSKI.
Connellsville, Pa.

Hints on Operating Power-Plant Switches

AN OPERATOR of a power plant should understand the switches and bus arrangement so that if any switch fails to operate he will know what to do. Knowledge of any past switch failure will prove helpful. The location of fuses in the control circuits should be known as well as the operation of the switch by hand. If the tripping element of a switch is out of order and if the switch must be left in service, some special operating procedure must be followed to isolate the trouble. The opening of bus selector, tie or transformer switches will be found convenient in some stations, while in others the generator switches would have to be opened unless a man were stationed near the switch to open it manually or by means of small rope. If the closing element of an alternating current generator switch is out of order although it can be closed by hand, temporary synchronizing lamps will permit synchronizing the generator. The lights should be near the switch.
Iron Mountain, Mich. I. W. WYSS.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Easy Method of Testing for Induction Motor Shorts

IN the Oct. 11, 1919, issue of the ELECTRICAL WORLD there appeared a description of a device used to locate short-circuited coils of an induction motor. Some time ago the writer had an occasion to test a large number of small induction motors and made use of a similar device, although slightly different in some respects. It was constructed similar to the one described, excepting that the "U" was flattened enough to span about six or eight slots, and the ends of the laminations were rounded, so that it could be used for different-size stators. In this instance it was used on motor sizes from ½ hp. to 20 hp. with good results.

If a thin piece of steel, such as a knife blade or a hack-saw blade, is placed on the stator slots with the "growler," energized, the steel will stick across a slot in which there is a shorted coil. With a little practice it is an easy matter to determine whether only one turn is shorted, as might be caused by the insulation being damaged where two wires cross in the slot, or whether the entire coil is short-circuited. In this way the faulty coil can be definitely located, as the steel will stick on both slots through which the coil passes. Thus it is not necessary to induce enough current in the coil to heat it, nor is any time wasted in waiting for it to heat. L. C. BEATY.

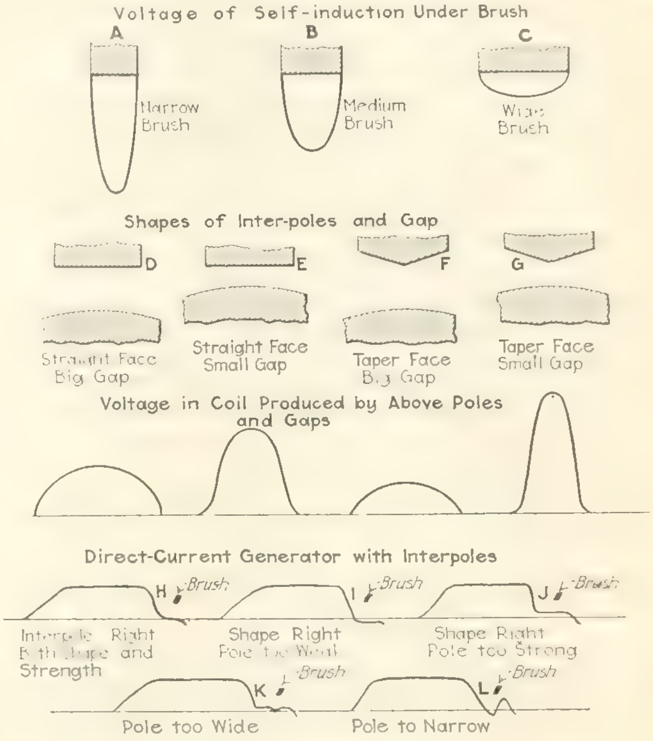
Pittsfield, Mass.

The Correct Shape and Strength of Interpoles

ALTHOUGH the selection of the correct strength and shape of interpoles should be made in the factory, it is not always possible to make complete tests under load, so that observation and adjustment may be necessary in the field. The main requirement for good operation is that the coil at the moment that its commutator bars leave the brush should be generating current in the direction opposite to that in which the current flowed just before the commutator bars reached the brush. Otherwise there would be a spark due to self-inductive kick at the instant the brush ceases to short-circuit the coil.

The voltage of self-induction under the brush is shown in *A*, *B* and *C* of the illustration. The interpole can be designed to overcome this voltage by making its strength a little greater than is necessary to overcome the armature reaction alone. A machine with narrow brushes needs a different interpole strength to counteract the self-induction than that which is needed by a machine with thick brushes. By shaping the interpole space and gap to suit conditions, satisfactory operation can be obtained. Interpole voltage waves can be actually observed unmixed with main voltage waves by operating the machine short-circuited. A few of the representative forms of interpole and gap voltage produced are shown at *D*, *E*, *F* and *G*.

If the machine has a self-induction effect like *A*, it needs an interpole like *G* to overcome it properly, and it is impossible to obtain good results with an interpole like *D* or *F* because they are not suitable. On the other hand, if a machine with wide brushes and self-induction curve, as *C*, has a straight-face interpole with big gap like *D* but a trifle stronger than needed to exactly counteract the self-induction, a result as shown at *H* will be obtained, which is correct. If the interpole is too weak, the curve is obtained like that in *I*. If too strong, it will be like *J*. Further, if a wide interpole *D* is used with self-induction curve like *B*, a voltage curve similar to *K* is obtained. However, if an interpole like *G* is used with a self-induction like *D*, then a voltage curve will be obtained like *L*.


Voltage of Self-induction Under Brush
A
B
C
Narrow Brush
Medium Brush
Wide Brush
Shapes of Inter-poles and Gap
D
E
F
G
Straight Face Big Gap
Straight Face Small Gap
Taper Face Big Gap
Taper Face Small Gap
Voltage in Coil Produced by Above Poles and Gaps
Direct-Current Generator with Interpoles
H
Brush
I
Brush
J
Brush
Interpole Right Both Shape and Strength
Shape Right Pole too Weak
Shape Right Pole too Strong
K
Brush
L
Brush
Pole too Wide
Pole to Narrow

EFFECT OF SHAPE AND STRENGTH OF BRUSH ON OPERATION

In general, bumps and reversals in voltage near the brush show the interpole to be of the wrong shape.

Crocker Wheeler Company, JAMES DIXON.
Ampere, N. J.

Jewelers' Furnace Found Satisfactory

FOR the heat treatment of steel and fusing enamel at 1600 deg. F. (870 deg. C.) a small electric furnace installed in the factory of Bastian Brothers Company, Rochester, N. Y., has proved highly satisfactory. This company manufactures small jewelry and nameplates, a work which requires accurate temperature regulation. The furnace is compact and self-contained, the desired operating temperature being maintained by adjusting a rheostat and watching a pyrometer. No auxiliary apparatus is required for control. The only permanent connections necessary are those which supply the energy to the furnace.

The furnace, which is of Hoskins manufacture, has a heating surface 12 in. wide by 8 in. high by 19 in. deep (30 cm. by 20 cm. by 48 cm.) and is well insulated by 2½ in. (6.3 cm.) of bonded "kieselguhr" covered with several inches of bonded asbestos and magnesia. It is supported on an iron stand 40 in. (1 m.) from the floor. The door, which is of the sliding type, counterbalanced, can be arranged so that it will stay set at any desired point. This counterbalance weight can be adjusted so that the door, when desired, can be closed automatically. The radiation loss of heat often caused by poorly insulated front heads of furnaces is reduced to a minimum by properly covering the door with asbestos. A shelf 6 in. (15 cm.) wide placed at the front head has been found to be of convenience in handling the finished work.

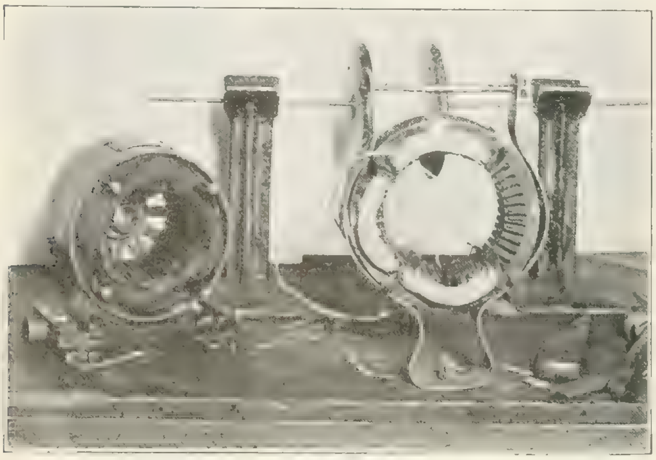
The heating element, an alloy of nickel and chromium, consists of three windings of nickel and chromium alloy in parallel with a total rating of 10 kw. at 230 volts. These windings are controlled by individual knife switches. Two of these are controlled from the side of the furnace. The third knife switch, also on the side of the furnace, acts as a shunt on the rheostat, which is in series with one of the three windings. The tubes or muffles of these windings are made of alundum, a refractory substance.

The bonded "kieselguhr," the bonded asbestos and magnesia insulation make it possible for this furnace to maintain a constant temperature of 1600 deg. Fahr. (870 deg. C.) at approximately 6 kw. imput. The furnace temperature as indicated by a Taylor pyrometer is controlled manually. On account of the small amount of heat radiated from the furnace the operator's discomforts are reduced to a minimum.

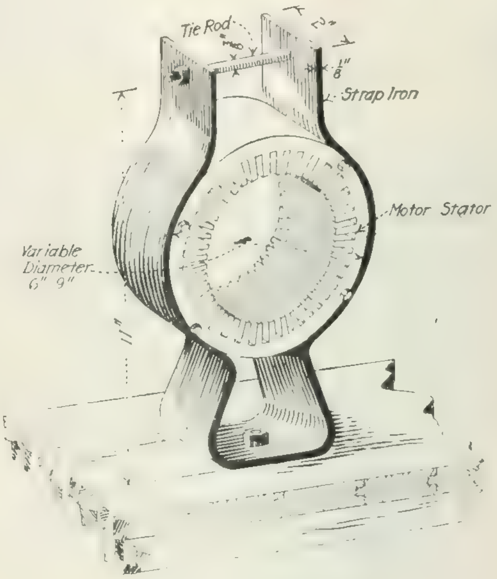
Rochester Railway & Light Co., FRANK C. TAYLOR.
Rochester, N. Y.

Convenient Stator Holder for Motor-Winding Shop

TO FACILITATE holding motor stators during rewinding at the shop of the American Electric Service & Maintenance Company, Springfield, Mass., a flexible metallic holder which consists of a piece of strap iron is used. The strap iron is about 28 in. (70 cm.) long, bent into the shape of a U-clamp, with the upper ends held in place by an adjustable rod and bolts. The lower end is bolted to the bench and the whole outfit forms a springy receptacle which can be adjusted to a wide variety of motor frames ranging in diameter from 6 in. to 9 in. (15 cm. to 25 cm.). The strap iron of which the holder is made is 2 in. wide and ⅛ in. thick (5 cm. by 3 mm.); the tie rod at the top is ⅜ in. (10 mm.) in diameter, and a ⅜-in. bolt fastens it to the bench. It stands about 11 in. (28 cm.) high.



STATOR IS HELD IN FRAME WHILE COILS ARE PUT IN PLACE



DETAILS OF STATOR HOLDER

Service Is Sectionalized at Stairway Landings

AT THE Hendee Manufacturing Company's plant in Springfield, Mass., the power service of various departments and floors is conveniently sectionalized by automatic oil circuit breakers installed in the stairway landings. A main cut-out box is also provided beside the breaker so that the control of power service is centralized. A group of departments can be isolated from the rest electrically and on account of the location of the circuit breakers can be restored to service with minimum loss of time. When repairs are necessary such an arrangement is of great convenience because it enables production to be resumed within a few seconds of the time when all is in readiness for the floor output.

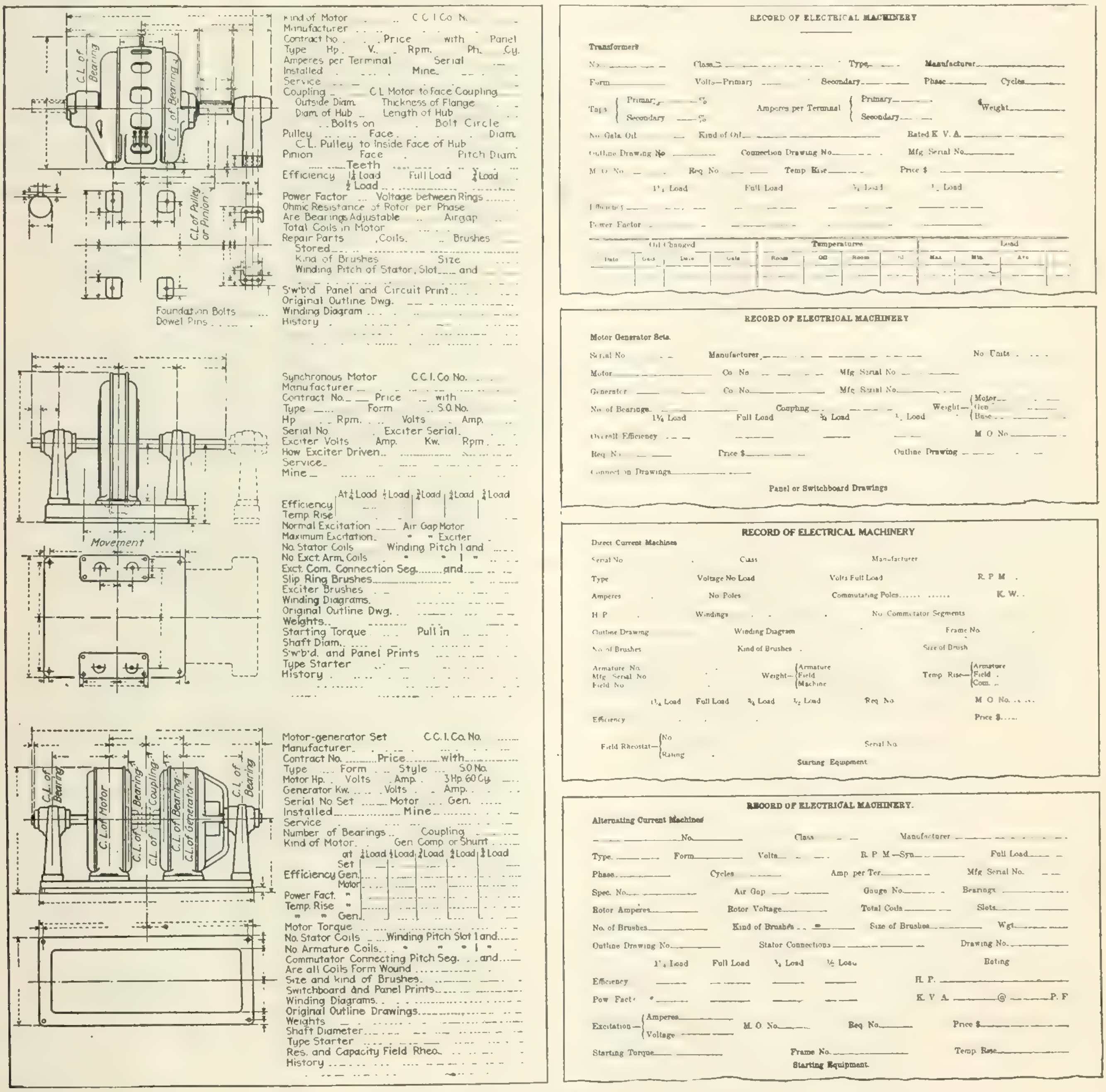
Necessity for Reading Watt-Hour Meter Daily

THE necessity for reading the watt-hour meter daily was brought forcibly to the attention of an industrial plant in the Middle West recently when the energy bill for one month greatly exceeded previous ones. An investigation showed that a 150-kw., 440/660-volt, three-phase, 60-cycle motor-generator set had been operating as a single-phase machine. The motor of this set is of squirrel-cage type, and it is started by means of a standard compensator, there also being an oil switch and an ammeter in the incoming circuit. The ammeter has a total scale of zero to 800 amp. A watt-hour meter registers the energy used and is a basis of the monthly bill by the electric service company.

This set operates under light load most of the time, and it is required to stop and start frequently. A study of the situation showed that when this motor had been started at one time a fuse had been blown, but it passed unnoticed. When starting, the fuses are shunted so that the motor first operates on three-phase energy, but later when the short circuit is open it operates on single-phase.

As the load carried by this set was very light after starting, it was kept running at single-phase and did not overheat. But nevertheless more energy was being taken to operate this motor single-phase than would have been taken to operate it three-phase, which accounts for the increased bill.

The ammeter scale being very high, the zero to 200 first division did not allow an indication of the excess current on the ammeter. From this experience it was decided that meters should be read, if not once in twenty-four hours, then at least once a week in order to check any irregularities in the system.


C.L. of Bearing
C.L. of Bearing
C.L. of Pulley or Pinion
Foundation Bolts
Dowel Pins
Movement
C.L. of Bearing
C.L. of Motor
C.L. of Coupling
C.L. of Bearing
C.L. of Generator
C.L. of Bearing

Kind of Motor C C I Co No.
Manufacturer
Contract No. Price with Panel
Type Hp. V. Rpm. Ph. Cy.
Amperes per Terminal Serial
Installed Mine
Service
Coupling C L Motor to Face Coupling
Outside Diam. Thickness of Flange
Diam. of Hub Length of Hub
Bolts on Bolt Circle
Pulley Face Diam.
C. L. Pulley to Inside Face of Hub
Pinion Face Pitch Diam.
Teeth
Efficiency 1¼ Load Full Load ¾ Load
½ Load
Power Factor Voltage between Rings
Ohmic Resistance of Rotor per Phase
Are Bearings Adjustable Airgap
Total Coils in Motor
Repair Parts, Coils. Brushes
Stored
Kind of Brushes Size
Winding Pitch of Stator, Slot and
S'w'b'd Panel and Circuit Print
Original Outline Dwg.
Winding Diagram
History

Synchronous Motor C.C.I. Co No.
Manufacturer
Contract No. Price with
Type Form S.O. No.
Hp Rpm. Volts Amp.
Serial No Exciter Serial.
Exciter Volts Amp. Kw. Rpm.
How Exciter Driven
Service
Mine

	At ¼ Load	½ Load	¾ Load	4/4 Load	5/4 Load
Efficiency					
Temp. Rise					

Normal Excitation Air Gap Motor
Maximum Excitation " " Exciter
No. Stator Coils Winding Pitch 1 and
No. Exct. Arm. Coils " " 1 "
Exct. Com. Connection Seg. and
Slip Ring Brushes
Exciter Brushes
Winding Diagrams.
Original Outline Dwg.
Weights
Starting Torque Pull in
Shaft Diam.
S'w'b'd. and Panel Prints
Type Starter
History

Motor-generator Set C.C.I. Co. No.
Manufacturer
Contract No. Price with
Type Form Style S.O. No.
Motor Hp. Volts Amp. 3 Hp. 60 Cy.
Generator Kw. Volts Amp.
Serial No Set Motor Gen.
Installed Mine
Service
Number of Bearings Coupling
Kind of Motor. Gen Comp. or Shunt

	at	¼ Load	½ Load	¾ Load	4/4 Load	5/4 Load
Efficiency	Set					
	Gen.					
	Motor					
Power Fact.	"					
Temp. Rise	"					
" "	Gen.					

Motor Torque
No. Stator Coils Winding Pitch Slot 1 and
No. Armature Coils " " " 1 "
Commutator Connecting Pitch Seg. and
Are all Coils Form Wound
Size and kind of Brushes.
Switchboard and Panel Prints
Winding Diagrams.
Original Outline Drawings.
Weights
Shaft Diameter
Type Starter
Res. and Capacity Field Rheo.
History

RECORD OF ELECTRICAL MACHINERY

Transformers

No. Class Type Manufacturer
Form Volts—Primary Secondary Phase Cycles
Taps { Primary % / Secondary % } Amperes per Terminal { Primary / Secondary } Weight
No. Gals. Oil Kind of Oil Rated K. V. A.
Outline Drawing No Connection Drawing No. Mfg. Serial No.
M. O. No. Req. No. Temp. Rise Price $
1¼ Load Full Load ¾ Load ½ Load
Efficiency
Power Factor

Oil Changed				Temperatures				Load		
Date	Gals	Date	Gals	Room	Oil	Room	Oil	Max.	Min.	Ave.

RECORD OF ELECTRICAL MACHINERY

Motor Generator Sets.

Serial No Manufacturer No. Units
Motor Co. No. Mfg. Serial No.
Generator Co. No. Mfg. Serial No.
No. of Bearings Coupling Weight— { Motor / Gen. / Base }
1¼ Load Full Load ¾ Load ½ Load
Overall Efficiency M. O. No.
Req. No. Price $ Outline Drawing
Connection Drawings
Panel or Switchboard Drawings

RECORD OF ELECTRICAL MACHINERY

Direct Current Machines

Serial No Class Manufacturer
Type Voltage No Load Volts Full Load R. P. M.
Amperes No. Poles Commutating Poles K. W.
H. P. Windings No. Commutator Segments
Outline Drawing Winding Diagram Frame No.
No. of Brushes Kind of Brushes Size of Brush
Armature No. / Mfg. Serial No. / Field No. Weight— { Armature / Field / Machine } Temp. Rise— { Armature / Field / Com. }
1¼ Load Full Load ¾ Load ½ Load Req. No. M. O. No.
Efficiency Price $
Field Rheostat— { No / Rating } Serial No.
Starting Equipment

RECORD OF ELECTRICAL MACHINERY.

Alternating Current Machines

No. Class Manufacturer
Type Form Volts R. P. M.—Syn. Full Load
Phase Cycles Amp. per Ter. Mfg. Serial No.
Spec. No. Air Gap Gauge No. Bearings
Rotor Amperes Rotor Voltage Total Coils Slots
No. of Brushes Kind of Brushes Size of Brushes Wgt.
Outline Drawing No. Stator Connections Drawing No.
1¼ Load Full Load ¾ Load ½ Load Rating
Efficiency H. P.
Pow. Fact. K. V. A. @ P. F.
Excitation— { Amperes / Voltage } M. O. No. Req. No. Price $
Starting Torque Frame No. Temp. Rise
Starting Equipment.

SAMPLE RECORDS OF ELECTRICAL APPARATUS

Records That Facilitate Replacements and Repairs

PARTIAL records of electrical machinery have proved so useless when information is needed that many iron and copper mining companies of the upper Michigan peninsula are now making their office records of electrical apparatus complete, irrespective of the amount of paper that may be required to do it. Separate forms are made up for direct-current, induction and synchronous machinery, motor-generator sets, and for transformers. Sample of the records are shown in the illustration on this page.

These records may seem too extensive, but it should be remembered that they are compiled only once (when the apparatus is bought). Furthermore, it takes only a short time per machine then, and when the work of compiling them is well done the records have proved invaluable many times during the life of the apparatus they cover.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Motor-Driven Refrigerators Give Detroit No Trouble

INQUIRY into the motor-driven refrigerator situation at Detroit, Mich., showed that there is no complete record of the refrigerating machines installed in Detroit homes. One company manufacturing these machines stated that it had about 350 of them in operation in the city. The number of installations made by other companies is not known. All these refrigerating machines are equipped with 0.5-hp. to 0.25-hp. motors. So far there is no case on record where any change in distribution or in meter equipment could be charged up to the installation of one of these refrigerating machines. In other words, no installation has resulted in complaints of poor service from the customer who operates the machine or from any other customers nearby.

More specifically the performance of ninety machines was followed up, and in these ninety cases there was no need of change of equipment to handle the load created. In no case had the customer any complaint to make of the quality of service received, and in no case, after careful inspection of conditions in the distribution system, were these found unsatisfactory or in need of any change to bring the system up to standard. Special meters were installed on a few machines. The highest reading for any whole working month was approximately 150 kw.-hr. However it may be possible that these machines were not operating during the warmest period of last summer.

The increase of revenue caused by the refrigerating load has not yet been noticed in the general income figures on account of the small number of machines installed, but it is quite evident that an increased revenue should be felt as a greater number of machines are installed. So far, naturally, only those customers living in the best classes of residences have been induced to purchase the refrigerating machines, so that in all cases they are operating on a 4-cent rate because the customer is a large user of energy.

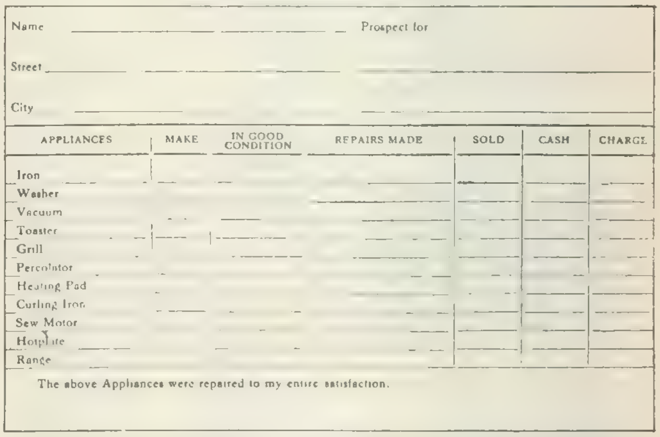
It is naturally interesting to speculate on the effect of a great number of refrigerating machines on a distribution system, and some investigation along this line has been undertaken by the central-station organization at Detroit. The first thing considered was that such a load is a summer load. This means that as far as the distribution system is concerned additional capacity is always available at that time. The distribution system in that period is usually going through a transition from being equipped for the preceding winter's peak load to a larger amount of equipment to handle the coming winter's peak load. However, with no increase over the equipment required to handle the preceding winter's peak load, in practically all cases, unless new buildings are going up very rapidly, there will be sufficient additional capacity to handle a refrigerating load and no special provision should have to be made. It seems, therefore, that as far as the distribution system is concerned the refrigerating load is ideal as it will require very little or no increase in equipment for its handling.

There is a possibility of some machines operating during the winter where ice boxes have no access to the outside air or where ice is wanted for use in drinking water. This should occur only in a small percentage of the total installations. Regarding the system as a whole, it is probable that some of the refrigerating load will superimpose itself on the peak load during the summer months and that this effect will be quite noticeable, although the load factor of the system should be somewhat improved. Interest is soon expected to develop in determining the diversity factor on these refrigerating machines.

Appliance Inspection Gets Business and Good Will

IN THE summer of 1919 the Houghton County Electric Light Company, Houghton, Mich., conducted what it called a service and convenience campaign which paid for itself and put many defective appliances back on the lines. The objects of the campaign were outlined as follows:

1. To repair and return to the lines all defective appliances.
2. To introduce and encourage the use of convenience outlets, current taps, feed-through cord switches, etc.
3. To compile a customers' appliance connected load report showing the number of the different makes and styles of appliances in use.



Name

Prospect for

Street

City

APPLIANCES	MAKE	IN GOOD CONDITION	REPAIRS MADE	SOLD	CASH	CHARGE
Iron						
Washer						
Vacuum						
Toaster						
Grill						
Percolator						
Heating Pad						
Curling Iron						
Sew Motor						
Hotplate						
Range						

The above Appliances were repaired to my entire satisfaction.

ONE OF THE CARDS USED ON SERVICE AND CONVENIENCE CAMPAIGN

The information was then summarized each day for a week and then placed on cards.

4. To take the opportunity to sell and acquaint customers with the merits of electric appliances in general.
5. To show that the company desired to give the best possible service with a minimum of inconvenience to customers.

Before making the campaign general the plan was tried out in a representative section of one of the towns supplied by the company. Boys were first trained for the work, but they did not prove so reliable or satisfactory as girls. One girl called on 618 customers and inspected 778 appliances in the forty-eight days of the trial period. One hundred and sixty-five customers, or 26.6 per cent of the total, had appliances which were not being used on account of burned-out heating elements, damaged plugs, defective cords, etc. A saturation chart was compiled from the inspector's cards showing the percentage of customers who had each of the different appliances. These figures were as follows:

	Per Cent		Per Cent
Irons	88	Heating pads	0.6
Washing Machines	10	Curling irons	1
Toasters	18	Sewing-machine motors	0.3
Vacuum cleaners	9	Hot plates	0.1
Grills	3	Electric range	
Percolators	4		

The added energy consumption of the appliances which were put back into service was said to be well worth the cost of the campaign, but the records show that the net profits from the sale of appliances by the inspectors was more than enough to pay the entire cost to the company. This was based on results from a typical section of Houghton, Mich., but since the company has extended the campaign to all its properties equally advantageous results have been obtained.

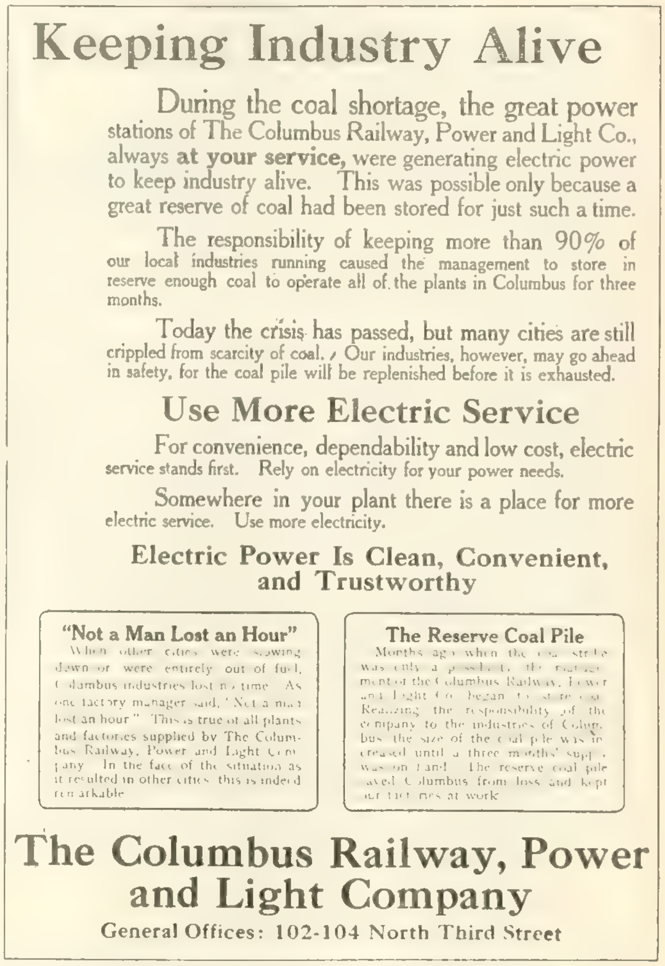
Each inspector carried a fiber case about 12 in. long, 18 in. wide and 6 in. deep (30 mm. by 45 mm. by 15 mm.). This case contained the tools required to make repairs to appliances, a supply of heating elements, terminal plugs, separable attachment plugs, several lengths of cord, tape, thread, terminal post screws, nuts, bolts, a current tap, two-way and three-way cluster plugs, a three-way switch and a duplex baseboard outlet. The cases were refilled every morning and at noon.

The inspector offered to notify contractors if there was defective any wiring to be repaired or new work to be done. A record of each call was made on one of the cards shown in the illustration and a weekly summary was made on the other. Any complaints of excessive bills, errors in bills or requests for meter tests were written on the reverse side of the customer's report card before it was turned in to the office at night. Such complaints were followed up by the proper department, but in case of anything requiring immediate attention the inspector telephoned the complaint to the head office and it was handled as a trouble call. Advertisements in the local papers notified customers when the inspectors would be in their district. The whole plan was conceived and carried out under the direction of R. A. Gordon, sales manager of the Houghton (Mich.) County company.

Monthly Message to Customers

To maintain friendly relations with its customers and at the same time to push the use of electrical appliances, the Cambridge (Mass.) Electric Light Company publishes each month a little fourteen-page magazine called "The Electric Maid," designed to interest women in labor-saving conveniences for the home. Anecdotes and sketches fill part of the book. However, the two middle pages of a recent issue feature the following "spread:" "Introducing six little servants for your home (their acquaintance is inevitable), the Misses Clothes Washer, Clothes Ironer, Dish Washer, Sewing Machine, Vacuum Cleaner, Electric Range. They come to you overburdened with recommendations for consecutive years of faithful and efficient service. A dollar a week, for the six, satisfies their every need."

Keeping Up the Power Supply in Columbus, Ohio



Keeping Industry Alive

During the coal shortage, the great power stations of The Columbus Railway, Power and Light Co., always **at your service,** were generating electric power to keep industry alive. This was possible only because a great reserve of coal had been stored for just such a time.

The responsibility of keeping more than 90% of our local industries running caused the management to store in reserve enough coal to operate all of the plants in Columbus for three months.

Today the crisis has passed, but many cities are still crippled from scarcity of coal. Our industries, however, may go ahead in safety, for the coal pile will be replenished before it is exhausted.

Use More Electric Service

For convenience, dependability and low cost, electric service stands first. Rely on electricity for your power needs.

Somewhere in your plant there is a place for more electric service. Use more electricity.

Electric Power Is Clean, Convenient, and Trustworthy

"Not a Man Lost an Hour"

When other cities were slowing down or were entirely out of fuel, Columbus industries lost no time. As one factory manager said, "Not a man lost an hour." This is true of all plants and factories supplied by The Columbus Railway, Power and Light Company. In the face of the situation as it resulted in other cities this is indeed remarkable.

The Reserve Coal Pile

Months ago when the coal strike was only a possibility, the management of the Columbus Railway, Power and Light Co. began to store coal. Realizing the responsibility of the company to the industries of Columbus, the size of the coal pile was increased until a three months' supply was on hand. The reserve coal pile saved Columbus from loss and kept our factories at work.

The Columbus Railway, Power and Light Company

General Offices: 102-104 North Third Street

The record of the Columbus (Ohio) Railway, Power & Light Company during the recent coal strike was so favorable that after the crisis was over it advertised its success in maintaining power supply.

Utility Establishes Free Market for Its Stock

TO PROTECT its stockholders from those not in accord with the company's policy of selling its stock direct to customers instead of through bond houses, the Union Electric Light & Power Company has established a permanent securities department through which any shareholder's stock may be offered for resale without charge. It is the purpose of the company to maintain an open market in which shareholders may be reasonably sure of being able to get the full market value for their holdings at any time. With this end in view the company has eliminated the slight amount which had heretofore been charged for reselling stock.

The St. Louis company is obtaining from its customers a substantial portion of the money required to finance its very rapidly growing business. A block of $2,000,000 of 7 per cent preferred stock was sold at par during 1917, and another $1,000,000 block of the same stock is now being disposed of. The company reserves the right to redeem the stock at $105 per share at any time.

The stock issue is advertised in the daily press, but the actual sales are made over the counter at the company's offices and by the company's sales force, which includes three outside security salesmen. The price per share is $100 cash or $102 on a deferred payment plan under which the purchaser pays $10.20 with the order and the same amount with the nine succeeding bills for electric service. The installment payments draw 5 per cent interest, and they may be withdrawn with interest at any time before the final payment is made.

The first $2,000,000 was sold to about 2,600 of the company's 110,000 customers, and forty-five days after the third $1,000,000 was offered for sale 835 customers had taken $350,000. The offers to resell stock without charge to allow installments to be withdrawn inspire confidence in prospective buyers, but they are rarely accepted.

The shares brought in for resale have been disposed of at par without the loss of a cent to the investor, whereas brokers resold the stock at less than par and they charged commission besides. Some brokers also make a practice of taking the utility's securities at par in exchange for other securities which cost them about 80 or 85. The brokers could then sell the Union company's securities taken in exchange at 95 and still make 10 or 15 points on the deal. In spite of this competition the Union company has been able to sell its stock at a cost of about 2½ points.

Analysis of Engineering Employed in Power Sales

Handy and Sufficiently Accurate Method of Estimating Load Factor and Energy Consumption of Small Factories

By A. G. Drury

THE proposition which the central station has to offer to a prospective power consumer who is generating his own electricity from a steam or gas engine can be put into one of three classes.

First, where the central station has the overwhelming advantage. This is instanced where the power company operates a hydro-electric plant and it is only a matter of inducing the consumer to use the central station's energy instead of a competitor's, if one exists, or where, as often happens at the present time, a manufacturer needs additional power in a hurry. There seems to be a general impression among manufacturers that if a wire is running past a plant (even though it be an arc circuit) all the electric company has to do to give the manufacturer service is to run the wire into the plant. This the manufacturer thinks the electric company would do as a matter of course if it were only half so progressive in its business as he is in his.

Now, pole lines cannot be built in a day nor existing lines reinforced in an afternoon, and this has to be explained, sometimes to very skeptical listeners. In either case it is a matter of pure salesmanship and no engineering work is required of a solicitor—which is, of course, the ideal condition.

The other extreme is where the central station is going after a rather large installation and the question of cost runs pretty close. Then a considerable amount of engineering is done—complete engine tests, weighing the coal burned, laying out proposed motor drives, finally ending up by curves of voltage regulation showing the the plant—usually operated on direct current—is responsive to voltage fluctuations, and how, when this voltage drops, every machine in the factory slows up.

The third case is that of the smaller isolated plant, say of 25 hp. to 50 hp. Here the solicitor is morally sure his proposition is the better. It would not pay, nor would it even be wise, to go into extensive research on such a plant. The manufacturer is usually afraid of the cost, and it is up to the salesman to give an estimate in which he as well as the customer can have some confidence.

The following plan has been used by the writer with satisfactory results both as to fair accuracy in estimating bills and in the psychological effect on the prospect. He has found that the data given in the "Electrical Salesman's Handbook" and the publications of the large electrical manufacturers on the amount of power required to run any individual machine are satisfactory if used intelligently. On the other hand, he has never been satisfied to use the published average load factors.

To assume, for instance, that the load factor of a certain woodworking shop is so many per cent simply because the plant is a woodworking establishment is nonsense. It is common knowledge that a plant may easily vary 60 per cent from the general average. However, the data published on the power required to operate the individual machine, used with a load factor based on observation of the particular plant in question, make a rational basis for estimating on the comparative cost of central-station and isolated-plant drive.

The plan pursued in obtaining data on the load factor was as follows:

Down the left vertical edge on the heavy horizontal lines of a piece of standard cross-section paper, twenty squares to the inch, are listed all the machines in the room of the factory. Along the bottom horizontal line is recorded the time of day, using one small square to record one minute. Seated in a convenient place in the shop, the observer begins to draw a horizontal line opposite the name of a machine and over the corresponding time when it was started up. While sitting there he continues to go over the list of machines from top to bottom, extending the lines if the machine is still running and stopping the line when the machine stopped.

If these data are taken for an hour at a time on each of three or four different days at different times, the investigator will have a pretty fair idea of what the plant is doing. The average of the percentage of the time that each individual machine is running while the investigator is present, multiplied by the working hours per month, gives a fair average of the hours that machine runs per month. This product, multiplied by the power required to drive the machine, as given in the tables, represents the number of kilowatt-hours it would consume in a month.

Take a simple example. Suppose the plant was visited four times for one hour each time. During that hour each day a planer drawing 10 hp. (by the handbook table) ran fifteen minutes, that is 25 per cent of the time; a jointer of 3 hp., thirty minutes, or 50 per cent of the time, a tenoner of 1 hp., ten minutes, or 16 per cent of the time. Now if the times were well selected, this can be assumed as an average operation.

	Hp.
Average power consumed by planer, 25 times 10 hp....	2.5
Average power consumed by joiner, 50 times 3 hp.....	1.6
Average power consumed by tenoner, 16 times 1 hp....	.16
Average total	4.16

Then 4.16 hp. times 240 working hours per month equals 998 hp.-hr., or nearly 750 kw.hr. per month.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Direct Method of Calculating Shunt-Field Coils Having Two Gages of Wire.—R. G. JAKEMAN.—In the design of shunt-field coils it often happens that the area of wire required is not included in standard wire tables, and then the two nearest standard gages above and below have to be used. It is necessary therefore to find out how much of each gage of wire has to be used to obtain the desired result. Experienced engineers can sometimes arrive at the correct results quickly by a trial method, but less experienced men often try four or five times, which makes the work tedious. In this article the author offers equations and curves for rapid solution of the problems.—London *Electrician*, Nov. 21, 1919.

Lamps and Lighting

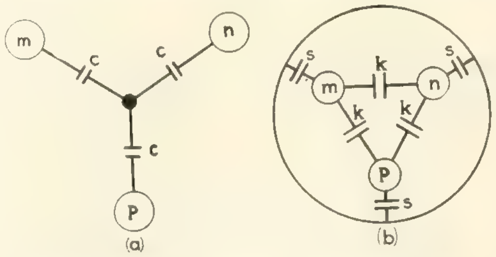
Automobile Headlighting Specifications.—In collaboration with the authorities in New York State the committee on automobile headlighting of the Illuminating Engineering Society has tentatively adopted for future use in connection with a model headlight law, a somewhat strengthened set of specifications for acceptability tests of headlights compared with those submitted within the last year or two. The gist of the new propositions is contained in the following set of test positions and candlepower limitations: (1) Some point between road level and a point on a level with the lamps in the axis of the car, 4,800 cp.; (2) in the axis of the car 60 in. (1.5 m.) above the roadway at 100 ft., 2,400 cp.; (3) 60 in. above the roadway, 7 ft. (2.1 m.) to the left of the axis of the car at 100 ft., 800 cp.; (4) at 100 ft. (30 m.) at some point between road level and a point on a level with the lamps and 7 ft. to the right of the axis of the car, 1,200 cp.—Convention Illuminating Engineering Society, Oct. 20, 1919.

Military Searchlamps of Large Caliber.—M. GROSJEAN.—Comparative descriptions are given of the various types of motor-regulated arc lamps and parabolic mirrors used for electric searchlamps in France during the war. The method of testing mirrors is described, and photographs are presented which show the results of tests on mirrors of glass and gold-plated metal, made by the Société Sautter-Harlé, the latter type being used almost exclusively during the later years of the war. Extensive numerical data regarding different kinds of carbons are given. In one of the recent lamps with 200 mm. ($7\frac{7}{8}$ in.) mirror diameter, built for 300 amp. and 90 volts, positive carbons of 3 cm. ($1\frac{3}{16}$ in.) diameter were employed, which had a strongly metallized core and were electrolytically copper-plated. The brilliancy obtained was from 250 cp. to 500 cp. per sq.mm., and the positive carbon was used up at the rate of 150 mm. (6 in.) an hour, the rate of combustion on the negative carbon, which was plated with copper and nickel, being about half as much. — *Revue Générale d'Electricité*, Oct. 4, 1919.

An Autogenerative Flash Lamp.—An electric flashlamp is described which does not contain any batteries but derives its current from a small six-pole permanent magnet generator, driven by ratchet and gears from a handle actuated by hand. A similar device is suggested for electric ignition of explosives.—*L'Industrie Electrique*, Oct. 10, 1919.

Generation, Transmission and Distribution

Capacity of Lead-Sheathed Three-Phase Cables.—R. BOUZON.—The author indicates a method by which the "star capacity" of a three-phase cable may be determined by a single measurement. Thence may be determined the capacitance current in the cable on open circuit. In the illustration (a) shows three conductors arranged at the corners of a triangle and (b) represents the case of a sheathed three-phase cable. This amounts to a system of three condensers k in delta, operating in parallel with three condensers s connected in star to the neutral (the lead sheath.) Measuring by ballistic galvanometer the capacity c' of m with regard to n, we have $c' = 3/2\ (k + s/3)$. Similarly, the capacity of m with regard to n and p connected together is $c'' = 2\ (k + s/3)$. This complex arrangement of condensers may be replaced by an equivalent star arrangement (a), in which $c = 2c' = 3/2c''$. In other words, the star-capacity c, permitting calculation of the capacitance current in a three-phase lead-sheathed cable, is twice the capacity measured between two conductors, the third being insulated, or 3/2 times the capacity measured between one conductor and the other two connected together. Knowing the equivalent star capacity c, the capacitance current $I = \omega c\ E/\sqrt{3} = \omega ce$, where e is the neutral voltage. Sometimes coefficients are used to determine c in terms of the capacity between one conductor and the two other connected to the lead sheath; this, however, involves two measurements to determine k and s separately. The author's method is the only one giving mathematically accurate results from a single measurement.—*Science Abstracts, Section B*, July 31, 1919. (Abstracted from *Rev. Gen. d'Elec.*, May 3, 1919.)



CAPACITANCE OF A THREE-CONDUCTOR CABLE

Automatic and Remote Control Generating Stations.—A. G. DARLING.—The author points to the successful automatic operations of substations and also two instances of attendantless operation of generating plants. It is suggested that many water-power developments which could not be economically operated on account of high labor costs may now be carried out and operated by remote control or automatic equipment. He discusses various means whereby the automatic generating station may be controlled, depending upon the conditions surrounding the installation and the object to be accomplished.—*General Electric Review,* November, 1919.

Fictitious Capacities in Polyphase Cables.—DELLA RICCIA.—The general Maxwell equations, giving charges in terms of the voltages and of the induction coefficients, lead to simple relations in the case of symmetrical polyphase cables. They permit the determination of these coefficients from the measured capacity of certain combinations, as, for instance, between one conductor and all the others. It has been shown that with balanced polyphased voltages impressed the charges on the conductors may be expressed in terms of fictitious capacities and the respective star voltages. The author extends this reasoning to cases where successive phases are not connected to successive conductors in the cable and gives expressions for the fictitious capacity in terms of the induction coefficients. This analysis permits a discussion of the effects of harmonics. If the specific inductivity of the dielectric depends on the voltage, the fictitious capacity cannot be treated as a constant, but will contain a periodic term of double supply frequency, and the charging current will contain a third harmonic. If the medium is dissipative, the periodic capacity term will appear displaced. Diagrams are given showing current distortion and power dissipation.—*Revue Générale d'Electricité,* Sept. 20, 1919.

Discontinuities in Overhead Transmissions.—Rushes of voltage are liable to occur when a surge of external or internal origin reaches a discontinuity in a transmission line. A discontinuity exists at points where the surge resistance of the line per unit length changes, for instance, where an overhead and underground line meet, the diameter of the conductor changes, the height of the conductor varies, or where conductors of different circuits that have been run along the same route branch off in different directions. Calculations are made of the variation of the surge resistance for changes in the quantities mentioned. The earthing of the lines is a matter of great difficulty in rocky regions, and in such places the height of the line above the earth must be measured, not to the rocky surface, but to the actual position of damp earth. In the Isonzo transmission line some of the numerous breakdowns were probably due to sudden changes of line characteristics at places where the earth dips down suddenly under large superimposed rock masses, thus producing a sudden change in the effective height of the line above the earth.—*Technical Review,* Oct. 14. (Abstracted from *Elektrotechnik und Maschinenbau,* June 29, 1919.)

Traction

Automatic Control for Boston Surface Cars.—A. D. WEBSTER.—This installation by the Boston Elevated Railway Company is notable in providing for the multiple-unit operation of city cars where private right-of-way is employed in the more congested district. The equipment complies with the recognized essentials of safety, convenience and speed. Besides the provision of efficient car appliances and a thoroughly worked-out scheme of auxiliaries operated from an independent low-voltage control source, the car is equipped with a fully protected automatic motor control.—*Electric Journal,* October, 1919.

The Safety Car.—N. H. CALLARD, JR.—The author points out the increasing use of safety or one-man cars and considers in particular safety features, operating costs and the car mileage obtainable with this type of electric railway car.—*Electric Journal,* October, 1919.

Overloads in Railway Motors.—F. W. MCCLOSKEY.—In addition to handling the normal traffic, railway motors are occasionally called upon to perform emergency service such as pulling in a "dead car." It is important that the motors be capable of performing such emergency service in order to prevent traffic tie-ups, even at the expense of damage to the motor itself, provided that the motor is not put out of service. The author points out that the work of "bucking" snow is particularly severe and advocates the use of snow plows equipped with heavy motors for this service.—*Electric Journal,* October, 1919.

The Electrification of the South African Railways.—A very comprehensive report of the desirability of electrification of certain sections of the South African railways has been prepared by Messrs. Merz and McLellan. They recommend that the working voltage be 3000, direct current, which would enable the substations to be spaced from 20 miles to 30 miles (32 km. to 48 km.) apart. The third-rail scheme was considered impracticable for South Africa, due to the danger of people straying on the track. The multiple unit system is recommended wherever this is possible on suburban lines. It is pointed out that this service would create the traffic if properly planned. An interesting suggestion for overcoming the possible shortage of water at any point is that of erecting small power stations containing one generating set at various points along the line and linking them by a high-tension transmission line, thus distributing the spare plant over the whole system.—London *Electrician,* Nov. 7, 1919.

Installations, Systems and Appliances

Improvements in Contactor Types of Industrial Controllers.—H. D. JAMES.—The writer considers means of suppressing quickly and definitely the arcs developed in contactor breaks which are apt to weld together the contacts. He states that the rolling contact is considered preferable at the present time. The correct design of magnetic blow-out is considered and also the proper insulation of the operating coil which has been improved by the use of better material and better processes.—*Electric Journal,* November, 1919.

High-Temperature Electric Resistance Furnace.—WALTER ROSENHAIN and E. A. COAD-PRYOR.—The underlying principle on which the construction of this furnace is based is the utilization not of the ohmic resistance of the graphite but of the resistance which exists wherever graphite surfaces are placed in contact. It is believed that the type of furnace, although still relying upon carbon or graphite for the material of the resistor, overcomes all the disadvantages encountered when graphite resistance is used, except that it does not entirely eliminate the necessity of keeping the resistor in a neutral atmosphere. The latter difficulty can, however, be overcome to a sufficient extent for many purposes.—*Transactions Faraday Society,* July, 1919.

A Current-Limiting Regulator for Alternating-Current Circuits.—The question of protecting a circuit against excessive overload, without at the same time making the device employed so delicate in operation that it is always coming to action, is an important one in connection with industrial loads. One solution of the problem is suggested in a current-limiting regulator. This has been arranged in the form of a transformer. The primary can be wound for any voltage, the secondary being wound to give the required working volts. Current can be taken from the secondary up to any predetermined amount within the capacity of the winding, and when this predetermined amount is reached the current remains constant and the volts decrease gradually to zero at short circuit. The device may be designed as a choke coil and in this form is connected in series with the work. In this position, when operating normally, it does not introduce any appreciable choke or resistance into the circuit, but after the current reaches a predetermined value the leakage flux increases and keeps the current constant at that value until the load becomes a complete short circuit.—London *Electrician*, Nov. 7, 1919.

The Future of the Electrical Equipment of Small Reversing Mills.—L. ROTHERA.—The writer points out the fact that higher speeds of rolling may be obtained by the use of motor drive and that, with an increasing necessity for large outputs and a reduction in operating costs, the future would see a wide extension of the electrical reversing drive for small mills. Extensive tables give the electrically driven rolling mills equipped by British firms and considerable detail regarding the type of mill, the motor and the drive adopted.—London *Electrician*, Sept. 26, 1919.

Electrophysics and Magnetism

Photoelectric Spectrophotometry by the Null Method.—K. S. GIBSON.—Reliable determinations of spectral transmission throughout the green, blue and violet have been made by means of the photoelectric null method described in this paper. All errors have been eliminated as well as the necessity of any tests, calibrations or corrections in connection with the current-irradiation law or the dark currents of the photoelectric cells, or with electrometer deflection methods. Measurements can be made from 380 to 650 millimicrons, the best range being from 410 to 550. Measurements of spectral diffuse reflection relative to that of magnesium carbonate have also been made.—*U. S. Bureau of Standards, Scientific Paper No. 349*, Oct. 11, 1919.

Electrochemistry and Batteries

Power Systems of the North Central States.—CHESTER H. JONES.—The writer points out the fact that hydroelectric systems and large steam plants in the States of Wisconsin, Illinois, Michigan and Indiana offer considerable prospects for electrochemical and chemical industrial developments. The extension of transmission lines in these states also opens way for development of natural resources. Excellent maps showing electrical lines accompany the article.—*Chemical and Metallurgical Engineering*, Sept. 15, 1919.

Tests on a New Insulating Material.—The Schnetzer insulating material for electric conductors has proved most resistant to atmospheric influences and to chemical fumes. In a stearine factory where rubber insulation was usually destroyed in four to five months it has been in use two to three years and is still in good condition. It has been used in wet situations, with good results, and resists acid better than lead coating. The material is coated with a special varnish, the composition of which is kept secret.—*Technical Review*, Oct. 28. (Abstracted from *Zeitschrift des Oesterr. Ingenieur und Architekten Vereines*, Sept. 5, 1919.)

Effect of Amalgamation Upon the Single Potentials of Certain Binary Alloys.—LOUIS KAHLENBERG and JOHN A. MONTGOMERY.—The writers studied the effect of amalgamation upon alloys of aluminum with copper, zinc and nickel.—*Proceedings American Electrochemical Society*, Sept. 23, 1919.

Telegraphy, Telephony and Signals

Variation in Direction of Propagation of Long Electromagnetic Waves.—A. HOYT TAYLOR.—The observed direction of radio waves as obtained with a direction finder varies with time when long waves are used such as those from very high power stations. The variations of direction are of the order of 90 deg. for very long waves. No such large variations are found for short damped waves produced by spark apparatus. A method of increasing the sharpness of determination of direction has been worked out. A theoretical explanation of the variations of direction is given, based on the existence of media in the earth's atmosphere capable of reflecting and refracting the waves.—*U. S. Bureau of Standards*, Nov. 29, 1919.

Radio-Telephony.—E. H. COLPITTS.—The writer gives a brief summary of the historical developments of radio communication and then passes on to a description of the apparatus as developed at the present time.—*Journal of Society of Automotive Engineers*, September, 1919.

Radio Stations of the United States.—This pamphlet gives a list of the radio stations of the United States with the call systems and wave lengths in use in each case.—*Department of Commerce, Bureau of Navigation*, June 15, 1919.

Design of Poulsen Arc Converters for Radio-Telegphy.—LEONARD F. FULLER.—The Poulsen arc-converter cycle is studied in detail, and the various relations between direct and alternating arc currents and voltages are obtained and discussed. The possible production of harmonics is considered. The effect of arc field strength on the arc phenomena is then taken up. The efficiency of the Poulsen arc cycle is obtained and checked experimentally. The theoretical relation between best field strength and wave length, arc current and voltage, and the nature of atmosphere surrounding the arc, is deduced and shown to be correct by elaborate experimental data. In this connection ethyl alcohol and kerosene atmospheres are compared. The design of the magnetic circuit is then handled in detail. The most economical pole shape is given, the tip being a triple-tapered conical frustrum. The tip-gap ratio and the pole-gap ratio are also experimentally obtained. Open and closed magnetic circuits are compared. The design of these large electromagnets is facilitated by the use of small models, the results thus obtained being reliable. Data are given for desirable chamber surface for various arc inputs and for the design of arc electrodes.—*Proceedings Institute of Radio Engineers*, October, 1919.

Direction Finding by Wireless Telegraphy.—RIALL SANKEY.—In this article are described and illustrated various stages of the direction-finding equipment used by the British.—London *Engineer*, Oct. 17, 1919.

Aircraft Telephony.—CAPT. B. S. COHEN.—The writer considers especially telephone apparatus designed for the use of kite balloons, airships and heavier-than-air craft where wire connections are possible.—London *Electrician*, Nov. 14, 1919.

CONTINUED heavy demands for power, high level of operating costs and stringent money rates point to a situation in 1920 that will call for co-operative action by central stations and the public service commissions. Ample supplies of power are urgently needed to meet the tremendous industrial requirements of the country. Costs of labor and materials entering into central-station expansion and operation do not recede, and the tendency is rather upward than downward. And money continues high, as is shown by the recent offering of Philadelphia Electric Company notes on a 7¼ interest basis, indicating that the net cost of the capital was even higher than this. Where the remedy is higher rates, companies will undoubtedly take the matter up promptly with the regulating commission.

The 25,000/66,000 volt tie line between the Edison Electric Illuminating Company, Boston, and the New England Power Company was put in service on Jan. 19, establishing interconnection of about 500,000 kw. capacity.

Informal conferences are under way between power company representatives and the California Railroad Commission to discuss the serious shortage of power due to continued drought. Curtailment in the agricultural load must take place in two weeks unless rain comes. Oregon also reports the driest January on record.

No temporary successor will be appointed to the late Dr. Richard C. MacLaurin, president Massachusetts Institute of Technology. An administrative committee of the faculty will govern the institution.

Rates for the Cleveland Electric Illuminating Company have been announced by the Ohio Public Utilities Commission.

Delegates of the American Institute of Electrical Engineers to the International Electrochemical Commission meeting in London last October have made a report to the Institute.

The Conference Club met at the Hotel Biltmore, New York, on Jan. 29, 30 and 31 to lay down a broad program for its future activities.

The movement for further standardizing control equipment and specifications for control apparatus will be given impetus at a meeting of the control apparatus section of the Electric Power Club at Chicago Feb. 6.

Bituminous coal production, according to the Geological Survey, has improved, but distribution is unsatisfactory.

According to Director Smith of the Geological Survey, this country is third in the world in potential water-power resources, but first in rank as determined by developed power.

Appointments of new officers for the Portland (Ore.) Railway, Light & Power Company include F. I. Fuller as first vice-president, in charge of railway operation, and O. B. Coldwell as second vice-president, in charge of electric light and power.

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

President Alex Dow of the Detroit Edison Company sees a busy year ahead and need for higher rates if operating conditions are not more favorable.

A report of the Geological Survey on power production in July, 1919, shows that in about 3,000 public service plants 39 per cent of the power was obtained from water.

B. G. Lamme, chief engineer of the Westinghouse Electric & Manufacturing Company, told the technical story of the synchronous converter to the St. Louis Section of the American Institute of Electrical Engineers on the evening of Jan. 28.

To enable the San Joaquin Light & Power Corporation to finance plant extensions and improvements, the California Railroad Commission has authorized it to issue $3,500,000 of 7 per cent preferred stock. This company plans to spend this year $2,500,000 on the new Kings River power project.

The Northern California Power Company, whose properties were recently purchased by the Pacific Gas & Electric Company, has been authorized by the Railroad Commission to issue $443,000 refunding and consolidating 5 per cent gold bonds. The Nevada California Power Company plans to spend during 1920 about $400,000 in development work on Leevining Creek, in Mono County, preparatory to the construction of additional plants to generate 15,000 hp.

In a report to the City Council of Seattle, Wash., Superintendent of Light J. D. Ross asks for $1,750,000 for completion of the Cedar Falls power plant to a capacity of 18,000 kw. He estimates the total cost of the Cedar Falls plant at $3,500,946.

President Ballard of the N. E. L. A. has reached New York.

The Pacific Coast convention of the American Institute of Electrical Engineers will be held in the Multnomah Hotel, Portland, Ore., on July 21 to 23.

At the fifteenth annual meeting of the Western Association of Electrical Inspectors in St. Louis this week steps were taken toward effecting a reduction in the cost of wiring.

F. G. R. Gordon addressed the New England Section of the N. E. L. A. on the dangers of Bolshevism.

Director Smith of the Geological Survey says that reasonable coal storage by central stations will help to abate seasonable demand for coal.

No let-up is evident in the jobbing field except in the Far West. There a decrease in shipbuilding, and a slowing down in the lumber industry has its effect on the jobbing market. Otherwise it is a buyers' market, the difficulty being to secure sufficient material to meet the orders. Wiring materials, except wire, are without doubt extremely short as for actual needs, to say nothing of being short as far as amounts for stocks are concerned. No quick relief is in sight for supplies of rigid conduit, outlet boxes, flexible armored conductor and the flexible conduits. The porcelains are short. Manufacturers are months behind on deliveries of virtually all materials, and transportation difficulties are further complicating the situation.

Price changes have been few this week. Merchant pipe went up, and it is not known on what card any future deliveries of rigid conduit will be based. Certain reflectors are up, washing machines are reported $50 higher and lamp cord and magnet wire have advanced again. With varying prices of cotton and labor, wire base prices are coming to mean less and less and some companies are quoting list prices based on actual costs.

Pacific Coast jobbers report considerable activity in the export of electrical appliances to the Orient, especially China and Japan.

A hydro-electric plant near Rimini to generate power for the streeet-lighting system of Helena, Mont., is being considered by the City Council.

Plans are being prepared for the erection of a new power plant for the United Illuminating Company on Congress Street, Bridgeport, Conn., to cost about $1,500,000.

New developments contemplated by the Western States Gas & Electric Company on the south fork of the American River, a few miles above the company's present hydro-electric development, include the construction of a reservoir for impounding waters in the Twin Lakes, Echo and Medley Lakes. A 1,900-ft. fall of water will be utilized, and it is expected that 30,000 hp. will be developed.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

President Ballard of the N.E.L.A. in New York

PRESIDENT R. H. BALLARD of the National Electric Light Association reached New York on Jan. 24. He was accompanied on the last stage of his journey from the Pacific Coast by M. H. Aylesworth, executive assistant to the president; Frank W. Smith, vice-president of the association, and Clarence L. Law, chairman of the lighting sales bureau.

During the present week Mr. Ballard has been engaged in meetings and business at national headquarters. Meetings of the public policy and executive committees were held as well as conferences with the vice-presidents and heads of the national sections and the headquarters staff.

George W. Elliott has taken active charge as master of transportation of the transportation arrangements for the 1920 Pasadena convention. President Ballard states that he expects an attendance of at least 4,000.

The following N. E. L. A. committee meetings were scheduled for the current week or for February:

Jan. 26—Executive committee meeting, Accounting Section, Hotel Statler, Detroit.

Jan. 27—Commercial aspects of lamp equipment division, lighting sales bureau, Commercial Section, New York.

Jan. 28—Executive conference, headquarters, New York.

Jan. 29—Executive committee, Electric Vehicle Section, headquarters, New York. Company sections special committee, headquarters, New York. Public policy committee, New York. Membership committee, New York.

Jan. 30—Executive committee, national association, New York.

Feb. 3—Meter committee, Technical and Hydro-Electric Section, Cleveland.

Feb. 16—Electrical apparatus committee, Technical and Hydro-Electric Section, headquarters, New York. Committee on inductive interference, Technical and Hydro-Electric Section, headquarters, New York. Committee on overhead systems, Technical and Hydro-Electric Section, headquarters, New York. Committee on prime movers, Technical and Hydro-Electric Section, headquarters, New York. Committee on underground systems, Technical and Hydro-Electric Section, headquarters, New York.

Feb. 17—Committee on inductive interference, Technical and Hydro-Electric Section, headquarters, New York. Committee on overhead systems, Technical and Hydro-Electric Section, headquarters, New York.

Feb. 26—Editing committee, Technical and Hydro-Electric Section, Chicago.

Feb. 27—Editing committee, Technical and Hydro-Electric Section, Chicago.

Poster Contest for the Cleveland Electrical Show

Chairman P. B. Zimmerman of the publicity committee for the Cleveland Electrical Show, to be held in Cleveland under the auspices of the Cleveland Electrical League March 10 to 20 inclusive, announces a contest for a poster drawing with which to advertise the coming show. The poster contest is under the direction of Henry Turner Bailey, dean of the Cleveland School of Art.

The sum of $200 is to be distributed in five prizes—$100 to the winner and $50, $25, $10 and $5 to the next four in order of the merit of their entries.

Winter Snows Lacking in High Sierras

In the year 1918-19 the snowfall in the high Sierras of California was the least of all the years on record. As a consequence power companies in California had great difficulty in operating hydroelectric plants throughout the entire season. The picture shows the snowfall on Jan. 1, 1920, at the Spalding Dam of the Pacific Gas & Electric Company to be unusually light. In fact, there is virtually no snowfall at all, and little storage of waters is possible.

Western Association of Electrical Inspectors Meets

Interesting Program and General Discussions in Which Many Members Take Part Mark St. Louis Convention

AFTER seven years the Western Association of Electrical Inspectors returned to St. Louis this week to hold its fifteenth annual meeting and to partake of the hospitality of the St. Louis Electrical Board of Trade. The business sessions occupied three full days and were largely taken up with discussions of methods by which experience and sound engineering principles could be utilized to reduce the cost of electrical installations without impairing their quality.

In the absence of President Charles K. Cregier of Chicago, the meeting was conducted by vice-president K. W. Adkins of Kansas City, who also replied to the address of welcome by Mayor Henry W. Kiel of St. Louis.

EFFECT OF DUST ON INCONDESCENT LAMPS

The first technical paper on the program was by Chester L. Dows, engineer of the National Lamp Works of the General Electric Company. He gave the results of tests and actual experience in the use of incandescent lamps in dusty places. These showed that the use of such lamps is safe when reasonable care is exercised in installation and maintenance. The maximum temperature which has been found on any type or size of incandescent lamps was about 360 deg. F. If only 300-watt type C lamps or smaller are considered, the maximum lamp temperature would be about 265 deg. F. when the lamps have become opaque from dust. This is about 200 deg. below the temperature at which the kind of dust commonly met with will ignite, though it will smoke at a lower temperature. The elimination of drop cords and frequent cleaning of the lamps were recommended in flour mills and other dusty places.

The paper was discussed by C. Renshaw of the Westinghouse Electric & Manufacturing Company, Victor H. Tousley of Chicago, R. L. Daniel of Minneapolis, W. L. Lodge of Chicago, C. E. Michel of St. Louis, O. M. Frykman of Minneapolis and B. H. Glover of Chicago.

The problems created by bringing high-voltage electric service into industrial and commercial buildings were considered from two angles. H. J. Woods, engineer of the Missouri Inspection Bureau, St. Louis, read a paper in which he gave the underwriters' views on the subject. A central-station viewpoint was outlined in a paper by Walter H. Millan of the Union Electric Light & Power Company, St. Louis. In the absence of the author this paper was read by J. H. Ryan, also of the Union Electric company. Mr. Woods enumerated some of the requirements of the Missouri Inspection Bureau for service supplied at from 500 volts to 3500 volts and recommended periodical inspections for all high-voltage installation. Mr. Millan gave the specifications with which all primary customers on his company's lines are expected to comply.

These two papers brought out a very general discussion. It seemed to be the opinion of the majority present that main switches and fuses should not be installed on the secondary side of users' transformers when there is a primary automatic switch which can be operated either electrically or mechanically from the outside of the transformer room. It was also agreed that such an arrangement would meet the requirements of the National Electrical Code. Victory H. Tousley led the discussion, which was also participated in by S. Legried of Springfield, Ill., H. F. Strickland Toronto, Canada; N. Rousseau of Chicago, F. O. Evertz of Columbus, Ohio; A. C. Schultz of Milwaukee, W. S. Boyd of Chicago, R. C. Loughead of Detroit, James H. Mahaney of Chicago, H. B. Gear of Chicago, H. W. Eales of St. Louis, L. Borer of Pontiac, Mich., and F. D. Varnam of St. Paul.

Last year the committee on rubber-covered wire gave a formula for figuring the number of wires of any size that could be used in conduit. The committee found that when large numbers of wires in a single conduit carry normal current the center wires may become dangerously hot. Therefore, in presenting the report of the committee this year, Chairman Tousley said that the number of wires in a conduit should not exceed nine and the I^2R loss of all wires should not exceed the maximum allowed under the code rules.

Among those who discussed the report were A. O. Boniface, L. A. Barley, F. O. Evertz, B. H. Glover, H. R. Cook, B. H. Glover and F. W. Derby of Chicago.

Victor H. Tousley, as chairman of the Committee on Demand Factors, recommended a graduated scale of demand factors down to 60 per cent for cranes. A special schedule is provided for apartment buildings. No action was taken, because the report had not been previously sent to members. J. H. Wood, F. O. Evertz, A. C. Schultz, S. N. Clarkson of Chicago, W. A. Haig, L. D. Smith, C. Renshaw, F. A. Barron of Schenectady and S. Legried discussed the report at considerable length.

REGULATING THE FIRE HAZARD

The obligations of manufacturers, electrical contractor-dealers and central stations to help regulate the electrical appliance fire hazard were recognized in a group of three H. J. Manger of the Edison Electric Appliance Company, Chicago, presented the manufacturers' side in a paper which was read in his absence by M. E. Long of the same company. The electrical contractor-dealers were represented by A. C. Brandt, department manager for the Frank A. Dam Electric Company, St. Louis, and C. E. Michel, sales manager Union Electric Light & Power Company, St. Louis, spoke on behalf of the central-station industry.

The speakers seemed to agree that the non-electrical merchants and manufacturers caused trouble by their ignorance of the conditions under which their goods are used. They advocated general education of the public in the correct use of electrical appliances. Mr. Brandt said that at present outlets were installed for illumination and that heavier wiring or separate circuits for appliances, though necessary, would not be generally used until the inspectors made it mandatory.

These papers were discussed by W. S. Boyd, John G. Gansber and J. Gallivan of Springfield, Ill.; L. Borer of Pontiac, Mich.; F. A. Barron of the General Electric Company, Schenectady; Victor H. Tousley and H. J. Hodson of East St. Louis.

An interesting account of conditions in Canada was presented by H. F. Strickland, chief electrical inspector for the Hydro-Electric Commission of Ontario. In Ontorio 660-watt sockets must be installed throughout. Steel service boxes and inclosed externally operated switches have been used there for the past four or five years. Industrial plants are not required to take out individual permits. They pay an annual inspection fee and are inspected monthly. Inspectors go to the schools to teach children how they should handle electrical appliances. Mr. Strickland's address was discussed by W. S. Boyd, C. E. Mickel and H. J. Hodson.

During the sessions set aside for the discussion of inspectors' problems about twenty questions were placed before the meeting for information or action. The questions were discussed by B. H. Glover of Chicago, John Poehlman of Milwaukee, J. Gallivan of Springfield, Ill.; W. B. Doss of Nashville, Tenn.; A. D. Boniface of Chicago, E. R. Chincholl of Topeka, Kan.; W. A. Haig of Milwaukee, F. D. Varnam, Charles D. Fox of St. Joseph, Mo.; F. G. Waldenfels of Chicago, H. F. Strickland, Victor H. Tousley, S. Legreid, C. J. Wagner of Joliet, Ill.; T. W. Martin of Topeka, Kan.; C. Renshaw, J. W. Kelly, Jr., of Camden, N. J.; R. W. E. Moore of East Pittsburgh, Pa.; F. O. Everetz, L. D. Smith of Minneapolis, L. Borer, W. S. Boyd, H. J. Woods. O. M. Frykman, L. A. Borley of Denver, A. G. Shultz, H. M. Maxwell of Dayton, Ohio, and A. L. Eustice of the Economy Fuse Company.

It was the decision of the meeting that a separate circuit should be run for washing machines because of the necessity of overfusing.

In the opinion of the meeting metal molding and flexible armored conductor are not the equivalent of conduit wiring, though permitted to be used in some places.

Some interesting electrical fire-loss statistics were presented in a paper by Charles H. Lum of the National Board of Fire Underwriters, New York. The annual fire loss from electrical causes has increased $10,000,000 in four years. During a typical week in January, 1919, there were 540 electrical fires, of which 46.2 per cent were attributed to electric flatirons, 15.2 per cent were caused by flexible cords, 7.1 per cent by attic and basement wiring, and the remainder, 31.5 per cent, were due to miscellaneous causes.

Mr. Lum said that it was American carelessness that made electric service cause more fires than anything except matches.

B. G. Lamme Tells St. Louis Engineers of Synchronous Converter

LAST Wednesday evening a large gathering of electrical engineers of St. Louis were treated to an address on the development of the synchronous converter by B. G. Lamme, chief engineer of the Westinghouse Electric & Manufacturing Company. The meeting was under the auspices of the St. Louis Section of the American Institute of Electrical Engineers and was conducted by Chairman G. A. Waters.

The paper had been printed before the meeting, but the speaker enhanced its interest by speaking without referring to the printed sheets or to notes. Mr. Lamme was able to do this because the story was largely a record of his own and his associates' accomplishments in one particular line. The troubles experienced in the development of the synchronous converters were graphically told, and the parallel development of both engineering knowledge and larger machines was dwelt upon. It is now practicable to build synchronous converters of any rating that may be demanded; it has become a question of cost, not design. However, the upper speed limit appears to have been reached in 25-cycle machines, while higher speeds may be reached in 60-cycle designs.

The discussion was opened by H. W. Eales, who said the economic limit of 250-volt Edison distribution makes it desirable to use a number of comparatively small rotaries close to the load. The question of attendants' power, however, had compelled the use of large machines. The advent of automatic rotary substations for light and power service will, if successful, permit the use of a larger number of small substations. To supply new districts as the load grows, V. A. Flynn described some of the converting apparatus used in Europe.

The address was also discussed by J. L. Hamilton, A. H. Timmermann, S. N. Clarkson and H. Weichsel. Mr. Lamme, in replying to questions, said that the dynamotor, which is a converting machine with independent alternating-current and direct-current windings, would have nearly eight times the copper loss of a six-phase synchronous converter unless the amount of copper were greatly increased over that required for direct-current generators.

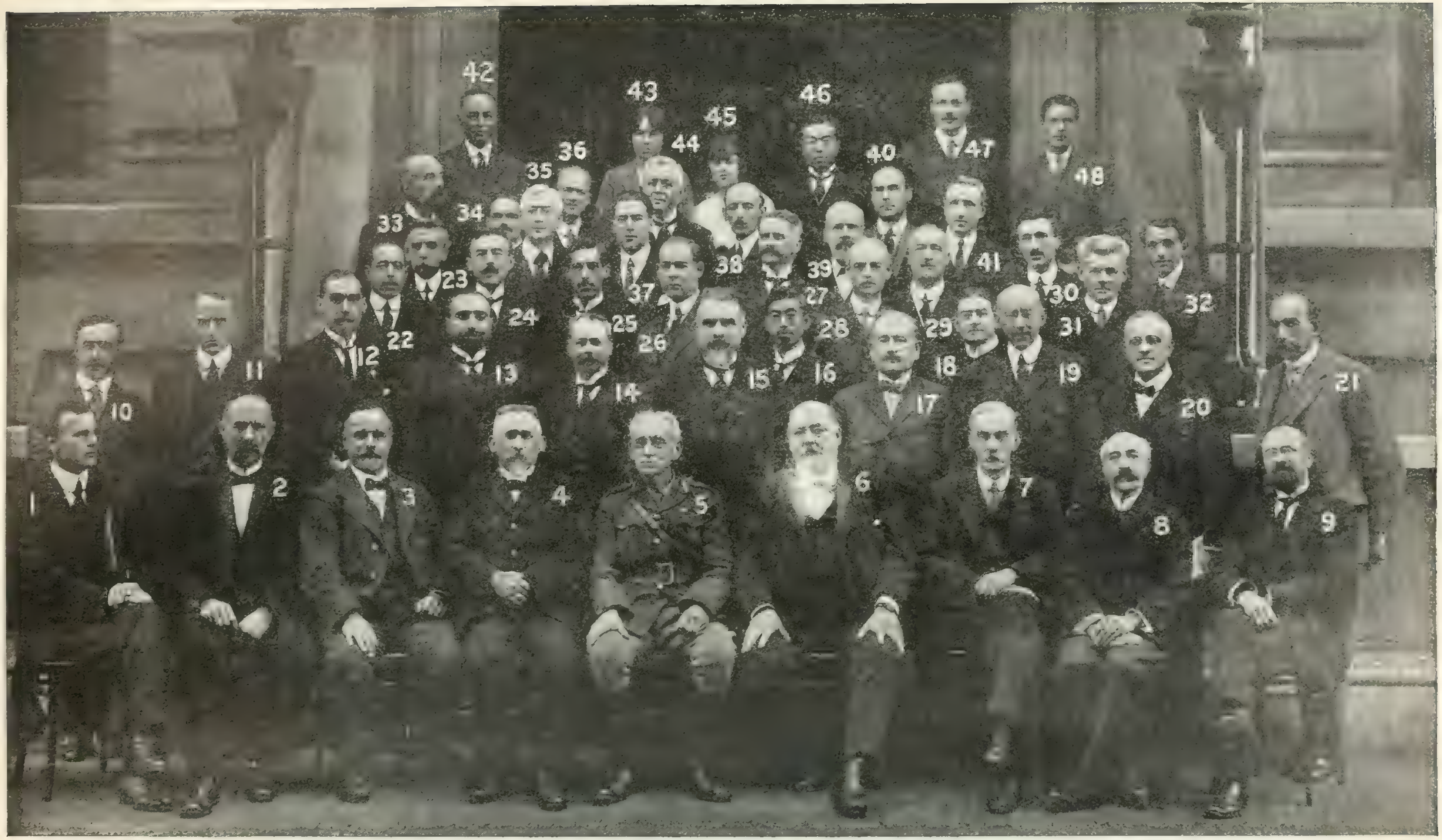
Electric Welding Companies Combine

A CONSOLIDATION of electric welding companies is being effected. The combined corporation will be called Associated Welding Companies, Inc. It will have 400,000 shares of authorized capital stock of no par value, of which 200,000 shares will be outstanding.

The consolidation is being arranged by J. M. Byrne & Company and M. J. Hoey & Company, bankers of New York, and is to include the following companies, of the capitalization stated: Electric Welding Company of America, New York, $1,000,000; Electric Welding Company of America, Baltimore, $150,000; Electric Welding & Shipbuilding Company of Canada, Montreal, $50,000; Electric Welding Company of America, Portland, Me., $50,000; Electric Welding Company of Boston, Boston, $300,000; Brooklyn Electric Welding Company, $50,000; New York Electric Welding Company, $25,000; Electric Welding & Ship Repairing Company of Pennsylvania, Philadelphia, $100,000; Electric Welding Company of America, Norfolk, Va., $100,000; Ohio Welding Company, Cleveland, $100,000; Electric Welding Company of the Argentine, Buenos Aires, $100,000; Compañia Soldatura Electrica de España, Bilbao, Spain, $100,000; Brooklyn Ship Repair Company, Brooklyn (no par value), 2,500 shares. The main office will be in Brooklyn.

Rates Made by Ohio Commission for Cleveland

Definite rates have been fixed for the Cleveland Electric Illuminating Company by the Ohio Public Utilities Commission. These rates have been used for some time but were not fixed definitely by the commission until Jan. 22, 1920. The rates for residential use are 10 cents per kilowatt-hour for the first 36 kw.-hr. and 5 cents for all in excess; for commercial users, 10 cents for the first 30 kw.-hr. and 3.5 cents for all in excess. This ruling ends a fight which started in 1914 when the City Council passed an ordinance seeking to compel a 3-cent rate.



Delegates to International Electrotechnical Commission, London, 1919

1. J. C. Holst, Norway.
2. Prof. A. Larsen, Denmark.
3. E. Huber Stockar, Switzerland.
4. E. Brylinski, France.
5. Col. R. E. Crompton, C.B., honorary secretary.
6. Maurice Leblanc (past president), France.
7. Sir Richard Glazebrook, C.B., Great Britain.
8. L. M. Barnet Lyon, Holland.
9. Prof. A. Halleux, Belgium.
10. C. le Maistre, general secretary.
11. C. Rodgers, Great Britain.
12. A. de Montmollin, Switzerland.
13. J. A. de Artigas, Spain.
14. Ch. David, France.
15. P.Boucherot, France.
16. Motoo Uchisaka, Japan.
17. Dr. C. O. Mailloux (president-elect), United States.
18. Capt. J. Slee, R.N., Great Britain.
19. Guido Semenza, Italy.
20. Dr. M. de Haas, Holland.
21. Roger T. Smith, Great Britain.
22. Col. J. Lucas, Portugal.
23. Prof. T. Mather, Great Britain.
24. Don Serafin de Orueta, Spain.
25. Menezes de Oliveira, Brazil.
26. Warrington Chubb, United States.
27. M. Rechniewski, France.
28. A. R. Everest, Great Britain.
29. Prof. E. Morelli, Italy.
30. A. Smith, assistant.
31. C. H. Wordingham, C.B.E., Great Britain.
32. P. Good, assistant secretary.
33. A. P. Trotter, Canada.
34. A. J. Stubbs, Great Britain.
35. James Burke, United States.
36. H. M. Hobart, United States.
37. E. S. Lane, Portugal.
38. G. Arturo Pani, Mexico.
39. Sir William Slingo, Great Britain.
40. Major K. Edgecumbe, Great Britain.
41. Capt. W. T. Taylor, Great Britain.
42. Maurice C. Simpson, British Indies.
43. Miss M. Madell, assistant.
44. Dr. A. Russell, Great Britain.
45. Miss K. Altlatt, stenographer.
46. Motosuke Masuda, Japan.
47. C. Silver, assistant.
48. E. L. Litton, assistant.

Report on I. E. C. Meeting by Institute Delegates

American Committee Gives Information On Meeting of the International Commission Held in London in October, 1919

A REPORT on the meeting of the International Electrotechnical Commission in London last October has been made to the American Institute of Electrical Engineers by the Institute delegates who were present. Some information regarding the meeting was printed in earlier issues of the ELECTRICAL WORLD. As stated previously, the delegates were Dr. C. O. Mailloux, James Burke, H. M. Hobart and H. E. Chubb. Dr. Mailloux, who served as president of the United States national committee at the meeting, was unanimously elected president of the international commission for the next period.

Following is the analysis of the work accomplished at the London meeting as reported to the Institute:

So far as relates to the subject of rating of electrical machinery, the work accomplished falls into two categories. In the first category is the work which was ratified on Oct. 22, the last day of the plenary meeting. In the second category is further work done by the advisory committee on rating of electrical machinery, which continued in session for three more days. The work in this second category will be brought together as a recommendation of the advisory committee, and will not, until ratified at a plenary meeting, have the status of I. E. C. rules. Even the portion ratified at the plenary meeting was in the form of notes from which the editing committee of the I. E. C. was authorized to prepare the official report. This report will be the one submitted to the various national committees for study.

Consequently, at the present time, any statement of the things done must be made with reservations. It does not seem worth while to attempt to distinguish between the different degrees of completeness of the work done. The best that can be done is to state the general trend of matters.

I. For the purposes of the I. E. C. Standards, electrical machinery is for the present divided into two groups.

In the first group fall:

1. Rotating machines of which the terminal pressures do not exceed 5,000 volts, or of which the rated output does not exceed 750 kva., or of which the stator cores do not exceed 50 cm. in length, measured axially.

2. All transformers which are not water-cooled.

II. For machines in this group there are recognized only two methods of temperature measurement for acceptance tests, namely:

1. Resistance and thermometer, whichever gives the highest.

2. Thermometer measurements.

III. For machines whose terminal pressures exceed 5,000 volts, or of which the rated output exceeds 750 kva., or of which the stator cores have an axial length greater than 50 cm., a third method of temperature measurement—namely by embedded temperature detectors—was recognized by the advisory committee on rating. This has at present no more status than that of being the recommendation of that committee.

IV. The alternative of permitting thermometer measurements alone with a 5-deg. penalty, practically as customary in America, has been adopted by the committee on rating, although with certain modifications.

V. Commutators and slip rings are permitted to have any temperature consistent with successful operation, but if temperature rises of more than 50 deg. are employed for commutators the manufacturer shall give a special guarantee that the temperature obtained shall not impair the commutation.

VI. An ambient temperature of reference of 40 deg. C. for air was adopted for I. E. C. ratings.

VII. The I. E. C. committee on rating purposes to consider the adoption of an ambient temperature of reference for tropical ratings. Among the values mentioned informally, considerable stress was laid upon the appropriateness of 55 deg. If this should ultimately be adopted, it would amount to a 15-deg. lower temperature rise for machines with a tropical rating.

VIII. An ambient temperature of reference of 25 deg. C. for water was recommended for I. E. C. ratings by the advisory committee on rating.

IX. For water-cooled transformers the advisory committee on rating recommended that the limits for the highest observable temperatures shall be decreased by 10 deg. below those permitted for other machinery. Since the ambient temperature of reference for water is 15 deg. below that for air, this amounts to permitting a 5-deg. greater temperature rise for water-cooled transformers than for transformers of other types.

X. The advisory committee on rating recommends a temperature limit of 90 deg. C. for the oil in which transformers are immersed.

XI. The principle of correction back of shut-down is recognized.

XII. The permitted temperature limits for non-impregnated cotton, silk and paper are 15 deg. below the limits for these materials when impregnated.

XIII. The rule for the duration of the temperature test for a machine with a continuous rating is that the test shall be continued until it is evident that the maximum temperature rise attained would not exceed the prescribed limits if the test were to be prolonged until the final steady temperature were attained.

XIV. Very satisfactory progress was made by the advisory committee on rating in its recommendations concerning high-voltage tests. So far as the matter was carried, the rules recommended are in quite good agreement with those already adopted in several countries, including America.

Meetings of the advisory committees will be held in Brussels in the spring.

Legislation and Education Are Aims in Kentucky

In his presidential address to the Kentucky Association of Public Utilities Jan. 16 at Louisville, Harry Reid, president of the association and president of the Kentucky Utilities Company of Louisville, emphasized the importance of the utility business in Kentucky. The Kentucky association has thirty-three member companies, serving 104 communities.

The association has been operating on an income of about 800 a year, and President Reid pointed out that this should be increased to $3,000 a year for the benefit of the association and to permit it to continue legislative and educational work which it has under way. A considerable portion of the money will be expended for the issuance of a bulletin containing public utility information.

The convention program included addresses by D. L. Gaskill and I. Oppenheimer, of the Ohio Electric Light Association, on association work. Other features were addresses on legislation by L. B. Herrington, Louisville; on safety by C. B. Scott, Chicago, and on educational work by J. B. Mullaney, Chicago.

The election of officers resulted as follows: President, P. S. Pogue, Louisville Telephone Company; first vice-president, L. B. Herrington, Kentucky Utilities Company; second vice-president, John Stoll, Lexington Waterworks; directors, Donald McDonald, Louisville; J. C. Pope, Lexington; A. S. Nicols, Paducah, and W. A. Harton, South Covington; secretary-treasurer, J. B. Riley, Westinghouse Lamp Company, Louisville.

Power Production Report of the Geological Survey

Compilation for July, 1919, Shows that About 39 Per Cent of the Total Was Obtained from Water Power

A REPORT on the July, 1919, "production of electric power and consumption of fuel by public utility power plants in the United States" has been issued by the United States Geological Survey. It follows reports for February, March and April, 1919, previously issued by the Geological Survey. Apparently no reports are being issued for May and June

The July return is issued with slight corrections of the figures of power production and combustion of fuels put out for the earlier months. As now given, the totals of production for these months are as follows: February, production by water power, 1,148,634,000 kw.-hr., production by fuels 1,834,222,000 kw.-hr., total 2,982,856,000 kw.-hr.; March, production by water power, 1,308,329,000 kw.-hr., production by fuels 1,841,542,000 kw.-hr., total 3,149,871,000 kw.-hr.; April, production by water power 1,308,573,000 kw.-hr., production by fuels 1,717,523,000 kw.-hr., total 3,026,096,000 kw.-hr.

The average daily output in kilowatt-hours was: February, 106,531,000; March, 101,609,000; April, 100,870,000; July, 101,366,000.

The percentage of total output produced by water power follows: February, 39; March, 42; April, 43, and July, 39.

Following are the statistics as issued for July:

State	Thousands of Kilowatt-Hours Produced		Combustion of Fuels		
	By Water Power	By Fuels	Coal, Short Tons	Petroleum and Derivatives, Barrels	Natural Gas, Thousands of Cu.Ft.
Alabama	28,442	3,689	15,458	8	....
Arizona	7,478	18,877	7,315	61,030	
Arkansas	88	7,692	8,364	450	182,848
California	200,528	116,804	....	550,799	242,228
Colorado	14,947	12,177	27,888	174	.....
Connecticut	5,943	48,182	67,513	213	.....
Delaware	.	5,225	6,604	....	......
District of Columbia	.	19,221	21,412	..	......
Florida	942	7,731	3,193	30,745	......
Georgia	34,224	6,595	13,560	2,386	......
Idaho	50,209	1,219	88	9	......
Illinois	15,323	183,518	304,160	984	.....
Indiana	2,736	54,354	142,587	402	1,878
Iowa	51,802	24,531	69,703	720	..
Kansas	981	35,068	50,817	60,742	80,846
Kentucky	4	19,205	39,390	341	....
Louisiana	.....	15,518	11,324	30,508	63,624
Maine	17,678	220	534	.....	...
Maryland	329	16,378	25,951	30	1,350
Massachusetts	15,163	110,467	130,506	21	......
Michigan	50,043	108,402	129,612	204	......
Minnesota	37,436	10,929	25,866	832	......
Mississippi	.	5,206	13,272	443	......
Missouri	2,237	39,132	82,045	18,847	......
Montana	83,220	848	4,894	502	912
Nebraska	1,302	16,602	31,904	3,387	......
Nevada	2,559	720	195	1,780	......
New Hampshire	4,499	3,814	5,808	3	......
New Jersey	151	79,546	116,944	79	....
New Mexico	144	1,603	4,133	1,610	....
New York	212,033	276,828	336,004	1,224	56,949
North Carolina	45,317	7,243	14,915	20	...
North Dakota	.	2,449	14,808	553	....
Ohio	2,378	208,240	283,658	689	*512,586
Oklahoma	161	13,826	8,717	20,067	474,930
Oregon	29,130	4,323	222	5,664	.
Pennsylvania	52,648	238,021	388,957	297	40,531
Rhode Island	240	19,821	22,648	....	....
South Carolina	42,649	3,480	8,281	102	......
South Dakota	3,468	2,920	6,841	3,192	....
Tennessee	32,316	9,164	22,156	82	......
Texas	191	45,537	29,269	188,691	114,148
Utah	12,405	..	.	.	.....
Vermont	11,748	976	3,909	2	.
Virginia	17,666	19,336	30,674	122	
Washington	79,881	5,434	2,060	22,071	.
West Virginia	1,399	66,523	83,556	45	264,054
Wisconsin	41,512	27,637	46,221	574	.
Wyoming	179	3,386	12,752	4,008	3,481
Total	1,213,729	1,928,617	2,676,688	1,014,652	2,040,365
Total by water power and fuels	....	3,142,346	....	....	....

* Includes 182,415 artificial gas.

An explanatory note issued with the statistics, which were prepared under the direction of A. H. Horton, says:

"These reports are based on returns received from about 3,000 electric power plants engaged in public service, including central stations, electric railways and certain other plants which contribute to the public supply. Returns were received from plants whose aggregate capacity of generators is about 90 per cent of the total installed capacity of public utility plants. Estimates of the output of plants which did not submit returns were made from available information. The figures given are subject to revision in subsequent statistical reports of the United States Geological Survey relating to power production."

Sir Oliver Lodge Discusses Atomic Structure

THE very close relationship between electricity and the physical sciences was pointed out by Sir Oliver Lodge in his lecture on "The Structure of the Atom" in New York City on Jan. 25. In the audience were many well-known scientists and engineers, making the gathering a notable occasion. The speaker explained that an unlimited supply of energy is bound up in matter, only awaiting sufficient progress in scientific research to find the means of releasing it.

Sir Oliver gave some idea of the characteristics of the electrons by pointing out that they move in infinitesimal orbits at the velocity of light (186,000 miles per second). The actual revolutions per minute, then, are of the order 10^{20}. The energy of one ounce of matter is thus equal to that now derived from about 1,000 tons of coal.

It was shown that the elements known may be classified according to the number of electrons which go to make up the atom of each, from the simplest (hydrogen) to the more complex such as uranium. This classification agrees very well with the older "periodic" system commonly used by chemists. It is upon the arrangement of the electrons in the atom of any element that its physical and chemical properties depend. Some idea of the size of the electrons may be had from the statement that 500,000,000 atoms would make up a train an inch long, whereas the size of an electron is to that of the atom "as a flea is to an opera house."

Many of the classic experiments were described which indicated the existence and later the properties of electrons.

Conference Club Meets to Discuss Industry Problems

A THREE-DAY meeting of the Conference Club was held at the Hotel Biltmore, New York, on Jan. 29, 30 and 31. Representatives of the other branches of the industry were present. The program included discussion by the contractors forming the club and by manufacturers, jobbers and central-station men. In addition to the business sessions a banquet was held. The meeting was held primarily to lay down a broad program for the future activities of the Conference Club and to make it of greater usefulness in helping to solve the problems of the industry as a whole.

F. S. Price Points Way Toward Co-operation

Prominent New England Jobber Advocates Defining Proper Spheres of Usefulness for Each Branch of the Industry

CO-OPERATION through specialization of functions and activities as a means of bettering relations within the industry was urged by Frank S. Price, president Pettingell-Andrews Company, Boston, before a meeting of the Boston district of the Massachusetts Association of Electric Contractors on Jan. 15.

Mr. Price said that he expected to see the volume of electrical trade double in New England during the next five years, and in voicing his desire to see all branches of the industry prosper the speaker recommended more direct contact between contractor-dealers and jobbers, the frank discussion of points of policy among representatives of different branches, the extension of organization influence throughout New England and a co-operative definition of proper spheres of activity, or an ethical code to aid all interests fairly to make the most of their opportunities.

The need of a spokesman for each local branch of the industry was touched upon by the speaker, who intimated that in the near future a New England electrical supply jobbers' club may be formed. A movement is also afoot to extend the Massachusetts electrical contractors' organization to cover New England activities outside of Connecticut, and a meeting to discuss this was scheduled to take place at Providence, R. I., Jan. 16, with the co-operation of the Narragansett Electric Lighting Company. A committee was appointed at the Boston meeting to discuss improved trade relationships with representative jobbers.

Mr. Price said that in his opinion the large industrial plants fall within the class of wholesale consumers and that the contractor-dealer cannot expect to serve these customers as well as can the supply jobber. On the other hand, small factories, hotels, buildings and other customers of a retail class should naturally be served by the contractor-dealer. Eighty per cent of all the fixture materials sold by Pettingell-Andrews are billed through local central stations or through contractor-dealers.

Regarding appliances, Mr. Price said that the jobber desires to sell these only at wholesale and asserted that in the case of his own house the volume of retail appliance sales is an insignificant percentage of the wholesale business. The speaker believed that if the central station retails along ethical lines and does business in accord with the contractor-dealer, it is a benefit to the industry for the central station to retail appliances. He did not favor jobbers engaging in contracting, or vice, versa, and maintained that where the jobber is assured of proper support he will generally be favorably inclined toward giving up the retail business. The same thing may be said of the central station in relation to the contractor-dealer. It is important for co-operation to be active in order that the merchandising of electrical supplies may be retained by the contractor-dealers instead of being allowed to fall into the hands of hardware stores and department stores.

Other speakers were H. A. Holder, Boston, who urged the maintenance of retail prices at the retail counters of jobbers, and W. F. Abely, assistant manager Western Electric Company, Boston, who said that a code of ethics would be most helpful in improving inter-trade relationships. The annual value of the electrical supply and construction business of New England, the speaker estimated, is now from $22,000,000 to $25,000,000.

Bituminous Coal Production Better, but Distribution Unsatisfactory

ACCORDING to the report of the Geological Survey, an increase of 185,000 tons carried the output of bituminous coal during the week ended Jan. 17 to the largest total attained in any week since the strike. Indeed the production was the largest in any week of January during the past three years, the period over which the Geological Survey's records of weekly production extend.

The total output for the week (including lignite and coal made into coke) is estimated at 11,655,000 net tons. Compared with the preceding week this was an increase of 1.6 per cent. Compared with the corresponding week last year it represented an increase of 1,772,000 tons, or nearly 18 per cent.

The year 1920 thus opens with production at a rate well above that of either 1917, 1918 or 1919. The total output since Jan. 1 now amounts to 27,925,000 tons, an increase over last year of more than 4,000,000 tons attained in fourteen and a third working days.

The week of Jan. 17 was the eleventh since the great bituminous strike began and the fifth since the miners generally returned to work. The strike is over, but its effects are still apparent in both production and distribution of coal. The men and mines are ready, but the extraordinary dislocation of the car supply necessitated by the strike has not yet been wholly corrected. Car shortages have therefore occurred frequently and unavoidably. With distribution proceeding irregularly local scarcities of fuel were bound to happen. To meet these difficulties vigorous measures are being taken by both the operators and the railroads.

Administrative Committee to Govern "Technology"

EVERETT MORSS, president of the Simplex Wire & Cable Company and chairman of a special committee of the executive board, Massachusetts Institute of Technology, which will serve in an advisory capacity in the management of the institute's affairs, has announced that no temporary successor to the late President Richard C. Maclaurin will be appointed. Other members of the special committee are Edwin S. Webster, of Stone & Webster, and Francis R. Hart, vice-president of the Old Colony Trust Company and treasurer of the Institute.

In place of a president *pro tem* the institute will be administered by a committee of three from the faculty, consisting of Dr. Henry P. Talbot, chairman of the faculty and head of the department of chemistry, Prof. Edward F. Miller, head of the department of mechanical engineering, and Dr. William H. Walker, director of the newly-established division of industrial co-operation and research. Frederick P. Fish, Boston, was elected chairman of the executive board at the meeting which decided upon the above administrative plan and made the appointments of the two committees named.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., Annual Convention.—The American Institute of Electrical Engineers will hold its annual convention from June 22 to 25.

A. I. E. E., Midwinter Convention.—Feb. 18 to 20 are the dates for the midwinter convention to be held by the American Institute of Electrical Engineers in New York City.

A. I. E. E., Philadelphia Section, and Franklin Institute Joint Meeting.—Prof. Comfort A. Adams, chairman of the electric welding committee, Emergency Fleet Corporation, will address a joint meeting to be held on April 8 by the Philadelphia Section of the American Institute of Electrical Engineers and the Franklin Institute, on "Electric Welding as Applied to Shipbuilding."

Institute of Radio Engineers.—A meeting of the Institute of Radio Engineers will be held on Wednesday, Feb. 4, at 8:15 p.m., at the Engineering Societies Building, 29 West Thirty-ninth Street, New York. A paper on "Multiplex Radio Telephony and Telegraphy," by F. M. Ryan, J. R. Tolmie and Roy O. Bach, will be presented by Francis M. Ryan, formerly at the University of Washington.

Ohio Electric Light Association.—The calendar of standing committee meetings is as follows: Meter committee, Feb. 14, joint meeting with N. E. L. A. at Cleveland, and April 22 at Columbus; new-business co-operations, lighting and merchandising section, March 10, at Dayton, and power and heating section, April 28 at Coshocton; transmission and distribution, Feb. 19 at Cincinnati, March 18 at Canton, and April 22 at Toledo; station operating, Feb. 18 at Toledo, April 7 at Cleveland and May 5 at Pittsburgh.

Pennsylvania State Association of Electrical Contractors and Dealers.—The annual meeting of this association will be held at Erie, Pa., on Feb. 18, with headquarters at the Hotel Lawrence. The tentative program includes a meeting of the executive committee at 10 a.m., a noonday acquaintanceship luncheon followed by an afternoon business session and a trip through the plant of the General Electric Company, concluding with dinner at 7 p.m., all branches of the electrical industry being invited. Information regarding space for display of electrical appliances, hotel reservations, etc., will be furnished by Paul Mueller, chairman entertainment committee, 604 Peach Street, Erie, Pa.

American Institute of Electrical Engineers.—The annual business meeting of the Institute is scheduled to be held in New York City on May 21.

A. A. E. Organizes Ohio State Assembly.—Representatives of all chapters of the American Association of Engineers in Ohio met in Columbus on Jan. 21 and formed the Ohio Assembly of the A. A. E. Members and applicants in Ohio now number about 1,500. Chapters are being formed at Canton, Youngstown, Newark and Marion. The existing chapters are Akron, Cleveland, Dayton, Cincinnati, Toledo, Ohio Valley, Steubenville, Ohio Northern and Columbus.

I. E. S., Philadelphia Section.—After Dr. Howard Lyon had talked on "Elementary Principles of Illumination for the Practical Man" at the Jan. 16 meeting of the section, M. Luckiesh made some interesting statements regarding the lighting of schools. Only nine out of the forty-nine states in the Union, according to Mr. Luckiesh, furnish proper artificial light in their schools. He gave figures to show that in some schools short-sightedness increases. Inverted translucent bowls were suggested as being best adapted to school lighting.

Mohawk Valley Engineers' Club.—With initial membership of about 125 the Mohawk Valley Engineers' Club, Utica, N. Y., was formed on Jan. 7, and the following officers were elected: President, Byron E. White, engineer Utica Gas & Electric Company; first vice-president, Hubert E. Collins, consulting engineer; second vice-president, Roy F. Hall, division engineer State Highway Department; third vice-president, Horace B. Sweet, consulting engineer; secretary, Frederick E. Beck, engineer Consolidated Water Company; treasurer, Clifford Lewis, Jr., civil engineer. Regular monthly meetings are held the first Tuesday of each month.

Question-Box Convention, New England Section, N. E. L. A.—The New England Section of the National Electric Light Association will hold a "question-box conference" at the American House, Boston, on March 18. Live commercial topics will be discussed at the sessions, with accounting, advertising, electric vehicle, power and lighting matters prominent on the program. The New England Section recently "signed up" its 1,200th member and is having an active season. At the first electrical luncheon for the year, held on Jan. 21, F. G. R. Gordon of Haverhill, Mass., addressed about 150 members and guests on "Bolshevism, Its Cause and Cure in the United States." The advertising committee held a meeting Jan. 21 at the Engineers' Club, Boston, which was attended by prominent representatives of manufacturing and central-station companies, including several from outside New England, and the electric range committee is actively engaged in furthering the development of this class of equipment through organized effort.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Temporary Rates Made Permanent.—The Illinois Public Utilities Commission has entered an order in the case of the Citizens' Gas, Electric & Heating Company of Mount Vernon, Ill., continuing in effect indefinitely rates for electric service which had been authorized temporarily Sept. 19, 1918. This order places the burden of proof of the reasonableness of the rates upon the company if complaint is filed.

Consolidation of Illinois Properties.—The Illinois Public Utilities Commission has authorized several purchases and consolidations recently. The commission has authorized the Central Illinois Public Service Company of Mattoon to purchase the entire capital stock of the Central Illinois Utilities Company, the property of which centers around Paxton, the Hoopston (Ill.) Gas & Electric Company, the Hamilton Utilities Company and the Eastern Illinois Ice Company for the purposes of merger and consolidation. This in effect consolidates definitely certain properties which were recognized as members of the Insull group. The Southern Illinois Light & Power Company has been authorized to purchase the property of the Wright Brothers Light & Power Company at Ramsey, and the Lee Power & Light Company has been authorized to purchase the electric property of John E. Malmberg to operate in the village of Lee.

"Seasonal" Rates in Maine.—The Maine Public Utilities Commission has decided in the case of J. L. Katterlinus, E. H. Macomber and others against the Bar Harbor & Union River Power Company that the rates, schedules and practices of the company are unlawfully discriminatory. The decision orders that on or before April 1, 1920, the company file a schedule of rates, services and practices, to be effective on or before May 1, 1920, and that the lighting rate for a "seasonal" customer shall be 20 cents per kilowatt-hour and for a "year-round" customer 13 cents per kilowatt-hour, a reclassification of customers to whom it offers service of any sort clearly setting forth in sufficient detail the time, condition and other elements relative to the use of service upon which each such classification is based and the rate at which any service will be rendered and such changes as may be necessary in any of the so-called terms, conditions or rules relating to any service offered. If the company desires, it may at the same time revise or amend its schedule in the so-called "Ellsworth" district.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

New England Power Company Paper.—The New England Power Company has established a monthly paper in the interest of its employees.

Ask Enlargement of Coal Commission.—It is reported that representatives of five groups of public utilities in Indiana have petitioned President Wilson to enlarge the Coal Commission, increasing the public representation.

Change Name of Mahoning & Shenango Company.—Stockholders of the Mahoning & Shenango Railway & Light Company, Youngstown, Ohio, have voted to change the name of the corporation to Pennsylvania-Ohio Electric Company.

Urges Steam Railroad Electrification for Atlanta.—City Electrician R. C. Turner of Atlanta, Ga., in his annual report recommends that with the return of the railroads to their owners the City Council should begin a movement to require electrification within the city limits.

Electrical Development in Finnish District.—U. S. Consul Parker W. Buhrman writes from Helsingfors, Finland, that a stock company has been organized in the communities of Middle Osterbotten, Finland, for the development of the water power of Korpela Falls on the Lestijoki River. The total cost of the development is estimated at 2,190,000 marks (now about $110,000).

Electrical Fires Small Percentage.—Owing to co-operation of the Dayton (Ohio) Power & Light Company and the officials of the local fire department, the practice of charging to electricity all fires of mysterious origin has been largely eliminated. The employees of the electric light company and the officials of the fire department jointly investigate all fires in which the cause is not readily apparent. The following statistics showing the causes of the fires in the year 1919 bring out that of the total number of fires, which was 1032, only nine were chargeable to defective wiring, and there was a total of only fifty-two electrical fires. The fires in Dayton were charged to the following causes: Chimneys, 456; coal stoves, 19; coal furnaces and boilers, 53; electric, 52; gas, 67; gasoline, 8; gasoline automobiles, 39; gasoline automobiles in garages, 19; oils, 7; miscellaneous, 312. The electrical fires were divided as follows: Defective wiring, inside, 9; defective wiring for motors, 7; defective wiring for street cars, 8; defective aërial wiring, 24; electric ironing exposures, 4; total, 52.

Engineering Council Needs Support.—The Engineering Council has issued, through Alfred D. Flinn, its secretary, an appeal for contributions to aid its work for 1920. It needs to carry out its proposed work an income of $45,000 in the year, of which $30,000 is desired from general contributions. From the four founder societies $12,000 will be received and from other member societies $3,000. For 1919 the total income was $50,000, including $25,000 advanced by Chairman Channing and not yet repaid. Letters have been sent to 50,000 engineers to meet the emergency.

Pacific Coast Section, N. E. L. A., Issues Press Service.—In connection with the widespread newspaper advertising campaign now being conducted by the electrical industry in the West, the Pacific Coast Section, National Electric Light Association, is publishing a complete press service which is sent regularly to the editors of this section of the country. All phases of "happenings in the industry" are included, from the broad policies of central stations to the development and use of electrical appliances. It has been found that the newspapers which are running electrical advertising pages welcome this prepared material, printing it usually in connection with those pages. The press sheets are prepared directly under the supervision of the chairman of the publicity committee, I. W. Alexander of the San Joaquin Light & Power Corporation, Fresno.

Brooklyn Edison Dinner to Industrial Leaders.—The Brooklyn (N. Y.) Edison Company tendered a dinner on Jan. 13 to a representative gathering of men who have made Brooklyn's industrial history. Among the more than 350 guests were the heads of large financial enterprises and officials of the city. The spirit of the dinner was set forth on the walls of the ballroom of the Hotel Bossert in electric letters—"Boost Brooklyn Products" and "Be a Better Brooklynite." The electric decorations were lavish. The principal address was made by Lewis H. Nixon, Public Service Commissioner, who spoke on the regulation of public utilities. M. S. Sloan, president Brooklyn Edison Company, spoke on the growth of the company and of its efforts in endeavoring to keep stride with the remarkable expansion of Brooklyn industries in the last few years. Theodore I. Jones, general sales agent of the company and toastmaster of the dinner, presented an exhaustive survey of the industrial situation in Brooklyn. William E. Halm, president New York Dock Company, spoke on "Some Phases of Brooklyn's Industrial Development." Borough President Riegelmann touched on the marginal railway, the Jamaica Bay development and the general expansion of Brooklyn. Brigadier General G. H. Harries, who represented the Allied forces in Berlin directly following the armistice, told of some of his experiences while in the capital of the former German Empire.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Review of Public Service Commission's Proceedings.—For purposes of petition for writ of certiorari to review an award by the Public Service Commission, the Supreme Judicial Court must accept as final the commission's finding of fact, according to a decision of the Supreme Court of Massachusetts. (125 N.E. 176.)

Powers of Public Service Commission.—No arbitrary powers were given by statute to the Public Utilities Commission, according to a decision of the Illinois Supreme Court, and its orders and decisions are subject to review and must be reasonable and lawful. When a public utility files a petition for a certificate of convenience and necessity it is the plain duty of the commission to consider the petition on its merits, and if the public convenience and necessity are shown, the certificate must be granted. (125 N.E. 373).

Law of Eminent Domain.—Commissioners of appraisal, in appraising value of property of water-power owner claiming damages because of the closing of reservoir gates, had, the Supreme Court of New York holds, in E. I. du Pont de Nemours Powder Company vs. City of New York, no right to consider the opinions of experts based on the assumptions that claimant had a right to a dam making a 40-ft. head where there was a strip of land under water over which claimant had no flowage rights and where the only right that claimant had acquired by adverse possession was to flood the land to the level of a 24-ft. dam. (179 N. Y. S. 122).

Impairment of Contract Obligation by Municipality.—It has been declared by the Supreme Court of the United States, in Hardin-Wyandot Lighting Company vs. Village of Upper Sandusky, that an electric light company which received a franchise to use the streets of a village when a statute provided that the "mode" of use thereof should be such as should be agreed on by the village authorities and the company, or, if they could not agree, as should be directed by the Probate Court, did not have the obligation of its contract impaired by a law afterward passed by the Ohio Legislature, in the exercise of police power, which gave to the municipality complete control over the placing in the streets of poles and wires by such companies; that is where the effect of the statute is not extended to poles and wires in use at the time but is limited to restoration of those that had been removed and to additional construction. (40 S. C. R. 104.)

A. G. Buckholz, who has been connected with the Union Light, Heat & Power Company at Fargo, N. D., in various capacities, has been appointed accountant for the Red River Power Company, Grand Forks, N. D., a subsidiary of the Northern States Power Company.

Louis H. Bean has resigned as general manager of the Tacoma (Wash.) Railway & Power Company to become vice-president of Dwight P. Robinson & Company, consulting engineers, New York. Mr. Bean was with the Tacoma company for nine years. He is now making a trip through the Orient.

Frederic Nicholas, contributing editor of the ELECTRICAL WORLD, has resigned, effective on Jan. 31. Mr. Nicholas began his service with the McGraw Publishing Company in May, 1908, as a result of the consolidation of the *Street Railway Journal* and the *Electric Railway Review*, forming the *Electric Railway Journal* He had been associate editor of the *Electric Railway Review* and the *Railway Age*, then published by the Wilson Company, Chicago, from January, 1907. His work with the McGraw Publishing Company was at first mainly on the *Electric Railway Journal*, with occasional contributions to the ELECTRICAL WORLD. Later he divided his time about equally between the two papers. For some years his work has been entirely on the editorial staff of the ELECTRICAL WORLD.

Vernon M. F. Tallman has been appointed power engineer for Charles H. Tenney & Company, with headquarters at Boston, Mass. Mr. Tallman is well known among the younger New England central-station men. He is a native of Newport, R. I., and was graduated from the Massachusetts Institute of Technology in the electrical engineering course in 1914. He entered the employ of the Worcester (Mass.) Electric Light Company in that year as assistant to the superintendent of distribution, and after a year of varied work in different branches of the company's service he was transferred to the power sales department. Here he established a reputation in commercial engineering which spread beyond the bounds of the local central-station system and which has been influential in the rapid expansion of the company's business. Mr. Tallman is chairman of the New England Association of Central Station Power Engineers, a closely knit organization of specialists in this branch of utility service, and at the time of leaving Worcester he was vice-chairman of the Worcester Electric Light Company section of the National Electric Light Association. Just before his departure for the Tenney organization he was presented with a gold wrist watch by fellow employees of the Worcester company, Harry D. Stokes, head of the power sales department, being master of ceremonies. In his new work, which began at Boston Jan. 2, Mr. Tallman will have charge of power engineering in all branches of the Tenney service.

Men of the Industry

Changes in Personnel
and Position—
Biographical Notes

H. W. Graeber, assistant superintendent of the Oklahoma Gas & Electric Company at Oklahoma City, Okla., has been advanced to the position of superintendent, succeeding H. W. Reilly, who on Jan. 1 was appointed vice-president of that company in charge of operation.

W. C. Anderson, statistical secretary and secretary of the Technical and Hydro-electric Section of the National Electric Light Association, has left the association to join the staff of R. J. McClelland & Company, 100 Broadway, New York, recently formed to handle investment securities. Just before leaving the N. E. L. A. Mr. Anderson was appointed secretary of a special committee on geographical sections. His committee work is being taken over by A. Jackson Marshall, who is also secretary of the Electrical Vehicle Section and executive representative of the Commercial Section.

Walter C. Fish, manager of the Lynn (Mass.) Works of the General Electric Company since 1894, has resigned and accepted the position of manufacturing engineer of the International General Electric Company. Mr. Fish was graduated from Harvard College in 1886 and received the degree of B.S. in electrical engineering from the Massachusetts Institute of Technology in 1887. As an executive engineer he has established a high reputation, and last fall he returned from Europe after a six months' study of conditions in the foreign field, drawing up a program for the development of overseas business. He first went to Lynn in 1891 as assistant to E. W. Rice, Jr., then general manager of the plant. Mr. Fish was scheduled to sail for Europe again on Saturday of last week to take up his new duties.

Obituary

Robert K. Sheppard, formerly president of the Associated Manufacturers of Electrical Supplies, died at his home in Newtonville, Mass., on Jan. 22. After his resignation as sales manager of the Simplex Wire & Cable Company, Boston, in the spring of 1919 he suffered a severe physical breakdown, from the effect of which he had never recovered. Mr. Sheppard's largest service to the electrical industry was in the organization of the Associated Manufacturers of Electrical Supplies, in which he was the prime mover. He saw the value of such an organization, and found able support for the steps which led to the formation of that now important association. He was its first president, serving in that capacity for two years and retiring only because of his belief that rotation in office was desirable. He served continuously as a member of the board of governors. Mr. Sheppard was born in Boston in 1871. He was graduated from Massachusetts Institute of Technology in 1895. He entered the employ of the Washburn & Moen Manufacturing Company and remained with that company and the American Steel & Wire Company, which absorbed it, until 1912. He served in different capacities with that company, representing the insulated wire department in New York and Chicago and having charge of the Philadelphia office for eight years prior to his retirement in 1912. He then became connected with the Diamond Rubber Company, Akron, Ohio, and when it was consolidated with the B. F. Goodrich Company, became connected with the latter company. He resigned his position as manager of sales for the insulated wire department of that company in 1915 to enter the Simplex Wire & Cable Company, from which the resigned last year.

R. K. SHEPPARD

Nathan Corning Kingsbury, who for last nine years had held the position of first vice-president of the American Telephone & Telegraph Company in charge of operation and public relations, died of heart disease on Jan. 24, at his residence in New York City. Mr. Kingsbury was born at Mentor, Ohio, July 29, 1866. He entered the telephone field in 1906 as vice-president of the Michigan State Telephone Company, with headquarters in Detroit. He was elected president in 1907, and during the several years of his connection with the company its lines were extended and the service was placed on a very efficient basis. On Jan. 1, 1911, he became first vice-president of the American Telephone & Telegraph Company and removed to New York City. He continued as a director of the Michigan State Telephone Company, and was also a director of several other companies.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Improvement Shown in Early Fan Ordering

JOBBERS and dealers are already ordering fan motors for the coming season. More orders are being placed than usual, and the orders are also larger. Constant directing of attention on this phase of the fan situation is gradually bearing fruit, and jobbers and dealers are coming more and more to understand the necessity of anticipating the season and having the fans in their stock when the call comes. There were many cases of lost sales during the past season because of short fan stocks, and it is evident that less of that can be expected this year.

It is not possible to predict in May better than in January the kind of fan season that will be encountered from June to September. On the other hand, manufacturers stand a better chance of filling orders received in January than those received in May and June. Some dealers who used to order ten fans in the initial order are this year placing orders for about twenty-five. As far as can be seen, there is sufficient raw material available to supply the entire season if manufacturers do not have to wait till midseason to turn raw material into fans.

Inclosed Externally Operated Switches Gaining Rapidly

TO THE observer of trends in the electrical industry it must now be apparent that the inclosed externally operated type of knife switch will sooner or later supersede the open knife switch for all applications except those regularly handled by skilled electrical workers. The curve of progress rose slowly at first but in the last few months it has shown marked upward tendencies. There are reasons to believe that the production at the present time of inclosed switches is around 100,000 monthly, while the approximate production of open knife switches for applications other than on panelboards, etc., is estimated variously at from 55,000 to 100,000 monthly.

In the early days of American wiring it was thought necessary in the interests of safety to inclose electrical circuits. The use of conduit was developed for this purpose. The switch, however, was still left exposed, in spite of the fact that it was approached as a rule more frequently than other parts of the circuit. That it was not inclosed before is due perhaps to two causes—first, some mechanical ingenuity was required, and second, the switch was usually backed by an insulating base and provided with an insulating handle, both of which, it was thought, might properly be expected to safeguard it sufficiently. The English, on the other hand, were more thorough in their electrical safety engineering. They inclosed their switches at the same time or shortly after they inclosed their conductors.

When this difference in practice was noticed in this country an attempt was made to introduce English inclosed switches into the United States. Because the English switches needed Americanizing to rid them of excess weight and high cost, the attempt was unsuccessful. Development in the inclosed knife switch field for several years has centered in this idea of retaining safety at lower cost. Several concerns have worked simultaneously on the job, so that no one firm holds control of all desirable patents. In fact, the patents which are useful are fairly well distributed among the fifteen manufacturers. Apparently there is opportunity for any maker of open knife switches to secure a license and get into the new field, and most of them have done so already.

In the trade jobbers and dealers, generally speaking, have stocks of open knife switches varying in size. However, it is doubtful if the time will ever come when it will be as easy as it now is for the trade to dispose of its stocks of these switches in view of this later development. In spite of the fact that the inclosed switch is most surely here to stay and is increasing in numbers it is not necessary, even where safety switch laws have been passed, to unload with precipitation at a sacrifice in price. In stocking switches, however, it would be well for the trade to bear this development in mind. The trade will not be slow to do this because the inclosed externally operated switch is more attractive than the open knife switch as a merchandising proposition. It is likely to become increasingly so as discounts to recognize the electrical contractor and dealer are arranged by more switch makers.

Attachment Plug Patent Cases Appealed

IT WAS announced in the Jan. 17 issue of the ELECTRICAL WORLD, page 184, that Judge Thomas had found infringement by the General Electric and the Bryant Electric Companies of Hubbell's patents 774,250 and 774,251, and it was stated that he held the Burton patent invalid. It has now been drawn to the attention of the ELECTRICAL WORLD, however, that the decrees which Judge Thomas entered in those three cases were entered last October and were all expressly stated to be *pro forma*, and that Judge Thomas did not write any opinions but merely expressed formal conclusions in order that, as he stated, "there may be no further delay in moving forward to the Circuit Court of Appeals." In other words, in no sense has there been a decision on the merits in any of the cases in question. Judge Thomas, since hearing the cases, has been part of the time ill and part of the time too busy to go into the merits of the patents and write opinions. The formal injunctions which were entered in the cases on the Hubbell patents were suspended, the three cases were all appealed to the United States Circuit Court of Appeals, and it is expected that they will be reached for argument and decision in the course of the next two or three months.

Shipments Long in Porcelain Industry Because of Curtailed Production

RECENT price advances in the high-tension insulator market have been attributed to labor. Effective Jan. 17, pin-type insulators and suspension-type insulator accessories were advanced 10 per cent in price, while suspension-type insulators and bushings went up 5 per cent. There is no inference that labor all along the line has received increases commensurate with the advance in price. The labor market is not only short in the pottery mills but also extremely unstable. Constant goings and comings greatly curtail production, because of the breaking in of new men, and it is expected that the percentage of damaged stock will mount. In one case this cutting of production has amounted to as much as 40 or 50 per cent.

At the same time, orders are extremely high. Consequently shipments, which under normal conditions would be around six weeks, have advanced to as long as three and four months. For certain lines of insulators, to be sure, shipments can be made in shorter time than sixty days, because machinery, materials and labor are available for this work. Car shortage also affects shipping dates in respect both to incoming raw materials and outgoing finished product. Shipping schedules embrace dates as long ahead as May and June.

As far as can be learned, there is sufficient raw material, both domestic and foreign, to satisfy the demand.

The low-voltage porcelain market — knobs, tubes and cleats—is in a similar predicament. In this case, however, all prices have been withdrawn and price at time of shipment rules. Shipments, too, are very long, with production booked up through the first half of the year. In addition, it has been stated by a leading authority in the low-voltage porcelain field that orders are six months behind and that by June the entire 1920 production will be booked. Orders are very large, but here, too, production is below capacity; a particular shortage of molders exists.

The export market shows considerable activity despite unfavorable exchange. Virtually no European country is in a position to supply any quantity of insulators, particularly high-tension type. The amount of hydro-electric work now under way on that continent and in the Far East provides a good market for this material, and the outlook in that direction is unusually bright. Moreover, it appears that there is not at present sufficient capacity available to supply both the foreign and domestic market at the rate of production now prevailing.

Southern Market Is Rapidly Expanding

PROBABLY no part of the country has changed or progressed more than the South in the last five years. In what was almost wholly an agricultural country, prosperous industrial and mining developments are growing up. Five years ago the prosperity, and therefore the potential market, of the South was good or bad in accordance with the condition of the cotton crop. While this crop is still looked upon as the ready-money crop, its relative importance has steadily declined. Neverthelss, cotton, the "barometer industry of the South," so called, will this year reach a total value of $2,250,000,000. The total worth of the agricultural products of the South for 1919 has been estimated at $6,000,000,000, which is $1,500,000 in excess of the figures for the year of 1918, the greatest year in the South's history.

The industrial activity of the South has served to bring about a large influx of population, which in turn has caused the housing situation in most Southern cities to become acute. The growth of business and expansion of industries have made serious inroads into office space until it is almost impossible to obtain adequate office facilities in the more desirable sections of the principal cities. The summary by the Sixth Federal Reserve district for the last three months of 1919 building activities in twenty-seven of the Southern cities is 3,430 repair and addition permits, valued at $2,660,836, and 2,261 new permits, valued at $9,753,142. These figures do not include any construction in cities of less than 5,000 of population nor the permits for any of the large centers in Louisiana, North and South Carolina, Arkansas and Texas. Every indication at the present time is for a great period of improvement and expansion, stimulated by the huge sums of money in the hands of the rural population.

Many Localities Without Service

Of the cities and towns in the South only approximately 1,150 now have electric lighting service. Many of those without it are preparing to install distribution systems, while many more will avail themselves of the farm and residence lighting outfits that can be obtained at the present time. Poles, pole-line hardware, wire and all of those classes of material which must be had for electrical installations will experience a steady and growing market.

Owing probably to the fact that the population is largely native-born, the South has been and is remarkbly free, comparativly speaking, from labor troubles. Foreign capital, therefore, has been encouraged in the establishment of many large plants in this section. There are proposed or building today 182 new textile mills and 104 additions to existing mills, in addition to the construction of a large number of oil wells and fertilizer plants and other industries, each of which will require more or less electrical equipment for its operation. During the continuation of war conditions nearly all central stations ceased making extensions and improvements, but there is now a noticeable tendency to begin again activities along this line.

A new ruling placing export rates to Southern ports on an equal basis with the rates to the big centers in the East will undoubtedly be a great stimulant to the Southern export trade. To handle this trade adequately, however, there must be a material increase in terminal and docking facilities, coaling stations and other requisites of a deep-water port.

The jobbing and manufacturing trade in this section are aware of all the conditions outlined above and are unanimous in predicting for 1920 the greatest year in their history. A glance at some of their prospectuses might be of interest. One of the largest manufacturing-jobbing firms places its estimates of the increase of 1920 over 1919 at 20 per cent over all, while an itemization of its estimate shows increases, as follows: farm-lighting outfits, 60 per cent; specialties and heating devices, 40 per çent; pole-line material, 15 per cent; schedule and building material, 15 per cent; industrial equipment, 20 per cent. Another manufacturing jobber, while reporting an expected slump in large turbo-generator sales, feels that this loss will be fully offset by an increase of 15 per cent in industrial motors and transformers, while the sale of schedule material, special industrial apparatus and electrical specialties will be limited only by the manufacturers' ability to furnish the goods. In anticipation of this future market, a number of the larger jobbers have recently established branch offices in Southern cities, while the three principal manufacturing jobbers are taking immediate steps to provide additional warehouse space to meet the growing demand, their present facilities having become outgrown. Several companies report the need of more traveling representatives.

Heavy Stocks Will Be Needed

It is difficult, if not impossible, therefore, to pick any one line of electrical material as being worthy of especial notice, for all of the better classes of construction must of necessity include a large slice of business for the manufacturer and jobber of electrical lines. The concensus of the trade's opinion is that the difficulty will not be to find a market for stocks but to find stocks to meet the demand of a wide and steadily growing market.

The period of prosperity and general optimism undoubtedly has a tendency to breed a spirit of recklessness in purchasing and stocking and in the extension of questionable credit. Conservatives are arguing that accounts should be scrutinized just as carefully as ever and the general pyramiding of orders be avoided; for should the supply catch up with the demand, many of those pyramided orders will melt away; and there are some who feel that the supply will catch up with the demand by midsummer of 1920 and that prices have about reached their peak. The conservatives, therefore, are buying freely but cautiously and are avoiding heavy purchases for speculative purposes.

Manufacturers in United States Urged to Accept Canadian Money

THE exchange rate between United States and Canada has had a marked affect on exports of American goods over the border. Canada is the largest foreign consumer of electrical goods made in the United States. While a number of American electrical companies have already established Canadian factories, others have not, and it is these who will suffer very materially unless some solution is found quickly.

Frederic Nickolls, president Canadian General Electric Company, Ltd., and Canadian Allis-Chalmers, Ltd., Toronto, Ontario, in a letter to American manufacturers outlines the situation and recommends that, notwithstanding the existing difference in exchange between the two countries, the manufacturers on this side of the border accept payment of their charges in Canadian funds. These they can deposit in banks in Canada or utilize in settlement of their Canadian commitments.

Rigid-Conduit Prices Expected to Go Higher

WITH the $7 advance in price of merchant pipe at the mills last week, the way seems to be clear for an advance in price of rigid conduit almost any day, as the price of electric pipe is closely related to that of merchant pipe. Information from conduit manufacturers shows that such an advance is expected. All rigid-conduit prices are now subject to price at time of shipment. Shipments which may be made from the mills today may be based on card 43, those made tomorrow may be on card 44, while those made next week may be on a still higher card. The price situation is so uncertain that no guess whatever can be hazarded as to when and how much it will advance.

Output of rigid conduit is badly curtailed. Shortage of coal and coke is keeping some furnaces down, this in turn reacting upon the amount of finished product which can be turned out by the mills. Steel-mill labor, too, is short; and in addition the freight-car shortage has a further direct bearing on supply of coke to the mills and of finished product away from them.

Rigid-conduit capacity is in general booked well up through the first half year, which brings shipments up to five months. At the same time a manufacturer would undoubtedly ship out of his warehouse by truck a few hundred feet of pipe for a contractor who was about to pour concrete and who really had to have it. Some jobbers' prices are a little higher this week on black pipe, probably because stocks are so very low. Galvanized pipe stocks are somewhat better than those of black.

Metal Market Situation

Producers' prices for spot and first-quarter electrolytic copper are quoted at 19.25 cents delivered, and second-quarter at 19.37½ to 19.50 cents a pound. The outside market is making some sales as low as 18.50 and 18.62½ cents for quick delivery, but there is little metal at that figure. Most outside sales are at 18.75 to 19.00 cents spot. Second-quarter sales are a little better at 19.50 and 19.62½ cents. The copper consumers are well supplied for nearby use, and a continuing quiet although strong market is expected for a short time. New drops in foreign exchange are making it still more difficult to trade abroad.

The official lead price remains at 8.50 cents this week, although the outside market is a quarter cent higher.

Antimony is strong, showing an upward revision to 11.12½ cents.

The used market is off about a quarter cent in several lines.

Although the principal steel interest is holding fast to prices as of March 21, 1919, other interests have made several upward revisions on steel and iron. As far as can be seen the end of these advances is not yet in sight.

NEW YORK METAL MARKET PRICES

	Jan 20	Jan. 27
Copper:	£ s d	£ s d
London, standard spot	116 5 0	119 15 0
	Cents per Pound	Cents per Pound
Prime Lake	19.50 to 20 00	19 50
Electrolytic	19.00 to 19 25	18 75 to 19.00
Casting	18.50 to 18.75	18.50
Wire base	22.25	22.25
Lead, trust price	8.50	8.50
Antimony	10.62½	11 12½
Nickel, ingot	42.00 to 43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Spelter, spot	9.50	9.50
Tin, straits	64.00	62.50
Aluminum, 98 to 99 per cent	31.50 to 32.50	31.50 to 32.50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	18.00 to 18.25	17 75 to 18 00
Brass, heavy	10.50 to 11.00	10.00 to 10.50
Brass, light	8.75 to 9.00	8 50 to 9 00
Bead, heavy	7.00 to 7.12½	6.75 to 7.00
Zinc, old scrap	5.25 to 5.50	5.00 to 5.25

THE WEEK IN TRADE

EXCEPT for the West coast, a heavy volume of business is reported from all sections. Deliveries are in general slower because of car shortages and other transportation difficulties. New England has placed a light embargo on certain freight shipments.

Stocks, however, are improving for such materials as rubber-covered wire, sockets, snap switches and lamps. Most wiring materials are short, especially pipe, loom, flexible metallic conduit, flexible armored conductor and outlet boxes. Motor demand is good, and in the South and West farm-lighting sets are selling well. Heavy orders from the Midwest for power cables are not expected to have much adverse effect on mill shipments.

Washing machine prices are reported $50 higher, while small advances have been applied to insulating compounds, lamp cord, magnet wire and X-ray lighting equipment. Pipe and outlet-box prices are expected to advance although on a price at delivery basis.

Surplus electrical equipment sold by the Government up to the end of 1919 brought $637,190. The original cost of the equipment was $1,080,440.

NEW YORK

All wiring materials are moving in very large volume, that is, up to the capacity of available material. It is with difficulty that stocks of these materials, excepting rubber-covered wire, can be accummulated. In many cases incoming shipments are immediately apportioned on waiting orders and do not find their way to the stockroom. Lamp stocks are building up again after a shortage a few weeks ago. Galvanized pipe is somewhat more available than the black, although in itself low. Outlet boxes are particularly low. Conduit prices are very unstable and are expected to advance because of a recent advance in merchant pipe at the mills. Condulets, taplets and the like are of different material and no advance has been predicted for them at this time. Outlet-box prices are also expected to increase. Lamp cord, heater cord and magnet wire are somewhat higher, in some cases to discourage ordering in an already overbought market. Insulating compounds are up a little. Fiber conduit is moving in good volume, and power cable is undergoing a demand which is setting ahead shipments to April and May. Collections are good.

Insulating Materials.—Recent price advances in the basic ingredients of insulating varnishes, shellacs and compounds have been reflected in higher prices of the finished insulating materials. Prices of fibre boards are steady and stocks are good.

Outlet Boxes.—Heavy demand for 3-in. cable boxes has almost caused their disappearance from the market. The substitution of 3-in. outlet boxes for them has broken stocks in that line. Prices are those ruling at time of shipment. Raw material has advanced so that higher prices on boxes are expected.

Heating Appliances.—Westinghouse 6-lb. iron manufacture has been discontinued, and for it has been substituted a 6½-lb. iron for domestic use, listing at $8.50. This change became effective Jan. 16. The 6-lb. iron stocks will be sold till exhausted.

Cords.—Lamp-cord prices are about 5 per cent higher, as of Jan. 26, and shipping dates are very long. Factories are far behind on heater cord and are not anxious for new business. Asbestos for the latter is short.

Magnet Wire.—Extremely heavy demand is so taxing mill capacity that prices are about 5 per cent higher in an attempt to discourage orders.

Rigid Conduit.—Under extremely low supply some jobbers' prices are a little higher. Prices of ½-in. black are around $85 for less than 1,000 ft., while for 1,000 ft. they are graded below $85 and as low as $75 in one case. Galvanized pipe is available in slightly better quantities than the black.

Fiber Conduit.—Recent heavy demands from central stations have reduced stocks considerably. Shipments are along a normal schedule, but stocks are not likely to hold out over a period of long-protracted buying.

Flexible Armored Conductor.—Supplies of raw steel and iron into the steel-strip mills are slightly decreasing so no better supply of finished conductor need be expected for some time. Steel prices over the second quarter are higher but are not yet reflected in the finished product. No. 14 double strip can be had for $88 in 1,000-ft. lots up to $105 in less than coil lots.

Wire.—Rubber-covered base is still averaging about 28 cents. Jobbers' stocks are good under satisfactory incoming shipments. The lowest price is $11.40 in large lots, running up to $12.50 and $13 for 1,000-ft. lots. Weatherproof base is 28 cents, and bare wire is 22.25 cents.

CHICAGO

The week has shown a slight improvement in jobbers' stocks for the territory, although deliveries are still very uncertain in most lines. Washing-machine manufacturers have announced price increases, in one case of as much as $50, making the present list price $200. The wringer situation has become so acute that the president of one large company went East this week to see if anything could be done toward speeding up the wringer manufacturers. The production of flatirons during 1919 was 1,200,000, with one company producing 750,000 of this total. The small-motor production has now reached the astounding figure of 200,000 per month and the demand still exceeds the supply. The building slump in Chicago still continues. Building permits this week amounted to $600,000 as against a weekly average of $2,000,000 for the past ten years. Several important announcements have been made, among them being one by the Buick Motor Car Company of extensions to the Flint (Mich.) plant to cost approximately $7,500,000 and an additional $3,000,000 on an assembly plant in St. Louis.

Wire.—Stocks are somewhat better on rubber-covered, with base price still holding at 29 to 30 cents. No. 14 is quoted at $12.50 per 1,000 ft. in 5,000-ft. lots and at $11.25 to $11.75 per 1,000 ft. in 10,000-ft. lots. No. 12 is quoted at $17 per 1,000 ft. in 5,000-ft. lots. Base price on weatherproof remains at 28 cents for sizable orders and 30 cents on small lots. Sizes of weatherproof on which base price is effective now range from No. 4/0 to No. 10 solid, instead of No. 4/0 to No. 4. Magnet wire is very difficult to obtain, especially in smaller sizes.

Lamp Cord.—No. 18 cotton-covered, is quoted at $24.25 in 1,000-ft. lots. Stocks are somewhat spotty in cotton-covered with silk-covered cords practically impossible to obtain.

Washing Machines.—Several manufacturers have annouced increases this week, in one case as high as $50, making a new list price of $200. Deliveries are very uncertain, manufacturers being held up on account of the very acute wringer situation.

Rigid Conduit.—Stocks are very short and jobbers consider themselves lucky to get a car without regard to sizes. One-half-inch enameled is quoted at $80 to $81.50 per 1,000 ft.; ¾-in., $105 to $108 per 1,000 ft., and 1-in., $155 to $159 per 1,000 ft.

Non-Metallic Flexible Conduit.—This material is coming through somewhat stronger, but stocks have not been built up to any extent. Current quotations on 7/32-in. loom are $33 in 5,000-ft. lots, showing an increase of from $3 to $5 since the middle of December.

Metallic Flexible Conduit.—Stocks are short. List price on the ½-in. is $10 per 100 ft. with 5 per cent off in coil lots of 100 ft. and 10 per cent off in 1,000-ft. lots.

Snap Switches.—Stocks are getting somewhat better, but are still uncertain. The 5-amp. single-pole non-indicating switch is quoted at $22.40 per 100 in standard packages of 250, and the 5-amp. three-way at $38.40 per 100 in standard packages of 100.

Sockets.—The supply is somewhat better, but stocks are still spotty with ⅛-in. cap key sockets in lots of 500 quoted at $26.40 per 100. Pull sockets are $48 per 100 in lots of 250, and keyless are $24 per 100 in 500 lots.

Reflectors.—The National X-Ray Reflector Company has announced an advance of 10 per cent list to jobbers and an increase to consumers of 50 per cent, in some cases, on direct-lighting equipment, and has reduced discounts from 27 to 20 per cent, making an increase of about 10 per cent on indirect reflectors. The glassware situation is reported as responsible for these increases.

BOSTON

Trade continues to put a heavy strain upon stocks and manufacturing facilities. Deliveries are lengthening, and a limited freight embargo on East-bound shipments has been declared by the New Haven and Central New England roads. Heavy snow is also retarding local deliveries. Collections are fairly good, although shortages in wiring materials are holding back the completion of wiring jobs and slowing down payments to and by contractor-dealers. Prices are steadier this week, but stocks are irregular and hard to maintain. Labor conditions are more stable. Building and engineering contracts to Jan. 22 total $13,677,000, against $3,643,000 for the same period last year. Office and industrial plant buildings are the chief features of this tremendous expansion. Central stations are making inquiries for distribution system equipment, and industrial plant activity is a feature of the cable market. Retail sales of appliances are holding up well, although some stores which were largely "cleaned out" at Christmas report dull trade this month. Jobbers are still buying far ahead, but the manufacturers are beginning to make an impression on commodity stocks, and there is an undercurrent feeling that the worst shortages are past in most lines.

Wire and Cable.—Prices are unstable, discounts from base quotations varying widely. Roughly, bases range around 28 to 30 cents for rubber-covered and weatherproof, bare being quoted on 24 cents base. Heavy buying of cable by Middle West central stations featured the market last week.

Non-Metallic Flexible Conduit.—Stocks are still low. Quotations on 7/32-in. and ¼-in. conduit in coil to 1,000-ft. lots are $34 and $37 per 1,000 ft. respectively. A large demand exists and contractors are complaining that important house-wiring jobs are delayed by the prevailing shortage.

Metallic Flexible Conduit.—A price of 15 per cent off list is noted on coil to 1,000-ft. lots. One-half-inch conduit is bringing $8.50 net per 100 ft., with many inquiries and low stocks.

Flexible Armored Conductor.—This material is scarce. Prices are firm, No. 14 single-strip bringing $90 per 1,000 ft. in coil to 1,000-ft. lots and $100 per 1,000 ft. in less than coil lots. No let-up in demand can be seen.

Sockets.—Fair stocks are being maintained, although building expansion predicates no material surplus. Pulls in case lots are quoted 47.5 cents each, keys 27 cents and keyless 25 cents.

Snap Switches.—A good supply is reported, with steady prices. Discounts run from 17 to 20 per cent off list.

Motors.—Manufacturers and dealers are swamped with orders. Prices are firm. Sales of motors in fractional horse power sizes are very active and a brisk demand extends even to 25-hp. and 50-hp. units.

Transformers.—Central stations are coming into the market for extension and industrial equipment. One Boston jobber had nearly $100,000 in transformer bids out at the end of last week.

Appliances.—Grills and irons are beginning to come from the factories, but in moderate quantities. Toasters are scarce. Retailers are being urged to schedule their orders on a basis of monthly shipments. Early fan shipments are about due on purchases made last fall. Washers and cleaners continue to flow in bulk into the retail market. Oblong grills are reported short, together with waffle-irons.

Ranges.—A fair demand exists, but deliveries are slow.

Industrial Electric Trucks.—Sales are steady if not rushing. Deliveries are longer, four to six weeks being quoted. Motor shortages appear responsible.

Fuses.—Trade is increasing. Stocks are still fairly full, but the future is likely to see a reduced quantity on hand. Forty-two per cent off list is quoted in ordinary cases.

ATLANTA

A constantly increasing demand for nearly all lines of electrical material is becoming more and more pronounced. Considerable difficulty in obtaining sufficient material is to be noted, and some of the jobbing firms reflect a feeling of uneasiness regarding the continued supply of the necessary commodities in their lines. As a result, orders are being placed anywhere that the material is to be obtained. The coming few months will witness the peak of the demand and every effort is being made to accumulate, if possible, sufficient stocks to supply in a measure at least the requirements of the trade. Slow shipments coupled with heavy demands indicate that this attempt to stock up for spring trade will not meet with much success. A number of jobbers are refusing to "back-order" any material.

Each week brings the announcement of the construction of a large number of new plants throughout the territory, while the chambers of commerce of the various cities are stressing the urgent need of additional housing facilities. Of course this activity is reflected in the tremendous increase in building permits for this section.

Conduit.—One of the largest jobbers reports an acute shortage in the larger sizes of rigid conduit, while a general shortage of the more popular sizes from ½-in. to 1½-in. is reported by all. Shipments continue poor, because of the inability of manufacturers to obtain raw material in sufficient quantities. Prices remain subject to quotations at date of shipment.

Safety Switches.—The recent ruling of the local electrical superintendent stimulates the demand, and while stocks are at present in fair shape, they cannot be expected to hold up for any length of time because of poor shipments.

Panelboards.—Contrary to the general rule, shipments on panelboards continue good. Brisk demands are being experienced, traceable largely to apartment house and office building construction.

Steel Boxes.—Despite a demand that is reported as only fair, a pronounced scarcity of steel boxes exists. Poor shipments show the impossibility of remedying this condition.

Printing-Press Motor Equipment.—Inability of the manufacturer to supply the fall and winter demands is responsible for the slight slackening in the receipt of orders for this eqiupment. Continued poor shipments, which are quoted at twenty weeks, preclude the possibility of an accumulation of stocks in the territory. One of the largest jobbers reports his Atlanta stock entirely wiped out.

Heating Devices.—An increase in prices in all lines of heating devices has been announced, the increase varying from 10 to 20 per cent. Such an advance does not seem to have in any way checked the demand. Shipments are coming in but are being quickly absorbed by the retail trade.

Farm-Lighting Outfits.—One of the largest jobbers reports a growing tendency of the consumer to purchase outfits of the separate unit type. A brisk demand has depleted the local stocks and shipments are slow.

Industrial Motors.—A brisk demand for motors continues, particularly in the popular sizes of 220-volts and 2,300-volts. One of the national manufacturers announces an advance of from 5 to 10 per cent in all motor prices, effective Jan. 23. Stocks throughout the territory are badly depleted, with the popular sizes almost unobtainable. Shipments continue poor, the average at the present time being eighteen weeks.

SEATTLE—PORTLAND

Conservatively speaking, according to a majority of jobbers in the Puget Sound district, business is quiet; if anything, the sales are less and of smaller consequence than during any January for several years. This is attributed to increasing lack of employment, to closing down of shipyards, lumber mills and logging camps and because of general prevailing uncertainty. With the exception of sales of domestic appliances and some scheduled materials nothing is moving with any unusual momentum. Jobbers are taking inventory and trying to replenish and build up stocks.

Appliances.—Stocks of washing machines are low, but supply of vacuum cleaners and sewing machines is adequate, although both are showing a fair movement. Other appliance stocks are in fair shape, because jobbers ordered far in excess of actual needs. Prices are holding firm.

Lamps.—Lamp business during the past month shows a slight decrease over the previous month because of continued slacking off in building and decreased buying from ship yards and allied industrials. However, according to two jobbing houses, indications are that 1920 will be as good as last year or the year previous. Stocks are in good shape on account of execellent factory shipments from California.

Farm-Lighting Plants.—Sales are exceeding expectations; in fact, jobbers are having a hard time supplying the increasing demand from eastern and central Washington and Oregon. Sales in Puget Sound territory also have been far heavier than anticipated. Stocks are low but prices remain stable.

Motors.—Movement in power apparatus, including large motors, is at a minimum, but movement of smaller fractional sizes recently has shown a fair increase.

SAN FRANCISCO

A leading power company reports that 80 per cent of its power at the present time is steam power, a startling situation in a state noted for its hydro-electric service. Rainfall is light. The fine weather has stimulated building and many small jobs have been reported. One of San Francisco's largest department stores, which carries electric devices, has recently promulgated a radical decision, namely, to bill out all devices at the retail prices prevailing during date of actual purchase by the department stores. This plan has not had time to mature, so that its effects cannot yet be estimated.

Bells and Buzzers.—The great increase of small building has caused a sudden jump in the sales of bells and buzzers. Several San Francisco jobbers are now out of style C. The 2½-in. size nonadjustable now sells for 40.5 cents each in hundred lots. Buzzers in the same quantity sell for the same price.

Inclosed Fuses and Cut-Outs.—National code fuses and cuts-outs have increased 10 per cent in price in all quantities the 250-volt size fuses in small quantities selling for 13.5 cents each in package lots. The demand for these fuses is increasing, and the call for renewable fuses, save from a few large plants that have installed cases and now wish links, has fallen to a mere trifle.

Vibrators.—The usual winter cold, and especially the heavy land fogs, has increased the sale of vibrators and heating pads. Side by side with this residential demand has grown a greater call for barber-shop and hotel installations of larger styles.

Porcelain Material.—Commercial porcelain, such as tubes and knobs, is selling at a surprising rate. Several orders of from 10,000 to 30,000 assorted pieces are reported in San Francisco, and such cities as Fresno and San José are ordering in lots of ten barrels. No. 5½ solid knobs are selling at $15 per barrel in barrel lots, 5/16-in. x 3-in. tubes at $9.45 per 1,000 in barrel lots. The demand for cleats is not so good.

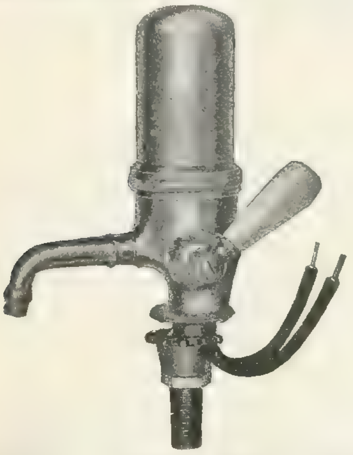
Sewing Machines.—Portable electric sewing machines are soaring higher and higher. The vibrating style now sells at $62 each and the rotary style full-head motor at $74 each, with about a 33⅓ per cent margin to the dealer.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Coilless Electric Faucet Water Heater

An automatic electric faucet water heater which has no switch or coils is now being marketed by the "Hotwat" Distributing Company, 402 Title Insurance Building, Los Angeles, Cal.



AUTOMATIC ELECTRIC FAUCET WATER HEATER OF SIMPLE DESIGN

The new faucet has but four major parts—the portion which is attached to the water pipe, a carbon cylinder, a graphite rod and a nickel cap. By turning the handle to the "hot" mark fresh cold water is said to be instantly heated by flowing into the upper part of the faucet. The faucet can be obtained with either a 4-in (10 cm.) or a 6-in. (15 cm.) heating cap and for operation with 110 volts or 220 volts, alternating current.

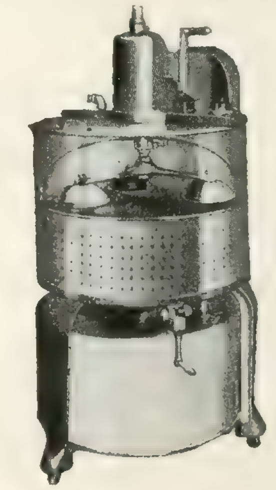
Multi-Cell Dry Battery

MULTI-CELL DRY BATTERY

Standard-size dry cells insulated from each other and hermetically sealed in one container make up the "Red Seal sparker." Only the terminal nuts project through the sealing compound. These nuts are plainly marked positive and negative and are covered with an insulating knob which is easy to handle and prevents accidental short circuit by metal objects laid across the top of the battery. A web handle is fixed on the battery for convenience in handling. The "sparker" is regularly made in combinations of four to ten cells and may be had in special sizes.

Machine for Boiling, Washing, Rinsing and Drying Clothes

An electrically operated washing machine which boils, washes, rinses and dries clothes without the use of a wringer and without any necessity for handling or removing the clothes from the machine has been developed by the Home Utilities Company of Chicago and is known as the "Klymas."



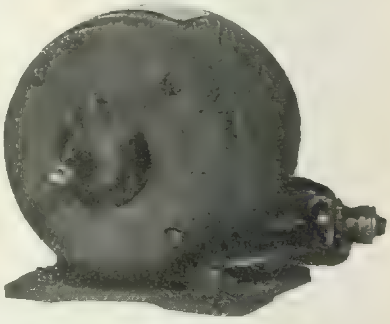
WASHES, BOILS, RINSES AND DRIES CLOTHES WITHOUT REMOVING THEM FROM MACHINE

Washing is done in the new machine by the vacuum and suction principle, three cups being used. A gas heater is provided so that boiling or steaming takes place and sterilizes the clothes while they are being washed. To rinse the clothes a faucet is first opened and the soapy water runs into a reservoir below the washing compartment. The fresh clean water is then turned on and the clothes are rinsed by the machine, the rinse water running off into the drain. Centrifugal force is used to dry the clothes. In cases where it is advisable to use the soapy water over again for the next batch of clothes it may be pumped back into the washing compartment free from dirt and foreign substances.

The new washing machine is operated by a ¼-hp. electric motor taking current from a lamp socket. Belt drive is employed and all moving parts are incased. The machine is constructed entirely of metal, aluminum, copper and brass being used for all parts coming in contact with water or the clothes. The capacity of the washer is eight sheets or their equivalent, and it is 26 in. in diameter and 42 in. high.

Splash-Proof Fractional Horsepower Induction Motors

A new line of fractional-horsepower induction motors has been brought out by the Ohio Electric & Controller Company, 5,900 Maurice Avenue, Cleveland, and are made in two frames and four ratings from ⅛ hp. to ⅓ hp. The housings are of the protected splash-proof type. A centrifugal cut-out starting switch is employed. The motors are ball-bearing and are provided with a ventilating fan.

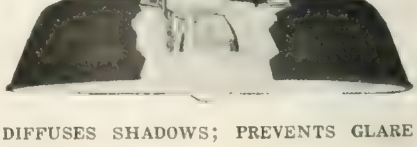


MADE IN TWO FRAMES AND FOUR RATINGS FOR ⅛ HP. TO ⅓ HP.

Standard specifications include pulley, detachable base with slotted holes allowing adjustment in mounting, and cord and plug. Direct-current motors of the same ratings and physically interchangeable with the induction motors are being developed.

Diffusing Industrial Lighting Fixture

High efficiency combined with uniform light distribution and low intrinsic brilliancy devoid of annoyance to the eye were the advantages sought for in designing the new "Maxolite diffuser," which is being offered by the Central Electric Company of Chicago.



DIFFUSES SHADOWS; PREVENTS GLARE

The glass globe of the new lighting unit is 5 in. (127 mm.) in diameter and has its lower part frosted. The 22-in. (55.8-cm.) enameled-steel reflecting shade, because of its large size, it is claimed, tends to eliminate and soften shadows and its curvature is designed to do away with glare. A deflector plate is fitted closely around the neck of the lamp to prevent loss of light in the top of the fixture. There are said to be no parts of the lighted surfaces which can collect dust and the reflector and globe are easily accessible to a duster.

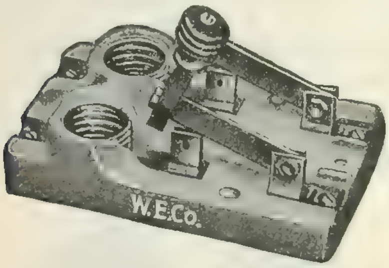
The new unit is recommended for use with a 200-watt gas-filled lamp, with 9 ft. (2.7 mm.) to 14 ft. (4.2 m.) spacing, mounted at a height of from 11 ft. (3.3 m.) to 14 ft. (4.2 m.). A unit for use with 100-watt or 150-watt lamps is also manufactured.

Insulated Danger Signs

Insulated danger signs made of asbestos slate and bearing the legend "Danger, —— Volts" in white on a red background are now made by C. B. Hughes, 7010 South Green Street, Chicago. These signs are said to be especially useful for hanging over transformers and other "live" equipment since should they fall down they will not cause a short circuit.

Two-Pole and Three-Pole Entrance Switches

Porcelain-base entrance switches in two-pole and three-pole styles are now being manufactured by the Ward Electric Company, Philadelphia Stock Exchange Building, Philadelphia, Pa.



TWO-POLE ENTRANCE SWITCH

Electrically Operated Railroad Crossing Signal

The Charles Adler Electric Brake Company, 1718 Eutaw Place, Baltimore, Md., has developed a safety railroad-crossing signal consisting of an audible alarm for warning vehicles of a train's approach and a railway-side visual signal to indicate to the engineer as his train enters the block whether or not the audible alarm or bell at the crossing some 1,200 ft. (365 m.) ahead is ringing. When the bell is out of order and does not ring it signals the engineer of the approaching train so that he may sound the locomotive bell and approach the crossing at slow speed.

Tree Trimmer Has Two Speeds

A distinctive feature of a new tree trimmer designed by the Bush Electric Company, 6,654 Broadway, Cleveland, Ohio, is the high and low gear at which it operates. One quick sliding motion of the handle, it is claimed, gives plenty of leverage for cutting small branches. For larger limbs the operating handle is swung around, giving a greater leverage for operating the cutter. It is said that with three or four pulls a limb 1⅞ in. in diameter may be cut.

The wooden handle is specially treated to withstand 5,000 volts per inch. There are no ropes, wires or metallic connections between the cutter and the operating handle.

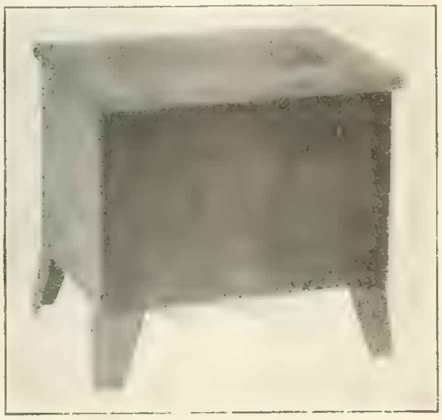
Rug Display Fixture

For illuminating rugs on display the Pittsburgh Reflector & Illuminating company has developed a fixture for mounting four or five lamps in reflectors directly in front of the rugs. The frame, which is of square steel tubing, black enamelled inside and out, is either mounted directly on the ceiling or carried on pipe hangers dropped from the ceiling. The lamp receptacles are mounted on the bottom side of this tube, and the wires are run inside of the tube. A pull switch with a cord is furnished. The fixtures are in two standard lengths one for four lamps and one for five lamps, and are in two types to accommodate either 50-watt or 100-watt lamps as desired.

MAY BE MOUNTED ON CEILING OR ON PIPE HANGERS

Bench Type Metal Melter

For melting lead, babbitt and similar metals what is known as the 25-lb. electric metal melter bench-type pot has been developed by the General Electric Company, Schenectady, N. Y. This new pot is of solid, durable construction, having four short legs on the bottom and a flange on the upper rim and has plug and socket fixture.



AUTOMATIC REGULATION OBTAINED BY USING WIRE WITH POSITIVE TEMPERATURE COEFFICIENT

The automatic regulation which is the principal feature of the device has been obtained by constructing the heating element of wire which has a positive temperature coefficient. When cold metal is put into the container the initial rise of current is enough to melt it quickly, but after it is melted the current is automatically reduced to just enough to keep it molten but not enough to burn it.

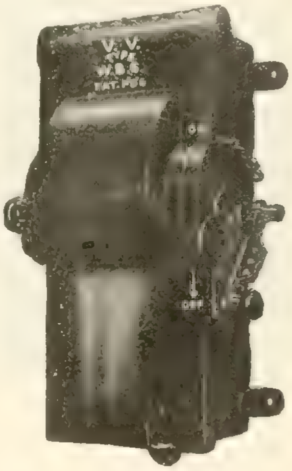
Helmet, Apron and Gloves for Electric Welding Operators

A protecting helmet shields and an apron and gloves treated with a fire-resistant compound have been brought out by the Electric Arc Cutting and Welding Company, 222 Halsey Street, Newark, N. J., for the use of electric welding operators.

Weatherproof Quick-Make-and-Break Safety Switches

A heavy cast-iron externally operated outdoor safety switch with rain-proof cover has been brought out by the V. V. Fittings Company, 1910 North Sixth Street, Philadelphia, and is designed with safety features to give maximum protection to the operator and to the circuit which the switch controls.

The cast-iron box of the new switch has fastening lugs on the outside to insure rigidity and a weatherproof installation. The switch mechanism is the same as that of the type BG switches made by this company and described in the ELECTRICAL WORLD of Jan. 24, 1920. These switches are obtainable in fusible style for N.E.C. fuses and for operation on alternating current or direct current of 250 volts. Either 30-amp. or 60-amp. sizes may be had in two-pole or three-pole styles.



Notes on Recent Appliances

Tension Device for Coil Winding

For use in high-speed coil winding the Belden Manufacturing Company Twenty-third Street and Western Avenue, Chicago, has developed a tension device.

Motor-Driven Deep-Well Pump

The Burnett-Larsh Manufacturing Company, 537 East Monument Avenue, Dayton, Ohio, has recently brought out its style No. 3000 "Duro" electrically driven directly connected deep-well pump.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

I. F. BAKER of the Westinghouse Electric International Company who has been in the New York office of that company for the past two years, is on his way to Tokio, Japan, where he will act as a special representative of the Westinghouse Electrical International Company.

R. M. MURPHY, recently made sales manager of the McCandless Miniature Lamp Works of the Westinghouse Lamp Company, commenced his electrical career with Sanderson & Porter, engineers, Jan. 1, 1906. On Jan. 1, 1909, he went into the employ of the Westinghouse Electric & Manufacturing Company at San Francisco, leaving the company in 1912 to manage the Los Angeles office of the Westinghouse Lamp Company. He returned in 1915 to San Francisco to handle general sales work for the company on the Pacific Coast. In 1917 he was transferred to the New York executive offices as manager of the company's syndicate activities. On Jan. 1, 1919, he was appointed assistant sales manager of H. W. McCandless & Company, a subsidiary of the Westinghouse Lamp Company, the sales departments of which were later more closely merged into the sales organization of the Westinghouse Lamp Company, after which consolidation he was made sales manager of the McCandless Miniature Lamp Works of the Westinghouse Lamp Company.

R. W. MURPHY

THE UNITED STATES LIGHT & HEAT CORPORATION, Niagara Falls, N. Y., has plans under consideration for the rebuilding of the battery building recently destroyed by fire.

THE EDISON ELECTRIC APPLIANCE COMPANY'S New York office will move from 147 Waverley Place to 140-142 Sixth Ave. between Tenth and Eleventh Streets, about Feb. 1. The new location will provide ample space for offices, showrooms and service station.

GEORGE M. CULLINANE, who, as assistant works engineer had charge of electrical design and construction of new plants for the Scullin Steel Company, St. Louis, Mo., resigned Jan. 1. 1920, to become sales engineer in the St. Louis office of the Westinghouse Electric & Manufacturing Company. Mr. Cullinane was graduated from the University of Illinois in 1917.

FUSE COMPANY BUYS EAST ST LOUIS PLANT. The Bussmann Manufacturing Company has completed the purchase of a modern factory in East St. Louis totaling 22,000 sq.ft. of floor space, according to a statement issued by Harry Bussmann, vice-president of the company. The new factory will be operated as plant No. 2 and will double the capacity of the Bussmann company, which manufactures electrical fuses of all types. Its sales in 1919 amounted to 16,000,000 fuses, and the 1920 production is based on an estimated output of 40,000,000. Additional ground adjoining the new plant has been acquired by the company, sufficient to permit an increase of 50,000 sq.ft. of floor space when it becomes necessary. Further enlargements are expected in the next eighteen months, and a capacity of 75,000,000 fuses a year will be attained in two years, according to present plans.

CHARLES CORY & SON, INC., 290 Hudson St., New York City, manufacturer of electrical signaling apparatus, electrical marine equipment, etc., is rushing work on the construction of its new plant at 183-187 Varick St., upon completion of which the company's works will be removed to the new location. The plant should be in operation by May.

THE CRESCENT INSULATED WIRE & CABLE COMPANY, Trenton, N. J., has completed plans for the construction of a new addition to its plant, one-story steel and concrete, about 50 ft. x 125 ft., to be built on property acquired recently at Taylor St. and Ginder Alley. The structure is estimated to cost about $40,000.

THE GENERAL ELECTRIC COMPANY has completed plans for the early construction of a large new three-story brick addition about 67 ft. x 196 ft., to its Windsor (Conn.) plant.

THE INCANDESCENT SUPPLY COMPANY, 468 West Broadway, New York City, has filed notice with the Secretary of State of an increase in capital from $250,000 to $500,000.

THE INDEPENDENT LAMP & WIRE WORKS, Weekhawken, N. J., has awarded a contract for the erection of a new building on Gregory Ave., to be used as an extension to its present works.

A. C. MANWEILER COMPANY, Fort Wayne, Ind., manufacturer of incandescent lamps, etc., suffered a loss of more than $10,000 in a fire which occurred in its factory on Jan. 3. So much of the machinery was destroyed that the plant had to be shut down, but Mr. Manweiler told a representative of the ELECTRICAL WORLD that he expected to resume the operation of the factory at an early date.

THE MATERIAL HANDLING MACHINERY MANUFACTURERS' ASSOCIATION, 35 West Thirty-ninth St., New York City, has changed the date of its meeting from Jan. 29-30 to Feb. 26-27. The sessions will be held at the Waldorf-Astoria Hotel, and the association invites to them all manufacturers of cranes of various types, hoists, winches, conveyors, industrial trucks, tractors and trailers, bulk-handling machinery, elevators and all forms of equipment and supplies used in construction and operation of mechanical handling machinery. Zenas W. Carter, 35 West Thirty-ninth St., is secretary.

L. S. MONTGOMERY, who joined the organization of the Fairbanks Company in March, 1918, as manager of the electrical department of that company's branch at Birmingham, Ala., has recently been transferred to the administrative offices at 416 Broome Street, New York City, and made manager of the electrical department of the mill, mine and railway supplies division in charge of the company's activities through its various branches in the handling of industrial electrical supplies. At Birmingham Mr. Montgomery organized the first electrical supply department for the company. The success of that department has caused the company to decide on the addition of similar departments to all its twenty-two branches. Those at New Orleans, St. Louis and Baltimore will take up this work first. It is the plan to specialize in industrial electrical supplies. It will be the aim to stock standard lines sufficient to meet all requirements of light and power installations. Mr. Montgomery's varied and successful experience in the organizing of electrical sales work makes him especially fitted to direct the policies of the Fairbanks Company in its new undertaking. Eleven years ago he was made district manager of the National Metal Molding Company and established that company's first office in the South at Atlanta, Ga. Four years later, in March 1913, he was transferred to the company's headquarters to organize a district office in Pittsburgh, Pa. A little later he was transferred to Buffalo as district manager in charge of the Canadian territory. After three years in that position he resigned to do military service on the Texas border as a member of the National Guard. When discharged he was appointed manager of the New York office and warehouse of the American Conduit Manufacturing Company, which position he held until the declaration of war with Germany. Mr. Montgomery served in the army with the rank of captain. He joined the organization of the Fairbanks Company shortly after being released from the service last year.

THE LOCKE INSULATOR MANUFACTURING COMPANY, Victor, N. Y., announces that, as of Jan. 1, Kent A. Hawley will have charge of the company's New York City office, at 233 Broadway. Mr. Hawley is a graduate of the University of California and has been connected since 1907 with the following firms and projects: Simmen Automatic Railway Signal Company, of Los Angeles; Charles C. Moore & Co., on the test of the Redondo power plant of the Pacific Light & Power Company; Great Western Power Company, on the construction of the Great Bend power plant with Vielè, Blackwell & Buck, engineers; design and construction of the Oakland substation and auxiliary power plant, and the construction of the generating and substations of the Appalachian Power Company. He was with the construction department of the General Electric Company at the McCall's Ferry power plant of the Pennsylvania Water & Power Company, and with Gibbs & Hill of New York on the electrification of the Norfolk & Western Elkhorn grade, the Pennsylvania Railroad at Philadelphia, the New York Connecting Railroad on Long Island, and recently on the electrified zone of the New York, New Haven & Hartford Railroad.

K. A. HAWLEY

GEORGE N. BROWN, before entering service in 1916 an electrical engineer and later assistant superintendent for the New York State Railways Syracuse-Utica lines in Utica, on his return as captain of engineers last July, again became connected with the railway company. In September he became manager of the Buffalo office, 601 Ellicott Square, of the Schiefer Electric Company, Rochester, N. Y. E. E. Strong, formerly superintendent of the Rochester lines of the same railway, is manager of the Schiefer Syracuse office.

THE DOEHLER DIE-CASTING COMPANY, Brooklyn, N. Y., at its Jan. 5 directors' meeting, re-elected the following officers: H. H. Doehler, president; H. B. Griffin, vice-president; O. A. Schroeder, treasurer; O. A. Lewis, assistant secretary. The company also added to its list of officers J. Kralund, second vice-president, in charge of production, and Charles Pack, secretary and chief chemist.

THE BLACK & DECKER MANUFACTURING COMPANY has further extended its permanent organization by the establishment of a branch office at 6523 Euclid Avenue, Cleveland, Ohio. Garth A. Dodge, formerly connected with the Austin Company at its Cleveland headquarters, has recently joined forces with Black & Decker in the capacity of branch manager for the states of Ohio and Indiana and will be in charge of the Cleveland branch.

Supply Jobbers' Notes

CLARENCE L. ELDER has been appointed general sales manager of the Varney Electric Supply Company, Indianapolis, Ind. Mr. Elder has been with this company for about ten years and was first assistant manager in the sales department at the time of his promotion on Nov. 1

THE ELECTRIC APPLIANCE COMPANY of San Francisco opened the new year with an annual dinner, to which the representatives of the manufacturers with which the company does its principal business were invited. The toastmaster, C. C. Hillis, vice-president and general manager, emphasized the value to both the company and the employees of maintaining the closest personal touch with the trade. The banquet tables were arranged in triangular form to symbolize the trademark of the company.

MEMBERS AND GUESTS OF ELECTRIC APPLIANCE COMPANY AT ANNUAL DINNER

J. LIVINGSTON & COMPANY, INC., New York City, is organizing a new company which will be known as the Livingston Sales Corporation, capitalized at $100,000. This company will take over the electrical appliance business of J. Livingston & Company and will sell through dealers exclusively in all territory where it has a dealer representation. The latest contract is with the Kelvinator Corporation of Detroit for the distribution of its household refrigerating machines for the Metropolitan district, eastern part of the State of New York, northern part of New Jersey, Long Island, Staten Island and a portion of Connecticut. The company has undertaken to sell upward of 1,700 of these machines during the year 1920 and anticipates that this quantity will not be sufficient to supply the demand. The company distributes nine different lines of household labor-saving devices.

Foreign Trade Notes

CONDUIT AND CABLE URGENTLY NEEDED IN SOUTH AFRICA.—According to the South African Mining and Engineering Journal, the present dearth of threaded tubing for underground use, is of immediate concern in the electrical world of Johannesburg. In lieu thereof contractors are being forced to use water piping. Other materials are coming in fairly freely. The supply of heavy cables is short, and there are only small shipments of electrical goods on the water in transit to South Africa, it is said, but it is generally expected that in the near future heavy consignments will be dumped there from Germany at prices much below English, American, and Japanese goods. As a mater of fact, goods bearing the trade mark "made in Holland" have already arrived.

GROWING DEMAND FOR ELECTRICAL SUPPLIES IN COLOMBIA—As a result of the large coffee crop of the last season and the high prices obtained for its export, the city of Manizales is now an excellent market for foreign goods, especially American. The largest part of the coffee crop of this vicinity is marketed in the United States and local merchants have therefore a large amount of funds located in New York with which to purchase American manufactured articles. All sorts of manufactured articles are in demand, but it is especially noteworthy that electrical supplies are coming into use.

DEVELOPMENT OF THE SWEDISH ELECTRICAL INDUSTRY.—According to the Electrical Industry Association of Sweden, the Swedish electrical industry has made splendid progress during the years of the war. The combined share-capital of Swedish electrical industries, which amounted to about 50,000 kr. in 1914, has at the present time reached a total of 230,000 kr. The total output-value of the trade was about 20,000 kr. in 1914 and would seem to have come to about 100,000 kr. in 1918. However, the Swedish electrical industry must be prepared to meet a much keener competition after the war both in the export and in the home market, according to the Association report.

FRANCE NEEDS ELECTRICAL SUPPLIES.—There is a certain demand for imported supply material in France. At the same time French manufacturers are increasing their output of electrical goods. Conduit is scarce, a conduit made of tumbler sheet metal tube with crimped joints lined with paper being substituted. This uses sleeve unions instead of screwed joints. This type is preferred to heavy metal conduit. Screw sockets rather than bayonet sockets are needed, and other inquires call for multiple snap switches, flush type push-button switches, fittings requiring hard rubber in their manufacture and high candle-power low-volt moving picture lamps.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

M. H. Dinshaw & Company, Green Street, Fort, Bombay, India, importers and dealers in machinery and electrical products such as generators, motors, nevelties, etc., requests catalogues, price lists with discounts and any other information from manufacturers of such apparatus, with a view to representing them in India.

A company in the Canary Islands (No. 31452) desires to secure an agency for the sale of electric material. Quotations should be given c. i. f. the Canaries, via Liverpool. Terms 30 days sight up to 60 days usually granted to purchasers. Correspondence should be in Spanish.

An engineer in the United States (No. 31464) who is about to make a visit to Venezuela and Porto Rico, desires to secure the representation of firms for the sale in those countries of electrical apparatus, power plants, and anything in connection with the electrical trade.

Trade Publications

OUTDOOR DISCONNECTING SWITCHES.—Hickey & Schneider, Inc., 439 East Jersey Street, Elizabeth, N. J., have just published Bulletin No. 15 on their various types of disconnecting switches for outdoor service.

MEASURING GASES.—The Bacharach Industrial Instrument Company of Pittsburgh, Pa., has issued pamphlet leaflet on Pitot tubes and orifices for measuring the flow of gases in connection with flow meters.

BATTERY CHARGER. — The France manufacturing Company, West 104th Street and Berea Road, Cleveland, O., is circulating bulletin No. 31 on the "F. F. Bantam Battery Booster" for home charging of storage batteries.

RADIATORS. — The Majestic Electric Development Company 1702 Allegheny Avenue, Philadelphia, Pa., has prepared a leaflet descriptive of its No. 8 radiant electric heater which has two heating units.

INSTRUMENTS.—A forty-page booklet has been issued by the Pyrolectric Instrument Company, 636 East State Street, Trenton, N. J. covering "pyrovolter" type instruments and thermocouples.

INDUSTRIAL TRUCKS AND TRACTORS.—A forty-eight page booklet has been prepared by the Automatic Transportation Company of Buffalo, N. Y., to tell about its "Automatic" electric industrial trucks, tractors and engines.

FLOOR MACHINE.—The International Floor Machine Company, 149 West Thirty-sixth Street, New York City, is circulating a folder about the "International" electrically operated floor polishing and surfacing machine.

JACKS.—Templeton, Kenly & Company, Ltd., Central Avenue, Taylor and Fillmore Streets, Chicago, have issued a circular announcing a new model automatic raising and lowering pole-pulling and pole-straightening jack.

PANELBOARDS AND CABINETS. — Safety panelboards and cabinets are covered in Bulletin No. 47,942 recently issued by the Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth Street, New York City.

CARPET WASHER.—The International Floor Machine Company, 149 West Thirty-sixth Street, New York City, has prepared a card describing and illustrating its "International" electrically driven carpet washer.

FARM-LIGHTING PLANTS. — The A-C Electrical Manufacturing Company of Dayton, Ohio, has issued a booklet covering "Dayton" country home-lighting systems, dynamos, batteries, switchboards, etc.

New Incorporations

THE GAIR REALTY CORPORATION of Brooklyn, N. Y., has been incorporated by R. Gair, 120 New York Avenue; G. Gair, 37 Pierrepont Street, Brooklyn, and R. Gair, Jr., Glen Cove, N. Y. The company is capitalized at $150,000 and proposes to do a realty, construction, electric lighting and garage business.

A. H. GREBE & COMPANY of Richmond Hill, N. Y., has been incorporated with a capital stock of $50,000 to manufacture wireless and electric instruments. The incorporators are: A. H. Gregg, 10 Van Wyck Avenue, Richmond Hill; L. C. Pacent, Winfield, L. I., and D. Rigney, 5 East 119th Street, New York City.

WILLIAM H. RABELL ENTERPRISES, INC., of New York, N. Y., has been chartered by W. Rabell and C. H. Secor, 720 Seventh Avenue, and C. E. Rabell, 854 Riverside Drive, New York City. The company is capitalized at $100,000 and proposes to install automatic electric light plants.

THE SQUIRREL ISLAND (ME.) ELECTRIC COMPANY has been incorporated with a capital stock of $25,000 to do a general electric lighting business, operate telephone and telegraph systems, etc. The officers are: Frank I. Cowan, president; Clement F. Robinson, treasurer, and Robert T. Whitehouse, clerk, all of Portland, Me.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

New England States

PORTSMOUTH, N. H.—Preparations are being made by the Rockingham County Light & Power Company for the hydroelectric power development on the Lamprey River in the Town of Durham.

SPRINGFIELD, MASS.—Bids, it is understood, will soon be asked by McClintock & Craig, engineers and architects, 33 Lyman Street, Springfield, for the construction of a large power house on Cold Springs Avenue for the Gilbert & Barker Manufacturing Company.

BRIDGEPORT, CONN.—Plans are being prepared by Wescott & Mapes, engineers, 207 Orange Street, New Haven, for the construction of a new power plant for the United Illuminating Company on Congress Street, to cost about $1,500,000.

LUNENBURG, VT.—Preliminary sketches have been made by C. F. Hardy, architect and engineer, 309 Broadway, New York, N. Y., for a power house for the Fitzdale (Vt.) Paper Mills in Lunenburg, to cost about $1,000,000.

Middle Atlantic States

BINGHAMTON, N. Y.—The Board of Supervisors of Broome County is considering the installation of a new electric light and power plant at the county farm.

ROUSES POINT, N. Y.—The installation of a new electric generating unit in the municipal electric light plant is under consideraton. H. A. Sabourin is manager.

SOLVAY, N. Y.—The Solvay Municipal Commission is contemplating increasing the capacity of power feeder lines to care for 300 additional hp. at Frazer & Jones Foundry. Charles H. Cross is superintendent.

UNION, N. Y.—The Board of Trustees is considering the erection of a transmission line to furnish electricity for street and commercial lighting in West Endicott. C. C. Clift is superintendent.

ATHENIA, N. J.—The Magor Car Company will soon call for bids for the construction of a new power house, to cost about $35,000. N. Schoonover, 31 Clinton Street, is engineer.

NEWARK, N. J.—Contract has been awarded by the Stanwood Rubber Company for the erection of a two-story power plant, 75 ft. x 84 ft., on Frelinghuysen Avenue near Virginia Street, to Charles Flocken, 681 Newark Avenue, Elizabeth.

CHAMBERSBURG, PA.—Plans are under consideration by the Borough Council for extensions and improvements to the municipal electric light plant.

DALTON, PA.—Plans are being prepared by the Scranton & Binghamton Railroad Company, 227 Wyoming Avenue, Scranton, for an addition to its local power house. New equipment, including three 500-hp. boilers and 15,000-volt electric generating units, will be installed. The cost is estimated at $95,000.

PHILADELPHIA, PA.—Plans have been prepared by the Department of Public Works for a new engine plant and pumping station at the Lardners Street waterworks plant.

SHARPSBURG, PA. — The installation of a condensor for one 300-kw. turbine in the municipal electric light plant is under consideration. W. C. Wetzel is superintendent.

VARDEN, PA.—The Varden & Lake Ariel Light, Heat & Power Company contemplates extensions to its transmission lines in the spring. W. W. Kizer is president.

MOUNT HOPE, W. VA.—The Mount Hope Electric Power & Water Company contemplates extending its transmission lines to two mines. George A. Waldo is president and manager.

WARRENTON, W. VA.—The Warrenton Electric Light & Power Company contemplates the installation of a 90-kw., 60-cycle, 2200-volt generator and a 150-hp. Erie boiler, the erection of 5 miles of transmission lines and a new series street-lighting system. M. J. O'Connell is secretary and manager.

BRIDGEWATER, VA.—The North River Electric Company is contemplating the installation of a new three-phase generator, increasing its water power, installing an auxiliary steam plant, and extending its transmission line to Mount Crawford, 2½ miles, and also building several mutual lines in the surrounding country. G. Richard Berlin is president and manager.

FREDERICKSBURG, VA.—The Rappahannock Electric Light & Power Company contemplates the installation of a 500-kva. steam turbine and boilers and rebuilding its distribution system. S. C. Foster is general superintendent.

North Central States

COLDWATER, MICH. — Contract has been placed for a 1,000-kw. General Electric turbo-generator set for the municipal electric light plant, to be delivered April 1. About 10 miles of transmission lines into the country districts are under construction. L. E. McQueen is superintendent.

DETROIT, MICH.—Plans are being prepared by the Detroit Edison Company for the construction of a power plant on Bounce Creek in Marysville.

GRAND RAPIDS, MICH.—The Board of Education is planning to erect a high school on Plainfield Avenue, to include coal storage and power plants. H. H. Turner, 234 Division Avenue North, is architect.

GRAND RAPIDS, MICH.—The installation of an additional 1000-kw. Allis-Chalmers turbo-generator in the municipal electric light plant is under consideration. Gerald J. Wagner is director of public service.

BRADNER, OHIO.—The Board of Public Works is contemplating extending the transmission lines of the municipal electric lighting system into the country districts. W. B. McCormick is superintendent.

CLEVELAND, OHIO.—Plans are being prepared by S. W. Weis, architect, Schofield Building, Cleveland, for the erection of a large garage on East Seventy-ninth Street and Hough Avenue, for the Realty Syndicate, 309 Williamson Building, to cost about $400,000.

DOVER, OHIO.—Preparations are being made to replace the gas engines now in use in the municipal electric light plant with steam engines and to equip the waterworks pumping station for electrical operation this year. Plans are also under consideration to rebuild the entire transmission system this spring. Homer H. Keppler is general superintendent.

LEWISBURG, OHIO.—The Brookville-Lewisburg Lighting Company contemplates changing its system from single-phase to three-phase in Lewisburg and Brookville and also the erection of several rural lines. Karl A. Katzenberger is local superintendent.

NEW PHILADELPHIA, OHIO.—The Wise-McClung Manufacturing Company contemplates a number of extensions to its plant, including a building for assembling and storage, machine shop, power plant, addition to motor and assembling building, polishing department and addition to foundry. W. E. McClung is secretary and treasurer.

JACKSON, KY.—O. G. Gillum, owner of the local electric light plant, is contemplating the installation of a 25-hp. oil engine directly connected to a 20-kva., three-phase, 2300-volt generator.

MARLOW, KY.—The installation of an ornamental street-lighting system is under consideration by the Electric Light Department. E. Faulkner is superintendent.

MAYFIELD, KY.—The installation of a 300-kw. generator in the municipal electric light plant is under consideration.

ALBION, IND.—The construction of an entire new electric light plant is under consideration by the water and light department. Edwin M. Maloney is manager.

ATTICA, IND.—The municipal electric light and Water department is considering extending the municipal electric lighting service for rural subscribers and small towns, requiring the erection of about 15 miles of lines. B. H. Freeland is superintendent.

BERNE, IND.—The Berne Electric Company is contemplating securing energy from the municipal electric plant at Bluffton. Amos Hirschey is secretary.

CRAWFORDSVILLE, IND.—The Crawfordsville Electric Light & Power Company is contemplating the erection of a three-phase transmission line, 3 miles, to supply 900 hp. H. E. Hayworth is manager.

DECATUR, IND.—The installation of ornamental lamps in all parts of the city is under consideration. The city will supply electricity to maintain the lamps if the property owners will purchase them. The cost of the lamps is placed at $32 each.

BELLEVILLE, ILL.—The St. Clair County Gas & Electric Company contemplates the installation of a frequency changer. John R. Hoffman is local superintendent.

CASEY, ILL.—The erection of a 5-mile transmission line is under consideration by the municipal electric light department. J. C. Pfister is superintendent.

CASS CITY, ILL.—Plans are under consideration for improvements to the municipal electric light plant and waterworks system this spring, including the installation of a steam-driven generator (2,300-volt) and possibly a waterworks pump. W. N. Straube is manager.

CHICAGO, ILL.—The Stromberg Electric Company, 606 South Michigan Avenue, it is understood, will ask for bids early in the spring for the erection of its proposed new plant, consisting of a group of buildings at Wrightwood and Greenview Avenues, to cost with equipment about $500,000. The company manufactures ,electrical appliances, etc. Robert J. Newberry, 108 South La Salle Street, is architect.

GRAFTON, ILL.—At a special election held recently the proposal to establish a municipal electric lighting system was carried. Another election will probably be held to authorize bonds to finance the project.

ALGOMA, WIS.—The city water and light department is contemplating the purchase of energy from the Wisconsin Public Service Company of Green Bay. The proposed transmission line would be 63 miles long, 66,000 volts, three-phase, 60 cycles. E. P. McCarthy is superintendent.

AMERY, WIS.—The Apple River Milling Company contemplates the erection of 39 miles of 22,000-volt transmission line. The company is building hydro-electric development at Colfax, which when completed will furnish electricity for lamps and motors in Colfax and Wheeler. Contracts have been closed by the company to furnish electricty in Barnette, Shell Lake and Spooner, Wis. The service will be extended to these places during this year. W. R. Haney is superintendent.

BAGLEY, MINN.—The Water and Light Commission is contemplating the installation of transformers for motor load. G. M. Hanson is manager.

JACKSON, MINN.—The Council is considering extending the electric lines of the municipal electric plant to serve a small town and also the erection of farmer lines. This work may be done this year. J. E. Barrett is superintendent.

MAYNARD, MINN.—Some line extensions are contemplated to the municipal electric lighting system. L. A. Sanner is manager.

MIDDLE RIVER, MINN.—The Middle River Light & Power Company contemplates the installation of a new electric generating unit. Emil Peterson is owner and manager.

NEW PRAGUE, MINN.—The electric light and waterworks department contemplates the erection of new 250-volt direct-current lines. Joseph T. Rynda is manager.

TWIN VALLEY, MINN.—The J. F. Heiberg Electric & Power Company contemplates the installation of a 125-kw. generator, umbrella type, with a 28-in. wheel. The company is now erecting a three-phase transmission line (15 miles long) to Ulen. J. F. Heiberg is manager.

WACONIA, MINN.—The Waconia Light & Power Company contemplates the erection of about 20 miles of transmission lines into the farming district and 6 miles of 12,000-volt transmission line. E. F. Strong is president.

WILLMAR, MINN.—A new boiler will be installed in the municipal electric light and water works plant. N. W. Larson is superintendent.

DUBUQUE, IOWA. — The Eastern Iowa Electric Company is contemplating the erection of 10 miles of farm lines. F. K. Altman is manager.

EARLHAM, IOWA.—The Council is considering extensions to the rural lines of the municipal electric lighting system. M. A. Thorp is superintendent.

ELDRIDGE, IOWA.—The People's Light Company of Davenport is erecting an electric transmission line from Eldridge to Long Grove, a distance of 3 miles.

GALT, MO.—The Galt Light & Power Company is contemplating the erection of an electric transmission line from either Trenton or Brookfield to Galt. D. H. Clark is president.

LATHROP, MO.—The Lathrop Light, Heat & Power Company contemplates rebuilding part of its system. E. S. Grant is secretary and manager.

ODESSA, MO.—The municipal electric lighting system will be taken over by the Green Light & Power Company of Pleasant Hill within the next few months. Electricity for the local system will be supplied over a 23,000-volt transmission line, 35 miles long. The local distributing system will be changed from 220 volts, direct current, to 60 cycles, 110 volts, alternating current. J. G. Lightner is manager of the municipal plant.

PARMA, MO.—James McMullen, owner of the local electric light plant, contemplates the installation of a 50-hp. engine and a 35-kw. generator.

PATTONSBURG, MO.—The Pattonsburg Electric Light & Ice Company contemplates extending its electric transmission lines to Kidder, Jameson and McFall, Mo. The company has recently completed lines to Winston and Altamont, where it will supply electrical service. O. L. Wright is president.

RICHLAND, MO.—The Richland Light & Power Company is contemplating the installation of a 60-kw., three-phase generator and fuel-oil engine of 60-hp. or 75-hp. this summer. E. R. Woodward is president and manager.

ST. LOUIS, MO.—The Century Electric Company, 1827 Pine Street, contemplates the erection of an addition to its plant for the manufacture of electric motors.

ARCADIA, NEB.—The Arcadia Electric Light & Telephone Company expects to install a new 75-hp. oil engine this season. J. P. Wait is proprietor.

FAIRBURY, NEB.—The Board of Public Works is considering extensions to the municipal electric light plant, including the installation of a 400-kw. generating unit, directly connected and the erection of 6 miles of three-phase, 6600-volt transmission lines. G. D. Myers is manager.

HARVARD, NEB.—The Harvard Electric Company contemplates extensions to its power lines. J. E. Person is manager.

OAK, NEB.—The Meyer Hydro-Electric Power Company contemplates raising its dam and installing an additional oil engine and extensions to its transmission lines. Ernst Meyer is manager.

PLAINVIEW, NEB.—A 175-kw. electric generating unit, directly connected, will be installed in the municipal electric light and water plant. An ice-manufacturing plant is being installed in connection with the water and light plant. O. N. Michener is superintendent.

RAVENNA, NEB.—The Ravenna Light, Heat & Power Company contemplates some extension to its generating capacity. A. T. Shellenbarger is secretary and manager.

ATTICA, KAN.—The installation of a 100-hp. oil engine in the municipal electric light plant is under consideration. J. C. McCaddon is city clerk.

CLAY CENTRE, KAN.—The erection of 12 miles of transmission line is under consideration by the Public Utilities Commission. C. S. Callender is superintendent.

COFFEYVILLE, KAN.—The installation of two additional boilers 375-hp. and 500-hp., in the municipal water and light plant is under consideration. E. J. Walcott is superintendent.

GRENOLA, KAN.—The installation of a 75-kw. generator and a 100-hp. engine in the municipal electric light plant is under consideration. Edgar Robertson is manager.

HIAWATHA, KAN. — The Hiawatha Light, Power & Ice Company contemplates the installation of a 365-hp. Diesel engine. R. H. Love is secretary and manager.

HUTCHINSON, KAN. — The United Water, Gas & Electric Company contemplates the installation of two 1,000-hp. boilers, feed-water pumps and the erection of a new boiler room The company also plans to erect a transmission line to supply electricity in Arlington, Partridge, Langdon and Turon; also one to supply Alden and another to supply Little River and Geneseo. W. E. Quillin is manager.

KANOPOLIS, KAN.—The installation of an electric generating unit in the municipal electric light plant and one 10-ton ice manufacturing plant is under consideration by the city of Kanopolis. John S. Holmquist is superintendent

Southern States

BURLINGTON, N. C.—The Piedmont Power & Light Company contemplates the installation of a 3,000-kva. generator and the erection of an electric transmission line to Simpsonville, a distance of 4 miles. Junius H. Harden is vice-president and general manager.

NEWBERNE, N. C.—Contract has been placed for a 1,250-kw. turbine for the municipal electric light plant; also for the erection of new transmission lines and for panels to serve same. F. G. Godfrey is superintendent.

GREENVILLE, N. C. — The Water and Light Commission contemplates the installation of a new turbine and condenser in the municipal electric light plant. F. A. Haskins is acting superintendent.

SCOTLAND NECK, N. C. — Work will begin at once on the construction of an addition to the municipal electric light plant and erection of a brick chimney. New equipment will be installed, including a 500-kw. Curtis turbo-generator, a 250-hp. Keeler water-tube boiler, Wheeler condenser, spray-pond outfit, pumps, soot blowers, switchboard, etc., for which contracts have already been placed. Preparations are being made to sell energy to the town of Hobgood. L. R. Mills, Jr., is superintendent.

BAMBERG, S. C.—The commissioners of public works are planning to install a 125-kw. generator in the municipal electric light plant soon. J. G. Black is superintendent of distribution.

HUMBOLT, TENN. — The municipal water and light department contemplates the installation of a 500-kw. turbine in the municipal plant and the erection of 8 miles of transmission line. W. M. Case is manager.

SOMERVILLE, TENN.—The installation of a 25-hp. oil engine directly connected to a 37½-kw. generator in the municipal electric light plant is under consideration by the municipal water and light department. The proposed plans provide for the installation of another 25-hp. unit later. J. L. Sanders is superintendent.

SENATOBIA, MISS.—A new 125-kva. Westinghouse turbo-generator unit will be installed in the municipal electric light and water plant within the next thirty days. About 3 miles of transmission lines will be erected next summer. D. D. Funderburke is manager.

EUDORA, ARK.—L. M. Parkman, owner of the local electric light plant, contemplates extending his transmission system to some of the neighboring towns.

HARRISBURG, ARK.—The Harrisburg Electric Light & Power Company will install two 75-hp. oil engines and two 55-kw. generators. Machinery has already been purchased. J. A. Metz is manager.

SPRINGDALE, ARK.—The installation of a new street-lighting system is under consideration by the Springdale Light & Power Company. V. McDaniel of Fayetteville is secretary and manager.

WILMOT, ARK.—The Wilmot Light & Power Company contemplates extending its transmission line to Parkdale, 4 miles north of Wilmot, to supply energy there. Benjamin Wright is owner and manager.

AMITE, LA.—The Central Light & Power Company is now installing a 200-hp. Fairbanks oil engine and contemplates the installation of a series street-lighting system this spring. H. E. Burnham is treasurer and manager.

BASTROP, LA.—The municipal electric light and waterworks department contemplates the purchase of a 150-hp. natural-gas engine and a 100-kw. generator and extension of its present line. Cary Robertson is superintendent.

CLEVELAND, OKLA.—The property of the Oklahoma Utility Company has been purchased by A. A. Boyd of Michigan City, Ind. The new owner, it is understood, will rebuild the plant.

CROWDER, OKLA.—The Crowder Light Company is considering the installation of a 15-hp. engine and generator. A. Boiles is secretary and manager.

DURANT, OKLA.—The installation of a new 100-kva. generating unit in the municipal electric light plant is under consideration. J. D. Asbury is superintendent.

WAYNOKA, OKLA.—Extensions and improvements are contemplated to the municipal electric light plant, including the installation of a 75-kva., 60-cycle, 2,300-volt Fairbanks-Morse generator, type "Y" oil engine with equipment to connect three generators together, one regulator, ½ car-load of 25-ft. poles, 1 mile of No. 8 weatherproof wire and fifty Westinghouse street series 110-volt incandescent lamps. It is not yet decided when contracts will be placed for the work. William Monfort is engineer in charge. M. M. Wright is electrician for the city.

WELEETKA, OKLA.—The Crystal Ice & Utilities Company contemplates doubling the capacity of its electric generating plant. C. A. Parrish is manager.

Pacific and Mountain States

SCIO, ORE.—The City Council contemplates the construction of a dam, flume and timber head gates, taking 47 second-ft. of water from Thomas Creek for a light, power and pumping plant. The cost is estimated at $38,427.

OAKLAND, CAL.—Plans are being prepared by the National Ice & Cold Storage Company, Postal Telegraph Building, San Francisco, for the construction of a plant on North First Street, to cost about $250,000.

OAKLAND, CAL.—The Strong & Scott Manufacturing Company, engineers, 413 South Third Street, Minneapolis, Minn., are preparing plans for a mill on the water front in Oakland for the Great Western Milling Company, Ninth and Alameda Streets, Los Angeles, to cost about $500,000.

SAN DIEGO, CAL.—Bids will soon be asked by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing and installing a complete power plant and generating equipment, including piping and accessories and distributing systems for electricity and steam at the Marine Corps base in San Diego. The cost is estimated at $150,000. A deposit of $10 will be required for plans and specifications.

STOCKTON, CAL.—New developments are contemplated by the Western States Gas & Electric Company on the south fork of the American River, a few miles above the company's present hydro-electric development, which will include the construction of a reservoir for impounding waters in the Twin Lakes, Echo and Medley Lakes, at the head of the south fork of the river. A 1,900-ft. fall of water will be utilized by a proposed hydro-electric plant, to develop 30,000 hp. The water after passing through the proposed plant and the present plant several miles down the American River will be used still farther down the stream for irrigation and domestic purposes.

Canada

MARYSVILLE, N. B.—Tenders are being received by the Canadian Cottons, Ltd., for a 5,000-kw. steam turbo-generator, with necessary switchboards, motors, etc., to supply electricity to operate its mills here. R. S. Kelsch, Power Building, Montreal, Que., is consulting engineer.

BRANTFORD, ONT.—Arrangements are being made to equip the old plant of the Brantford Motor Trucks for the manufacture of Bluebird electric appliances. Local capital amounting to $200,000 has been subscribed toward the project. J. B. Detweller, general manager of the local branch of the Steel Company of Canada, will be manager of the company.

WOODSTOCK, ONT.—The erection of a 13-000-volt substation and 1⅓ miles of 13,-000-volt transmission line to serve the west end of the city is under consideration by the Woodstock Water and Light Commission. J. G. Archibald is superintendent.

MAGOG, QUE.—The Dominion Textile Company is building a new dam for power development in connection with its large mills here. Two 1,500-kw. units will be installed. R. S. Kelsch, Power Building, Montreal, Que., is consulting engineer.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer of the Panama Canal, Washington, D. C., until Feb. 11 for scrap-cutting machine, steam boilers, copper cable, brass, bronze, copper, lead, zinc, copper pipe, copper tubing, brass tubing, porthole glasses, etc. Blanks and further information relating to this circular (1,337) may be obtained from the above office.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Feb. 3 for construction of traveling crane, magnet wire, motor, switches, water coolers, etc. Blanks and information relating to this circular (1,333) may be obtained at the above office.

Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 30, 1919)

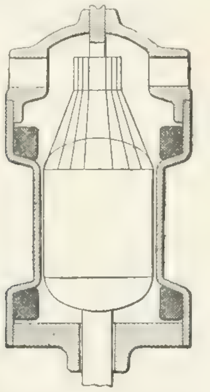
1,327,548. CONTROL OF POWER ABSORBED IN ELECTRIC FURNACES; Colin C. Gow and Donald F. Campbell, London, England. App. filed April 21, 1919. Power absorbed dependent upon the position of electrodes.

1,327,593. SERIES CONDENSER; William Dubilier, New York, N. Y. App. filed April 11, 1919. Condenser with variable terminal connections.

(Issued Jan. 13, 1920)

1,327,619. FIELD-MAGNET FRAME; Carl G. Koppitz, Greensburg, Pa. App. filed July 14, 1917. Consists of single piece.

1,327,622. CALLING MECHANISM FOR TELEPHONE EXCHANGES; Frank A. Lundquist, Chicago, Ill. App. filed March 11, 1918. Pneumatically operated keys for different numbers.



1,327,619—Field-Magnet Frame

1,327,642. ELECTRIC REGULATOR; Leonard Sykes, Fort Wayne, Ind. App. filed Jan. 18, 1918. Contact travels over resistance for increasing current supplied to lamp.

1,327,649. STORAGE-BATTERY JAR; Theodore A. Willard, East Cleveland, Ohio. App. filed Aug. 27, 1917. Minimum weight and size for given capacity.

1,327,650. STORAGE BATTERY ADAPTED PARTICULARLY FOR AEROPLANES; Theodore A. Willard, East Cleveland, Ohio. App. filed Aug. 27, 1917. Used upside down as on aeroplanes.

1,327,682. SWITCHBOARD FOR CHARGING STORAGE BATTERIES; Clarence E. Ogden, Cincinnati, Ohio. App. filed Sept. 9, 1918. Limits wastage.

1,327,736. PROCESS OF PRODUCING CARBIDE; James H. Reid, Newark, N. J. App. filed March 15, 1913. Resistance principle; economical and prolongs life of furnace.

1,327,737. PROCESS OF PROCURING AND SECURING PRODUCTS FROM CARBOHYDRATES; James H. Reid, Newark, N. J. App. filed Jan. 13, 1914. Successive stages of heat through resistance.

1,327,738. MEANS ACTUATED BY ALTERNATING ELECTRIC CURRENT FOR CONTROLLING OR OPERATING ELECTRIC FURNACES OR OTHER MECHANISMS; James H. Reid, Newark, N. J. App. filed Dec. 19, 1914. Alters distance between electrodes.

1,327,774. ELECTRIC WATER HEATER; Albert E. Plante, Montreal, Quebec, Can. App. filed June 2, 1919. Concentric electrodes inclosed in cylinder.

1,327,777. CIRCUIT INTERRUPTER; Karl C. Randall, Edgewood Park, Pa. App. filed Nov. 19, 1917. Overload trip and a current-limiting resistor with fuse for short-circuiting resistor.

1,327,784. SYSTEM OF CONTROL; Gerald F. Smith, Braddock Township, Allegheny County, Pa. App. filed Sept. 1, 1917. One motor utilized for exciting field windings of other machines during regenerative period.

1,327,787. MOTOR-CONTROLLER; William C. Stevens, Milwaukee, Wis. App. filed Sept. 6, 1917. Windings act cumulatively in starting and effect quick disengagement of main switch contacts for stopping.

1,327,789. SYSTEM OF CONTROL; Norman W. Storer, Pittsburgh, Pa. App. filed July 5, 1917. Electrical and mechanical braking for electric locomotives.

1,327,790. IGNITION SYSTEM; Horace V. S. Taylor, Pittsburgh, Pa. App. filed Jan. 5, 1916. Automatically opens primary circuit.

1,327,792. SPOT-WELDING APPARATUS; Frank Thornton, Jr., Mansfield, Ohio. App. filed April 18, 1919. Current both for compressive force and for heating.

1,327,795. SYSTEM OF CONTROL; Charles C. Whittaker, Wilkinsburg, Pa. App. filed June 19, 1917. Prevents slipping of wheels in regenerative systems for locomotives.

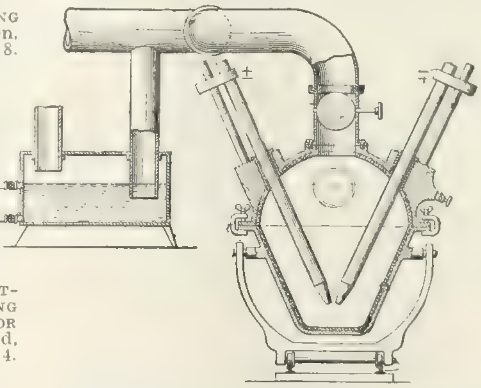
1,327,804. ELECTRICAL COMB; James M. Brooks, Washington, D. C. App. filed Aug. 25, 1919. Toothed dressing surface and an ironing surface.

1,327,805. AUTOMATIC TELEPHONE EXCHANGE; Albert M. Bullard, New York, N. Y. App. filed March 12, 1906. Selective switching for exchange with 10,000 lines.

1,327,814. METHOD OF AND APPARATUS FOR SPOT WELDING; Charles L. G. Fortescue, Pittsburgh, Pa. App. filed March 7, 1919. Welding current produces an electromagnetic force to compress articles when heated.

1,327,818. SIGNALING DEVICE; Irvin W. Gruhl, Los Angeles, Cal. App. filed Feb. 11, 1918. Manually or electrically operated projecting signal.

1,327,819. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Dec. 29, 1915. For parallel-connected direct-current regenerating machine.



1,327,737—Process of Procuring and Securing Products from Carbohydrates

1,327,820. DYNAMO-ELECTRIC MACHINE; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Jan. 10, 1916. Prevents sparking of single-phase commutator-type motor with distributed cross-field winding.

1,327,821. DYNAMO-ELECTRIC MACHINE; Rudolf E. Hellmund, Swissvale, Pa. App. filed Dec. 14, 1916. Protects insulation against destructive influences of vibration.

1,327,822. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed Jan. 16, 1917. Combination regenerative and automatic mechanical-braking system.

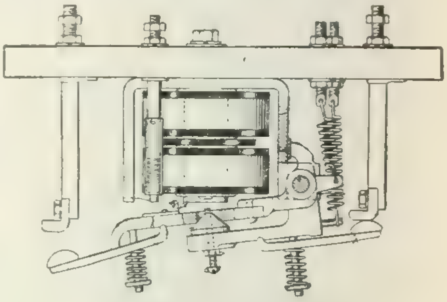
1,327,823. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed Jan. 16, 1917. Combination of electrical and mechanical-braking systems.

1,327,837. ELECTRICAL INDICATOR; Frederick A. Muschenheim and Frederick W. Blasdale, New York, N. Y. App. filed Jan. 12, 1918. Various signal indications for use by hotel clerks.

1,327,947. SYSTEM OF BONDING RAILS; Lawrence P. Crecelius, Cleveland, Ohio. App. filed April 10, 1914. Soft soldering bonds on to flat bond plates brazed to rail.

1,327,986. ELECTRIC HEATER; Charles E. Clark and Archie G. Dowell, San Francisco, Cal. App. filed Feb. 26, 1919. Uniformly distributed over large area surrounding heating structure.

1,327,989. GAS-METERING APPARATUS; Louis A. Ferguson, Evanston, Ill. App. filed Nov. 18, 1914. Records total gas consumption over long and short periods.



1,327,787—Motor Controller

1,328,027. DRY BATTERY; O. Sakizo, Tokyo, Japan. App. filed Jan. 30, 1919. Tight joint formed between seal and container wall.

1,328,032. INCUBATOR; Stanley C. Calow, Calgary, Alberta, Can. App. filed June 1, 1918. Heated electrically and automatically ventilated.

1,328,041. ELECTRIC RELAY AND THE LIKE; Kuno Fischer, Charlottenburg, Germany. App. filed Aug. 15, 1913. Protecting transmission lines or cables from electrical disturbances by ionization of gas gap through high-frequency currents.

1,328,068. ELECTRICALLY HEATED HUMIDIFIER; Daniel H. Young, Manchester, Iowa. App. filed May 22, 1919. Obviates excessive initial reaction.

1,328,069. ELECTROTHERMOGENIC DEVICE FOR HUMIDIFIERS; Daniel H. Young, Manchester, Iowa. App. filed May 22, 1919. Special electrodes for rapid vaporization.

1,328,083. SPEED TRANSFORMER; Maximilian M. Goldberg, Dayton, Ohio. App. filed Nov. 4, 1915. Direction of rotation of driven member reversed without changing speed of driving device.

1,328,126. ELECTRIC CONTROLLER; Theodore T. Cater, Aurora, Mo. App. filed Feb. 15, 1919. Provides time-regulated automatic cut-off.

1,328,149. AUTOMATIC VOLTAGE CONTROL; William S. Harley, Milwaukee, Wis. App. filed Sept. 19, 1917. Generator voltage constant irrespective of speed of motorcycle engine.

1,328,187. DEVICE FOR INDICATING MAGNETIC POLARITY; Henry D. Oakley, Syracuse, N. Y. App. filed July 6, 1916. Trouble shooting on motors and generators.

1,328,224. RECEPTACLE; Reuben B. Benjamin, Chicago, Ill. App. filed April 1, 1915. Electrical contacts effectively insulated.

1,328,229. ELECTRIC HEATING UNIT; Frank W. Hewitt, Arlington, Mass. App. filed May 13, 1918. Bath mats and heating pads for therapeutics.

1,328,245. SIGNAL INDICATOR AND RECORDER; Frederick Liebler, New York, N. Y. App. filed Aug. 5, 1912. Solenoid-operated automobile signal.

1,328,247. ELECTRIC CLOCK SYSTEM; Arthur F. Poole, Chicago, Ill. App. filed Sept. 10, 1917. Secondary clocks continue to run when current supply is temporarily cut off.

Electrical World

The consolidation of Electrical World, Electrical Engineer *and* American Electrician

Volume 75 New York, Saturday, February 7, 1920 *Number* 6

Thomas Alva Edison

THE first to resent the idea that his work is ended would be the great American pioneer in Electrical Science who now at the Orange Laboratory celebrates quietly, amid universal applause, his seventy-third birthday. We are confronted by a vigorous, stalwart, energetic figure, by a man doing blithely his twelve or fifteen hours of work a day, and probing Nature for her secrets just as keenly and irresistibly as when he gave the world his quadruplex, his incandescent lamp, his phonograph, his motion-picture art, not to mention other inventions and industries to which he has been a more or less direct but always vital contributor. His great achievements are shown by about 1500 United States patents, of which to-day 500 at least have been "master" or remain "controlling." We shall not treat such a splendid career and such a wonderful life as rounded out, but hasten simply to add our congratulations to the general acclaim, and, looking forward to even more gifts from the lavish hand of this patient genius, seeking ever to improve the world he lives in, to say in the terse, pertinent phrase of Shakespeare, "What you do still betters what is done."

Dimensions of the Electron and the Atom

TWO hundred and sixty years ago a Frenchman who was equally eminent as ecclesiastic and as mathematician wrote an eloquent passage on the position of man, "suspended between the two abysses of infinitude and of nothing," in which he dwelt on the idea that nature possesses marvels "as astonishing by their smallness as others by their magnitude." Blaise Pascal lived long before the electronic theory was dreamed of, but he was of the opinion that, just as the earth is a minute speck in the ample bosom of nature, so a whole universe may be contained in a drop of the blood of the smallest insect. Now comes Sir Oliver Lodge to tell the lay world that, whereas five hundred million atoms would make up a train only an inch long, the size of an electron is to that of an atom "as a flea is to an opera house," and that each of these electrons revolves in its orbit one hundred billion billion times a minute. To the eyes of the scientist infinity works both ways and multiplication and division in the last analysis are one.

The Residence Power Load

IT IS interesting to trace the causes for the unprecedented growth of the central-station output, now in the order of three billion kilowatt-hours per month. First and greatest are, of course, the basic and elementary demands, ever increasing, for light and power—once constituting all that the central station had to meet. Upon this load have been imposed the necessities of the electrochemical industry, including the operation of electric furnaces for the production of carborundum, graphite and other metallic substances. Then have come the demands of electric furnaces in the steel industry. Electric energy for industrial welding and heating has been requisitioned next. Finally, the vast extension of the use of household appliances heated or driven by electricity has swelled the total to its present size. Nor has the end come yet. No insignificant portion of the millions needed by the electrical interests will be expended in the building of generating stations and lines to handle this potentially gigantic power load in our homes.

Paving the Way for Progress

AN EXCELLENT proposal has come from the Conference Club. This body, which has filled so useful a function as a forum where the policies and major problems of the contractor were discussed, now is ready to dedicate itself with its traditions to the service of the electrical industry as a whole. It is suggested that the Conference Club idea shall be planted in the larger field that includes central stations, manufacturers and jobbers as well as contractors, in order that through its instrumentality the purposes of these various branches of the industry may be co-ordinated in so far as they bear upon interrelations. It is not proposed that the Conference Club shall have mandatory powers of any kind. It will do its work more effectively without them. Its part will be a thinking one, and its strength will come from voluntary adherence on the part of the industry to the sound and self-establishing principles it hopes to be able to lay down. Action, it has been said, is the father of thought, but assuredly thought may also be the father of action; and this is what the Conference Club has in mind.

Experience has shown that when men associate and know each other better it is easier to bring about a meeting of minds. That, in a word, is the whole object of the Conference Club. There can be no question of the desire for such a forum, where in an atmosphere of friendship and frankness constructive effort on interrelated matters may be attained and principles be laid down which will, in the words of the committee's report, "constitute a fundamental economic and ethical code for the future guidance of groups and individuals." Obviously the usefulness and the success of such a body will depend on its personnel. It must be small in numbers, it must represent all interests, and it must contain the really big men, the judicial, constructive minds of the electrical world.

The movement is one of high promise and should have, as we believe it will, the earnest support of all those who wish to see the central-station, manufacturing and commercial branches of the industry keep step in an ever-quickening march of progress.

Playing Fair With the Public

CANDOR and fair play in the dealings of men is an effective dissolver of misunderstandings. It sobers the impulsive, shames the arrogant and establishes a basis for the settling of disputes that makes the courts unnecessary. In no phase of business relations is this aid to a mutual understanding of good intentions more effective than in the relations of the utility to the multi-minded public it serves. An open public policy that conceals nothing and meets aggravating service conditions due to apparent deficiencies on the part of the company with a frankness that inspires sympathetic understanding has often been proclaimed but rarely found in practice. In these days of overloaded stations, enforced curtailments of service or extensions of lines and the need for confidence on the part of the investing public in the stability of the industry, a true example of a desire to take the public into confidence is most inspiring. Such an example is found on page 331 of this issue in the statements made by the Detroit Edison Company recently when one of its large turbines was disabled and the service was curtailed. The conditions were beyond human control; they were the result of a sacrifice of reserve equipment in order to win the war and an honest effort to make inadequate generator capacity handle the tremendous increases in load. The company needs more generating apparatus. Every possible step has been taken to provide it and at the same time maintain uninterrupted service under difficulties. This is the plain story that is told, full of convincing facts that create a desire on the part of every red-blooded customer to help out. It is the golden rule practically applied, and it works.

Induction-Motor Operation on Unbalanced Voltages

THE problem of determining the behavior of an induction motor in regard to slip, torque, heating and current unbalance, when operated on an unbalanced three-phase system, appears at first sight to be very difficult because of the dissymmetrical currents, fluxes and powers developed in the three separate phases. The problem becomes greatly simplified, however, when the unbalanced three-phase voltage impressed on the motor is resolved into two component balanced three-phase systems, one having forward and the other backward rotation. This leaves the motor subject to two simple three-phase actions which are virtually independent of each other and the effects of which are simply superposed.

J. Slepian contributes an interesting article in this number on this subject. He indicates the graphical construction by which the two component opposite-balanced three-phase voltage systems can be deduced when the unbalanced three-phase voltage system is given. The ratio of these component voltages is called the unbalance factor. It is a simple numeric, varying from zero in the case of a perfectly symmetrical three-phase system to unity in the extreme opposite of a three-phase system flattened out into a single-phase system.

By considering the separate effects of the forward and backward component voltage systems on the induction motor, the article goes on to show that unless the unbalance factor exceeds 0.1 the effect on the starting torque, or on the pull-out torque of the motor, is ordinarily very small, but the heating effect in parasitic currents through the windings may be surprisingly large. In some cases it may be advantageous to start the motor as a three-phase motor, and then to operate it with one phase open, in order to reduce the heating effect of the unbalance. The pull-out torque of the motor will, however, be weakened by this expedient; so that the motor may not be able to carry its full complement of load under this condition.

We recommend this method of treating the problem to our readers, on acount of its simplicity. The formulas to which it leads are surprisingly simple and comprehensive. They do not appear to be doubtful; nevertheless, it would be well worth while to have them experimentally confirmed. Some indirect corroboration is given in the article, based on observed and computed unbalance current values. These are good as testimony, so far as they go, but direct trial and proof would be still better. Here is an opportunity for experimental research work, such as might be carried on in a college laboratory. The problem would there be to establish a constant, definite three-phase voltage unbalance and to test the behavior of a standard carefully measured three-phase motor subjected to this pressure.

One World at a Time

"ONE world at a time, Parker—one world at a time," said the dying Thoreau to an oversolicitous friend who thought the hermit-philosopher of Walden should be having visions of life beyond the tomb. Might not this counsel of sanity and restraint, which came from a man as little a materialist as he was a mystic, be quoted without offense as indicating the proper bound of scientific inquiry? That eminent physicists should join others in attempts to commune with ghosts, if it be one of the consequences of the world convulsion, is not one of the least regrettable. For, however sincere they may be and however authentic the psychic phenomena to which they testify, the public result can only be an irruption of charlatans, a mob of dupes and a fillip to credulity and superstition from which tangible gain will accrue to "Mr. (or Mrs.) Sludge the Medium," but only harm to others.

Similarly it is to be regretted that some technicians and college professors have allowed themselves to be quoted as inclined to treat with respect the fantastic newspaper suggestions of wireless messages from Mars, which have even reached the crowning absurdity of endowing the Martians with a knowledge of the Morse code.

Are there not visions better worth cherishing than these insubstantial ones concerning conversations with the dead or with the inhabitants of other planets? The days of every man are numbered, and if identity persists beyond this life he soon will know it. In the meantime what better preparation for a future existence or what better antidote to the grief of bereavement than to work toward the perfection of the world in which we live? Its moral, mental and physical improvement are inseparably bound together. To the scientist and the inventor falls especially the part of working for the last of these, and the physical improvement of the world depends on utilizing in ever larger degree the forces of nature. Of these forces electricity is the greatest. It is futile to speculate about the degree of civilization in Mars; it is warranted by every achievement of the past to picture a world in which it will be as easy and as cheap to converse by telephone with the Antipodes as it is now to talk with the man a few blocks away. There can be little real joy in extorting incoherent inanities from an elusive shade; there must be great happiness in doing something to advance the day when every home as a matter of course shall not only be lighted by electricity but cooled in summer and warmed in winter, and all the year around have the heavy part of the household tasks performed without dirt or noise by the same great agent; when electric travel for short distances or great shall be as safe, as comfortable and as inexpensive as it is swift; when because of electricity's help in production the world need no longer be content with hand-to-mouth subsistence—when, in short, men shall have really broken to harness this herculean servant once undreamt of:

Edison and Bell have done more for mankind than all the clairvoyants and hypnotics since time began.

Safety Switchgear

THE average standard switchboard is designed with convenience and safety in mind and as a rule is pretty well arranged. It is often, however, far from being foolproof, and it must not be forgotten that even pretty well trained switchboard attendants sometimes have lapses of memory that result disastrously. B. E. G. Mittell's article on the development of British switchgear is therefore a welcome addition to the literature of the subject, especially with reference to the requirements of personal safety. One of the chief points of design which experience shows as demanding close attention is the matter of safety with respect to the disconnecting switches. Accidents have not infrequently occurred through fouling the live side of these when working on the oil switches which they isolate. The plan evolved in British practice is aimed at completely protecting the disconnecting switches. This is done by inclosing them in separate sheet-metal cubicles with hinged doors arranged so that when the main switch is cut off and all metal parts in its compartment are dead the disconnecting switches will be completely shut in and inaccessible. In some cases rotary disconnecting switches are used, operated from the outside of the cubicle and arranged so that the handle may be locked either in the "on" or the "off" position. This is regarded as a particularly efficient scheme both in saving space and in insuring safety.

Going further, the same arrangement is found especially useful in the not infrequent cases where the oil switches are operated from the front of the board and the disconnecting switches from the back, involving danger that the latter may be opened when the current is flowing. To prevent this a system of interlocking has been carried out so that when the oil switch is closed the disconnecting switch is automatically locked. Several other applications of interlocking catches have been used to a similar effect, the point of them all being to keep the disconnecting switches from becoming sources of danger through carelessness or ignorance of the operator. Some special precautions for potential transformers have also been developed. The potential transformer involves greater risks of all kinds than are generally realized. It is carrying full system voltage and is quite commonly connected inside the fundamental safety devices. There have been quite a few instances of fairly large stations being shut down through accident at this point, to say nothing of the danger to the operators. In British practice plug disconnecting switches are commonly employed and are operated outside the metal cubicles containing the working contacts. This not only insures safety but it has been found that in practice it gives facilities for connecting the transformers which sometimes reduce the number necessary for the whole installation.

There is some prejudice against mechanical interlocking switchgear in this country. It unquestionably at times involves inconvenience. The British official requirements, however, seem to have resulted in working out, as shown in the article, some very useful devices. Panels permitting complete withdrawal of the main switch, with interlocking arrangements to present such action when the contacts are closed, have been developed, and of these Mr. Mittell gives a somewhat complete account. Of particular interest is the device for dealing with duplicate busbars, allowing connection of the switch to either without opening disconnecting switches or working on any live metal. For lighter work the truck-type switchgear, which has been previously described in these columns and is by no means unknown to American engineers, has found considerable use.

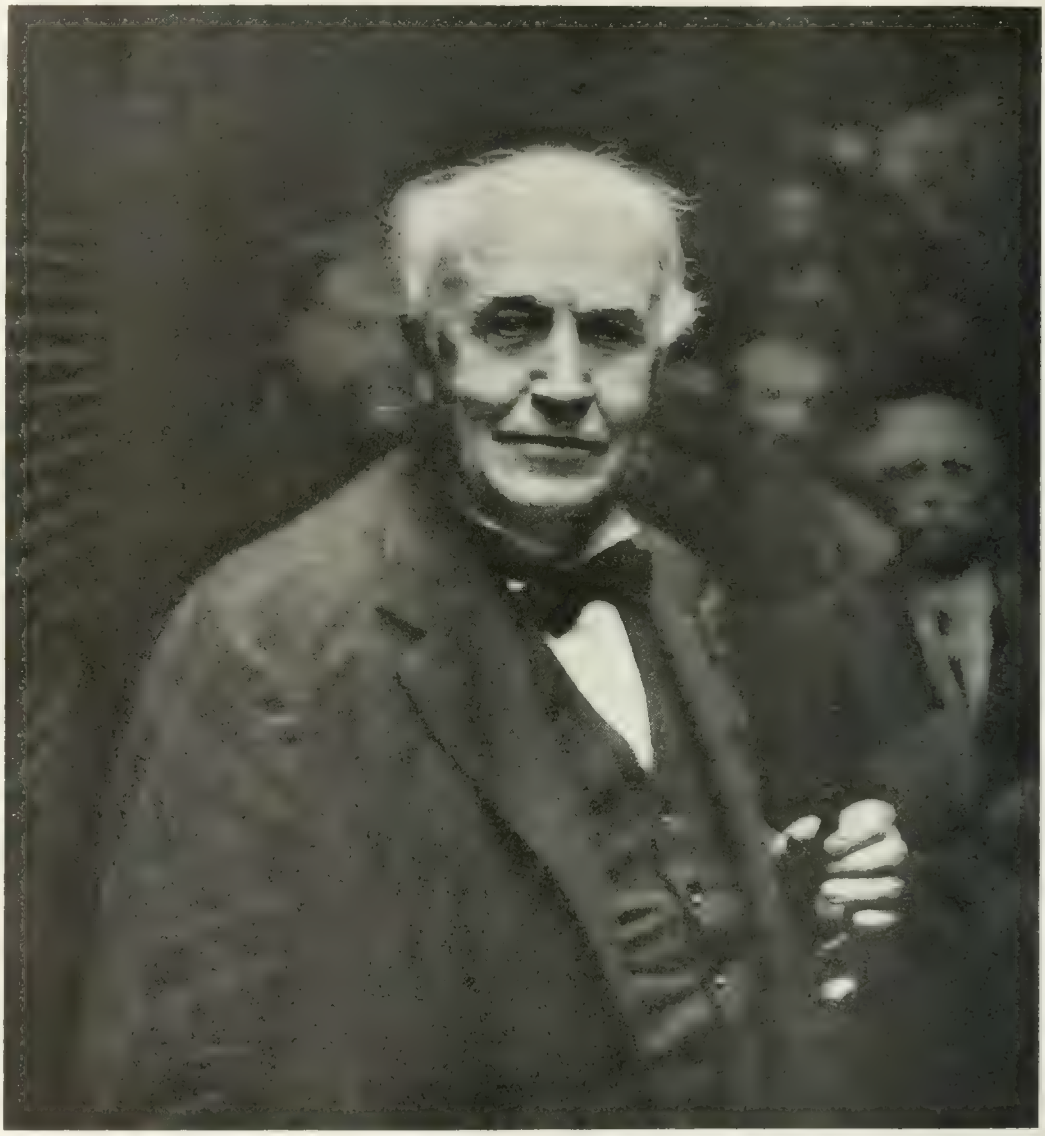
Mr. Mittell's article is full of useful information which, although not all readily applicable to American types of board, certainly gives important suggestions for future designs. The whole subject of the switchboard is one that needs very close attention as stations increase in size and the feeder systems in complication.

Field Testing of Instrument Transformers

ONE of the most useful types of current transformers in use is the "hole" or "doughnut" type, in which an annular laminated core is provided with a fixed secondary winding of fairly numerous turns, while the primary winding has but a single turn, including the entire alternating-current circuit. The conductor carrying the primary current has, therefore, only to pass through the hole in the middle of the core to act as a primary winding of a single turn. If the fixed secondary winding of such a transformer has, say eighty turns, then for each 80 amp. carried through the straight primary wire, passing through the hole, 1 amp. will be measured by a correctly calibrated ammeter in the secondary circuit.

Every such current transformer has, however, a certain small vector error—*i. e.*, an error in the numerical ratio and also in the phase of the current ratio.

H. M. Crothers describes this week an ingenious method of measuring the correct current ratio of a hole transformer, either in the laboratory or in the field. It may be described as temporarily taking the hole out of the hole transformer under test, by filling in the central space with a test winding having the same number of turns as the secondary coil. The transformer, thus modified, becomes a level or a one-to-one transformer. The Agnew or Silsbee method may then be readily applied to determine the ratio factor and phase angle of the level transformer.



Thomas Alva Edison at Seventy-Three

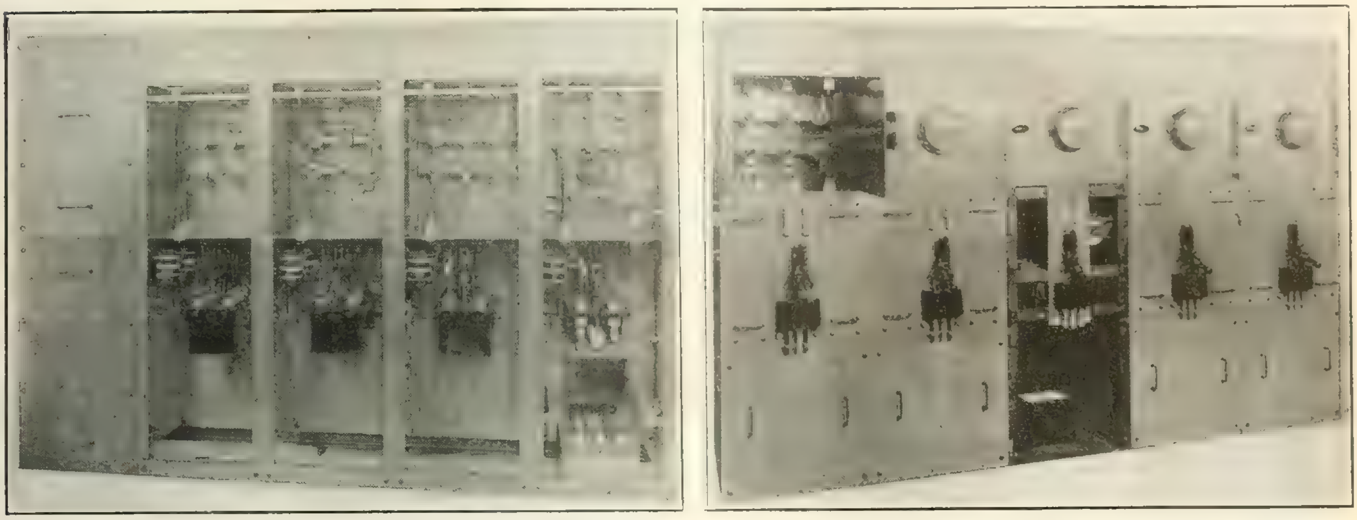
EDISON celebrates on Wednesday, Feb. 11, his seventy-third birthday, and telegraphers all over the country are planning to send him their "73," the goodwill salutation of the key. Societies and corporations, electrical and otherwise, are joining in the congratulations, and the Edison Pioneers will have luncheon with their grand old chief at the Orange Laboratory, where ten thousand greetings have already been received. The readers of the ELECTRICAL WORLD unite with this journal in one great "73" to the inventor and pioneer who has done so much to make this the great electrical period in history. The value of American electrical production and service of all kinds in 1919, according to an estimate recently published in these pages, is more than three billion dollars. Thomas Alva Edison, since he started his electrical career as a plug operator sixty years ago, has not only been a foremost creator of this total, but has set a world's record for productive genius and patience in making practical the inventive conceptions which now proclaim his name the world around. Who can estimate the total contribution to the wealth, happiness and prosperity of the world of this great American electrical engineer, father of the incandescent lamp and of the phonograph, founder of the motion picture industry, and a leader in domains so widely apart as chemistry and cement making? Nor should his directly patriotic service be forgotten as head of the Navy Consulting Board, the first of such agencies to be created by the government in the Great War. The above picture of Mr. Edison was taken recently while viewing the tablet which now marks the location of first central generating plant in New York City, the old Pearl Street station, which was placed in operation on Sept. 4, 1882.

Safety Features of British Switchgear

Progress Has Been Made in England Toward Protecting Operators from Shock in Switchboard Manipulations—Three Types of Switchgear in Common Use Are Described in Detail to Show How the Safety of Operators Is Effected

By B. E. G. MITTELL

London, England



FIGS. 1 AND 2—REAR AND FRONT VIEWS OF SWITCHBOARDS TOTALLY INCLOSED WHEN IN SERVICE

(1) Operator has access from the back of board, but in (2) the front is removed for the operator's purpose

THE design of British switchgear has been greatly influenced by certain requirements of the British Home Office which were formulated for the purpose of preventing accidental shocks to operators. The switchboard designs along safety lines may be briefly described as sheet-metal-inclosed and complete draw-out types and a compromise between these two known as the truck type. The last named is also well known in American practice. Some details of the first two designs should be of interest to American engineers.

Referring to the sheet-metal-inclosed switchboards, one primary requirement is the fitting of separate compartments for all high-tension disconnecting switches which form part of the switchboard. This was brought about by the fact that accidents have occurred through contact with the live terminal of the disconnecting switch when working on gear which it has isolated. The same considerations require each circuit which is fitted with disconnecting switches to be totally inclosed so that when working on a circuit which has been efficiently isolated there will be no danger of accidental contact with the live metal of neighboring circuits.

Fig. 1 shows a typical substation switchboard viewed from the back. The left-hand cubicle has its covers in position, as would the other cubicles in ordinary working. All gear in the oil switch compartment is dead when the disconnecting switches are opened so that if the covers are replaced on the upper compartments there is no possibility of touching live metal. As a further precaution hinged doors are provided on the latest designs of cubicles to obviate the possibility of danger to an attendant which is possible in the removable door owing to an edgewise or a cornerwise position in the cubicle.

The arrangement in Fig. 1 requires, of course, sufficient gangway behind the board to admit of access from the back. In many cases this is not possible, and the board is accordingly arranged for access from the front.

Fig. 2 shows a similar substation board to Fig. 1, but arranged for erecting against a wall. Here also will be noticed the separate compartments, with hinged doors, for the disconnecting switches. The middle cubicle has this door closed after opening the disconnecting switches, it then being safe to remove the covers of the oil-switch compartment for overhauling the gear.

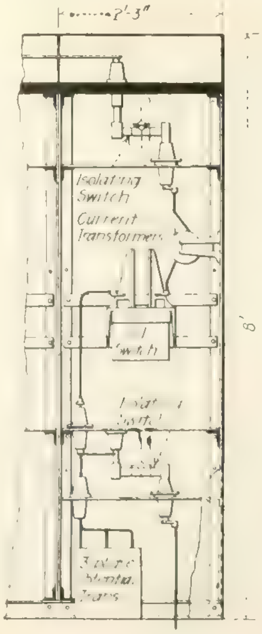


FIG. 3 — TYPICAL OIL SWITCH LAYOUT WITH ROTARY DISCONNECTING SWITCHES

Many cases exist where it is possible to make the gear in the cubicles alive from the feeder side, and in these it is specified that the disconnecting switches shall be supplied on the feeder side of the oil switch as well as on the busbar side. These cases include the following:

1. Ring main feeders.
2. Duplicate feeders feeding on to common substation busbars.
3. Feeders supplying transformers which are inter-connected on the secondary sides.

A switchboard equipped with double sets of rotary disconnecting switches is shown in

Fig. 3, these being of a special type described later.

In the event of a potential transformer fuse blowing it is generally most undesirable to have to shut the main circuits down, more especially in the case of busbar potential transformers, and it has therefore been fairly common practice to insert a new fuse by means of special tongs. A number of accidents have occurred from this practice, owing to the fuse's blowing immediately on insertion in the clips. For such cases, therefore, separate disconnecting switches are now required to be fitted. The effect of this regulation is to reduce the number of potential transformers installed and frequently to eliminate the busbar potential transformer by using for the purposes for which it would be required the potential transformer connected to a running machine or incoming feeder. These disconnecting switches usually take the form of plugs as shown in Fig. 4, which shows the high-tension cubicles of a 6,600-volt generating station switchboard. These plugs are so arranged that they can be operated from outside the cubicles with the sheet-iron covers in position.

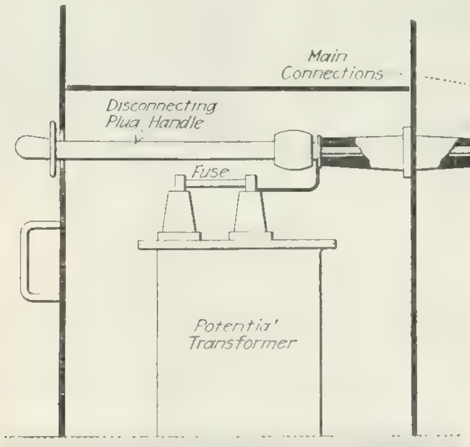
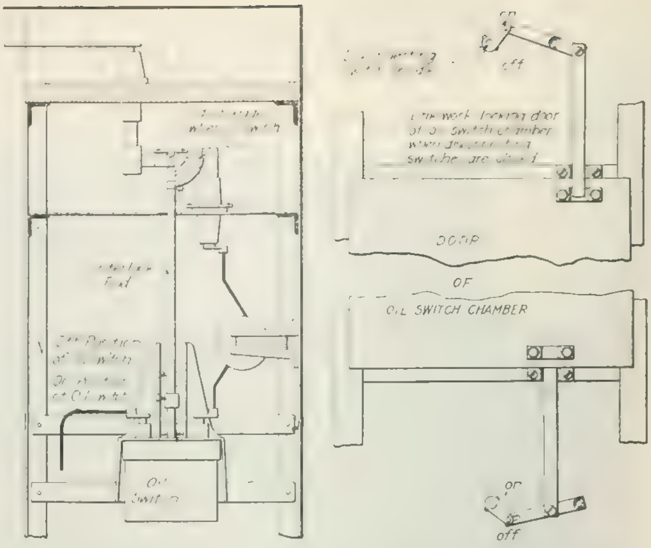


FIG. 4—PLUG-DISCONNECTING SWITCH FOR POTENTIAL TRANSFORMER

The regulations regarding disconnecting switches introduce difficulties in the case of duplicate busbars. In the case of back-to-back construction having three disconnecting switches on one side and three on the other, the two sides being divided by a vertical division, there is no difficulty. This design, however, is not always admissible on account of space, and where the six switches are mounted side by side special precautions must be taken. These amount to the fitting of vertical divisions separating each switch from its neighbor, and an auxiliary sliding shutter in front by which access can be had at one time only to the disconnecting switches connected to one set of busbars. The thing which is to be guarded against is of course accidental contact with the live terminals of the set of disconnecting switches connected to the live set of busbars.

Gangways are specified to have a minimum clear height of 8 ft. (2.4 m.) and clear width of 3 ft. 6 in. (1.1 m.) for high-tension boards. Ordinary flat-back low-tension boards are required to have a back passageway 7 ft. by 3 ft. (2.1 m. by 0.91 m.) minimum. This means that all panels supported by wall-stays must be at least 7 ft. 3 in. (2.2 m.) high.

Before the passage of the employers' liability act the only legal compulsion to consider human safety in switchboard construction was imposed by the Home Office as outlined above. Now, however, an accident results in very heavy damages even though the Home Office regulations have been fulfilled. It may be thought that the fulfilment of the latter would insure freedom from accidental shock. This is frequently found, however, not to be the case, owing to operators failing to make efficient use of the precautionary measures provided. The routine adopted in stations is frequently such that a senior engineer has to withdraw the disconnecting switches before a junior starts to work to clean the gear. Misunderstandings between the two have often resulted in serious accidents.



FIGS. 5 AND 6—MECHANICAL INTERLOCKS WHICH PREVENT ACCESS TO LIVE PARTS

Accidents have also occurred with switchboards of some length where the disconnecting switches are on one side of the board and some of the gear to be cleaned is on the other side—involving a fairly long walk between the actions of disconnecting and cleaning, with the accompanying possibility of mistaking live gear for gear which has been disconnected.

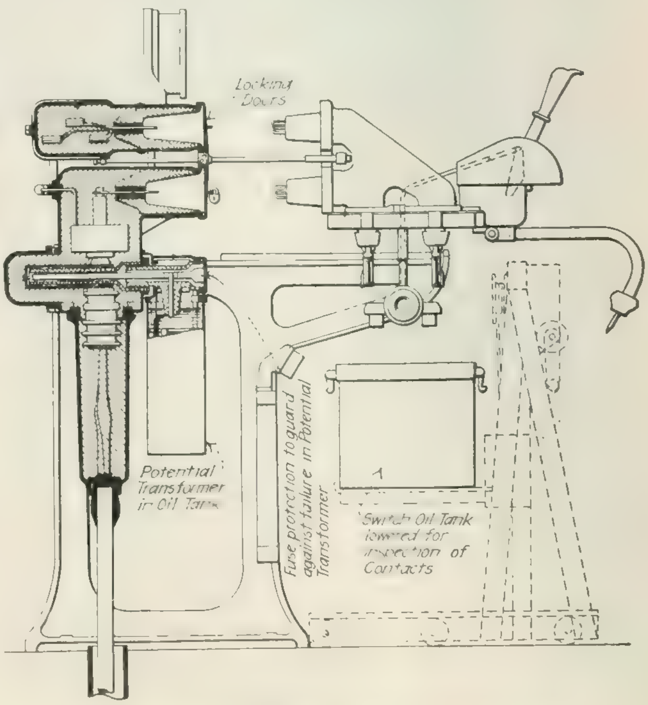

Locking Doors
Potential Transformer in Oil Tank
Fuse protection to guard against failure in Potential Transformer
Switch Oil Tank lowered for inspection of Contacts

FIG. 7—DRAW-OUT GEAR—SWITCH DRAWN OUT AND TANK LOWERED

Again, a very common construction requires the oil switch to be operated from the front of the board and the disconnecting switches from the back (see Fig. 1). The possibility here is that disconnecting switches may be opened when the oil switch is closed and current flowing.

Actual accidents have realized all the above possibilities, and interlocks have been developed from time to time for their prevention. On large main station boards the standard of intelligence among the operating staff is usually high, and interlocking arrangements are therefore comparatively seldom required; if they are necessary, however, sufficient money is available to get out a special and substantial scheme. In the cases of substation and smaller generating station boards, however, interlocks have frequently been found both proportionally expensive and unreliable.

Continued demand for this gear has evolved in the latest types a satisfactory arrangement in which most of the difficulties have been overcome by the use of rotary isolating switches. For voltages up to 11,000 these consist of a square steel shaft covered with a special molded micanite sleeve and carrying the three blades of the disconnecting switches. The spindle terminates in a handle outside the cubicle and therefore may be operated without exposing live metal. The handle may, moreover, readily be locked in the "on" or "off" position. For voltages above 6,600 the insulation sometimes consists of porcelain. Both classes of material have been found most efficient.

Fig. 3 shows the back view of cubicles equipped with these switches. Examination of that illustration will disclose the fact that crossing of connections is avoided and head room reduced.

Fig. 5 shows a closer view of one of the interlocks. The vertical rod shown is rigidly attached to the oil switch link work and is lowered when the oil switch is closed. It then engages with a cam on the disconnecting switch spindle and prevents its being moved either "on" or "off."

Another interlocking arrangement attached to the other end of the disconnecting switch spindle is shown in Fig. 6. The short rod shown hanging from the crank on the end of the spindle is inserted in the housing on the inside of the oil-switch compartment door, when the disconnecting switches are closed.

When both of these interlocks are fitted it is therefore impossible to break current on the disconnectors, and it is also impossible to touch live metal when overhauling the gear. The door of the oil-switch chamber is quite separate from that of the disconnecting switch chamber, and the latter need never be removed except when the busbars themselves are being overhauled.

The above are typical of the switchgear of the steel cubicle type made in large quantities by a number of firms. It should be remembered that by far the greater part of high-tension distribution is carried out at 3,000 and 6,000 volts. Next in importance is 11,000 volts, and the highest is 20,000 volts. Cubicle construction for the latter voltage is invariably of the remote-control type with the notable exception of the Reyrolle armored gear of the draw-out type.

INSTALLATIONS OF THE COMPLETE DRAW-OUT TYPE

The draw-out type of gear has been developed to take the place of the cubicle type of gear and to give an equal or greater protection to life by the use of the very simplest interlocking arrangement. In spite of the fact that it is somewhat more expensive, it has found a very extensive use, more particularly for mining work and substations. Its performance in these positions has been so successful that it has frequently been installed for very large main station boards at voltages up to 20,000.

FIGS. 8 AND 9—FRONT AND REAR VIEW OF A DRAW-OUT SWITCHBOARD BUILT INTO STATION WALL

A typical panel is shown in elevation in Fig. 7. The switch has been withdrawn and the tank lowered by means of special tank carriage and lowering gear. An interlocking arrangement makes it impossible to withdraw the switch when its contacts are closed and when the possibility exists of current flowing, so there is no likelihood of drawing out an arc on the isolating contacts.

A pair of doors shown at *A* is normally tucked away between the busbar and transformer chambers. These automatically follow the switch carriage out and close over the orifices which contain the plug connections to the busbars and transformers respectively. The illustration also shows an oil-immersed potential transformer in position at *B*.

The busbars are inclosed in a separate iron chamber made in segments with band joints between panels. The busbars themselves and the joints are immersed in an insulating compound such as is used for potheads, etc. The current transformers are immersed in a separate chamber for each panel and like the busbars are immersed in compound. These two chambers are supported on standards which form the framework of the gear. A plug connection is shown between the oil-switch mechanism and a base normally mounted below the oil-switch tank and carrying relays. The switch is the only part of the gear which can possibly require periodical inspection, and the only way to inspect the contacts is to withdraw the switch carriage, thus making all the metal parts safe to handle. In spite of its small bulk the insulation of the gear is very sound. The usual test is three times working pressure, and it is possible to play upon the whole gear with a hose pipe while in actual operation on high tension.

The use of this type of construction for main station switchboards is illustrated in Fig. 8, which shows the front view of a switchboard made for operating through the wall of the engine room. By this means it was not necessary to encroach upon engine floor space.

The view of the other side of the wall is shown in Fig. 9, where all the oil switches are in position with the exception of the one at the front. This has been taken away on a carriage and run to the other end of the chamber. It will be noticed that all live metal is completely inclosed and that the switch can be taken away to a separate shop for overhauling. This actual switchboard is working at 20,000 volts.

Previous mention has been made of the difficulty of insuring safety in overhauling gear connected to duplicate busbars. The problem has been overcome in a most simple and effective manner in the case of draw-out gear, as shown by Fig. 10. Two sets of busbars are run in standard cast-iron troughs one above the other, and the oil switch is fitted with two sets of plugs. The actual contacts, however, are only fitted in position in one set according to which set of busbars it is required to connect. To do this the oil switch is racked out, and the contacts are changed from one set of receptacles to the other. Nothing has to be done to the live gear. This particular switch is suitable for controlling generating plant in a power station having an aggregate capacity of 50,000 kw. Approximate dimensions can be obtained by comparison with the yard rule which is resting against the standard in the foreground.

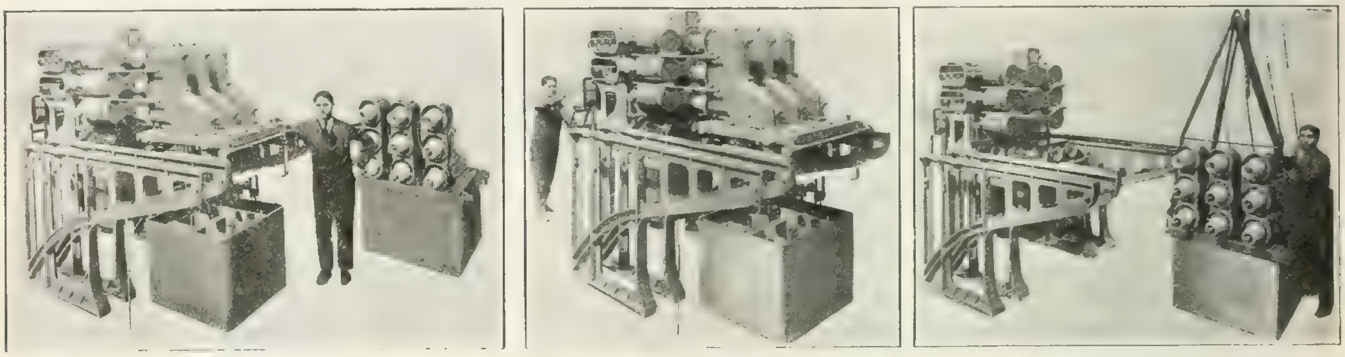


FIG 10—SWITCHGEAR FOR A STATION OF 50,000 KW. RATING SHOWING EASE OF HANDLING FOR INSTALLATION AND REPAIR

TRUCK-TYPE BOARDS FOR SMALL POWER WORK

A compromise is made by most firms between the plain sheet-steel cubicles and the completely armored draw-out gear by mounting the oil switch and transformers together with the front panel and instruments on a wheeled truck. Normally the truck is completely inclosed by the sides of the cubicle, but on pulling it out to inspect the gear contact with the cables and busbars is broken and it is safe to handle in the same way as the fully ironclad draw-out gear.

Fig. 11 shows a typical single panel being drawn out for inspection. All the gear is dead, and the live contacts are well out of the way inside the cubicle. Automatic shutters are sometimes fitted to cover them up. The lower contact which can just be seen is to insure that the frame of the truck is properly grounded when pushed home. For medium voltage and small power work such gear proves quite satisfactory.

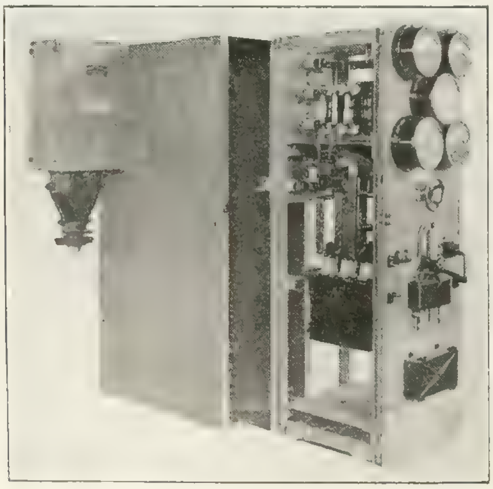


FIG. 11—VIEW OF THE SINGLE PANEL OF THE TRUCK-TYPE SWITCHBOARD

Taxes and the Public

TAXES *have to be paid by the public. They cannot be imposed on any class. There is no power that can prevent a distribution of the burden. The landlord may be the one who sends a check to the public treasury, but his tenants nevertheless make the payment. A great manufacturer may contribute a large share of his income, but still the money comes from the consumer.*

Taxes must and do fall on the people in whatever form or name they are laid. There is no other source rich enough or powerful enough to meet the public requirements. It is useless to delude ourselves, and fraudulent to attempt to delude others, with the claim that the public revenues are or can be derived from any source save the people themselves.—CALVIN COOLIDGE, *Governor of Massachusetts.*

Induction Motors on Unbalanced Voltages

The Continuous-Load Capacity of a Motor May Be Increased by Opening One Phase in Case of Serious Voltage Unbalance—Test Data Bear Out Mathematical Deductions of Author

By J. SLEPIAN

Research Division, Engineering Department, Westinghouse Electric & Manufacturing Company

IT IS well known that when the voltages are unbalanced the operation of induction motors from a polyphase line is adversely affected. With the increasing use of single-phase furnaces and other large single-phase loads it is a matter of some importance to be able to determine from a given voltage unbalance the resulting reductions in continuous capacity, starting torque and pull-out torque of induction motors. Methods for making these calculations, though simple, do not seem to be generally understood.

The formulas developed here show that for moderate unbalance the starting and pull-out torques are only slightly reduced, but that the continuous capacity of a motor is seriously reduced. When the voltage unbalance exceeds 15 to 20 per cent, depending upon the motor design, greater continuous capacity may be obtained by running with one phase open, but the pull-out torque is thereby greatly decreased.

By far the best way to handle problems in unbalanced voltages is the method of resolution into polyphase components. This method has long been used in treating the single-phase induction motor and has been recently very greatly extended and given quantitative mathematical expression by C. L. Fortescue.*

The method, in essence, consists in resolving the given unbalanced line voltages into the sum of two systems of balanced polyphase voltages, one of which, however, is of opposite phase sequence to that normally associated with the polyphase line. The performance which the induction motor would give under each of the two polyphase systems taken by itself is readily calculated, and then by merely summing the results for the two systems the operation under the unbalanced voltages is found.

An understanding of the resolution of given unbalanced voltages into polyphase components is perhaps most easily obtained by considering first the inverse operation, or the result of combining two polyphase systems of opposite phase sequence. In Fig. 1 *A* represents the vector triangle of a balanced three-phase voltage of what we shall call positive or direct rotational phase sequence. The voltages a', b', c' are all equal; b' is obtained by rotating a' through 120 deg. in a counter-clockwise sense, and c' is obtained by rotating b' through 120 deg. in a counter-clockwise sense. In Fig. 1 *B* shows the vector triangle of a balanced three-phase voltage of negative or counter-rotational phase sequence. a'', b'', c'' are all equal, but b'' is obtained by rotating a'' through 120 deg. in a clockwise sense, and c'' is obtained by rotating b'' through 120 deg. in a clockwise sense. In *C* is shown the triangle whose sides are respectively the sums of the corresponding sides of triangles *1A* and *1B*, that is, $a = a' + a''$, $b = b' + b''$, $c = c' + c''$. It is obvious that the three sides, a, b, c, are unequal, and that the triangle abc represents an unbalanced three-phase voltage. Such a voltage acting upon an induction motor is equivalent to a superposition or addition of the effects of the balanced voltages a', b', c' and a'', b'', c''. Thus a', b', c' and a'', b'' c'' are respectively the direct rotational and counter-rotational polyphase components of a, b, c.

An interesting case presents itself when the two polyphase components are equal in magnitude. This is shown in Fig. 2. Here the voltage a reduces to zero and b and c become equal; in other words, we have single-phase voltage.

Generally, however, in practice the unbalanced voltages a, b, c are given, and the polyphase components a', b', c' and a'', b'', c'' must be determined therefrom. The following graphical method is the equivalent of the mathematical formulas given by Fortescue. Rotate the side b (Fig. 3A) about the base vertex through 120 deg. in a clockwise sense. Rotate side c about its base vertex through 120 deg. in a counter-clockwise sense.

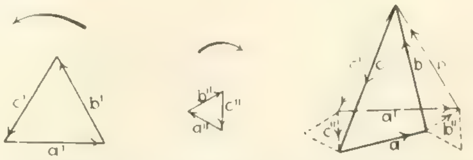


FIG. 1—COMBINING TWO BALANCED POLYPHASE SYSTEMS INTO AN UNBALANCED ONE

A—Direct rotational voltage triangle. B—Counter-rotational voltage triangle. C—Sum of triangles *A* and *B*.

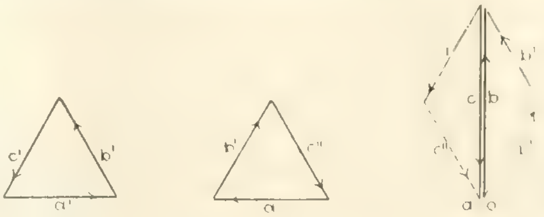


FIG. 2—COMBINATION WHEN POLYPHASE SYSTEMS HAVE EQUAL VOLTAGES

The vector joining the extremities of the new positions of b and c will be three times a', the direct-rotational component of the given unbalanced voltages.

To obtain the counter-rotational component, rotate side b (Fig. 3B) about its base vertex through 120 deg. in a counter-clockwise sense. Rotate side c through 120 deg. in a clockwise sense. The vector joining the extremities of the resulting positions of b and c will be three times a'', the counter-rotational component of the given unbalanced voltages. It is not difficult to show by elementary geometry that equilateral triangles of opposite phase sequence respectively constructed upon a' and a'' as found in this way will add into the given triangle a, b, c after the manner of Fig. 1.

UNBALANCE FACTOR DEFINED

In the formulas which follow the ratio of the magnitudes of the counter-rotational and direct-rotational components of voltage frequently appear. This ratio

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*"Method of Symmetrical Co-ordinates," *A. I. E. E. Transactions*, Vol. 37, 1918, p. 1027.

is a measure of the degree of voltage unbalance and deserves the name "unbalance factor," *u.f.*, which we shall hereafter assign to it. For balanced voltage the unbalance factor has the value zero, and for single-phase voltage, since the counter-rotational and direct-rotational components are equal, the unbalance factor is unity or 100 per cent.

In treating induction motors by the method of polyphase components it should be remembered that for a given speed the slips referred to the two components respectively are in general different, as the two components are tending to produce rotation in opposite senses. At standstill the slips for the two components are both 100 per cent. As the motor comes up in speed the slip relative to the direct-rotational component decreases, while the slip relative to the counter-rotational component increases. At half speed the direct-rotational slip is 50 per cent, while the counter-rotational slip is 150 per cent. At synchronism the slips are respectively zero and 200 per cent. In general, if s_1 and s_2 are the two slips $s_1 + s_2 = 200$ per cent.

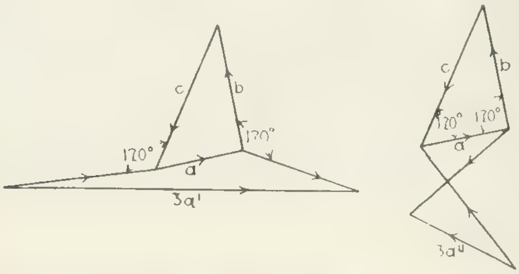


FIG. 3—RESOLVING AN UNBALANCED SYSTEM INTO TWO BALANCED SYSTEMS

A—Obtaining direct-rotational component of *a*. B—Counter-rotational component of *A*.

Starting Torque.—Fig. 4 gives the torque for various speeds of an induction motor with low-resistance rotor, and Fig. 5 the torque of a high-resistance rotor motor. The upper curves are for full voltage in the direct-rotational sense, and the lower curves for full voltage in the counter-rotational sense. At standstill or 100 per cent slip for both components the direct and counter-rotational torques are equal and opposite.

Usually the counter-rotational voltage is much smaller than the direct-rotational voltage. The lower curves in this case should be scaled down in proportion to the square of the counter-rotational voltage, inasmuch as for a given speed the torque of an induction motor varies as the square of the impressed voltage. If *u.f.* is the unbalance factor, the counter-rotational torque will be $(u.f.)^2$ times the direct-rotational torque. Since the counter-rotational torque is opposing the direct-rotational torque, we have

$$\text{Resultant starting or standstill torque} = [1 - (u.f.)^2] \times \text{direct-rotational starting torque.}$$

When the lines are only slightly unbalanced, the direct-rotational starting torque is very nearly equal to the normal starting torque, so that,

$$\text{Resultant starting torque} = [1 - (u.f.)^2] \times \text{normal starting torque.}$$

Thus a 10 per cent unbalance gives only 1 per cent reduction in starting torque.

The effect of unbalanced voltage upon the continuous-load capacity of an induction motor depends obviously upon the amount of counter-rotational current which the counter-rotational voltage is able to circulate through the machine. Since the slip relative to the counter-rotational voltage is nearly 200 per cent for a running motor, the counter-rotational current, with the usual low-resistance rotor, will be limited almost entirely by the reactance of the machine. It is convenient to use here the term "per cent reactance," which may be defined as the percentage of normal voltage required to circulate full-load current through the machine when running at very large slip. Bearing this in mind, we see that the counter-rotational current circulated by the counter-rotational voltage is given by

$$\text{c. r. current} = \frac{\text{c. r. voltage}}{\text{normal voltage}} \times \frac{1}{\text{per cent reactance}} \times \text{full-load current}$$

$$= \frac{\text{d. r. voltage}}{\text{normal voltage}} \times \frac{\text{c. r. voltage}}{\text{d. r. voltage}} \times \frac{1}{\text{per cent reactance}} \times \text{full-load current}$$

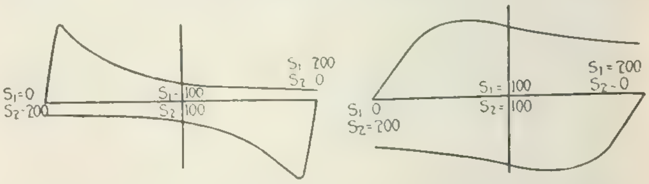
$$= \frac{\text{d. r. voltage}}{\text{normal voltage}} \times \frac{\text{unbalance factor}}{\text{per cent reactance}} \times \text{full-load current.}$$

When the lines are only slightly unbalanced the direct-rotational voltage is very nearly equal to the normal voltage, so that we have

$$\text{c. r. current} = \frac{\text{unbalance factor}}{\text{per cent reactance}} \times \text{full-load current.}$$

This counter-rotational current circulates through the windings of the machine generating heat but contributes nothing to the useful output of the motor. The formula shows the serious effect which even only a small unbalance may produce. Take, for example, a motor of 15 per cent reactance operating on a line of 15 per cent unbalance factor. The counter-rotational current, according to the formula, will be equal to the full-load current. Thus, even when running light, full-load current circulates through the motor, and no mechanical load can be further imposed without making the machine run hot.

To get the continuous capacity, in general, of a motor with given voltage unbalance, we proceed thus: The useful output is determined by the direct-rotational current. When this last is at its maximum safe value, its heating effect added to the heating effect of the counter-rotational current must be equal to the heating effect of the normal full-load current. We neglect here the counter-rotational iron losses, which are small compared to the counter-rotational copper losses. Since the heating effect of a current varies as the square of its magnitude, we have



FIGS. 4 AND 5—TORQUE CURVES FOR (4) LOW-RESISTANCE AND (5) HIGH-RESISTANCE ROTOR MOTOR

$$(\text{Full-load current})^2 = (\text{max d. r. current})^2 + (\text{c. r. current})^2$$

Substituting from the preceding formula,

$$\text{Max d. r. current} = \sqrt{1 - \left(\frac{\text{unbalance factor}}{\text{per cent reactance}}\right)^2} \times \text{full-load current.}$$

Since the useful output is approximately proportional to the direct-rotational current, we have

$$\text{Reduced output} = \sqrt{1 - \left(\frac{\text{unbalance factor}}{\text{per cent reactance}}\right)^2} \times \text{normal output.}$$

The continuous capacity of a motor is thus drastically reduced when the unbalance factor has a value comparable with the per cent reactance. In this case it frequently happens that a larger continuous capacity can be obtained by opening one phase of the motor and allowing it to run single-phase. The continuous capacity of a polyphase motor running with one phase open is somewhat less than 70 per cent of its normal capacity.

The preceding formula shows that if the unbalance factor is greater than 70 per cent of the per cent reactance, the reduced output is less than 70 per cent of the normal output, so that better continuous performance will be obtained by opening one phase of the motor. This last assertion may seem paradoxical, but is soon cleared up if we recognize that although one phase is open, voltages between the open and the other phases of the running motor continue to exist and may be measured with a voltmeter. These voltages will have an unbalance factor actually smaller than the unbalance factor of the line. The pull-out torque of the motor run with one phase open will, however, generally be considerably less than when run with all phases on the line.

PULL-OUT TORQUE

Inspection of Figs. 4 and 5 shows at once that the reduced pull-out torque is given very closely by

$$\text{Reduced pull-out torque} = \text{direct-rotational pull-out torque} - (\text{unbalance factor})^2 \times (\text{direct-rotational 200 per cent slip torque}).$$

The last parenthesis is small for the usual low-resistance rotor motor, and the next to the last parenthesis will be very small for moderate unbalance factors. Hence the pull-out torque is practically that corresponding to the direct-rotational component of voltage, and will be reduced only in so far as the direct-rotational component is less than the normal voltage. For small unbalance, therefore, the pull-out torque will be but slightly affected.

When a motor is run with one phase open, thus causing the current to be single-phase, the direct- and counter-rotational components of current are bound to be equal. The counter-rotational voltage, however, will be small compared to the direct-rotational voltage, because the counter-rotational current is circulated at 200 per cent slip, while the direct-rotational current is circulated at small slip. The voltage across the connected phases will be then almost entirely that due to the direct-rotational component. As the slip of the motor and the current are increased, the counter-rotational voltage increases, and this necessitates a decrease in the direct-rotational voltage, as the two components must combine to give the voltage across the connected phase, which is kept constant. When the pull-out point is reached the direct-rotational voltage component is so far reduced that the reduction in torque is very large.

EXPERIMENTAL VERIFICATION OF THE PRINCIPLE OF RESOLUTION INTO POLYPHASE COMPONENTS

While the author has not found any data bearing directly on the formulas derived above, from which a quantitative check might be made, he has found numerous tests in which unbalanced voltages and unbalanced currents were observed for motors of known reactance. From the observed voltages the counter-rotational component may be determined by the graphical method of this paper, and from it the counter-rotational current may be calculated by the formula

$$\text{c. r. current} = \frac{\text{c. r. voltage}}{\text{normal voltage}} \times \frac{\text{full load current}}{\text{per cent reactance}}.$$

The counter-rotational current obtained in this way may be checked against the counter-rotational current determined graphically from the three observed currents.

Agreement must be considered as verification of the principle of resolution into polyphase components, of which the formulas of this paper are arithmetical consequences. The table gives the check obtained from data for a compressor motor.

SQUIRREL-CAGE MOTOR, 5-HP., THREE-PHASE, 25 CYCLES, TWO POLE, 900 VOLTS, 1425 R.P.M.

Full-load current, 3.27 amp. Volts giving 3.27 amp. at standstill, 130 per cent reactance = 130 ÷ 900 = 14.5 per cent

Test No.	Volts Observed	Amperes Observed	C.r. Volts from Observed Volts	C.r. Amp. from Observed Amp.	C.r. Amp. Calculated from Observed Volts
1	844,958,877	1.6, 4.6, 5.2,	66.7	1.8	1.7
2	709,816,738	2.1, 4.8, 5.5,	67.6	2.0	1.7
3	870,966,852	4.1, 4.6, 0.9	76.0	2.1	1.9
4	702,744,813	3.2, 5.2, 2.4	64.0	2.0	1.6

It will be noticed that the maximum discrepancy amounts to 20 per cent of the counter-rotational amperes. Bearing in mind the lack of absolute simultaneity of reading of the three voltages and currents, and noticing that an error of 1 per cent in a voltage reading would make an error of over 10 per cent in the counter-rotational voltage, the agreement must be considered very good.

Motor Repair Cost of Large Steel Mill

THE total cost of armature repairs at the Lehigh plant of the Bethlehem Steel Company for nine months amounted to about $24,000, or an average of somewhat less than $3,000 per month. During the nine months about 450 armatures were repaired, thus bringing the cost of armature up to nearly $50. These average units are especially useful for estimating the cost of repair work.

Of all armature repairs 50 per cent was shown to apply roughly to new work in rewinding the armatures and the remaining 50 per cent to minor repairs. Seven and a half hours of labor was the required interval for minor repair jobs on the armatures, and about twenty hours for rewinding.

For eighteen months the average time required for armature repairs was about fourteen and four-fifths hours both for minor repairs and for rewinding. Of this about 75 per cent covered material and about 25 per cent labor, thus pointing to the great need for special care in the purchase of repair parts. The common opinion would probably have been that the labor item would be the larger of the two.

Cost data submitted by other plants differed somewhat from the foregoing figures, owing doubtless to different conditions or different methods in cost accounting.

Design of a Unit Boiler Plant

Unit Boiler Room That May Be Built in Sections, Each Unit Being Complete in Itself and Able to Render Efficient, Reliable and Low-Cost Service with a Minimum Investment

By LOUIS R. LEE
Chief Engineer E. W. Clark & Company Management Corporation

THE principal function of the unit idea in power-plant construction is to provide a simple and flexible design that will secure low first cost and high plant efficiency for any desired capacity, plant efficiency being defined as ratio of net output to gross input. The net output is the kilowatt-hours of energy sent out at transmission voltage, and the gross input involves the fixed charges on the investment—the cost of operation, such as labor, fuel, depreciation, supplies and repairs. The value of the output in kilowatt-hours divided into the input, or total cost expressed in dollars and cents, gives a measure of the efficiency of a plant that is unquestionable.

It is impracticable to build any plant of a size sufficient at the outset to take care of all future requirements. Every plant must sooner or later be extended or supplemented. It is often advantageous to build only a portion of a plant each year, providing for extensions to be built over a period of years as the growth of the business confirms the old or requires new estimates. The scheme when properly executed reduces fixed charges caused by idle investment during construction periods. In the unit design it is planned to have each unit practically dependent upon itself, eliminating the expense and complication of interconnections, loop lines, by-passes and other features of like character. Each extension, therefore, will involve minimum disturbance and changes in the part already built and in operation.

Obviously, the unit must start with the boiler. The boiler, its furnace with draft equipment and feed-water supply, is essentially a complete unit. It is only necessary to multiply the output of such a unit to secure any desired total output. By carrying out the unit design with a limited selection of characteristic equipment and by careful design of the different parts of the unit a design is obtained whereby a finished plan for any given installation can be presented on very short notice with a complete estimate of the cost of the total installation. A very definite estimate can be made of the cost of operation, including cost of labor, fuel and the fixed charges on the investment.

In making this unit design each part of the design must represent increased efficiency which will justify the fixed charges which it involves as well as the cost of operation and maintenance of this piece of equipment. Consequently certain parts of a design may be varied according to the commercial value of coal or other fuel, giving due consideration to the future commercial value of these commodities, and if necessary making allowance for the future installation of such additional equipment as the higher cost of coal would justify.

With these ideas in mind it is recognized that the building, foundations and supporting steel for the equipment must be made as simple as possible, so that the cost will be low, while, on the other hand, the equipment must be built of the very best material and of a design which actual use has shown to be practical and efficient. Therefore, where space permits, the plant will preferably have ample ground plan area and minimum elevation. High structures will be resorted to only in congested city districts where increased ground area is not available or where land values for other reasons may be excessive. Moreover, in any case it must be recognized that the operating force can only be at a minimum when all operation may be conducted on one floor level. Again, proper facilities must be provided for the maintenance and general care of the equipment. All equipment must be located so that all parts are quickly accessible and that disassembly of one unit does not interfere with operation of the other units.

Savings in the first cost of construction must be made only where they do not jeopardize savings that may be made later in operation and maintenance and will be such as not unnecessarily to limit the arrangement to the exclusive use of certain equipment; that is, the design will be such as to accommodate certain types of equipment which are made by several different manufacturers. For example, a certain type of stoker is made by three manufacturers, with the result that while the three stokers function essentially in the same manner, there are many detailed differences which will not change the principle of the unit layout.

UNIT-BOILER-PLANT RATING TABLE

Kilowatt ratings at 12.5 lb. (5.6 kg.) steam per kilowatt-hour. Steam pressure, 250 lb. (17.5 kg. per sq.cm.). Temperature, 600 deg. F.

(Light-face figures, 275 per cent boiler rating; bold-face figures, 350 per cent)

No. Units	Unit Sizes							
	$\frac{7}{10}$	$\frac{8}{10}$	$\frac{9}{10}$	1	2	3	4	5
1	4,100 **5,400**	4,700 **6,100**	5,300 **6,800**	5,900 **7,500**	6,500 **8,300**	7,100 **9,000**	7,700 **9,700**	8,300 **10,400**
2	8,200 **10,800**	9,400 **12,200**	10,600 **13,600**	11,800 **15,000**	13,000 **16,600**	14,200 **18,000**	15,400 **19,400**	16,600 **20,800**
3	12,300 **16,200**	14,100 **18,300**	15,900 **20,400**	17,700 **22,500**	19,500 **24,900**	21,300 **27,000**	23,100 **29,100**	24,900 **31,200**
4	16,400 **21,600**	18,800 **24,400**	21,200 **27,200**	23,600 **30,000**	26,000 **33,200**	28,400 **36,000**	30,800 **38,800**	33,200 **41,600**
5	20,500 **27,000**	23,500 **30,500**	26,500 **34,000**	29,500 **37,500**	32,500 **41,500**	35,500 **45,000**	38,500 **48,500**	41,500 **52,000**

BOILER PLANT SELECTED FOR UNIT CONSTRUCTION

The unit selected to accomplish the aims which have just been set forth is shown in the accompanying view of its side elevation. This unit consists essentially of a cross-drum boiler, set singly with suitable stoker furnace and provided with a direct-connected economizer. In the majority of cases it may be that the underfeed stoker, which is the one illustrated, will be most satisfactory; therefore the draft equipment will consist of a forced-draft fan and an induced-draft fan, both fans being motor-driven by direct-connected constant-speed induction motors.

Without changing the essentials of this unit the rated capacity of the unit may vary from 700 boiler hp. to 1400 boiler hp., with a possibility of operating any boiler selected at a maximum of 350 per cent of its rating with an overall thermal efficiency for the unit of 80 per cent and possibly a maximum thermal efficiency somewhat higher, at about 275 per cent rating. Owing to the fact that there are practically no constant loads to be applied to boiler plants, the average rating obtained from them must be less than the maximum; hence the maximum efficiency point can be placed to advantage somewhat below the maximum capacity.

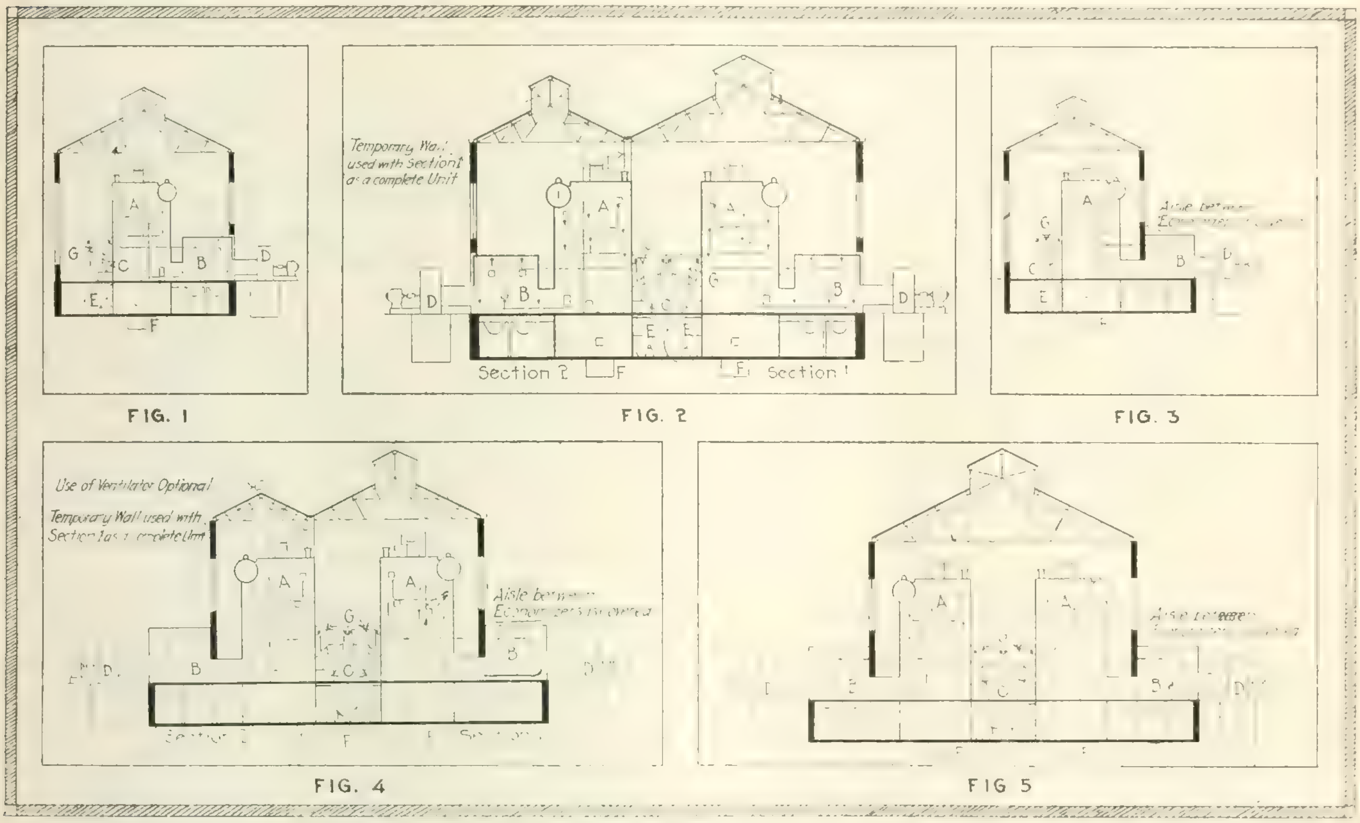

Temporary Wall used with Section 1 as a complete Unit
Section 2
Section 1
Use of Ventilator Optional
Temporary Wall used with Section 1 as a complete Unit
Aisle between Economizers
A
B
C
D
E
F
G

FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG 5

FIGS. 1, 2, 3, 4 AND 5—SIDE ELEVATIONS OF FIVE ARRANGEMENTS OF UNIT BOILER PLANTS TO MEET THE NEEDS OF A WIDE RANGE OF CONDITIONS

Building is provided with monitor roof for illumination and ventilation. Where high side windows are used the illuminating surface is 60 per cent of wall surface; for short windows it is 30 per cent. A—Boiler. B—Economizer. C—Stoker. D—Induced-draft unit. E—Forced-draft fan. F—Ash-handling equipment. G—Traveling coal larry.

By studying the accompanying diagrammatical drawings it will be noted that the unit may be used in single or double row, with the complete unit housed or with only the boiler and stoker part of the unit housed. Where space permits all of the essential equipment will be installed upon one level, but where space does not permit the draft equipment may be placed over the economizer section.

Each unit of this design will be entirely complete and self-sustaining in itself, with the exception that the coal supply and ash disposal will be worked out for the combined layout. However, each row of units will have a separate coal supply and ash disposal, and since it may be desirable to increase the plant by increasing in length, it will only be necessary to extend the track for the coal car and the travels of the conveyor.

Comparison of any of these building plans with the best present-day practice will show much saving in cubical contents of building, also great saving in material for supporting structures for equipment, particularly the economizer and draft equipment. The entire absence of flue between boiler and economizer, with a consequent saving in cost and heat loss; the accessibility of the economizer through the inspection doors of the boiler and inside of the economizer covers, and the accessibility of the economizer for erection, cleaning and repairs, are features of the layout.

The economizer as well as the boiler is provided with mechanically operated soot blowers which use superheated steam. The economizer is standard for 200 lb. (14 kg. per sq.cm.) pressure for any plant, while the boiler may use any pressure from 200 lb. to 400 lb. (28 kg. to 56 kg. per sq.cm.) with superheat to suit requirements; but a terminal steam temperature of 600 deg. Fahr. (315 deg. C.) ought to be obtained and considered standard for turbine stations.

CONTROL STATION FOR OBSERVING PERFORMANCE

A central observing and control station is provided at the side of each boiler unit, these stations being arranged where desired, right-hand and left-hand, so that one operator may observe and control two units. The control at these stations will cover the operation of the stoker, forced and induced-draft fans, draft regulation, feed-water supply and ash dump. The operator will also be able to observe the steam pressure, temperature and flow, the draft loss through furnace, boiler and economizer, and also the temperature of the flue gases at the boiler and economizer exits and the temperature of the feed water entering the economizer and boiler.

An indicating wattmeter will show the operator at all times the total station output. A recording wattmeter will give the energy used by the auxiliaries—that is, fans, stoker and feed pump—and a record will also be made of the coal used. Therefore a complete record will be made which will be an exact check and record of the performance of each unit. Practically all of this information may be recorded on charts for future reference, the records being automatically kept so that the operator may give his best attention to the work.

Piping will be of the best material, using steel flanges, vanstone joints and monel-metal gaskets, with welded nozzles for all branch lines. The aim should be to make the arrangement of piping as simple as possible, locating the main valves in the most convenient place so that little experience will be required of an operator in order to assume charge of a unit.

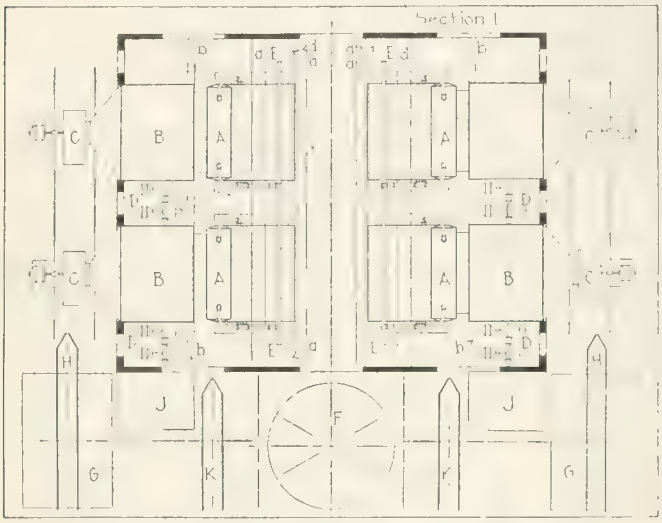


FIG. 6—PLAN OF BUILDING ARRANGEMENT

A—Boiler. B—Economizer. C—Induced-draft unit. D—Feed-water pumps. E—Main steam header. F—Coal bin. G—Coal hopper. H—Coal track. J—Ash pit. K—Ash-removing track. a—Location of temporary wall to be used with Section 1 as a complete unit. (See elevation, Fig. 1.) b—Location of outside walls in layouts with economizers outside of building. (See elevation arrangements C and D.) d—Walkways.

Walkways are provided at the side and top of the boiler and economizer so that repairs, cleaning, inspection and such operation as is necessary on these higher elevations may be quickly and safely taken care of. It is to be noted that the boiler may be cleaned without interfering with the operation of the other units, and special arrangements are provided at the back of the boiler for carrying off the waste water in washing out the boiler .

All soot and ash deposited in the economizer is taken care of by the boiler ash-disposal system. This system consists essentially of a duplicate drag-chain conveyor, the drag chain being made of extra heavy malleable-iron links travelling on flat cast-iron slabs laid in concrete pits. In this way the ash comes in contact only with malleable or cast-iron parts which have a low cost and a low depreciation even with the worst kind of ash. This same equipment conveys the ash to the proper elevation for depositing in cars, there being no elevators, cars or skips required for elevating and depositing the ash in railroad cars.

The building is a simple, standard steel structure with basement and main floor, without galleries or elevated floors, the walls usually being made of plain, hard-burned red brick. The roof, which is provided with a monitor for ventilation and light, is constructed with a concrete slab waterproofed with asbestos fabric and asphalt. In warm climates it has been found entirely satisfactory to cover the walls and roof with asbestos-covered corrugated iron, thus securing considerable saving in first cost. The side walls, being unobstructed by equipment, admit of the use of large steel-frame windows which provide maximum light and ventilation. This assists materially in getting a satisfied and efficient operating force.

The induced-draft equipment, together with the stack, is located out of doors where space permits, and fans are readily inspected through a doorway opposite each unit aisle. The width of these aisles may be varied to suit local conditions, but a width of 10 ft. (3 m.) is recommended as standard.

The feed-water supply system consists principally of flow meters for measuring the return from turbine condensers and added make-up water, a surge tank and an open feed-water heater, which receives a regulated supply of steam from the main turbine to raise the feed water to a predetermined temperature. For standard conditions 140 deg. Fahr. (60 deg. C.) is recommended.

HOW THE UNIT SYSTEM IS APPLIED

By reference to the diagrammatic drawings it is to be noted that boiler units are to be set in rows facing each other, two rows constituting a group, and it is recommended that five units be considered a full row; in other words, a station having two rows would have ten units or a complete group. By referring to the rating table the capacity of the station can then be determined according to the number of units and the size selected. There are five standard sizes with three fractional sizes. For example: Unit size No. 1 has a maximum capacity of 7500 kw., while five of these units would have a capacity of 52, kw., and consequently a double row or group would have a capacity of 104,000 kw. Considering the fractional sizes, one therefore has a range using two size 7/10 units of 10,800 kw. or for a group of ten units of the size No. 5 of 104,000 kw., it being practicable to obtain various combinations between these ranges. For example: For a station of 25,000 kw. capacity, with a possible future growth up to 50,000 kw., four size No. 2 units arranged in single row, building Fig. 1, would provide 26,000 kw. average initial capacity. Later, a second row of four units, building Fig. 2, would give 52,000 kw. In the first case any three units in service would have a maximum capacity of 24,900 kw., thus allowing one unit for cleaning and repairs. The load characteristics and seasonal variations would govern to a large extent the selection of units. As a general proposition it would be considered good practice to lay out all boiler plants with at least three units, this arrangement giving a reasonable insurance against power shortage due to a unit being out for cleaning or repairs.

The cost of the building can be varied by selecting different arrangements. For example, if the economizer is housed, the building will have a maximum size for a given number of units. Considerable saving can be made by allowing the economizer to be out of doors, but even in the outdoor location the operating aisle between the economizer units is housed so that the piping for soot blowers, drains, feed-water supply, etc., is housed and will not cause trouble by freezing. The housing in this case consists of a covering even with the top and outward side of the economizer unit.

For standard construction the induced-draft fan units are out of doors.

When building arrangement Fig. 1 is selected with the expectation of later doubling the capacity of the plant, a temporary side wall can be constructed of corrugated asbestos-covered iron, this material later being used in roof and floor construction of the extension. Various combinations may be worked out to provide for future extensions, the details of the arrangements being controlled largely by local conditions.

Unit-design boiler room reduces first cost and at the same time offers possibilities of increased efficiencies.

Plant efficiency based upon output and input is the only true measure of value of results.

A small plant or a large plant may be constructed, each plant deriving proportional advantage.

The present load demands may be cared for, and future extension may be made when needed at proportional added investment.

Testing of Instrument Transformers—III*

A New Method for Absolute Calibration of Current Transformers—Sufficiently Accurate for Any Except the Most Precise Laboratory Work—The Accuracy of the "Loop-Through" Current Transformer Depends Upon the Distribution of Windings

By H. M. CROTHERS
Electrical Engineering Department, University of Wisconsin

PRACTICALLY the only methods of testing instrument transformers open to small shops and laboratories are comparative tests in which the unknown ratio and phase angle of a transformer under test are found by comparing them with the known ratio and phase angle of a standard transformer having the same nominal ratio. The matter of the reliability of the standard transformer and of methods of calibrating it therefore becomes a question of prime importance.

In order to get as many nominal ratios as possible combined in one transformer, current transformers used as standards usually fall into one of two classes—first, the type in which the fixed primary winding is divided into four sections and by varying the connections between sections four different ratios may be obtained; second, the "hole" or "loop-through" type, in which only the secondary winding is permanent. The primary winding is arranged as needed and may be looped through the core once, twice or as many times as desired. This paper will deal entirely with transformers of the second type.

ABSOLUTE METHOD OF CALIBRATION

The new absolute method of calibrating loop-through transformers consists in winding on primary turns until a nominal ratio of one to one is secured. Then the secondary current may be compared with the primary current by the same method that is used in comparing the secondary currents of two transformers. The Agnew method and Silsbee method are both available for this purpose.

The writer has used the Agnew method of comparison exclusively, and it is as satsfactory for this purpose as for the original purpose. The proper equations to be used under these conditions may be obtained from the first paper of this series* by the following considerations. The results obtained by comparing this secondary current with primary current are exactly the same as would be obtained by comparing this secondary current with the secondary current of a perfect current transformer, one in which the ratio factor is 100 per cent and the phase angle is zero. Thus the equations given in the previous paper may be written as

$$F_s = 100 + 100\left[\frac{B_p - B_s}{2\,A_p}\right] \qquad [1]$$

and

$$\alpha_s = 0 - \frac{34.38}{\tan\theta}\left[100\,\frac{B'_p - B'_s}{2\,A'_p} - 100\,\frac{B_p - B_s}{2\,A_p}\right] \qquad [2]$$

Since α_s is usually positive, (2) is more convenient when written

$$\alpha_s = \frac{34.38}{\tan\theta}\left[100\,\frac{B_p - B_s}{2\,A_p} - 100\,\frac{B'_p - B'_s}{2\,A'_p}\right] \qquad [2]$$

F_s is the ratio factor of the transformer stated in per cent.

α_s is the phase angle in minutes.

θ is the angle by which the voltage on the watt-hour meters is shifted ahead of the currents.

A_p is the registration of meter A when in the primary circuit.

A_s is the registration of meter A when in the secondary circuit.

B_p is the registration of meter B when in the primary circuit.

B_s is the registration of meter B when in the secondary circuit.

And A'_p, A'_s, B'_p, B'_s, are the corresponding readings taken with the watt-hour meters at low power factor.

The method is sufficiently accurate for anything but the most precise laboratory work. It gives results which are correct within 0.1 per cent easily.

It may seem at first as if excessive time would be required to put on the primary winding, but this is not the case. The first time the scheme was tried, lamp cord was used and only about thirty minutes was required for eighty turns—a 400-to-5-amp. transformer. Later, using a ten-strand cable made for this purpose, the time was much reduced. The cable was made up by taping together ten strands of No. 16 fixture wire. For a primary winding of 160 turns, for example, the cable would be looped through sixteen times and the strands then connected in series. This was easily and quickly done by means of a magneto or dry cell for testing.

The characteristics of any current transformers are affected by changes in the resistance or reactance of the secondary circuit, so the same precaution must always be taken in that respect, that is, to calibrate the transformer with its normal working load.

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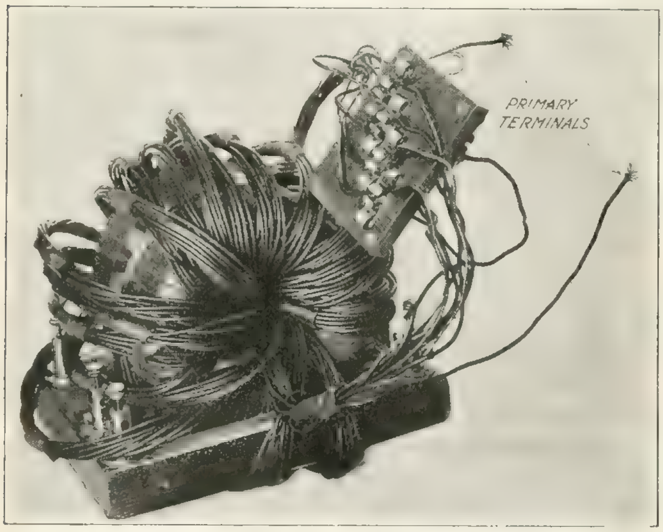
*See ELECTRICAL WORLD, March 15, page 516, and July 19, 1919, page 119.

The special error which must be guarded against in loop-through transformers is due to changing the position of the primary winding between one test and another. This affects the characteristics in two ways.

The first way is by changing the leakage reactance of the secondary winding. If the secondary winding is bunched on the core, the reactance varies considerably with the position of the primary, and this in turn affects the ratio and phase angle. If the secondary winding is well distributed over the entire length of core, the position of the primary does not affect the reactance very much, and if the secondary winding is distributed around an annular core the effect is a minimum and is hardly appreciable.

The second way in which the position of the primary winding affects the characteristics of the transformer is by changing the reluctance of the magnetic circuit and thereby changing the exciting current. When the primary winding is bunched on a small part of the core, there will be a large primary leakage flux through the iron in that part of the core and a small decrease in the flux in other parts of the core. The permeability of the iron depends on the flux density, and thus the reluctance of the core depends on the position of the primary.



CONVENIENT METHOD OF PUTTING PRIMARY WINDING ON A "LOOP-THROUGH" CURRENT TRANSFORMER

The errors due to this cause are reduced to a minimum by always keeping the primary winding symmetrical with respect to the core. If a single turn is looped through the core, it should lie along the axis of the core to a distance of about 18 in. (46 cm.) to each side and the remainder of the circuit should be kept at least 18 in. from the core. If a number of turns are used, they may be wound closely around the core provided the winding is well distributed.

When a well-distributed secondary winding is used on an annular or even a rectangular core, the difference in ratio caused by changing from a distributed to a bunched primary winding is of the order of 0.1 per cent, usually less. With a bunched secondary winding, however, the result is entirely different as shown by the following data.

A transformer having a secondary winding bunched on one leg of a rectangular core was tested with the primary winding first on the same leg and then on the opposite leg. The change in position of the primary caused a change of 1 per cent in the ratio and of 1.5 deg. in phase angle. Transformers of this type with bunched secondary windings should never be used as standards.

The question often arises whether the ratio factor and phase angle determined with one number of primary turns will hold for another number of primary turns. If the precautions are taken in regard to keeping the windings well distributed, no appreciable error will arise.

CONVENIENT TYPE OF TRANSFORMER FOR USE AS STANDARD

It is seen that from one loop-through transformer a large number of nominal ratios may be obtained by changing the number of primary turns. The number of possible ratios may be further increased by putting taps on the secondary winding. The standards laboratory of the University of Wisconsin has arranged a secondary winding of 160 turns on an annular core, providing taps at 100 and 120 turns. The winding is so put on that whatever tap is used, the active winding will be well distributed. This transformer may be used as a standard in testing any commercial transformer with primary current rating between 5 amp. and 800 amp. It is almost a "universal standard." A similar transformer with 600 secondary turns extends the range of primary current ratings up to 3,000 amp. Each secondary winding must have a separate calibration, since the difference between any two secondaries on the same transformer is appreciable.

By properly choosing transformer standards and using the method of calibration outlined any meter shop may be prepared to undertake current transformer testing without outside assistance.

A summary and comparison of the methods of testing current transformers described in this series will appear in an early issue of the ELECTRICAL WORLD.

Improper Spacing of Bonding Clips Causes Generator to Heat

ALTHOUGH it is good practice to band the head of armatures on clips spaced at short distances around the periphery, trouble may sometimes be caused if the same method is used for banding the core. This is especially true if the magnetic field of the machine is very strong because the trouble will be exaggerated owing to the eddy currents generated in the bands. In one instance the heat generated by these eddy currents was so great after the armature had been repaired and rebanded that the solder holding the banding irons was melted. The generator was rated at 500 kw., 250 volt, 500 r.p.m., and had banding clips at intervals of 10 in. (25 cm.) around the periphery of the core.

To overcome this trouble, new bands were wound on the core, but the clips this time were spaced the same distance apart as the poles of the machine. As this was an eight-pole machine four clips were used on each band spaced 90 deg. apart. By this arrangement all the clips on each band are at any instant under the poles of the same polarity and the tendency to generate eddy currents in the bands is reduced to a minimum. It is also advisable to make the bands narrow using more of them to get necessary mechanical strength. After the new bands and clips had been attached to the core the machine operated without any trouble.

Year of Preparation in Welding

Organization of American Welding Society and American Bureau of Welding Promise Real Work in the Future—Steady Extension in the Application of Welding and Definite Assurance of Great Development

By **PROF. COMFORT A. ADAMS**
President American Welding Society

N WELDING development the year 1919 was one of preparation. The work which was started by the welding committee of the Emergency Fleet Corporation to utilize welding as a means of increasing production in shipbuilding was necessarily discontinued at the end of the war before the possibilities of its application had been thoroughly developed. However, the accomplishment was sufficient to warrant those connected with this movement in taking steps to place it on a permanent peace-time basis. To this end the members of the old committee, together with members of the National Welding Council, organized the American Welding Society and the American Bureau of Welding. Two separate bodies were needed to accomplish the objects in view, which were:

First—To provide an organization which could take the initiative in educating the industrial public and in opening new fields to welding.

Second—To have all research in welding which might be conducted independently by existing scientific societies, educational institutions and departments of the government brought together and conducted jointly, thereby avoiding duplication of effort and securing more reliable and authoritative results.

Third—To secure a proper body for standardization.

Without going into the details of organization, it may be stated that the Bureau of Welding is a body of delegates from the existing societies and governmental departments—including delegates from the American Welding Society—which provides a means of joint action in research and standardization. Its research work comes under the auspices of the engineering division of the National Research Council and is officially attached thereto. Its standardization work is under the auspices of the American Engineering Standards Committee, and its standards committee is a sectional committee thereof.

The American Welding Society through its journal gives wide publicity to the work of the bureau, in order that welding may be placed upon a sound scientific basis and that its use may be extended and become an important factor in our national productivity. It requires work and time to develop and put on its feet an organization of this sort, and the time of the officers during the past year has been largely occupied with matters of organization and getting the society established as a going concern. Thus the real work is only now ready to begin.

But the year was not devoid of achievement in welding. The most noteworthy event was probably the construction and launching of a welded battle target at the Norfolk (Va.) Navy Yard, built under the supervision of Commander H. G. Knox. This target is, in reality, a completely welded vessel, 200 ft. (60 m.) long, constructed of full-sized ship plate. Its action in service, particularly as a target, will be watched with interest.

As a contribution to our knowledge of arc welding, Professor Hudson's investigations, reported in the *Journal* of the American Welding Society for October, 1919, mark a distinct advance and give us a new conception and basis for further research that is likely to become of great practical value.

From the manufacturers the report comes that the most notable advance during the year is the extension of the applications of welding. Welding is in the air. It is talked about everywhere, and the prospect for business in the future is good. I have asked the manufacturing companies to give me their views, and from the replies received several interesting points stand out. A. M. Candy of the Westinghouse Electric & Manufacturing Company summarizes the spread of welding as follows:—

It seems to me that possibly the greatest advance is psychological. By this I mean the very great stimulating effect resulting from the inauguration of the old welding committee of the Emergency Fleet Corporation and its subsequent reorganization into the American Welding Society. This work has given the arc-welding industry a very great impetus even in our own organization, which has resulted in an extension of the application of welding for work where it was considered impracticable heretofore."

In the development of welding machines there is a decided tendency toward a single-arc machine, that is, a separate machine for each operator. The Westinghouse company has produced such a machine of a new design. Besides this, W. A. Turbayne of the United States Light & Heat Corporation writes of his single-operator welding machine with improved electrical characteristics. Alexander Churchward of the Wilson Welder & Metals Company states that its machines have been reduced in weight 50 per cent with an increase in efficiency of from 5 per cent to 10 per cent. J. F. Lincoln of the Lincoln Electric Company speaks of the general acceptance of the idea of the individual machine for each operator. He also states that there has been a great advance in carbon arc welding. C. J. Holslag of the Electric Arc Cutting & Welding Company speaks of improvements in alternating-current arc-welding apparatus which facilitate holding the alternating arc and assure lower open-circuit voltage.

In automatic machines for arc welding the General Electric Company has taken the lead in development, producing during the year a machine that will make a practically perfect weld in the classes of work for which it is adapted, which are enormous. H. D. Morton of the Automatic Arc Welding Company has also developed a semi-automatic portable machine of great promise.

The training of welders has received attention by the development of welding schools by the Westinghouse company and by the General Electric Company, the latter having taken over and built up the school started by the Emergency Fleet Corporation.

Electric spot welding in the thin-plate field has been spreading with great rapidity, as the saving in labor and cost is very great when compared with that of any other method. In the heavy-plate field, however, development has been practically throttled by the patent situation. This is exceedingly unfortunate, on account of the tremendous possibilities in connection with steel structures of all kinds. There is promise of a clearing up of this situation in the near future.

Henry M. Hobart, recently returned from a trip abroad, reports that the use of electric welding in England continues to extend, especially in shipyards, but that the application in railway workshops is still far more limited than in America. The covered electrode is still almost exclusively employed. At Cammell-Laird's shipyard at Birkenhead a 150-ft. (45-m.) all-welded ship for coastwise service is practically ready to be launched. The 125-ft. (37.5-m.) cross-channel barge launched eighteen months ago is still in service between England and France. In government dockyards the increase in the use of electric welding is very rapid. W. E. Symons reports, from his recent trip to France, that the field for welding in France is large but that the awakening is slow. England is making great headway, but while the French engineers are undoubtedly ahead of us in research work, they are correspondingly behind in the application and spread of the results of their investigations. Only a few French engineers and French manufacturers know of the possibilities of electric welding.

The fields for welding are almost unlimited, and if the art is placed on a sound scientific basis by thorough going research and frank discussion the year will be enormous. There is hardly a branch of the metal-working industry where it cannot be employed with a great saving of expense and labor.

Daily Returns Surpass Records

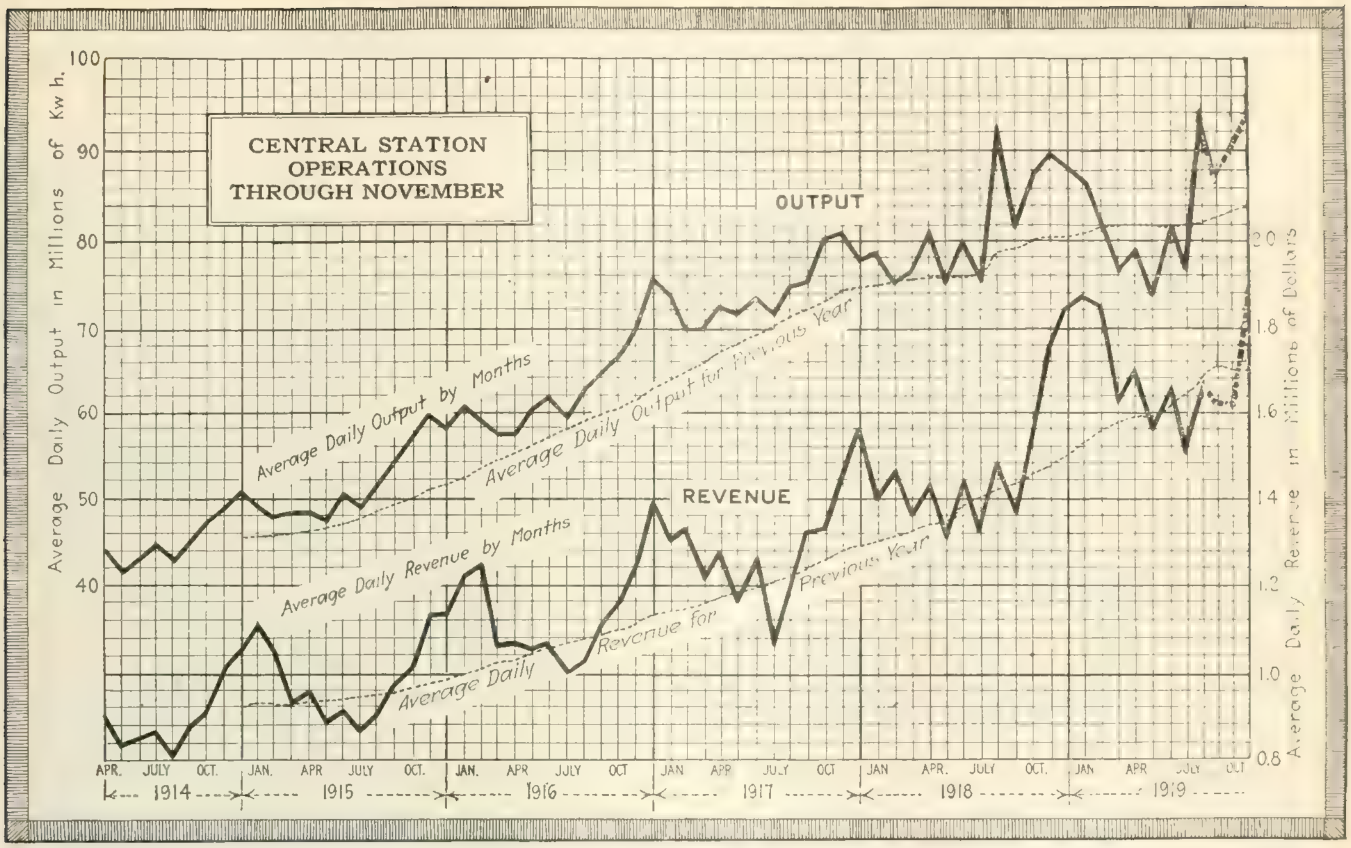
Central-Station Returns for November Indicate Output of 2,828,000,000 Kw.-Hr., and Revenue of $56,600,000—Strikes in Atlantic States Seriously Affect Central-Station Operations in That Section of the Country

CENTRAL-STATION operations during November last ran ahead of those for any previous month. According to the returns received by the ELECTRICAL WORLD from 58 per cent of the central-station industry, the average daily revenue for November was $1,887,000, or $7,000 above the previous record daily revenue, which was reported in January, 1919. That the post-war slump in revenue should have been overcome within a period of only ten months speaks volumes for the substantial position attained by the central station in the industrial life of the country. The November daily output was also a record beater, being 94,276,000 kw.-hr., or 1,954,000 kw.-hr. in excess of the highest war-time output, which came in August, 1918.

Figures compiled by the Bureau of Census show that the textile mills in New England were working at about 93 per cent capacity, and that production was greater than at any time since September, 1918, when the mills

TABLE I—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Industry Represented	New England States			Percentage of Industry Represented	Atlantic States			Percentage of Industry Represented	Central States			Percentage of Industry Represented	Pacific and Mountain States		
			1918	1917	Per Cent Increase		1918	1917	Per Cent Increase		1918	1917	Per Cent Increase		1918	1917	Per Cent Increase
REVENUE	Dec	64	$4,097,000	$3,449,000	18.7	55	$11,927,000	$10,199,000	16.9	50	$10,781,000	$8,836,000	22.0	79	$5,253,000	$4,644,000	13.1
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan.......	63	4,253,000	3,443,000	23.5	60	13,444,000	11,168,000	20.3	47	10,410,000	8,484,000	22.7	77	5,187,000	4,494,000	15.4
	Feb	63	3,895,000	3,048,000	27.7	53	10,894,000	8,943,000	21.8	45	9,305,000	7,484,000	24.3	73	4,036,000	3,618,000	11.5
	March....	64	3,608,000	3,044,000	18.4	58	11,731,000	10,244,000	14.5	47	9,012,000	7,447,000	21.0	81	4,218,000	3,685,000	14.4
	April.....	64	3,473,000	2,964,000	17.2	51	11,408,000	10,114,000	12.7	47	8,420,000	6,981,000	20.5	76	4,328,000	3,755,000	15.3
	May	62	3,194,000	2,800,000	14.0	51	9,430,000	8,571,000	10.0	47	8,297,000	6,888,000	20.4	77	5,468,000	4,764,000	14.7
	June......	64	3,321,000	2,925,000	13.3	55	10,535,000	9,478,000	11.2	50	8,757,000	7,504,000	16.7	78	5,516,000	4,767,000	15.8
	July......	61	3,329,000	2,949,000	13.0	50	9,319,000	8,375,000	11.8	50	8,854,000	7,442,000	18 0	79	4,214,000	3,756,000	12.3
	Aug	64	3,579,000	3,192,000	12.2	59	11,401,000	10,490,000	8.3	49	9,469,000	8,260,000	14.5	79	5,415,000	4,930,000	10.0
	Sept.	64	3,707,000	3,276,000	13.2	58	10,711,000	9,383,000	14.2	51	9,125,000	7,915,000	15.3	83	5,501,000	4,965,000	10.8
	Oct.......	64	4,029,000	3,384,000	19.0	59	12,009,000	10,248,000	17.2	55	10,841,000	9,046,000	19.4	81	5,462,000	4,806,000	13.6
	Nov... .	62	4,305,000	3,713,000	15.9	62	13,247,000	11,470,000	15.5	44	9,551,000	7,851,000	21.6	80	5,665,000	4,983,000	13.7
			1918	1917			1918	1917			1918	1917			1918	1917	
KW.-HR. OUTPUT	Dec......	64	145,543,000	129,838,000	12.1	55	405,253,000	421,973,000	12.6	50	489,864,000	443,544,000	10.4	79	428,906,000	374,906,000	14.6
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan .	63	143,254,000	124,632,000	14.9	60	525,322,000	458,545,000	14.5	47	463,394,000	403,127,000	14.9	77	390,690,000	371,156,000	5.2
	Feb .	63	128,660,000	109,993,000	17.0	53	406,702,000	374,958,000	8.4	45	426,965,000	378,992,000	12.6	73	287,479,000	293,492,000	−2.0
	March....	64	125,510,000	124,707,000	0.7	58	459,166,000	461,096,000	−0.4	47	442,591,000	423,802,000	4.4	81	330,714,000	331,769,000	−3.0
	April .	64	123,211,000	118,322,000	4.1	51	382,282,000	369,701,000	3.4	47	373,116,000	345,213,000	8.1	76	328,925,000	333,405,000	−1.0
	May .	62	120,949,000	122,531,000	-1.3	51	362,207,000	383,860,000	−5.6	47	389,805,000	375,944,000	3.6	77	382,637,000	385,543,000	−0.7
	June......	64	127,355,000	119,946,000	6.3	55	406,102,000	417,441,000	−2.7	50	417,942,000	386,422,000	8.4	78	445,814,000	443,209,000	0.6
	July......	61	139,133,000	129,639,000	7.4	50	373,105,000	378,053,000	−1.5	50	428,370,000	408,165,000	5.0	79	366,275,000	365,263,000	0.3
	Aug	64	148,442,000	143,100,000	3.4	59	595,812,000	625,000,000	−4.8	49	470,475,000	445,000,000	6.0	79	444,026,000	465,518,000	−4.8
	Sept ...	64	141,743,000	137,452,000	3 1	58	569,894,000	570,187,000	−0.1	51	444,219,000	398,026,000	11.5	83	423,656,000	420,707,000	0.7
	Oct......	64	159,084,000	141,353,000	10 4	59	595,931,000	567,807,000	4.9	55	567,982,000	492,840,000	15.2	81	434,566,000	417,192,000	4.1
	Nov......	62	149,060,000	138,611,000	7.5	62	668,275,000	655,215,000	1.9	44	399,857,000	349,547,000	14 4	80	422,812,000	390,744,000	8.2



were largely engaged in turning out government orders. This means the employment of additional spinning spindles, carding machines and looms, and consequently a strong call for additional energy.

ABNORMAL CONDITIONS IN ATLANTIC STATES CAUSE REDUCED PRODUCTION IN NOVEMBER

The November operations of the central stations in the Atlantic States were seriously affected by the strikes in that section of the country, and the usual seasonal gain in the output of this section lags considerably behind that reported in the remainder of the country. The steel strike was still in force, though waning fast, and the coal strike started on the first day of the month. Many local strikes were also in progress, such as the printers' strike in New York City, which was broken on Nov. 8. Even by the end of November the steel industry had not recovered from the disastrous effects of the steel strike, although the strike itself was practically over. Organization had been disrupted, and it was probable that the production of the industry was not more than 65 per cent capacity as compared with 85 per cent capacity preceding the strike.

TABLE II -CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Industry Represented	Revenue from the Sale of Energy			Kw.-Hr. Output		
		1918	1917	Per Cent Increase	1918	1917	Per Cent Increase
Dec.	56	$32,058,000	$27,128,000	18.1	1,539,161,000	1,369,542,000	12.3
		1919	1918		1919	1918	
Jan.	57	33,294,000	27,589,000	20.6	1,522,660,000	1,357,460,000	12.1
Feb.	54	28,130,000	23,162,000	21.4	1,249,806,000	1,157,275,000	7.9
Mar.	57	28,569,000	24,420,000	16.8	1,357,981,000	1,341,374,000	1.2
Apr.	54	27,629,000	23,814,000	15.9	1,278,273,000	1,240,842,000	2.9
May	55	26,389,000	23,023,000	14.6	1,255,598,000	1,267,878,000	—1 0
June	57	28,129,000	24,676,000	13.8	1,397,213,000	1,367,018,000	2.2
July	55	25,716,000	22,523,000	12.5	1,306,883,000	1,281,120,000	2 1
Aug.	58	29,864,000	26,590,000	12.7	1,658,755,000	1,672,000,000	—0.8
Sept.	50	29,044,000	25,539,000	13.7	1,579,512,000	1,526,372,000	3.4
Oct.	62	32,341,000	27,484,000	17.6	1,757,563,000	1,619,192,000	8 5
Nov.	58	32,768,000	28,817,000	16.9	1,640,004,000	1,534,117,000	6.9

Broadly speaking, two-thirds of the country's 600,000 soft-coal workers were involved in the coal strike. Starting with only 29 per cent of the normal coal production, the percentage was raised to fully 50 per cent as the strike waned in various regions.

During November the Central States were probably not seriously affected by the strikes. The steel mills in the Chicago district were working at 85 per cent capacity near the first of the month, and the steel mills in the Birmingham district were working at maximum capacity throughout the month. The large cotton mills of the South Central States use hydro-electricity to a great extent and were not seriously affected by shortage of fuel. The mid-continental oil fields reported increased activity during the month even as far north as Kentucky, notwithstanding the coming of colder weather. Largely increased calls for energy as compared with the previous year were evident throughout the Central States.

The Central States show a gain in revenue of 21.6 per cent over November, 1918, which is the largest yearly gain exhibited by any section since February, 1919. Revenue in other sections of the country show substantial gains over the preceding year.

General industrial prosperity in the Mountain and Pacific States was reflected by the returns, the percentage gain over the previous year, being the largest since December, 1918. The output over 1918 has been steadily increasing since July, despite the fact that the copper output for the latter part of 1919 was far below that of the previous year.

The Mountain and Pacific States section of the country was unaffected by serious strikes, and the fuel question was unimportant because of the high percentage of hydro-electric energy employed.

Readers' Views and Comments

The Universities and Their Problems

To the Editor of the ELECTRICAL WORLD:

SIR: Much has recently been said concerning the serious financial problems now confronting most of our universities. It is not exaggerating the situation to say that our whole system of public education is confronted with deterioration which will require many years to overcome.

In general, this condition has arisen from causes beyond the control of those in authority, but I do think that the policy followed by some of our university administrations is wrong and is partly to blame for the present situation. We have been expanding our work in the universities until there is a class to be found in nearly every subject under the sun, many of them containing only a few students. Much of this work is elementary and should have no place in a college curriculum. Take the classes beginning language study, those in elementary mathematics, typewriting, etc., for example. Yet these elementary classes are usually very large and are great consumers of teaching hours. Instead of expanding to the *n*th degree, why would it not be better to stick more closely to certain fundamental lines of endeavor? Then, too, we find a College of Forestry in a state where there are no forests, a College of Mines in an agricultural state, etc. There is much useless duplication brought about by mutual competitions and mutual rivalries This costs money that could be more wisely spent. These are a few of many possible lines of improvement.

It would interest the readers of the ELECTRICAL WORLD, I am sure, to have the views of some prominent administrators of engineering colleges as to possible plans for heading off the approaching calamity.

New York City. EDGAR A. BOYNTON.

"Turbines and Waterwheels"

To the Editor of the ELECTRICAL WORLD:

SIR: The interesting article by L. J. Moore in the Dec. 27 issue of ELECTRICAL WORLD brings up again a point which has been the subject of previous correspondence. This is the use of the terms "turbine" and "waterwheel." We are doing our best to further the growing tendency to use the phrase "hydraulic turbine" or the word "turbine" when speaking of either impulse or reaction type units, instead of the word "waterwheel." The only possible exception is that of our small standard units, which should be distinctly and properly known as Pelton waterwheels. Everything else in a hydraulic power developing unit which requires special engineering or special design is logically a turbine.

I would refer you to Funk & Wagnalls' new dictionary and to Webster's Unabridged, as in these you will find the definition of the words "turbine," "reaction turbine" and "impulse turbine" given as indicated above. Engineering langauge has always been regarded as being the most expressive, the most difficult and the most exact, and, as we feel that way, we further as far as possible the proper designation of hydraulic units.

Inference has been made that our company has a selfish ulterior motive in urging the proper use of the turbine designation. This inference can be very simply and completely neutralized by remembering that at the present time the impulse type of unit is known almost universally as a Pelton waterwheel. When we deliberately urge the discarding of the term "Pelton waterwheel" or "waterwheel," except in limited cases, and the use of the words "hydraulic turbine," "impulse turbine" and "reaction turbine," it would be rather difficult to convict us of selfish motives.

Nothing gives me greater pleasure than to be able to tell you how glad we are that ELECTRICAL WORLD is no longer a homeless prodigal but has come back to the fatted calf. CHARLES H. TALLANT.

The Pelton Waterwheel Company,
San Francisco, Cal.

Wiring for Induction Motors

To the Editor of the ELECTRICAL WORLD:

SIR: The writer was very glad to see the article entitled "Requirements for Industrial-Motor Service" on page 12 in the Jan. 3 issue of the ELECTRICAL WORLD. A movement to procure suitable code changes and standardization in wiring for induction motors should be heartily endorsed. I have always believed that the National Electric Code ruling with respect to the wiring of squirrel-cage induction motors should be revised. As it stands, unnecessary expense is imposed on the user of the motors either on account of misinterpretation of rules or rulings of local inspectors.

In my opinion, the fusing and the wiring of motors should not be confused with each other. In order to make an installation of wiring and fuses for squirrel-cage induction motors conform to what we may term good engineering practice, it is necessary to consider fuses and wires separately.

In the ordinary installation, as referred to in the second paragraph of the article mentioned, the branch fuses must be of sufficient size to carry the starting current during the starting period of say fifteen seconds. The starting current depends on (1) short-circuit characteristics of the motor, (2) per cent tap used on autotransformer.

For most installations a branch fuse having a rating of double the normal full-load current of the motor will carry the starting current for fifteen seconds or more, since the fuse has a time limit for certain overloads. Owing to liberal ratings of wires for continuous amperage, a starting current of three or four times normal for the starting period of fifteen seconds will scarcely cause a perceptible rise of temperature in the wires, even if they are only large enough to fill the normal full-load requirements.

All starters or compensators, in order to conform to the Underwriters' requirements, must be so constructed that it is impossible to leave the starter or starting position. The writer, therefore, believes that the size of wires from branch fuse to starter and motor can safely be rated for 125 per cent of the full load current of the motor and that a definite standard ruling based on this figure would be advisable. H. W. CHENEY.

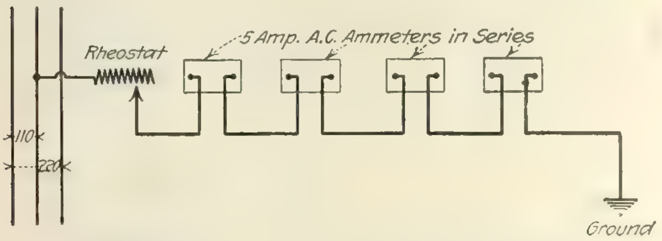
Allis-Chalmers Manufacturing Company,
Milwaukee, Wis.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Meters in Series Show Station Load in Boiler Rooms

INSTEAD of installing large and expensive gages to show the electrical load of the power plant to boiler-room employees and to turbine-room employees, the Indianapolis (Ind.) Light & Heat Company has developed a scheme of using 5-amp. alternating-current ammeters at each point where readings of the station load will be of benefit to employees. These ammeters are connected in series with an adjustable rheostat and receive energy from the neutral of a 110/220-volt circuit, one end of which is connected to ground. The scales of these instruments are marked in kilowatts. The switchboard operator reads the totalizing kilowatt-meter on the switchboard and then sets the adjustable resistance so that the indicator, which is in series with the ammeters on each ammeter, registers the desired reading. At the Mill Street station of Indianapolis Light & Heat Company, one of these ammeters is installed on the main switchboard, one in the chief engineer's office, one at each turbine and one in each boiler room. The company has found them to be very effective.



AMMETERS SHOW LOAD OF STATION IN BOILER ROOM

The switchboard operator reads the kilowatt meter on the switchboard and regulates the resistance of the circuit until the indicator on the ammeters registers the desired reading.

Indianapolis, Ind. T. N. WYNNE.

Street-Lighting Service for Relatively Large City

SIX substations of the Narragansett Electric Lighting Company serve the carefully graded system of street lighting used in Providence, R. I. In these substations there are twenty-two seventy-five lamp series rectifier sets operating at 6.6 amp. with two tubes in series. The rectifier tubes have an average life for the whole system of 1,689 hours per tube, with a maximum life of 6,600 hours on a single tube. There are also twenty-one 35-kw., 5.5-amp. constant-current transformers for series incandescent lamps. These carry an average load of 365 100-volt gas-filled lamps. One circuit per transformer is used in the city of Providence and two circuits are used in the lighting of outlying towns. Both arc and incandescent lamps are supplied from single-conductor No. 6 solid wire, with an average line loss of about 7 per cent. About 1,600 ornamental luminous-arc lamps are in use for lighting seventy-six miles of streets, and there are about 7,946 series incandescent lamps for lighting 285 miles of streets.

The ornamental luminous-arc lamps were first placed in operation in 1913, replacing about 2,000 of the old 9.6-amp. direct-current series open-carbon arc lamps. In the residential section in some places incandescent lamps with closer spacing have replaced the open-arc lamps, thus allowing the ornamental luminous-arc lamps to be placed closer together in the business section than the lamps which they replaced. Most of the arc and incandescent lamps burn 4,013 hours per year, and the outage for 1918 on the ornamental luminous-arc lamps was less than 0.5 per cent.

In winter three trimmers care for the arc lamps and in summer two. The trim period ranges from eight to fourteen days, the actual number of trimmings per year being thirty-seven, which gives an average life for the lower electrodes of 110 hours. A complete card index is kept, including the location of each lamp, with its number, date of installation, reported outages and other notes. If four outages are reported for an arc lamp within a short period, it is removed and overhauled.

Method of Determining the Size of Static Condensers

THE size of static-condenser equipment required to correct power factor expressed in percentage of existing kilowatt load is shown in Fig. 1, as included in a paper presented recently before the convention of the Pennsylvania Electric Association by O. C. Roff of the General Electric Company. The curve affords an easy method of determining the amount of condenser capacity needed, and indirectly therefore the cost entailed.

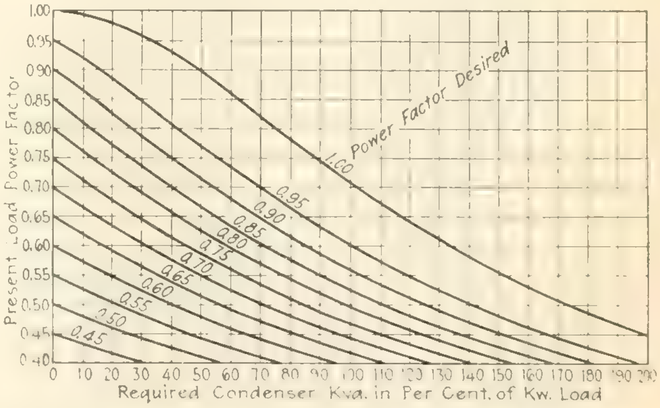


FIG. 1—CONDENSER KVA. REQUIRED IN PERCENTAGE OF EXISTING KILOWATT LOAD

The required capacity is obtained by following a horizontal line from the ordinate representing the present power factor to the curve noted as the power factor desired. Then directly below on the horizontal scale is the required condenser kva. in per cent of kw. load.

A concrete idea of the saving made by correction of the power factor is given in the curve of Fig. 2 (also included in this report), which shows the amount of load in kilowatts at the original power factor which can be added to the system with a given improvement in power factor. It is assumed, of course, in the calculation of this curve that the circuit was carrying the maximum current before the correction was made.

If, however, when the connection is accomplished only the load on the circuit at the time was considered, the addition of more load at the original power factor will cause a consequent reduction in power factor. Therefore, additional static-condenser capacity must be added if it be desired to maintain a certain power factor with the line loaded to maximum carrying capacity.

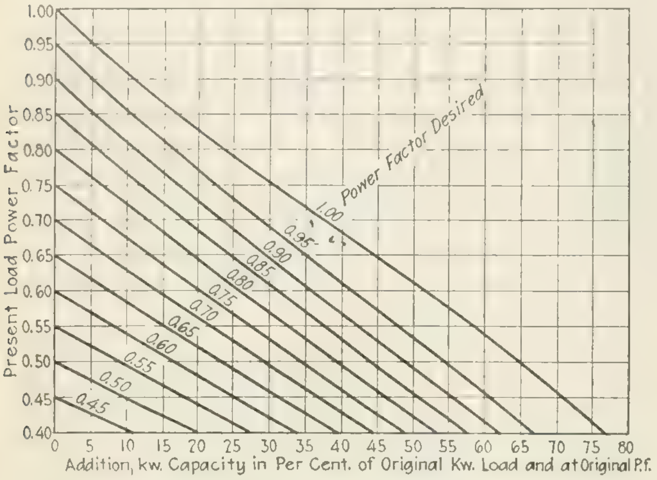


FIG. 2—ADDITIONAL KVA. CAPACITY MADE AVAILABLE BY POWER FACTOR CORRECTION

This value is obtained in percentage of the original kilowatt load and at original power factor by following a horizontal line from the ordinate representing the present power factor to the curve noting the power factor desired and noting the value directly below on the horizontal scale.

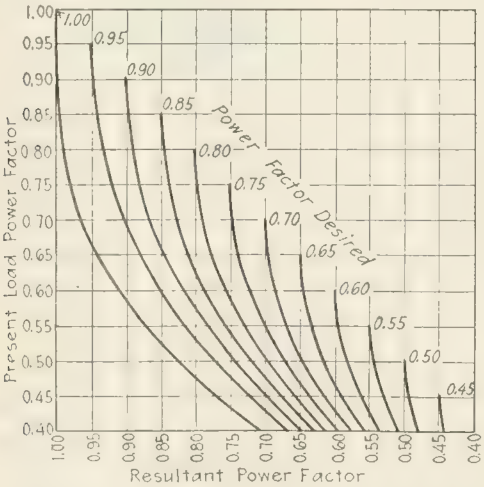


FIG. 3—RESULTANT POWER FACTOR AFTER INSTALLATION OF APPARATUS WHEN LINE HAS AGAIN BECOME LOADED

This value is determined by original load at corrected power factor plus additional load at original power factor so that total kva. of circuit is equal to original kva. In other words, when the present load factor is raised to a desired value, a certain additional generating capacity is available. If this capacity is utilized, the power factor will be lowered, but not to the original and objectionable value. The value is obtained in a manner similar to that explained for Figs. 1 and 2.

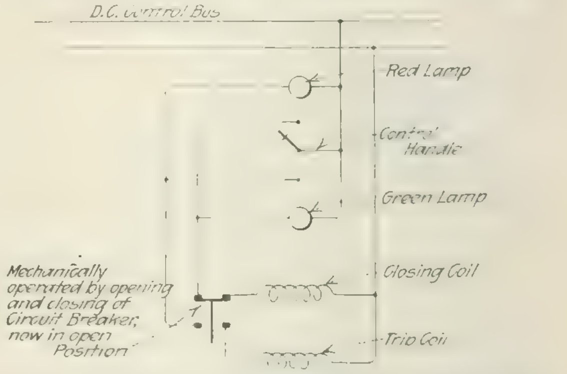
The remaining curve, Fig. 3, illustrates the resultant power factor for different corrections, assuming that the line is again loaded to capacity. This curve is valuable because it shows that although additional capacity is available when the power factor is raised, the power factor will be lowered if this capacity is utilized. The solution of practically any power-factor problem may be developed from the use of these three curves.

Effect of Lamp Short on Switch Operation

IN MAINTAINING apparatus the method of operation should be studied in order to guard against possible trouble and to keep the equipment in good condition. For instance, where the circuits for remote-control apparatus were installed as shown in the illustration precautions had to be taken against possible short circuit of the socket.

The results of a short circuit in the red-lamp socket would only open the switch and nothing worse than a service interruption would result, but a short circuit in the green-lamp socket might cause serious damage. It is best to change to another scheme of wiring so that this cannot occur, but if this cannot be done careful inspection of the lamp sockets will give additional security.

Extra mica insulation can be added to some sockets. The clearance of others can be increased by cutting or bending copper on the center socket contact, while care should be taken not to screw the lamps in too tightly, which may bend the center contact dangerously near the threaded one.


D.C. Control Bus
Red Lamp
Control Handle
Green Lamp
Closing Coil
Mechanically operated by opening and closing of Circuit Breaker; now in open Position
Trip Coil

SHORT CIRCUIT IN EITHER SOCKET OF SIGNAL LAMPS WILL CAUSE SWITCH TO OPERATE

The majority of remotely controlled breakers, especially the larger ones, are equipped with mechanically operated contacts which carry the tripping and closing current and which break the circuit whenever the switch has made the desired move. As the closing coil or motor current of large switches is considerable for the small contacts sometimes used, these contacts should be cleaned and inspected; otherwise a switch may fail to operate at a critical moment.

Iron Mountain, Mich. L. W. WYSS.

Emergency Operation of Frequency Changer Set

ONE of a bank of star-connected 25-cycle transformers supplying a 5,000-kw. frequency changer in St. Louis burned out some time ago at an especially inopportune time because a 20,000-kw. turbine on the 60-cycle system was out of service. The 60-cycle end of the frequency changer was needed to relieve the generators by supplying some of the wattless component of the load, but there was no compensator with which to start the set from the 60-cycle energy, and so it was necessary to utilize the 25-cycle transformers.

The defective transformer was first disconnected, and its lead from the 25-cycle end of the set was then connected to what had been the transformer neutral. This gave an unbalanced open-delta transformer connection with 3,800 volts on two phases and 6,600 volts on the other. The set was then started up with the 25-cycle compensator in the regular way except that the set was pulled into synchronism from the 60-cycle end. It may have been possible to synchronize from the 25-cycle end, but not wishing to take any unnecessary chances, the 25-cycle field was left short-circuited through resistance and the field on the 60-cycle machine was excited. This caused an appreciable jolt on the 60-cycle system but did no damage. The 25-cycle oil switch was then opened and the 60-cycle end of the set was operated as synchronous condenser. This gave the needed voltage compensation on the 60-cycle system, and the set was operated in this manner for a few hours while the two good 3,800-volt, 25-cycle transformers were being reconnected to operate at 7,200 volts (balanced) open delta. The set was then operated as a frequency changer at 70 per cent of its normal rating until the damaged transformer had been repaired. H. W. EALES,

Chief Electrical Engineer.

Union Electric Light & Power Company,
St. Louis, Mo.

Turbine and Motor Drive Jet Condenser

THERE are two reasons why the lighting department of the city of Seattle, Wash., of which J. D. Ross is superintendent, installed a combination of a steam turbine and motor for driving a jet condenser—first, the motor floats on the line and acts as a brake to prevent runaway in case of accident to the turbine governor; second, the load can be divided to give only the steam needed for the hot-water heater. The motor gives much better economy than the turbine.

Tabulation of Sags for Stringing Conductors

THE accompanying table for sags was used by the San Diego Consolidated Gas & Electric Company on the 78½-mile (125-km.) transmission line which runs from San Diego to San Juan Capistrano to tie in the San Diego with the Southern California Edison system. For a brief distance where the line already existed between Oceanside and Del Mar, No. 2 copper wire was installed, elsewhere No. 1 seven-strand, medium-hard-drawn bare copper was used. On some especially long spans a steel conductor is substituted. There are fourteen spans over 1,100 ft. (350 m.) in length.

TABLE OF SAGS FOR VARIOUS TEMPERATURES

No. 1 Medium-Hard-Drawn Stranded Bare Copper Conductor

Temp., Deg.	Span	100 Ft.		110 Ft.		120 Ft.		130 Ft.		140 Ft.		150 Ft.		160 Ft.		170 Ft.		180 Ft.		190 Ft.		200 Ft.		210 Ft.		220 Ft.	
		Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
40	SAGS		12		13		14		15		16		18		19		20		22		23		24	2	1	2	3
45			13		14		15		16		17		19		20		21		23		24	2	1	2	2	2	4
50			14		15		16		17		18		20		21		22		24	2	1	2	2	2	3	2	5
55			14		15		16		17		18		20		21		22		24	2	1	2	2	2	3	2	5
60			15		16		17		18		19		21		22		23	2	1	2	2	2	4	2	5	2	7
65			16		17		18		19		20		22		23		24	2	2	2	3	2	5	2	6	2	8
70			16		17		18		19		21		23		24	2	1	2	3	2	4	2	6	2	7	2	9
75			17		18		19		20		22		24	2	1	2	2	2	4	2	5	2	7	2	8	2	10
80			18		19		20		21		22	2	1	2	2	2	3	2	5	2	6	2	8	2	9	2	11
85			18		19		20		21		23	2	2	2	3	2	4	2	6	2	7	2	9	2	10	3	0
90			19		20		21		22		24	2	2	2	3	2	5	2	7	2	8	2	10	2	11	3	1

Temp., Deg.	Span	230 Ft.		240 Ft.		250 Ft.		260 Ft.		270 Ft.		280 Ft.		290 Ft.		300 Ft.		310 Ft.		320 Ft.		330 Ft.		340 Ft.		350 Ft.	
		Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
40	SAGS	2	4	2	6	2	8	2	10	3	0	3	2	3	4	3	7	3	9	3	10	4	2	4	6	4	10
45		2	5	2	7	2	9	2	11	3	1	3	3	3	5	3	9	3	10	3	11	4	3	4	7	5	0
50		2	6	2	8	2	10	3	0	3	2	3	4	3	6	3	10	4	0	4	1	4	5	4	9	5	1
55		2	6	2	8	2	11	3	1	3	3	3	5	3	7	3	11	4	1	4	2	4	6	4	10	5	3
60		2	8	2	10	3	0	3	2	3	4	3	6	3	8	4	0	4	2	4	3	4	7	4	11	5	4
65		2	9	2	11	3	1	3	3	3	5	3	7	3	9	4	1	4	3	4	4	4	8	5	0	5	5
70		2	10	3	0	3	2	3	4	3	6	3	8	3	10	4	3	4	5	4	6	4	10	5	2	5	7
75		2	11	3	1	3	3	3	6	3	8	3	10	4	0	4	4	4	6	4	7	4	11	5	4	5	9
80		3	1	3	3	3	5	3	7	3	9	3	11	4	1	4	5	4	8	4	9	5	1	5	5	5	10
85		3	2	3	4	3	6	3	8	3	10	4	0	4	2	4	6	4	9	4	10	5	2	5	6	5	11
90		3	3	3	5	3	7	3	9	3	11	4	1	4	3	4	8	4	10	4	11	5	4	5	8	6	1

Temp., Deg.	Span	375 Ft.		400 Ft.		425 Ft.		440 Ft.		450 Ft.		475 Ft.		500 Ft.		525 Ft.		550 Ft.		575 Ft.		600 Ft.		650 Ft.		700 Ft.	
		Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
40	SAGS	5	5	6	2	7	0	7	7	8	0	9	0	10	2	11	5	12	8	14	1	15	7	18	1	22	3
45		5	7	6	3	7	2	7	9	8	2	9	2	10	4	11	7	12	10	14	3	15	9	18	3	22	5
50		5	8	6	5	7	4	7	10	8	3	9	3	10	6	11	9	13	0	14	5	15	11	18	5	22	7
55		5	10	6	7	7	6	8	0	8	5	9	5	10	8	11	11	13	2	14	7	16	1	18	7	22	9
60		5	11	6	8	7	7	8	2	8	7	9	7	10	10	12	1	13	4	14	9	16	3	18	9	22	11
65		6	1	6	10	7	9	8	4	8	9	9	9	11	0	12	3	13	6	14	11	16	5	18	11	23	1
70		6	2	6	11	7	10	8	6	8	11	9	11	11	2	12	5	13	8	15	1	16	7	19	1	23	3
75		6	4	7	1	8	0	8	7	9	0	10	1	11	4	12	7	13	10	15	3	16	9	19	3	23	5
80		6	5	7	3	8	2	8	9	9	2	10	3	11	6	12	9	14	0	15	5	16	11	19	5	23	7
85		6	7	7	4	8	4	8	11	9	4	10	5	11	8	12	11	14	2	15	7	17	1	19	7	23	9
90		6	9	7	6	8	6	9	1	9	6	10	7	11	10	13	1	14	4	15	9	17	3	19	9	23	11

All copper conductors were sagged in accordance with the table shown. Foremen were given instructions never to string at less than these sags, although special conditions might make it necessary to exceed them at points where this could be done without unduly decreasing clearances. All long sags where steel was used were sagged with a dynamometer. Spans were 440 ft. (135 m.) on tangents in level country, varied to meet topography. Spans were made shorter where the line passes through towns. The longest span on the line is 3,069 ft. (950 m.) at the San Diego River. Here one tower is 100 ft. (30 m.) below the other, and the lowest point in the sag is 17 ft. (5 m.) below the lowest tower. The wire tension was 8,750 lb. at 60 deg. Fahr. (4,000 kg. at 15 deg. C.)

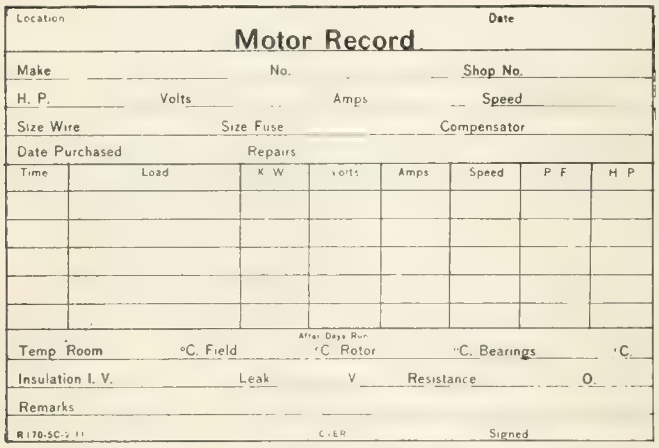
Over railroads and street-railway tracks clearances are 34 ft. (10 m.). Over street and highways a clearance of 30 ft. (9 m.) is maintained. Telephone, telegraph and signal wires are cleared by 8 ft. (2.5 m.).

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Motor Card Record Which Is Useful in Transfers

BOTH repair and test records are tabulated on a motor card used by the Gillette Safety Razor Company, South Boston, Mass., for keeping a live card-index inventory of all motors in the plant. Motors in this plant range in size from ¼ hp. to 35 hp., there being a total of 360. The cards used differ somewhat from the design described by W. A. Hefner on page 361 of the ELECTRICAL WORLD for Aug. 16, 1919. They are 3⅞ in. by 5⅞ in. (10 cm. by 15 cm.) in size, and besides having space for recording the usual motor name-plate data, they provide for six sets of test readings, temperature observations, date of purchase, repair notes, and the size of wire used in motor leads, with the fuses installed.



Location Date

Motor Record

Make No. Shop No.

H. P. Volts Amps Speed

Size Wire Size Fuse Compensator

Date Purchased Repairs

Time	Load	K W	Volts	Amps	Speed	P F	H P

After Days Run

Temp Room °C. Field °C Rotor °C. Bearings °C.

Insulation I. V. Leak V Resistance O.

Remarks

R 170-5C-2 11 C-ER Signed

CARD FOUND CONVENIENT WHEN MAKING CHANGES

The inclusion of the wiring information proves convenient when relocations of motors in order to readjust load conditions are effected, and it also aids insurance companies in inspections.

I. H. GASKIN,
Electrical Engineer.

Gillette Safety Razor Company,
South Boston, Mass.

Phase and Voltage Change of An Induction Motor

AFTER purchasing a used boring mill an industrial concern in the East found that the driving motor was rated at 220 volts, three-phase, whereas the energy supplied to the plant was 440-volt, two-phase. Instead of buying a new motor it was decided to rewind the motor for the correct voltage and phase. This was accomplished as follows: The squirrel-cage induction motor was rated at 3 hp., sixty cycles, 1,750 r.p.m., and it had four poles. It had forty-eight slots and twenty-four coils, forming a basket winding, one coil per slot, each coil wound with forty-eight turns of single No. 14 (0.0641) double cotton-covered wire. The coil pitch was one and twelve, and the winding was connected series-star, twelve groups of two coils in series per group.

As the two-phase winding required 16.667 per cent more turns than the three-phase, the total turns for the two-phase winding for 440 volts was 2 (1.16667 times three-phase turns). The 220-volt, three-phase winding was connected series-star, and therefore the turns for the 440-volt winding had to be doubled. In addition, the area of copper for the two-phase, 440-volt winding had to be decreased in the following proportion: $(4{,}106 \times (1 - 0.16667)/2$. (4,106 is the area in circ.mils of No. 14 gage wire.

When calculating the two-phase winding the equation will be $2(1.16667 \times 48) = 111.4$, or 111 turns, and $(4{,}106 \times (1 - 0.16667)/2 = 1{,}710.8275$ circ.mils. As No. 18 (0.0403) is the nearest size having an area of 1,625 circ.mils, then the two-phase, 440-volt winding will require 111 turns of single No. 18 (0.0403) double cotton-covered wire. Twenty-four coils were wound with 111 turns of No. 18 gage single-covered enamel wire, and the stator was wound and connected with eight groups of six coils in series per group.

The rotor bars were welded to the end rings, and the end rings were turned off in the lathe after welding. The motor was then assembled and given a load test which proved satisfactory.

C. A. JOHNSON.

New York City.

Operating Cost Data for Industrial Trucks on Piers and Transfers

ALTHOUGH not a great many data have been compiled on the comparative cost of the use of hand and electric trucks for moving freight, enough information has been obtained to show that in most instances electric trucks or electric tractors with trailers are economical. Figures presented by F. B. Fink, Elwell-Parker Company, show that on piers and railroad transfers the saving made by the use of the electric vehicle will often pay for the entire installation during the first year. In addition to the saving in the actual cost of handling the freight, there is an incalculable saving made in handling the material.

Where the piers are of sufficient length to warrant the use of tractors and trailers, the author of the paper favors their use. On a pier in the North River, New York, where the tonnage hauled per day is comparatively small, an electric truck with a platform was purchased in order to try out its possibilities for pier work; but it was found that the truck was not the proper unit, as time consumed in loading and unloading was too great to warrant the investment. It was then decided to try using the truck as a tractor, and five trailers were put in service with it. Notwithstanding the unfamiliarity of the force with tractor and trailer operations, 119 tons were handled, at a cost of 26.4 cents per ton.

To have moved this same tonnage by hand trucks would have cost 56 cents per ton, and therefore there was a saving by the use of the tractor of 29.6 cents per ton.

In one of the large railroad transfers, a number of load-carrying trucks are used, which handle about 1,200 tons per day at a total cost per ton, including everything chargeable to the operation, of 61 cents per ton. This economy is secured because manual labor is reduced to a minimum, the loaded truck running into and to the end of the car, where its load is removed from the low platform by hand, and vice versa when unloading. In another large transfer, where only tractors and trailers are used and where about 1,200 tons average per day are handled, it is interesting to note that on Nov. 7, 1918, nineteen gangs of five men each with two wheel hand trucks, fourteen tractor gangs of three to a gang, fourteen floaters and forty-one packers, or 192 employees in all, were thought necessary to handle 1,352 tons of miscellaneous freight, at a cost of 95.5 cents per ton. By proper supervision and rearrangement of the handling it was found that 1,221 tons could be handled by four gangs of five men each with two wheel hand trucks, eleven tractor gangs of three men each, thirteen floaters and thirty-nine packers, or a total of 105 employees, at a cost of 76.9 cents per ton, or a saving of 18.6 cents per ton over the cost without proper supervision.

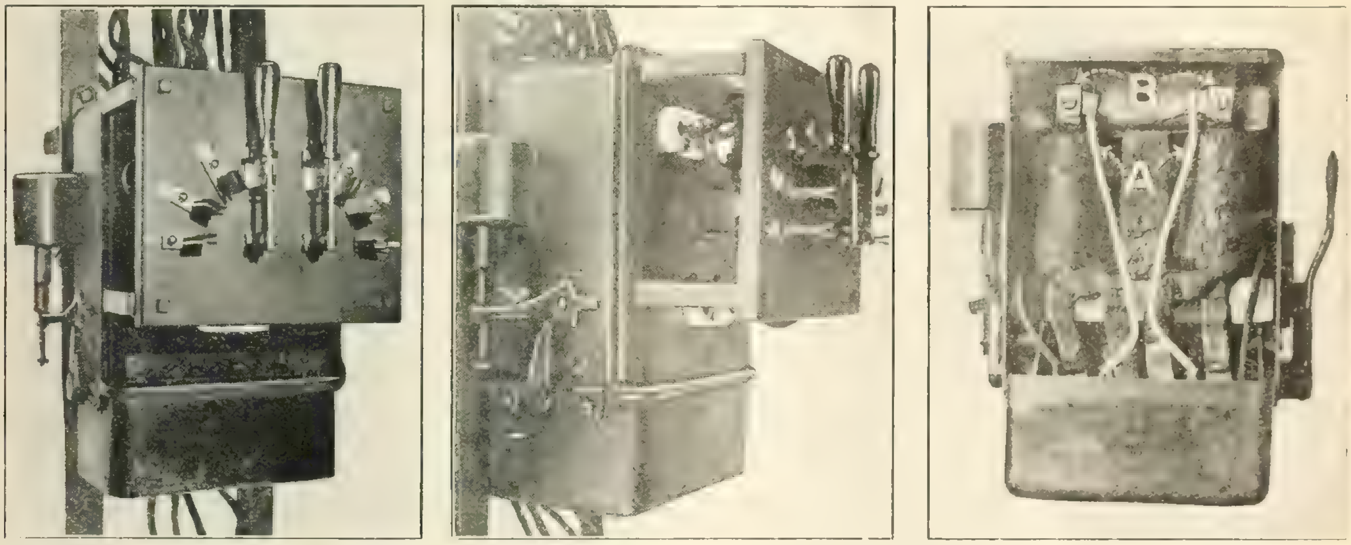
By the above comparisons it will be seen that in two transfers handling about the same class of freight and about the same tonnage per day a difference of 15.9 cents per ton is shown in favor of the load-carrying truck over the tractor and trailer system of handling. Where 1,200 tons are handled each day this saving would amount to $190 per day, or $57,000 per year.

However, in small transfer stations, tractors are being used with good results. Two of these small transfers report that in the handling of 300 tons apiece per day, each with one tractor, one transfer having but sixteen trailers and the second having forty trailers, both tractors working under adverse conditions as to cross-overs, platforms, etc., the first shows a saving of 6 cents per ton, owing to the small number of trailers used, and the second shows a saving of 10 cents per ton. Another gain is that the receiving platforms are kept clear, something unknown before, and the entire operation is speeded up.

Test Voltages Obtained with Compensators

IN DETERMINING the characteristics of induction motors either by the circle diagram method or the prony-brake test it is desirable to take a number of readings at different voltages. These voltages may be obtained with an ordinary motor-starting compensator by using the starting taps (usually four) with which it is provided. If a sufficient number of steps cannot be obtained with one compensator, two may be used in series.

Thus if from one compensator we get 40, 58, 70, 85 and 100 per cent of line voltage, with two we may obtain 16, 23.20, 28, 33.64, 34, 40, 40.60, 49, 49.30, 58, 59.50, 70, 72.25, 85 and 100 per cent. Eliminating those which are practically the same, we still have ten steps from 16 to 100 per cent of line voltage. If a voltage higher than 100 per cent is required, it may be obtained by reversing the connections of a compensator designed for a higher line voltage and using it for raising the voltage instead of lowering it. Thus, in testing a 440-volt motor, if the line is connected to the 85 per cent tap of a 550-volt compensator, approximately 518 volts will be impressed on the motor.



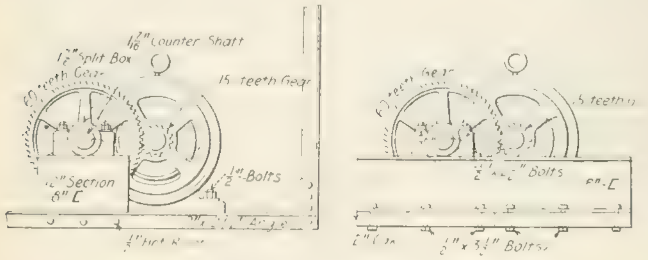
FIGS. 1, 2 AND 3—FRONT OF COMPENSATOR IN TWO VIEWS, SHOWING METHOD OF CONSTRUCTION AND BACK OF PANEL SHOWING LEAD CONNECTIONS

An objection to using compensators for this purpose is the time consumed in changing from one voltage to another. To overcome this objection Ovid Falardeau of the electric repair shop of the Brown Company, Berlin, N. H., mounted two dial switches on the front of a two-phase compensator as shown in Figs. 1 and 2. These switches were constructed in the shop, using a piece of slate 1 in. by 12 in. by 14 in. (2.4 cm. by 30 cm. by 35 cm.) and parts of ordinary back-connected switches. The leads *A* of Fig. 3 are connected to the center contact of each switch and the taps *B* to the radial contacts. The leads where they pass through the case are insulated by condulet porcelain covers. The test voltage may be quickly changed by shifting the blades from one contact to another. The same scheme may be used on a three-phase compensator by using a larger piece of slate and three dial switches.

These compensators as made in the shop provide a substantial piece of apparatus at a comparatively small cost.

Mounting Motors on Back-Geared Machines

ON ACCOUNT of the comparative scarcity of back-geared motors, a concern which manufactures machinery for handling heavy materials has utilized a method of mounting ordinary motors in connection with speed-reducing gears which has proved fairly satisfactory. The motor, without sliding base, is bolted to the frame of the machine and on either side, at a distance sufficient to provide for the large gear, is hot-riveted a section of standard 8-in. (20-cm.) channel 12 in. (30 cm.) long. On top of these sections are bolted split boxes of $1\frac{7}{16}$-in. (3.6-cm.) bore, to carry a section of cold rolled shafting about 30 in. (75 cm.) long, on the extension of which is mounted an eight-tooth sprocket which carries the drive chain. The gear which is carried on the counter shaft is a sixty-tooth cast gear, while the pinion on the motor shaft is of fifteen teeth, thus giving a four-to-one speed reduction from the motor, which is of 1,750 or 1,800 r.p.m. speed. In the case of a 3-hp. motor a five-pitch gear and pinion are used, and for a 5-hp. motor a four-pitch combination.



FIGS. 1 AND 2—SHOP AND FIELD METHODS OF ARRANGING GEAR DRIVE

The gear and pinion are held in proper relation by means of four ½-in. bolts which secure the motor to the frame and two ½-in bolts which secure the boxes to each of the supports. The mounting has been in use in a number of instances for two years with no trouble or adjustment. It is desirable, however, often to inspect the anchoring of the boxes so as to make sure that they do not work loose and thus result in a breaking of the teeth of the gears.

In several instances the same company has replaced gasoline engines with electric motors because of troubles incident to starting the engines. In such cases the replacement has been done in the field, the engine removed and a special integral mounting of motor and gears bolted in the space occupied by the engine. The base of this mounting is of 2-in. (5-cm.) oak plank, the sections of channel, about 20 in. (50 cm.) in length, being bolted to this planking, and the motor bolted in place, the gears being mounted as in the case of the machines already described. In one instance two machines which had been used a short time with gasoline engine power were re-equipped with electric motors, a period of severely cold weather making it impossible for the operators of the machines to start the engines at all. Flexible cable connections were installed from a power line giving three-phase, 220-volt service, and the specially mounted motors were brought from the factory of the machine company by truck and the machines set in operation with but two or three hours' delay.

The accompanying drawings illustrate the method of mounting the motors, Fig. 1 showing the usual method of securing the motor, shaft and gearing, and Fig. 2 the special mounting in the instance in which the engines were replaced by motors in the field.

Boston, Mass. S. HOWARD.

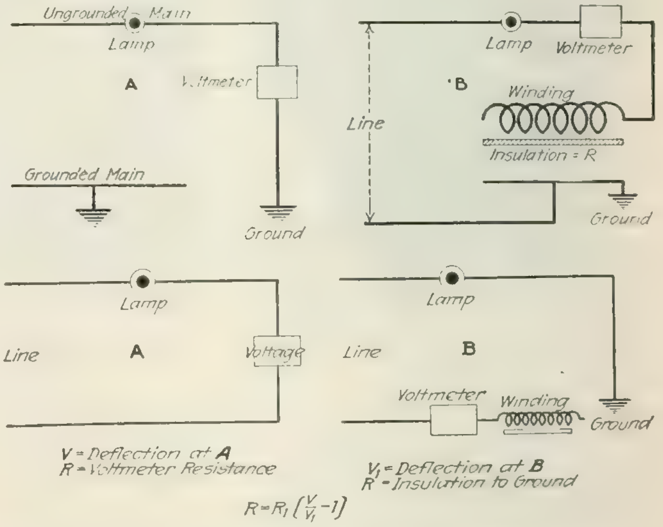
Voltmeter Method of Testing Resistance of Insulation

WITH only a voltmeter and an incandescent lamp available, the insulation resistance of generators or motors can be tested in the following manner: Place the lamp in series with the line with a voltmeter across the line as shown in *A* of the figure and note the deflection. The resistance of this voltmeter should be known. Then obtain the voltage between each side of the line and ground to see if they are grounded. If not, connect the side of the line that has the lamp in it to the frame of the machine and connect the voltmeter in the other side of the line so that the conditions shown in *B* of the illustration will then be had.

The insulation resistance to ground can be obtained by calculation from the following formula:

$$R \quad R_1 \frac{V}{V_1} - 1$$

where R_1 = voltmeter resistance, V = voltmeter deflection when connected as *A*, and V_1 = voltmeter deflection when connected as *B*.



CONNECTION DIAGRAMS USED FOR DETERMINING INSULATION RESISTANCE

The diagrams at the top show the connections when one main is grounded, whereas the bottom diagrams illustrate the test in use when the mains are not grounded.

When no outside energy is available the insulation can be determined by operating the machine at part voltage. Then, using the same voltmeter for each reading, take the voltage across the mains and then between each main and frame. Add the two frame readings together and use their sum for V_1 in formula. For V use voltage at which machine is run during the test. To operate safely the insulation should not be less than 500,000 ohms on a direct-current machine of ordinary size. For high-voltage transformers it should be several million ohms.

The two sets of diagrams show the connections when one main is and is not grounded.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Utility Employees Arrange for Special Instruction

EMPLOYEES of the Union Electric Light & Power Company of St. Louis are taking special evening courses of instruction at Washington University. The work is all under the direction of the extension division of the university, and the classes were arranged for and organized by the employees' mutual benefit association.

There are five courses of instruction of five months each in subjects chosen by the majority of those who replied to a questionnaire sent to all the company's employees. These subjects are: (1) Automobile construction and operation; (2) elementary electrical engineering; (3) commercial law; (4) elementary english; (5) elementary accounting.

The company paid the university for each student at the beginning of the term, Jan. 5, 1920, and the employees are to pay back the company on easy terms. As an added incentive the company has agreed to refund one-half the tuition fee to every one who successfully completes the course. The total enrollment is 140, which is about one-half of all the employees who are taking courses of instruction to help them in their work.

Higher Transmission Voltage for Farm Service Lines

WHEN planning service to farmers central-station managers have sometimes endeavored to keep the initial cost at a minimum value by the use of 2,300-volt transmission. This practice restricts the service to a comparatively limited area. From a standpoint of good business it is much better to employ 6,600 volts or 13,200 volts, as future extensions can then be easily made.

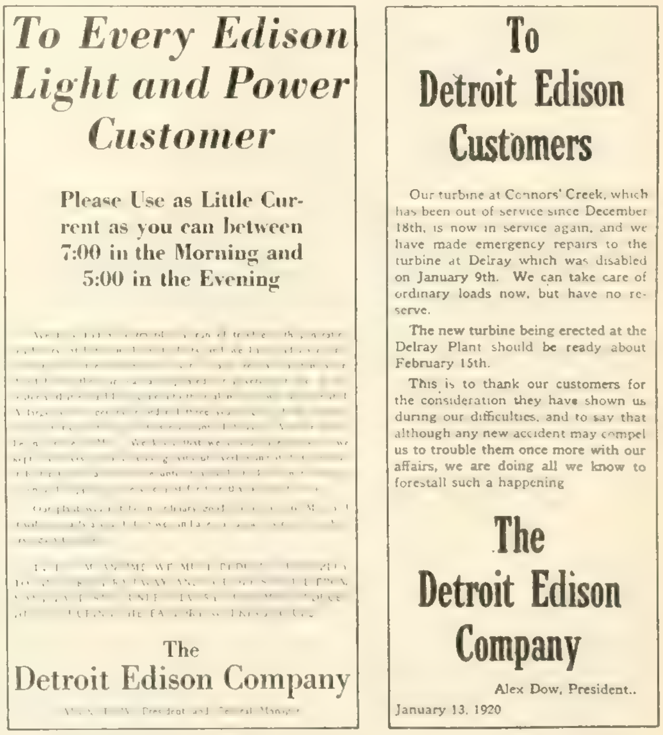
Owing to the very nature of the farm-line business, where extensions are commonly made from one farm to another in distances of ½ mile to 1 mile or more (0.8 km. to 1.6 km.), these extensions soon exceed the limit of territory possible to serve properly the farmer at 2,300 volts. The cost of changing to a higher voltage at a later date will total more than the cost would have been had the initial construction been made at 6,600 volts or 13,200 volts. The burden of costs due to future changes in transmission voltages will invariably have to be borne by the power company, and it will be found very difficult to convince the farmer of the necessity of such changes or to prevail upon him to share the additional expense.

When the transmission company starts out to serve the farmers, it has something that the farmer wants—electric service. It can therefore initially advocate the necessity of a 6,600-volt or a 13,200-volt transmission line to better advantage than it can later, or than it can after electric service has become a part of the farmer's daily life. It will be found easier to secure farm power and lighting business initially on the basis of 6,600 volts or 13,200 volts operation than it will to induce the farmer later that he should bear a portion of the expense when the increase in voltage is necessary. The reason for this is that once a farmer secures service he is not always interested in line extensions to his neighbor or to another town. It is therefore good policy to start the business right by insisting at the time of installation on the higher transmission-line voltage for farm service.

Facts Customers Should Know

How the Cause of an Operating Trouble, the Company's Service Policy and Plans for Relief Were Told at Detroit

TWO newspaper advertisements are reproduced on this page to show how one large central-station company is securing the co-operation of its customers in time of need by publishing plain statements of fact concerning operating problems that are beyond control. A careful reading of the "copy" will reveal that the company has simply stated that it had trouble without going into technical details. There is also a frank statement of the cause for the breakdown which not only tells why machines were not overhauled, but establishes the company's policy in the furnishing of electric service. The second advertisement telling of progress toward repairs is an interesting example of the policy of keeping customers fully informed on company matters that affect their own interests and thus converts the disposition to complain into forbearance and sympathetic endurance.



To Every Edison Light and Power Customer

Please Use as Little Current as you can between 7:00 in the Morning and 5:00 in the Evening

The
Detroit Edison Company

To Detroit Edison Customers

Our turbine at Connors' Creek, which has been out of service since December 18th, is now in service again, and we have made emergency repairs to the turbine at Delray which was disabled on January 9th. We can take care of ordinary loads now, but have no reserve.

The new turbine being erected at the Delray Plant should be ready about February 15th.

This is to thank our customers for the consideration they have shown us during our difficulties, and to say that although any new accident may compel us to trouble them once more with our affairs, we are doing all we know to forestall such a happening

The Detroit Edison Company

Alex Dow, President..

January 13, 1920

HOW ONE CENTRAL-STATION COMPANY KEEPS ITS COSTOMERS INFORMED

Retail Rate-Making for Energy Bought at Wholesale

Increasing Practice of Selling at Wholesale for Retailing by Private or Municipal Local Utilities Brings Problems for Study

By EARLE D. JACKSON
Consulting Engineer, St. Paul, Minn.

THE widely spreading practice of the purchase of electrical energy wholesale by both private and municipally owned utilities to retail to local distributing systems has introduced problems in rate making which heretofore have not been of such general interest or concern.

Where a utility generates its own power the general components that go to make up the cost of production of a kilowatt-hour—namely, fuel, labor, supplies, repairs, taxes, insurance, interest, depreciation and general administration expense—are each clearly separable from the whole and in general divisible into two classes, constant and variable costs.

Where energy is purchased wholesale the unit cost is not billed as a number of separate, constant or variable items, but is lumped together as a total cost, each item, however, entering proportionately into the price of every kilowatt-hour purchased, independently of the time or amount, unless it is stipulated otherwise in the contract.

Some might urge that, despite this, in the end the net result to the wholesale purchaser will be the same in the case of both privately generated energy and purchased energy if the average energy cost is the same, regardless of whether the cost is billed as a whole or in separate parts.

However true this may appear to be, it is of interest to demonstrate whether or not there is any difference involved in rate making as between purchased energy and privately generated energy, so far as the rate is concerned, that may be made to the retail consumer under various forms of power contracts.

Assume first that the price for the purchase of electric energy is a fixed rate per kilowatt-hour, with no demand charge or sliding-rate scale, but a straight energy rate. No such rate could, strictly speaking, be made scientific or equitable; but it is a form of contract that is in effect in numerous cases where both private and municipally owned utilities have closed down their generating stations or for other reasons are purchasing electrical energy for resale to individual consumers. It is at once seen that the retailer has eliminated his control of the allocation of his energy costs, with the result that, regardless of the amount, time, demand or service value of his customer's load, the selling cost is the indivisible energy cost plus the distributing cost.

One perceives that the retailer is handicapped by having no control over the energy costs, which with his own generating plant he could separate into fixed and variable costs. This may not be a serious matter in the case of the ordinary lighting or small power customer, where the cost of power is only a relatively small part of the total cost of retail service—probably not to exceed 20 per cent in some instances—and where, furthermore, a central station has virtually no competition to fear, since at any reasonable price the ordinary lighting and small power users with private generating equipment cannot possibly compete with central-station service.

Approaching, however, the large power user and the prospecting electric range customer, where the energy cost often represents the largest part of the total cost, the wholesale energy purchaser with the form of contract under discussion finds it a more serious matter to have his power cost fixed for him—that is, to be unable to split it up into the fixed and variable costs and distribute it according to his customers' service conditions, and thus remove certain costs from the retail charge on strictly competitive business and place them on non-competitive business, where justly the power may be worth more to the consumer.

For example, if the wholesale purchase price of electric energy is 2 cents per kilowatt-hour, the retailer, of course, cannot sell under 2 cents without pocketing a loss. With his own plant, assuming that his average total energy cost was even as high as 3 cents per kilowatt-hour, of which 1 cent was fuel cost or a variable cost, it is obvious that his monetary loss is selling electric energy for 1 cent per kilowatt-hour in this case will not be as great as selling it for 2 cents in the case of energy purchased wholesale, especially in the case of an off-peak customer, notwithstanding the curious fact that the average total cost of energy is less in the latter case.

CONSIDERATION OF LOAD CHARACTERISTICS IN CONTRACTS

The inequality lies in the form of contract for the wholesale purchase of energy, which does not recognize that the retail customers' load characteristics are not all alike. It is possible, of course, with the power contract under discussion, to sell power for even 1 cent per kilowatt-hour where the purchase price is 2 cents, by arbitrarily transferring the loss to the non-competitive retail business. This might not be an unjust discrimination under some circumstances, but it would be generally recognized as unsound business to rob Peter to pay Paul. All in all, there can be found no logical way under a contract of this nature to enter on the books other than as a loss electrical energy sold below the price paid for it, unless there is some corresponding compensating factor which does not appear in the majority of cases.

Again, the total energy purchased wholesale is divisible into two parts, that which is sold and that which is lost. The energy lost, in turn, is separable into constant and variable losses, the constant losses preponderating, including, as they do, transformer-core losses, meter loss, theft, ground and unaccountable losses. The constant losses of distribution form a considerable and at the same time an ideal load for the wholesaler, twenty-four hours in duration every day in the year, with no peaks or valleys; yet under the above form of wholesale purchase contract no distinction can be made in the price paid per kilowatt-hour, thus clearly violating one of the principles of rate making.

Another form of power contract is one where the fixed charge is modified to include a sliding-scale energy charge, with or without a demand charge. The first few thousand kilowatt-hours are charged off at a high rate, which the purchaser must regard as covering the fixed and variable costs of energy production, while as the amount purchased increases fixed costs are eliminated, imposing only certain variable costs. It is not conceivable that any contract for power could thus be drawn so as to permit a retailer to make correctly the necessary distribution of costs demanded by the diversified character of the progressive central-station retail load. It is improbable that the many retail rates, either in the aggregate or in any instance individually, can be made to synchronize, as it were, with the one wholesale blanket energy rate, no matter how carefully the contract may have been drawn. The retailer is still kept more or less in the dark as to where his retail power contracts are going to land him, especially if complicated by the demand charge, in a contract in which no distinction is made in the various kinds of retail load, a kilowatt-hour of power load being considered and charged exactly as a kilowatt-hour of lighting load. As in the other case, the retailer has lost control of the situation and cannot safely or logically make certain necessary rates that are essential to his business.

THE EQUITABLE CONTRACT CONSIDERS EACH CONSUMER AS AN INDIVIDUAL CASE

The ideal, and also in the final analysis the really practical, form of wholesale power contract for the retailer with a diversified form of load is one which recognizes the amount, time, character and corresponding service value of the retail load, considering each customer, as well as the energy lost in distribution, as an individual case. Instead of a single blanket rate which endeavors—and fails—to cover every kind of retail load, as is the case for the most part with the contracts previously discussed, an individual wholesale rate for every type of customer must be made to insure the fullest development of load both for the wholesale power seller and the purchaser and the retail consumer.

Before a contract of this kind is formulated a careful study of the local retail users should be made by both the wholesaler and the retailer for classification into the various groups of energy users, and then wholesale purchase rates should be agreed upon based upon scientific principles coupled with business principles of energy marketing which oftentimes cannot be expressed mathematically. Following the putting into effect of an agreed schedule of rates, each month the retailer would submit a classified summary of his retail kilowatt-hour readings. With this information, based upon prearranged prices, the retailer would pay his monthly wholesale power bill. Each retail account would clearly stand out on the books, bearing its just part of the entire expense, not only as to distribution, but also as to generating costs, giving the retailer entire control of the situation, as well as permitting the wholesaler to develop his wholesale load by permitting the retailer in turn to enjoy the advantages of giving logical, business-getting rates to the ultimate consumer.

Some power companies, it is true, maintain the practice of rebating to their retail distributing customers in the case of certain classes of service—electric cooking, for example—to permit the retailer to make a salable rate to the consumer. But this merely demonstrates, in the writer's opinion, the need in all wholesale power contracts of recognizing not only one or two, but all, the problems that the retailer must solve. Charging too much for any commodity is only secondary to charging too little in the adverse results eventually produced. In short, the wholesaler must pass on to the retail distributer all the flexibility of rate making that the generating station possesses, so that, to the mutual advantage of all, the result will be a complete co-ordination and the fullest use of every factor in the generation and marketing of electrical energy.

How to Keep 4,000 Range Customers Satisfied

Managers in Small Towns Personally Demonstrate at Installation and Call Every Week or Two for Two Months Afterward

EDUCATION of the customer by personal visits of managers at the time of installing a range, and frequently for a while thereafter, has resulted in 4,000 satisfied range users in a number of small and medium-sized towns in the Middle West which are served by a large holding company. This company's properties have sold in the last six years over 4,000 ranges, including 200 bake ovens. The majority of the ranges are used in residences for home cooking, but some have been installed in restaurants where it is difficult to insure a high standard of cleanliness.

Most of the towns are of not more than 10,000 population, and the manager of the local company himself sells the range. He makes an inspection of the installations to see that a neat as well as a safe job has been done and then demonstrates and explains the operation of the range. In some companies attention to the customer after this point has been reached is limited to sending the monthly bill, but the local managers of the company in question call personally at the homes of the new range customers once every week or two weeks for two months after the installation. Thus they not only can explain any difficulty that may have arisen, but the feeling of personal interest which they inspire is of value.

AS A RESULT OF PERSONAL VISIT POLICY, CUSTOMERS MAKE FEW COMPLAINTS

In a larger city the manager himself may not be able to make these calls, but a man as capable as possible is thought necessary. The company referred to does not think the time expended wasted, and the manager rather welcomes the opportunity for getting into closer personal contact with customers. The result of this personal interest, together with easy payments and reasonable rates, is that very few customers have complained, and the company states that not a single customer has discarded his electric range for other methods. Four hundred letters written to range users in one state did not bring back a serious complaint Moreover, the old customers have "sold" new customers. In the year 1919 sales were over 240 per cent above 1918 sales.

As evidence that the range load is worth such effort this company presents a table to give an ordinary example of two residential blocks which it serves. The blocks contain nineteen residences, one church and one library, nine of the twenty-one customers having ranges. It will be noticed that the range income approximates the lighting income and that very little additional distribution equipment is needed. The entire load is handled by a 15-kw. transformer, while the total annual income per customer is $56. The rates per kilowatt are 10.5 cents for the first 10 kw. and 3 cents for all in excess with 0.5 cent discount. The yearly minimum is $24. Here is the table:

	Load Kw.	Annual Income
Light	21.59	$622.76
Range	52.80	557.97
Total	74.39	$1,180.73

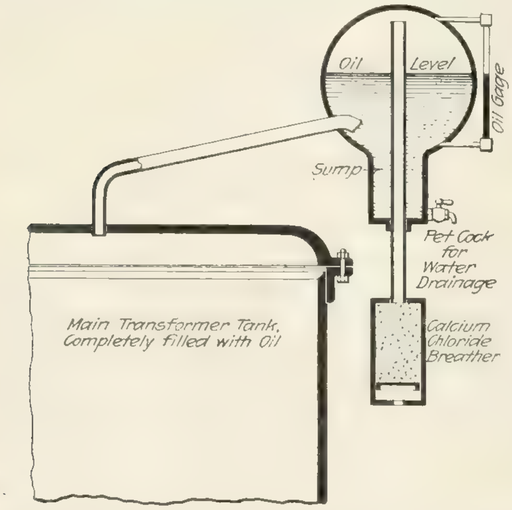
Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Di-Polar Diagrams of Synchronous Machines.—ANDRÉ BLONDEL.—In an earlier article (*Comptes Rendus*, Vol. 156, 1913) the author has developed the di-polar diagram of the "Joubertian emf." of a synchronous machine. At a constant excitation and for constant permeability, the locus of this emf. will be a circle. If the iron core works on a straight-line part of the magnetization curve, the line will be a cardioid. The curves showing internal power as a function of internal angular phase lag, and also the lines for constant torque, are now considered from a mathematical standpoint, and the effect of losses upon their form is discussed. —*Comptes Rendus*, July 7, 1919.

Some Recent Developments in Power Transformers.—W. S. MOODY.—It is stated that the improvements in self-cooled transformers brought about by the development of the radiator tank have made it possible to use self-cooled units in many places where water cooling would formerly have been considered essential. The author tells how the special problems involved in the design of transformers for electric furnaces were met successfully and also deals with the use of conservators. —*General Electric Review, November*, 1919.


Oil
Level
Oil Gage
Sump
Pet Cock for Water Drainage
Main Transformer Tank, Completely filled with Oil
Calcium Chloride Breather

CONSERVATOR TYPE OF TRANSFORMER FOR EXCLUSION OF MOISTURE

Determination of the Output Characteristics of Electron-Tube Generators.—LEWIS M. HULL.—Owing to saturation and rectification effects in three-electrode vacuum tubes, the currents which they deliver to any type of output circuit when used as a generator are heavily loaded with harmonics. Experimental results indicate that the frequency of the oscillating currents generated is the natural frequency of the output circuit. Hence this circuit behaves as a filter in series with the tube and the direct-current power system, and the useful output current is approximately sinusoidal, whatever the distortion of the tube currents depending in amplitude solely upon the fundamental constituents of the tube currents. General expressions are derived for the power and current output in terms of static characteristics of the generating tube and are corroborated by experimental results obtained with a particular tube. —*U. S. Bureau of Standards, Paper No. 355.*

Lamps and Lighting

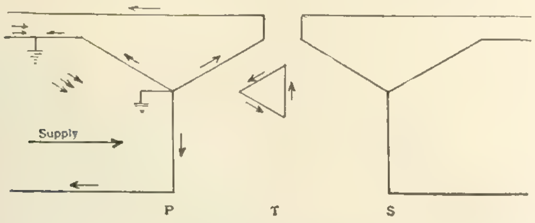
The Wiscott System of Factory Lighting.—In this system which has been developed by the Allgemeine Elektricitäts Gesellschaft, reflectors of a special type are used which are so shaped as to illuminate a circle of diameter equal to the height of the lamp, or of twice this height. The reflectors are made of unbreakable, heat-resisting material and have silvered surface protected by a varnish coating. It is claimed that, while 33 per cent of the light is usefully employed in case of a lamp without reflector, the Wiscott reflector utilizes 72 per cent, thus giving the same illumination with less than half the energy.—*Technical Review*, Oct. 28. (Abstracted from *Elektrotechnische Rundschau*, July 23, 1919.)

Photometric Measurements on Searchlights.—GEHLHOFF.—It is often assumed that the inverse-square law holds for a searchlamp with parabolic mirror if the distance is measured from the point behind the mirror where those rays which reflect from the rim of the mirror would intersect if produced backward. The author demonstrates theoretically and experimentally the inadequacy of this assumption. It is shown that for distances greater than a certain limiting value the inverse-square law will apply exactly also to searchlamps if the distance is measured from the mirror itself. Abberration and atmospheric absorption, however, necessitate certain precautions and corrections.—*Zeitschrift für Beleuchtungswesen*, April 1919.

Generation, Transmission and Distribution

Steel-Cored Aluminum Conductor for Power Distribution.—FISCHINGER.—A number of important high-tension transmission lines erected during the last three years in Germany have been fitted out with aluminum conductors of the steel-core type. The author warns emphatically against the use of non-reinforced aluminum wire and recalls the frequent accidents with the brittle copper conductors of earlier days. In normal times, he says, the aluminum conductor itself will be more expensive than copper of corresponding size, and since the poles must be built for a higher side-ways pull, owing to the large diameter of the wire, the aluminum transmission line will in general not stand the competition. However, the steel-core aluminum conductor is of great importance in certain special cases, such as river crossings, etc., and when the so-called long-span system is resorted to. This system is characterized by very high towers with long spacing and may prove highly economical in cases of right-of-way difficulties and for voltages where the insulator cost is very high. —*Elektrotechnische Zeitschrift*, Aug. 14, 1919.

Tertiary Windings in Transformers.—J. F. PETERS.—Tertiary windings when placed in transformer banks are primarily for the purpose of supplying that part of the necessary magnetizing current to produce a sine-wave voltage that cannot be drawn from the line when certain schemes of connections are employed. However, tertiary windings can be used in many cases to limit single-phase short-circuit currents to relatively small values. The author explains the functioning of these windings for the two cases just suggested and shows what current-carrying capacity they should have. —*Electric Journal*, November, 1919.

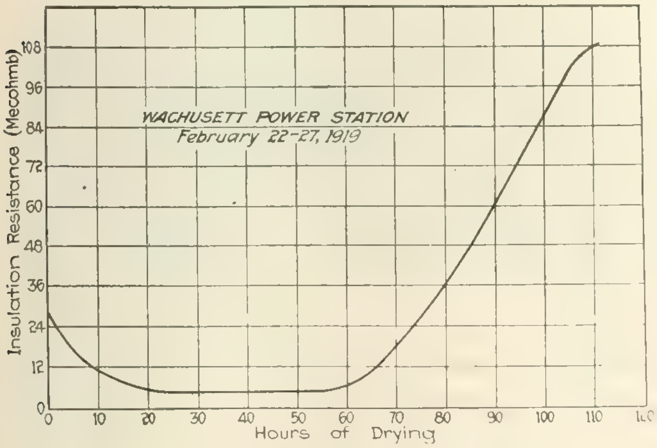


CURRENTS IN A STAR-STAR CONNECTED BANK CONTAINING A TERTIARY WINDING

The Electrical Layout of Large Power Systems.—ROBERT TREAT.—The author discusses means for insuring continuity of service with comments on the investment in protective apparatus and spare equipment which may be justified under varying conditions. A typical transmission network is described, and the application to this system of the principles of selective relays is taken up in detail. The paper is a good discussion of switching arrangement in large generating systems. —*General Electric Review*, November, 1919.

Electrical Characteristics of Transmission Circuits.—IV.—WILLIAM NESBIT.—In this number of the series the author deals particularly with the corona effect, making use of the formula originally proposed by F. W. Peek, Jr., which many experiments have shown to be quite accurate. Data is also given for the application of this formula in different climates, altitudes, etc.—*Electric Journal*, November, 1919.

Putting a Flooded Power Station Back Into Commission.—C. L. KASSON.—The writer describes the methods used in drying out and testing the electric equipment of a 4,000-kw. generating station which was flooded by the bursting of a hydraulic turbine. In an emergency of this kind he states that the best results can be obtained from the co-operation of the local operating force with a technical laboratory organization, the local men being familiar with the station, while the laboratory has suitable apparatus and trained personnel for such work. The curve showing how the insulation resistance varied in the drying-out process is of interest.—*Electrical Record*, October, 1919.



INSULATION RESISTANCE OF A GENERATOR DURING DRYING

Installations, Systems and Appliances

Power Consumption in Group Drive of Self-Acting Spinning Machines.—It is shown by the results of practical tests that the electric group drive of self-acting machines generally has important advantages over the individual drive. Nevertheless, conditions vary to such an extent that each special case requires careful examination. With the group drive there is a certain equalizing of load, as the maximum load never occurs simultaneously on all the machines, and the inertia of the transmitting shafts and pulleys has a further equalizing effect. On the other hand, each motor of an individual drive has to be rated for the peak load of the machine it drives, thus necessitating the installation of large motors that run at times with only a fraction of their full load. In a series of tests on a group-driven factory it is shown that the power per machine falls from 20.2 kw. to 7.3 kw. as the number of machines to be operated rises from one to eight. The power required depends greatly on the quality of the material that is being spun.—*Technical Review*, Oct. 14. (Abstracted from *Elektrotechnik und Maschinenbau*, June 22, 1919.)

Large Electric Steel-Melting Furnaces.—VICTOR STOBIE.—Requirements in the design of transformers for such furnaces are stated as follows: (1) The current density of both the low and extra high-tension windings shall be low enough to prevent the inevitable overloads from unduly heating up and deteriorating the insulation. (2) The ventilating channels in the windings must be specially well considered so as to provide low resistance paths for the cooling oil without excessive magnetic leakage. (3) Windings shall be braced on all sides. (4) The low-tension windings shall be taped with such material as empire tape, in addition to press-spahn or similar stiff insulation. (5) All clamps, no matter how small they may be, should be anchored to the transformer frame work. (6) The whole of the apparatus must be as unyielding to magnetic stresses as mechanical skill can make it. (7) As much as possible of the total reactance required in the whole of the furnace installation should be incorporated in the transformers. The writer also discusses automatic electrode regulators, the reactance to be put in series with the furnace to limit overloads without making the power factor too low, and the arrangement of electrode openings in the furnace to limit the loss of energy heating of electrodes.—London *Electrician*, Nov. 7, 1919.

Relay Protection for Large Power Stations.—O. C. TRAVER.—This article is concerned principally in the application of relays for the protection of electrical systems. It is said that the relay has possibilities which can be obtained only by some one who understands the nature and characteristics of his entire system. Only by harmonizing all the characteristics of each item entering into the system can the real value of the relay be obtained. The writer deals quite fully with balanced protection of two parallel transmission lines, mechanically balanced differential relays, differential protection for alternators, direct-current reverse power and many other relays for power-plant service.—*General Electric Review*, November, 1919.

Electrophysics and Magnetism

On the Solutions to the Differential Equation for Oscillations in Coupled Circuits.—J. SOMMER.—Following the theories of Sturm and Hermite regarding the roots of algebraic equations of the fourth degree, a discussion is given of the conditions which govern the appearance of singly and doubly periodic oscillations of various types in coupled circuits. Several representative cases are illustrated by means of curves.—*Annalen der Physik,* March, 14, 1919.

Electrochemistry and Batteries

Cadmium Electrode for Storage-Battery Testing.—H. D. HOLLER and J. M. BRAHAM.—In the operation and testing of storage cells it is frequently important to know the individual potentials of the positive and negative plates. No standard method has been recognized. The results obtained with the cadmium electrode are often contradictory. This investigation has been made to determine the reliability of the cadmium electrode and the errors in measurement to which it is subject. The standard electrode used was the mercurous sulphate half-cell. It was found that the most serious error in using the cadmium electrode is due to the polarization. By measuring the potential of the negative plate and computing the potential of the positive plate from this and the cell voltage the most serious error of the cadmium electrode can be avoided, even when using an ordinary voltmeter. This investigation deals only with the accuracy of the cadmium electrode and does not discuss the cadmium readings with reference to the age or condition of the battery.—*Technical Paper No. 146, U. S. Bureau of Standards,* Dec. 12, 1919.

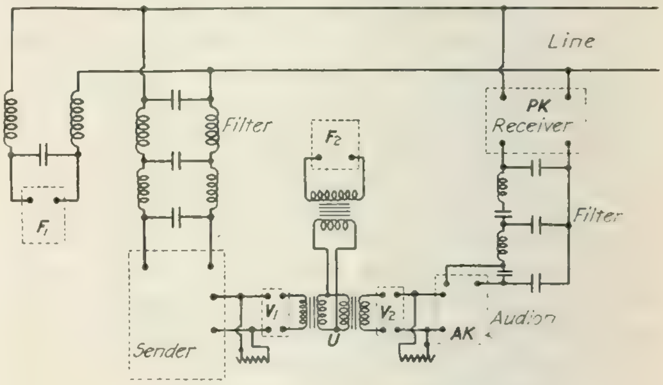
Telegraphy, Telephony and Signals

Principles of Radio Transmission and Reception with Antenna and Coil Aërials.—J. H. DELLINGER.—The functioning of the two principal types of radio aërials is worked out quantitatively from fundamental electromagnetic theory. Experiments have verified the formulas and conclusions presented. Formulas for the current received in either antenna or coil aërial in terms of current in either type of transmitting aërial are given, as well as comparison formulas giving the relative performance of antenna and coil aërials under various conditions. The advantages of the condenser type of aërial are presented. The theory and nature or radiation are discussed and applied to the elucidation of some current fallacies. The basic principles of design of aërials are given. Desirable lines of future research are pointed out. The use of the coil aërial as a direction finder, interference preventer, reducer of strays and submarine aërial are not treated in this paper.—*Scientific Paper No. 354, U. S. Bureau of Standards,* Dec. 11, 1919.

Radio Direction-Finding Apparatus.—A. S. BLATTERMAN.—In this paper are given very fully the theory, design and practical results in the use of radio direction-finding apparatus by means of closed coil antennas.—*Journal of Franklin Institute,* Sept., 1919.

Electric Light for Train Signals on Swiss Railroads.—G. SCHLOSSER.—A considerable number of Swiss railroad stations have been provided with electric installations for train-signaling purposes. Alternating-current distribution at 50 volts is employed, each signal group being fed from a small transformer unit of 250 watts. The use of cables having been found uneconomical, an agreement has been reached with the telegraph authorities so that the signaling conductors may be carried on existing telegraph poles. In each lantern two 10-watt incandescent lamps are used, and special control devices are provided which immediately indicate any decrease in current caused by one or more lamps giving out.—*Elektrotechnische Zeitschrift,* Aug. 21, 1919.

Multiplex Telephony and Telegraphy.—K. W. WAGNER.—Several proposed systems of multiplexing by means of high-frequency carrier waves are discussed, and the propagation of alternating currents on smooth and loaded lines is considered. The author then describes some experimental work carried out by the German Telegraphen Versuchs Amt during 1917-1918. Experiments were made on a 300-km. (187-mile) line between Berlin and Hanover. The carrier wave was generated by vacuum-tube oscillators of about 10-watt output, and frequencies from 75,000 to 15,000 p.p.s. gave best results. At first considerable trouble was experienced due to cross-talk, overtone and insufficiently sharp separation of the carrier waves at the receiving station, and various types of filter-circuits were developed. The final arrangement is shown in the figure. *PK* is a tuned receiver, which picks up the desired carrier frequency and through a filter impresses the oscillations on the vacuum-tube remodulator *AK*. The audio currents, through an amplifier V_2 and a differential transformer *U*, arrive to the subscriber's set F_2. The transmitter receives in opposite order its modulating currents from F_2, through an amplifier V_1, and feeds its modulated carrier wave through another filter out on the line. An interesting system of high-frequency telegraphy, due to Fassbender and Habann, is also described. Frequencies corresponding to wave lengths between 600 m. and 1,300 m. are used. The two senders, one in each end of the line, are slightly out of tune, and reception is made by the beat method. Distances of 200 km. (125 miles) were covered, over a line of 3-mm. (No. 9) copper wire, using tube oscillators of only 0.05-watt output.—*Elektrotechnische Zeitschrift,* Aug. 7 and 14, 1919.



CONNECTIONS FOR MULTIPLEX TELEPHONY

Miscellaneous

Electricity in Agriculture.—The prejudice of the German farmers against electrical appliances has now been overcome, and electrically-heated incubators are coming into favor. Small progress has been made with electric plowing machines, but although electric heating has proved too costly for agricultural purposes, such as drying of crops and heating of the ground, successful attempts have been made to utilize the waste heat of electric generating stations for such purposes.—*Technical Review,* Oct. 14. (Abstracted from *Elektrotechnische Zeitschrift,* July 31, 1919.)

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

Electrical Interests of Montreal Plan "Get-Together" Meeting

INSPIRED by the success of the two days of meetings and sessions on Jan. 15 and 16 at Toronto, Ontario, participated in by utility operators, manufacturers, jobbers and contractor-dealers, when the details of the Goodwin plan of co-operation were one of the main topics of discussion, the Associated Electrical Interests of Montreal have scheduled two days of "get-together" meetings during the week of Feb. 16.

The program calls for an Electrical Club luncheon at the Windsor Hotel at 1 o'clock Wednesday, Feb. 18, at which time W. L. Goodwin, author of the "Goodwin plan," will explain its objects and the things it stands for in the development of the electrical business by the central station, the jobber, the manufacturer and the contractor-dealer. For the evening of Wednesday an informal smoker is scheduled. On Thursday, Feb. 19, a special meeting, to which all the contractor-dealers of the city have been invited, has been arranged. On Thursday evening a banquet will be held which representatives of all electrical interests as well as prominent public officials are expected to attend. This event is planned along the same lines as the banquet held at Toronto on the evening of Jan. 16, which was attended by more than 600 electrical men of Canada, who had as their guests to hear Mr. Goodwin the Lieutenant-Governor, the Prime Minister of Ontario, several Cabinet members, the Mayor of Toronto, Senator Nicholls and others.

Massachusetts Manufacturers Organize to Defend Americanism

A STATE-WIDE call to arms to defend Americanism has been sounded by a large number of electrical and other manufacturers organized under the Associated Industries of Massachusetts, 1024 Kimball Building, Boston, Mass., and active work by a speakers' bureau in answer to radical propaganda has been begun. It is felt that the time has come not only to counteract the false utterances and destructive doctrines of socialism and of revolutionary agitators, but to build up a constructive understanding by the public and by industrial employees which will establish the credit of industry, improve relations between capital and labor, and replace unrest with contentment. About forty speakers have been enrolled for service, and the addresses include a wide variety of subjects. Among these topics are: "Employees' Representation or Shop Committee Systems," "Fifty Years of Human Progress in Our Industries," "Organization in Accident Prevention," "The Foreman's Big Opportunity," "What the Present Employee Gets in His Pay Envelope Besides Dollars," "Practical Americanization Work," "Thinking Straight in Industry" and many others. Included among the speakers available are Sidney W. Ashe, General Electric Company, Pittsfield, Mass.; F. P. Cox, manager Federal Street shops, General Electric Company, Lynn, Mass.; L. H. Allen, Fred T. Ley & Company, Inc., Springfield, Mass.; E. C. Gilbert, Chapman Valve Manufacturing Company, Indian Orchard, Mass., and Ralph Barstow, Greenfield Tap & Die Corporation, Greenfield, Mass.

Need for Further Patent Legislation

OPPORTUNITY was taken during the discussion of the South American trademarks bill in the House of Representatives to point out the need for further patent legislation which is about to be reported by the House committee. Representative Tilson of Connecticut read an extract of a letter from a prominent manufacturer, as follows:

"It is difficult—almost impossible—to get a printed copy of a granted patent or the rendering of an opinion. It was formerly possible to get such copies within two or three days. Now it takes at least a week or ten days, and in many cases printed copies of patents are exhausted, so that no copies can be obtained. When it comes to manuscript copies, which are of great importance and very necessary at times, they are so difficult to obtain that oftentimes a copy must be prepared by the attorney, sent to the Patent Office to be certified, and paid for when it is certified the same as if it had been made by the Patent Office; and when copies are sent to be certified it is several weeks or months before they are returned with the certificate.

"There is also a great delay in the acknowledgment of applications sent to the Patent Office for filing, or assignments sent for record, which is again very detrimental to business. . . . These conditions seem to be unjust to the inventors and manufacturers, because the Patent Office is self-supporting, has to its credit some $8,000,000 which have been paid in fees, in excess of expenses, and it would seem there is no valid reason why Congress should not appreciate the situation and pass some legislation which will relieve it."

Mr. Ballard to Tour South

PRESIDENT R. H. BALLARD of the National Electric Light Association will tour the South on his return journey home, leaving New York to-night. This is part of his program to see and meet men in the different sections of the country in order to talk over things electrical and particularly N. E. L. A. affairs.

The first stop in his itinerary is Atlanta, Ga., on Feb. 9. He expects to be in New Orleans, La., Feb. 11; Dallas, Tex., Feb. 13; El Paso, Tex., Feb. 15 and 16; Alburquerque, N. M., Feb. 17 and 18, meeting with the New Mexico Electrical Association, and Phœnix, Ariz., Feb. 19, meeting with the Arizona member companies.

A. E. Wishon, president of the Pacific Coast Section N. E. L. A., and K. E. Van Kuran, chairman of the commercial section of the Pacific Coast, will meet President Ballard in El Paso and continue with him to Los Angeles, where he expects to arrive about Feb. 20.

SEVERAL factors contributed to a slight diminution of business last week. In the Middle West another coal shortage has begun to curtail the output of several factories supplying the electrical trade; in the New York territory the influenza epidemic has hit the ranks of electrical contractors and supply dealers, and in outlying districts the cold weather has temporarily stopped some building. The South and New England report vigorous trade. Rain is still needed in California. Trade is quiet in the Seattle district, but good in Portland (Ore.) territory.

A FEATURE in the jobbing market is the increasing number of orders being placed with jobbers without recourse to quotations.

PLANS HAVE been prepared by the Syracuse (N. Y.) Lighting Company for improvements and additions to its plant and system, the cost of which will be about $500,000.

WORK HAS been begun by the Lehigh Navigation Electric Company on the proposed enlargements and extensions in its local electric light and power station at Hauto, Pa., to cost about $3,000,000.

THE ELECTRICAL department of Chicago is asking the city to issue $15,000,000 of bonds to cover the cost of adding 85,000 100-cp. lamps to the municipal street-lighting system.

IT IS expected that Lansing, Mich., will spend $1,640,000 for the municipal electric light and power system in the immediate future.

A CONFERENCE of public service representatives was called in New York City on Thursday by the Public Service Commissioner to consider the threatened shortage of coal.

AT A meeting of the Conference Club held in New York on Thursday and Friday of last week a plan for reorganization was presented and aroused much interest. By this plan the Conference Club would become a deliberating and debating body for the whole industry, its object being to produce a "balanced co-ordination of group functions." It would ultimately be composed of representatives of the contracting group, the jobber group, the manufacturers and the central stations, the engineers and the architects, and the press. The plan was received with enthusiasm by those present and was heartily indorsed in speeches made at the Friday evening banquet by President Ballard of the N. E. L. A., William L. Goodwin, W. H. Onken, Jr., editor of the ELECTRICAL WORLD, and others.

IN THE tentative program for the mid-winter convention of the American Institute of Engineers, which is to be held in New York on Wednesday, Thursday and Friday of next week, fourteen papers by well-known members are included. Trips to many points of electrical engineering interest in and around New York City have been arranged.

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

THERE ARE three water-power bills pending before the New York State Legislature, two having been introduced in the Assembly and one in the Senate. The Assembly bills affect the amount of water diverted from the St. Lawrence and Niagara Rivers and Lake Erie. The Senate bill adds a new article to the conservation law empowering the commission to acquire, control and utilize waters appropriate for power purposes.

GUY E. TRIPP of the Westinghouse Electric & Manufacturing Company and O. D. Young of the General Electric & Manufacturing Company were appointed members of the public policy committee of the National Electric Light Association by President Ballard. This is the first time that representation on this committee has been given to manufacturing interests.

RADIO-TELEPHONE CONVERSATIONS with low-power sets have been carried on successfully in the last month between Ossining, N. Y., and Chicago—a distance of about 900 miles. Messages from Ossining of which no advance information was given were picked up in Ohio, Indiana, Massachusetts and South Carolina.

PRESIDENT R. H. BALLARD of the National Electric Light Association leaves New York tonight on his return journey to Los Angeles. En route he will visit Atlanta, New Orleans, Dallas, El Paso, Albuquerque and Phoenix.

IT IS proposed to departmentalize the headquarters activities of the National Electric Light Association and reorganize control through the executive committee in such a way as to give all parts of the country representation in direct proportion to the volume of business done.

THE POWER shortage on the lines served by the Ontario Hydro-Electric Commission, which supplies 236 municipalities, is now placed at 50,000 hp., with a probability of a growth by next winter to 120,000 hp.

DR. CHARLES P. STEINMETZ announces the development of a lightweight, low-cost truck as the result of long research, and it is said that both road and industrial vehicles will be on the market in the fall.

THE UNITED STATES Geological Survey has issued figures showing the sources of power supply for the nation in four months of 1919. East of the Rocky Mountains there is still a great preponderance of fuel-burning over water-power plants.

K. W. ADKINS of Kansas City, Mo., was elected president of the Western Association of Electrical Inspectors at its convention in St. Louis. The committee on outside wiring declared that great need exists for the formulation of uniform rules to apply to different cities and states.

GERMAN MECHANICAL and electrical manufacturers are uniting to bring about an all-German system of standards for parts, details and types, with the object of promoting exports to foreign markets.

THE CARNEGIE CORPORATION of New York is to give $5,000,000, part of which will be used for the erection of a home in Washington, D. C., for the National Academy of Sciences and the National Research Council and the remainder as an endowment fund for the Research Council.

AT A meeting of the new-business co-operations committee of the Ohio Electric Light Association held in Akron synchronous motors were advocated as a remedy for the low power factor of rubber mills, of which it is estimated that two hundred will be started in five years.

DR. ALEXANDER C. HUMPHREYS, president of the Stevens Institute of Technology, has been chosen to head the American Institute of Consulting Engineers.

THE PHILADELPHIA RAPID TRANSIT COMPANY has decided to equip its Mount Vernon Street power station with a powdered-coal system for firing the boilers. Considerable economy is expected from the plan.

THE UNUSUALLY high vacuum of 30.35 in. was obtained during the cold snap at New York on a turbogenerator of the United Electric Light & Power Company. This machine is rated at 25,000 kva. and is equipped with a 40,000-sq.ft. surface condenser and a Le Blanc air pump.

Manufacturers Appointed on N. E. L. A. Public Policy Committee.

IN KEEPING with the broad usefulness aimed at by the present administration, the National Electric Light Association has for the first time gone outside of the electric light and power field for members of one of its major committees. At its meeting on Jan. 30 the executive committee of the association confirmed the president's appointments of Guy E. Tripp, chairman of the board of the Westinghouse Electric & Manufacturing Company, and O. D. Young, vice-president of the General Electric Company, as members of the public policy committee. This action of the association was characterized by President Ballard as the "first step in the new era of the united industry."

In his telegram of notification, John A. Britton, chairman of the public policy committee, said: "For years I have been strongly of the opinion that the association would be largely benefited by a more direct contact with the manufacturers. There is a relationship in the industry that makes manufacturers as essential to the success of the organization as operators." Mr. Britton urged their acceptance because of the good it will do the industry as a whole.

Railroad Administration Diverts Coal Cars for Power Plants

ON ACCOUNT of the shortage of transportation facilities and winter conditions, utilities in several parts of the country are facing a serious coal shortage. In the East the situation is further aggravated by heavy snows and the congestion of ice in the harbors.

In New York City the shortage had become so threatening that Public Service Commissioner Lewis Nixon called a conference on Thursday morning of the representatives of the public service corporations and the district fuel administrator. Other than for an immediate curtailment in rapid transit service, probably in the matter of heating, no orders were issued.

The Interborough and Brooklyn Rapid Transit companies, it was stated by Commissioner Nixon, each had in the neighborhood of a three days' supply on Wednesday.

The New York Edison Company, according to a statement by the commissioner, was in a better position, having on hand on Wednesday 55,000 tons, or about a two week's supply. The foresight of the New York Edison Company, as well as its action in bringing coal to the city by steam at a cost several dollars a ton in excess of that paid by other utilities which had depended upon the usual methods, was praised by the commissioner. It was learned at the offices of the commissioner that the Edison company had brought 50,000 tons by the outside route up from Norfolk. Owing to the draft of the steamers it has been necessary to unload these vessels at other docks where hand unloading had to be employed. Consequently, but 1,000 tons a day are available from this source.

The Brooklyn Edison Company has a five-days' supply at its Gold Street station, which can be used as a reserve by the entire system. The company reported the seizure of twenty-three cars of coal by the Federal Railroad Administration, which were diverted elsewhere. This is in spite of the fact that cars loaded with coal for public service corporations are plainly marked. Out of 300 cars consigned to the Brooklyn Edison Company the company reports that but four have come through.

Synchronous Motors as Remedy for Low Power Factor of Rubber Mills

THE low load factor and power factor of electric drives as they are installed in the rubber industry and the advisability of replacing the present induction motors with synchronous motors were the topics of a meeting of the new-business co-operations committee of the Ohio Electric Light Association held in Akron, Ohio, Jan. 21. H. C. Stephens, power engineer of the Northern Ohio Traction & Light Company, Akron, read a paper which was discussed extensively by H. B. Bixler of Akron, C. W. Drake of Pittsburgh and F. W. Sweet of Akron. It was said that electric drive is particularly favorable on mills, crackers, washers and calenders. For mills, the loads on which vary from 200 per cent to 50 per cent, there is now a growing tendency to install synchronous motors to replace the induction motors which operate at a power factor averaging 60 per cent. Calenders are usually driven by direct-current motors because of the wide speed range required, while tubing mills are driven by induction or direct-current motors. A plant making 250 to 300 tires a day requires about 375 hp. in motors, while one making 500 to 600 tires requires 750 hp. The demand averages 70 per cent of the connected load and the load factor is 20 per cent to 40 per cent.

Mr. Bixler predicted that two hundred new rubber plants will be started within the next five years. Mr. Drake advised the use of 50-deg. motors on account of the short deviation of heavy overloads and the low average load.

Water-Power Bills for New York State

THREE bills affecting water power are before the New York State Legislature. Two of these were introduced by Assemblyman Adler of Monroe County. Of these one adds a new section to the law chartering the St. Lawrence Power Company, which limits the amount of water diverted from the St. Lawrence River for the production of hydraulic power by this company to an amount sufficient to produce 86,000 hp. at the shafts of the hydraulic turbine. The other provides that no water shall be diverted from Lake Erie or the Niagara River for use in developing hydraulic power except as authorized in Chapter 597, Laws of 1918, and except such quantity as is now being diverted into the state's canal system, or except as may hereafter be authorized by legislative act, notwithstanding the charters of the Niagara County Irrigation & Water Supply Company, the Model Town Company, the Niagara, Lockport & Ontario Power Company and the Lower Niagara River Power & Water Supply Company.

The third bill was introduced by Senator Fowler of Chautauqua County. It adds a new article to the conservation law, empowering the conservation commissioner "to acquire, control and utilize the waters in state and boundary waters appropriate for power purposes; to develop water power and generate electric current, power and energy and transmit, distribute, sell or lease same to municipalities and inhabitants of the state." Energy is to be supplied at cost.

Conference Club Dedicated To Electrical Industry

'Thought" Organization Without Mandatory Powers to Formulate Fundamental Principles Conceived in Reorganization Plan

IN THE belief that the electrical industry is now getting down to fundamentals and the conditions are ripe psychologically for some sort of spontaneous co-operative movement the Conference Club met at the Biltmore in New York on Thursday and Friday of last week to discuss a proposed plan for reorganization wherein the club with its traditions dedicated itself "to be utilized as the industry might decide for producing an orderly, balanced co-ordination of group functions which would make possible a healthy normal development resulting in maximum service to the consumer and increasing benefits to the industry."

Sixteen members of the Conference Club, with L. K. Comstock chairman and Sullivan W. Jones secretary, ex-officio, drew up the proposed plan and presented it to the meeting in a twenty-one page report.

To this series of meetings were invited members of the other branches of the industry, who were urged to participate in the discussion. Those who attended hailed the plan as a forward movement.

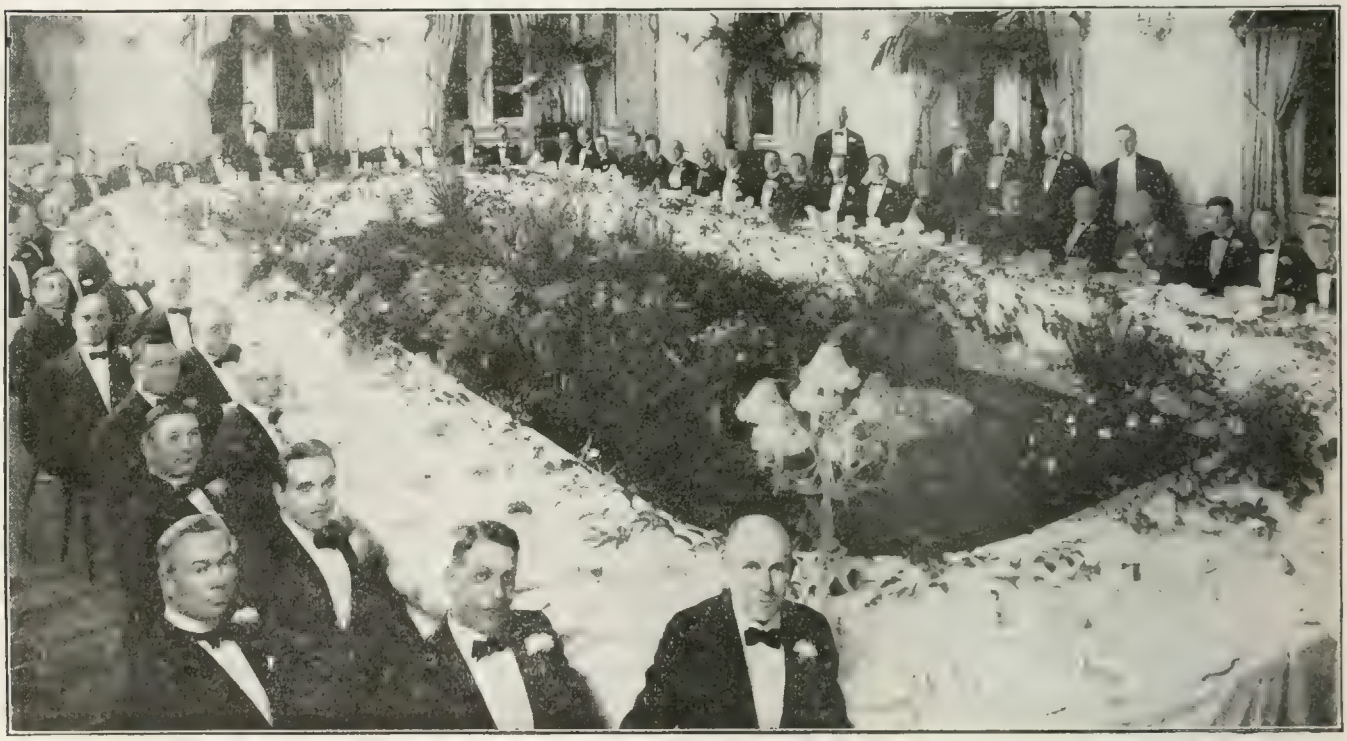
Discussion of the plan to a large degree served to clarify and to unify the thoughts of those present. It was generally felt that the organization should be a neutral body with a membership chosen not by functional groups but by the members of the club.

Emphasis was placed on the "thought organization" feature, which would make the club the debating society for the industry. It was clearly evident that such an organization, if it is to be a guiding instrument in the industry, must function only as a body of deliberation and never as a body of action.

Owing, undoubtedly, to its timely importance, the relation of the club's activities to the labor question was recurrent in the discussion, and while many ideas were expressed, those present appeared to be convinced that no agreements could be made with labor and that if labor were discussed the deliberations should be only on broad principles.

The committee on trade relations and trade development submitted a number of recommendations on organization, and these were accepted and passed on to the executive committee as follows:

1. The future Conference should be ultimately composed of representatives of the contracting group, the jobber group, the manufacturers and the central stations, the engineers and the architects, and the press.
2. The membership in the future Conference should be limited.
3. A place should be provided in the membership for counsel whose past activities and associations have made them peculiarly familiar with the problems confronting the various groups.
4. No member of the Conference should have the privilege of sending alternates to the meeting.
5. The members of the future Conference should be selected by the Conference.
6. An entirely new constitution and bylaws should be prepared, and a committee representing all of the principal interests should be appointed at this meeting for that purpose.


MEMBERS OF ALL BRANCHES OF THE INDUSTRY COME TOGETHER AT CONFERENCE CLUB BANQUET

Friday afternoon was given over to a consideration of proposed standard sub-contract documents for recommendation to the American Institute of Architects, which publishes standard documents on building contractual relations. The institute was represented, and after a full and frank discussion it was felt that considerable progress in this direction had been made.

THE BANQUET AT DELMONICO'S

At Delmonico's on Friday evening, Jan. 30, a banquet was held at which seventy-two members and guests were present. L. K. Comstock as toastmaster called for impressions formed from the talks at the various sessions. W. L. Goodwin as the first speaker pointed out that the electrical industry until recent years has depended on engineering skill in the solution of its development problems. Now the commercial problems are assuming an importance equal to those of engineering, and soon it will not be a question of selling electrical products but of supplying the demand. In studying the problems involved, Mr. Goodwin maintained that the various interests affected should be considered in the following order: (1) Those of the public; (2) of the electrical industry as a whole; (3) of the groups of the industry; (4) of individual companies and corporations, and (5) of individuals. Five pressing needs of the industry which might come before the Conference Club for discussion he outlined as follows: (1) A code of ethics; (2) publicity in the public press; (3) standardization of current, voltage and frequency for residence service; (4) commercial courses in educational institutions; (5) legislation that will permit the proper expansion of the industry.

R. H. Ballard, president of the National Electric Light Association, stated that a committee had been appointed to consider the proposal of the Conference Club to create a forum for the industry and report what part the association should take. He pointed out that the N. E. L. A. is interested not only in central-station matters but in those of the other groups of the industry and in this connection said that Guy E. Tripp of the Westinghouse Electric & Manufacturing Company and O. D. Young of the General Electric Company had been appointed members of the public policy committee in recognition of the need to take into consideration the problems of the manufacturing side of the industry. Mr. Ballard concluded by saying that the big job of the future is making the supply equal the demand and that in this work all branches of the industry must get together and stay together.

W. H. Onken, Jr., editor of the ELECTRICAL WORLD, spoke in part as follows:

"It is a great and glorious task you have set out to accomplish in bringing together all elements of the electrical industry into a common forum, there to discuss dispassionately its great problems for the common good. This function is closely allied with the functions of the electrical press, and, needless to say, we welcome a movement of this sort and stand ready to assist in the general uplift. You may therefore count on our active co-operation and support.

"Our industry has had a wonderful development, and if it is to continue to develop, expand and grow, all branches of it must work together in all fairness and justice for the common good. We need, of course, plenty of optimism to achieve success. But ours is a vocation for optimists—idealism is the very stuff we thrive on. There is no room for pessimists in the electrical industry. Our function is to help the individual, help the community, help the state and nation, and at the same time make a worldly success for ourselves.

"There is a grandeur and a majesty in the irresistible, onward march of the electrical industry, and we may become so accustomed to such things that they make little impression on us. But if one only considers what electricity has done to embellish and advance the country, if one can contemplate what a living mass of intelligence, activity and improvement it leaves in its wake as it rolls on its sure and steady course, if he can see desolation transformed almost with the suddenness of enchantment into fruitfulness and beauty, and all passing before his very eyes, how can he fail to evince feelings of pride and admiration for the industry which made this possible?"

After telling the story of how the composer Klepman was finally enabled to complete an opera which had been delayed for years, Mr. Onken added:

"Idealism was the impulse which spurred the musician, and idealism is the motive power back of this movement. We have the four parts—the central station, the manufacturer, the jobber and the contractor—from which to create this tune of victory, and if at times the treble is shrill and the bass rude, harsh and discordant, a master performer can still bring out above it all the stately, measured tramp, tramp of victory. While, on the other hand, if each branch sustains its part and functions properly, we have perfect harmony. Under the stirring strains of that tune we can march forward and win, for just as the impulse of 'La Marseillaise' spurred the French to victory, so will this march of harmony spur us on to greater and greater endeavor for the good of the electrical industry."

Other speakers included Frank S. Price of the Pettingell-Andrews Company, Boston; C. W. Appleton of the General Electric Company; Bassett Jones, consulting engineer, New York; J. J. Jackson, Westinghouse Electric & Manufacturing Company, Pittsburgh, and H. E. Parker, American Institute of Architects.

Steinmetz Develops Truck with Regenerative Braking

AFTER a number of years of research in the field of light-weight, low-cost electric vehicles, Dr. Charles P. Steinmetz has recently announced the development of a light-weight electric truck, one of the principal features of which is the method of motor control, which gives the motor compound characteristics by a storage cell floating on the field circuit.

The result of this method of control, Dr. Steinmetz pointed out, is speed maintenance, quick starting, power saving in the field at large currents and the feature of regeneration both on down grades and on stopping.

The field and armature of the motor revolve in opposite directions, each driving one of the car wheels. In this way motor weight is saved, the differential is eliminated and the truck is as a result simpler and more compact.

By saving in motor weight and in battery weight, by the elimination of differential and in other ways a lower-weight truck is obtained. The ½-ton truck without body for instance, will have a weight, it is stated, of only 2,300 lb.

As a result of the above features and with the use of standard parts, it is claimed that lower operating cost and lower price will result.

To manufacture and distribute this truck the Steinmetz Motor Car Company, 512 Fifth Avenue, New York, has been incorporated with a capitalization of $2,000,000.

Both industrial and road trucks are to be produced, the former in three sizes and the latter in ½-ton and 1-ton sizes. The first year's production schedule calls for 500 road trucks and 1,500 industrial trucks. The road trucks, according to the present plans, are to be distributed largely through the central station and the industrial trucks through special agents. The company expects to be able to start production in the fall.

Program for A. I. E. E. Midwinter Meeting

Arrangements Include Many Trips to Points of Electrical Engineering Interest in the Metropolitan District

AT THE eighth annual midwinter convention of the American Institute of Electrical Engineers, to be held Feb. 18, 19 and 20, in the Engineering Societies Building, New York City, elaborate arrangements have been made for trips to points of electrical engineering interest in and around New York City. These include the Bell Telephone research laboratories, New York Edison Waterside stations and Thirty-ninth Street substation, Electrical Testing Laboratories, and power plants of the following companies: Brooklyn Edison Company, Brooklyn Rapid Transit Company, United Electric Light & Power Company, Public Service Electric Company, New York Central Railroad and Interborough Rapid Transit Company. The entertainment committee has arranged for a dinner-dance at the Hotel Astor for Thursday evening, Feb. 19.

On Feb. 18 the board of directors will meet and among other things plans to decide on the place of the annual convention, scheduled to be held June 22 to 25.

On the evening of the first day the following papers will be presented: "Daylight Saving," by Preston S. Millar, manager Electrical Testing Laboratories; "Essential Statistics for General Comparison of Steam Power Plant Performance," by W. S. Gorsuch, engineer economics, Interborough Rapid Transit Company, and "Standard Graphic Symbols," by E. J. Cheney, chief of division of heat, light and power, Public Service Commission, Albany, N. Y.

On Thursday morning the session will be devoted to a symposium on the "Economical Supply of Electric Power for the Industries and Railroads of the Northeast Atlantic Seaboard" by a number of authorities.

In the afternoon two parallel sessions will be held, the papers being as follows: "Printing Telegraph Systems," by J. H. Bell, telegrapher engineer, Western Electric Company; "Maximum Output Networks for Telephone Substation and Repeaten Circuits," by G. A. Campbell, research engineer American Telephone & Telegraph Company, and Ronald M. Foster, assistant to research engineer American Telephone & Telegraph Company; "A Method of Separating No-Load Losses in Electrical Machinery," by C. J. Fechheimer, designing engineer Westinghouse Electric & Manufacturing Company; "Inherent Regulation of Direct-Current Circuits," by A. L. Ellis, Thomson Laboratory, General Electrical Company, and "Measurements of Projectile Velocities," by P. E. Klopsteg, physicist, Leeds & Northrup Company, and A. L. Loomis, formerly Major Ordnance Department. U. S. A.

Three papers will be read on Friday morning, the subjects being as follows: "A New Form of Vibration Galvanometer," by P. G. Agnew, physicist, United States Bureau of Standards; "Precision Galvanometer for Measuring Thermo Emfs.," by T. R. Harrison and P. D. Foote, both of the United States Bureau of Standards, and "Notes on Synchronous Commutators," by J. B. Whitehead, professor of electrical engineering, Johns Hopkins University, and T. Isshiki, engineer Shibaura Engineering Works, Japan.

The last technical session will be held on Friday afternoon, and these two papers will be presented: "Oscillographs and Their Tests," by A. E. Kennelly, professor of electrical engineering, Harvard University; R. N. Hunter, engineering department, American Telephone & Telegraph Company, and A. A. Prior, instructor, Case School of Applied Science; and "The Accuracy of Commercial Measurements," by H. B. Brooks, physicist, United States Bureau of Standards.

Large Utility to Halve Boiler Needs by Use of Powdered Coal

THE Philadelphia Rapid Transit Company has decided to equip its Mount Vernon St. power station with a powdered-coal system for firing the boilers, using river and buckwheat anthracite coal. At present this plant is producing daily about 75,000 kw.-hr. of electrical energy employing twenty 375-hp. Babcock & Wilcox water-tube boilers. With powdered-coal firing it is expected the needed output will be obtained by using only ten boilers, although the fuel to be used is low in volatile matter and high in ash content. Considerable economies are to be expected through greater combustion efficiency, saving in labor and ability to use a lower-grade fuel.

The powdered-coal equipment to be installed, which will be the Quigley system, includes complete apparatus for preparing, distributing and burning the fuel. Arrangements will be provided for making accurate records of fuel consumption for each individual boiler. The regulation of the fuel feed to each burner will be controlled by a hand wheel. Changes will be made without interruption of service.

Wringers Big Problem in Washing-Machine Production

AT ITS meeting in Chicago on Jan. 20 the American Washing Machine Manufacturers' Association authorized its president to appoint a committee of three to investigate thoroughly the wringer situation and report back its recommendations as soon as possible. The president was also authorized to appoint a committee of five on standardization of fractional-horsepower motors. A committee on merchandising of washing machines also will be appointed. At the same meeting Miss Mary E. Keown, head of the extension service, United States Department of Agriculture, addressed the members, outlining the possibilities of co-operative work with this department of the government. This department will co-operate with the association in the preparation of a booklet.

Officers of the committee were elected as follows: President, H. L. Barker, Binghamton, N. Y.; first vice-president, R. D. Hunt, Fairfield, Iowa; second vice-president, John Rocke, Pontiac, Ill.; third vice-president, Howard Power, Davenport, Iowa; treasurer, William H. Voss, Davenport, Iowa; secretary, E. B. Seitz. Executive committee: J. D. A. Johnson, Muskegon, Mich.; F. H. Bergman, Newton, Iowa; Walter Conlon, Cicero, Ill.; P. V. D. Brokow, Alton, Ill.; Raymond Marsh, Syracuse, N. Y. Advisory committee: Sam T. White, Davenport, Iowa; H. W. Eden, Chicago; W. L. Rodgers, Pittsburgh.

Uniform Rules Needed for Outside Electrical Construction

THE latter half of the fifteenth annual meeting of the Western Association of Electrical Inspectors at St. Louis last week was devoted to business and pleasure in about equal parts.

F. A. Barron of the General Electric Company told of a number of changes in the code rules, applying to wiring of motors, motion-picture machines and garages, which will be acted upon by the electrical committee in March. The rules, it was stated, will be arranged in more convenient form conforming to modern practice.

The association voted that the neutral blade could not be omitted from three-wire switches with safety and also that it was not necessary for cases of transformers on poles to be grounded.

Uniformly adequate rules for outside electrical construction are badly needed, according to the report of the committee on outside wiring, of which F. W. Derby of Chicago is chairman. The many conflicting laws and rules cause much confusion to wire companies operating in different cities and states. A committee of this association will try to correct these conditions.

The association agreed with its theater wiring and show equipment committee, Frank L. Lucas chairman, that Rule 38 c of the code should read as follows:

> Must be made of non-combustible, non-absorptive insulating material and where accessible from stage level must be of the dead-front type to prevent accidental contact with live parts on the board and to comply with Rule 3.

The use in underground ducts of rubber-covered cable without lead covering was advocated in the report of the underground committee as read by Charles D. Fox of St. Joseph, Mo., in the absence of F. F. Sengstock, chairman, and the report was accepted.

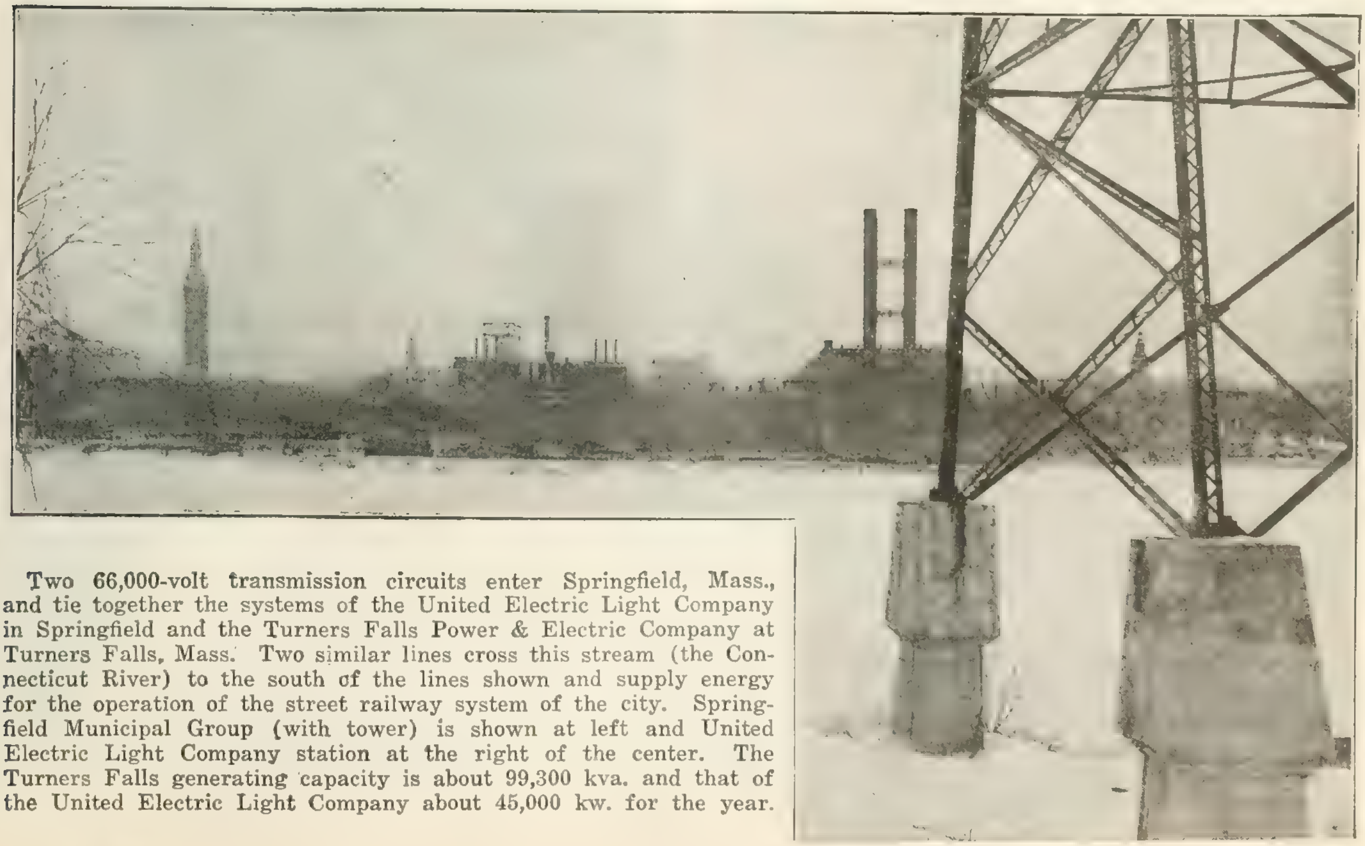
The election of officers resulted as follows: President, K. W. Adkins, Kansas City, Mo.; first vice-president, J. H. Fenton, St. Louis, Mo.; second vice-president, F. O. Evertz, Columbus, Ohio; secretary, W. S. Boyd, Chicago; treasurer, James S. Mahan.

The complimentary banquet and luncheon which were tendered the visiting members by the St. Louis Electrical Board of Trade, the luncheon given by the Century Electric Company after the visit to its factory, the visit to the stations of the Union Electric Light & Power Company and the trip through the plant of the Wagner Electric Manufacturing Company were diversions which were greatly appreciated by the delegates.

House Passes Bill Protecting Trademarks in South America

WITH only three votes against it, the bill giving effect to the provisions of the convention for the production of trademarks and commercial names made and signed in Buenos Aires in 1910 has been passed by the House of Representatives. The bill is identical with a measure which passed the Senate in the last Congress without opposition. All of the South and Central American republics and Cuba have ratified the trademark convention. The delay of the United States in ratifying it has resulted in much unnecessary expense to American manufacturers, since it has been necessary for them to register their patents and trademarks in each of the republics separately. Under the present bill all that would be required for protection throughout South America, Central America and Cuba would be the payment of $50, which would enable the registration of trademarks and commercial names at a central bureau which has been established in Havana.

Springfield-Turners Falls Interconnection



Two 66,000-volt transmission circuits enter Springfield, Mass., and tie together the systems of the United Electric Light Company in Springfield and the Turners Falls Power & Electric Company at Turners Falls, Mass. Two similar lines cross this stream (the Connecticut River) to the south of the lines shown and supply energy for the operation of the street railway system of the city. Springfield Municipal Group (with tower) is shown at left and United Electric Light Company station at the right of the center. The Turners Falls generating capacity is about 99,300 kva. and that of the United Electric Light Company about 45,000 kw. for the year.

To Departmentalize N. E. L. A. Headquarters Activities

IN ORDER to strengthen association activities by making individuals responsible for certain work, the executive committee of the National Electric Light Association favors, on recommendation of the president, departmentalizing the work at headquarters and reorganizing control through the executive committee in such a way as to give all parts of the country representation in direct proportion to the volume of business done.

M. H. Aylesworth, whose title has been changed from executive assistant to the president to executive manager of the association, has prepared a full report on this subject, which is now being studied by a committee appointed for the purpose. This committee is composed of Vice-president Frank W. Smith, Vice-president M. R. Bump, Chairman J. G. Learned, Commercial Section, Chairman I. E. Moultroup of the Technical and Hydroelectric Section, and Chairman W. C. L. Eglin of the constitution committee, with M. H. Aylesworth a member ex-officio.

Such a plan would involve expenditures, and therefore this committee and Treasurer H. C. Abell, in conjunction with the finance committee under Chairman J. B. McCall, is studying plans for financing the activities under the new plan. The plan will not be effective until July 1 next, subject to approval of the convention at large at Pasadena, in May.

Under the plan it is proposed to add at once two departments, one of engineering and the other of publicity, to the three existing departments of committee service, company service, and financial and accounting.

New York to Chicago Radio-Telephony With Low-Power Sets

RADIO-TELEPHONE conversations with low-power sets have been carried on during the last thirty days, it has just been announced, from Ossining, N. Y., with Chicago, a distance of about 900 miles (1450 m.) as well as with cities and towns in Indiana, Ohio, Massachusetts and South Carolina. While greater distances have been traversed by the use of high-power sets, in these experiments the transmission was accomplished by the use of a small aërial, a low wave length and the use of about one-third kilowatt generating capacity. The success of the experiment is ascribed by Robert F. Gowen, engineer of the De Forest Radio Company, who conducted the tests, to a new type of modulating circuit and the use of the oscillion, the vacuum-tube generator developed by the De Forest company.

Mr. Gowen said that, while the chief field for the radio-telephone appears to be in communication over water, where wire circuits cannot be conveniently established, still the possibilities of communication over land by means of radio sets offers a very attractive field for development. He pointed out that communication circuits along transmission systems are frequently put out of service by trouble on the power lines, and that for such service radio-telephone sets, employing a vacuum-tube generator, should prove practicable. It is said that the new system is highly selective, so that a considerable number of wave lengths may be used over a comparatively limited range.

In speaking of the experiments conducted at Ossining, Mr. Gowen said in part:

"The effect of the new circuit is to render the voice transmission much clearer, while the use of a new type of glass permits of much greater input current in the development of the wireless power.

"The experiments are being conducted on a comparatively low wave length (about 375 m.); that is to say, the special amateur wave lengths permitted by the government regulations. In addition, the experiments show that the distance between Ossining and Chicago is covered with only one-third of the energy which the De Forest oscillion, or oscillating audion, is capable of developing."

Telephone messages sent out from Ossining were first picked up at St. Mary's, Ohio. On other evenings Mr. Gowen was heard at Columbia City, Ind.; Salem, Ohio; Gaffney, S. C.; Wakefield, Mass., and Chicago. "In no case was any advance information given that the tests were in progress," said Mr. Gowen, "so that those receiving the message were not on the lookout for it."

Ontario Hydro Commission Embarassed by Power Shortage

THE unprecedented shortage of power in the Province of Ontario, including the Niagara Falls district, is chiefly on the system of the Hydro-Electric Power Commission, which serves 236 municipalities. The total shortage at the present time is stated to be about 50,000 hp. It is reported that the present shortage is liable to be materially increased in the winter of 1920-1921, probably to 120,000 hp., because of the normal growth of the business and also because the commission is now taking 15,000 hp. from the Toronto Power Company under a contract which expires Oct. 15 next.

The Toronto Power Company, while heavily loaded, might be able to offer some relief to the situation by the operation of its 15,000-kw. steam plant during peak hours of the winter, whereby it would be possible to absorb an additional load of 30,000 hp. to 35,000 hp. Furthermore, should the government restrictions limiting the Niagara plant of this company to 125,000 hp. on an instantaneous momentary peak be modified to allow the plant to generate to its full capacity, it is calculated that the shortage would be relieved by an additional 25,000 hp.

Vacuum of 30.35 In. Reached in New York

DURING the recent cold period the barometer went unusually high (30.85 in. or 30.9 in.), and operating companies which had an eye to turbine economy increased the vacuums on their condensers as much as possible to keep up with the rise in the barometer. At the United Electric Light & Power Co.'s 201st St. Station, New York, the unusually high vacuum of 30.35 in. was obtained on its 25,900-kva. turbo-generator. The turbine is equipped with a 40,000-sq.ft. surface condenser and a Le Blanc air pump. The vacuum obtained speaks well for the condition of the equipment since very slight leaks in any part of the turbine or condenser might increase the duty on the air pump so much that it would be difficult to maintain even an ordinary vacuum.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Florida Engineering Society.—This society will hold its annual meeting at Tampa on Feb. 16 and 17.

New York Section, American Electrochemical Society.—On Feb. 27 electric furnaces and reducing agents will be the subjects of discussion at the regular meeting.

New Society in Memphis.—The Electrical League of Memphis, Tenn., was organized recently by the contractors, jobbers and central-station men of the city to educate its members along better merchandising lines and influence public opinion in the same direction. C. K. Chapin was elected president and H. G. Street secretary.

Philadelphia Section, A. I. and S. E. E.—"Control of Blooming-Mill Tables and Screw-Downs" is to be discussed before the Iron and Steel engineers by Walter C. Kennedy of the Worth Steel Company, Claymont, Del., on March 6, and "Welding—Electric Versus Gas," by James E. Wilson of the Treadwell Engineering Company, Easton, Pa., on April 3.

Michigan Engineering Society May Join A. A. S.—At the forty-first annual meeting of the Michigan Engineering Society, held in Lansing on Jan. 28, 29 and 30, the members present discussed the report of the committee on amalgamation with the American Association of Engineers and voted decisively to refer the project to the entire membership by letter ballot. The decision will be announced on March 20.

Local Officers of the A. A. E.—H. T. Best has been elected president and H. B. Cassin secretary of the Louisville (Ky.) Club of the American Association of Engineers. Dean T. M. Butler of the College of Engineering, University of Arizona, has been re-elected president of the Southwestern District. The Louisiana Chapter has made Major Frank T. Payne president, and the newly organized Idaho Chapter has elected E. B. Darlington of Jerome to that office.

Alabama Section, A. I. and S. E. E.—A meeting of this section of the Iron and Steel association will be held in Birmingham on Feb. 14. Two papers will be read and illustrated with lantern slides—one on "The Theory and Practice of Lightning Protection" by Q. A. Brackett, of the Westinghouse Electric & Manufacturing Company, and one on "Theory and Construction of the Bennett Water-Vapor Arrester," by C. E. Bennett, chief engineer of the Electric Service Company.

Engineers' Club of Philadelphia.—A conference of the four founder societies of the club is to be held on Feb. 21, to consider its future development, and the committee having the matter in hand will report to a special meeting of the club on Feb. 28.

Seattle Engineers Elect Officers.—The Seattle Engineers' Club has elected the following officers: President, J. Thomas Dovey; vice-president, E. D. Wean; treasurer, A. Slater; secretary, A. L. Valentine. H. E. Horrocks, E. J. Bartels and F. H. Fowler were elected trustees for three years, and H. Bowen trustee for one year.

Philadelphia Section, I. E. S.—This program for the coming months has been approved: Feb. 20, "Artificial Daylight Equipment," by Norman Macbeth; March 19 (at Cosmos Club, Washington, under the auspices of the Washington Section, A. I. E. E.), "Development of the R. L. M. Standards for Industrial Lighting," by Ward Harrison, and "Residence Lighting," by M. Luckiesh; April 16, "Daylight Saving," by Preston S. Millar; May 21, "Color Photography," by Henry Hess; June 14, outing with Philadelphia Section, A. I. E. E., at the Howard McCall Field, Highland Park.

Committees on Meters Confer.—The meter committee of the Ohio Electric Light Association and the meter committee of the National Electric Light Association were to hold a conference at Cleveland, Ohio, in the rooms of the Electric League, Statler Hotel, on Wednesday. These subjects were to be discussed: "Thermal Demand Meters," by Paul Lincoln, Westinghouse Electric & Manufacturing Company; "Measurement of Kilovolt-Amperes," by R. C. Lamphier, Sangamo Electric Company, and W. H. Pratt, General Electric Company; "Instrument Transformer Testing," by L. T. Robinson, General Electric Company.

Coming A. I. I. E. Meetings

Philadelphia Section.—Francis A. Fitzgerald is to speak on "Electric Furnaces" at the meeting on Feb. 9.

Baltimore Section.—There will be a joint meeting of this section with the local body of the American Society of Mechanical Engineers on Feb. 18.

Joint Meeting of A. I. E. E. and American Electrochemical Society.—The American Institute of Electrical Engineers and the American Electrochemical Society are to meet jointly in Boston on April 9.

Boston Section.—On March 2, Dr. E. B. Rosa, chief physicist of the Bureau of Standards, is to address the section on "Investigations in the Electrical Division of the Bureau of Standards During and Since the War." On April 9 a meeting of the national Institute will be held in Boston in conjunction with the American Electrochemical Society. On May 20, Prof. H. K. Barrows and H. I. Harriman are to speak on New England water powers.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Good Service Obtainable Only Through Equitable Treatment.—In authorizing the Fort Smith Light & Traction Company to charge an increased fare the Arkansas Corporation Commission said: "The law forbids the establishment of rates whose effect will be confiscation of property of utilities. What the commission has no legal right to establish it has no moral right to maintain. Good service can be obtained only by just and equitable treatment. The utilities have been deprived of the power to make unjust profits; they should also be protected against unjust losses."

Lighting Rates and Railway Fares.—A decision has been rendered by the British Columbia Public Utilities Commission on a complaint against a discriminatory electric lighting rate, made by the municipality of Burnaby against the British Columbia Electric Railway Company, Ltd. The electric lighting rate is higher in Burnaby than in South Vancouver or other municipalities, while the street car fare on the Hastings extension line is lower. The respondent said, and the applicant acquiesced, that there were negotiations between them toward bringing about an increase in car fares on both the Burnaby Lake and the Hastings railways, and a decrease in lighting rates. The applicant said it did not initiate such negotiations and definitely declined the respondent's offer. Commissioner Retallack found no discrimination in this as Burnaby had the same opportunity as other municipalities but preferred to stand on existing agreements under its franchise. Apart altogether from the negotiations for increased fares on city lines, the company applied for and received authority to increase fares on the Barnaby Lake line, an interurban line, from the Board of Railway Commissioners of Canada. The municipality of Burnaby appealed against this decision, contending that the commission did not have power to override agreements. At the last session of the Dominion House of Parliament an amendment was passed to the railway act, giving the board this power. Thus the municipality was precluded from appealing against the decision and the rates were put into effect. Commissioner Retallack said that, in view of the question as to jurisdiction, he considered that in justice to the company he should not deal with electric rates alone. He adjourned the application until either his jurisdiction over the respondent's railway business is restored or it is definitely decided that it has been removed.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Utah Company Raises Salaries.—The Utah Power & Light Company has granted an increase in salaries affecting all employees receiving less than $200 a month. This adds to the total annual payroll more than $125,000.

More Money for Co-operative Campaign.—The convention of the California Association of Electrical Contractors and Dealers at Sacramento on Jan. 17 unanimously indorsed the California electrical co-operative campaign, making an increased appropriation for 1920.

Tacoma Officials Negotiating for Power Site.—It is announced that city of Tacoma officials are in Washington, D. C., negotiating for acquisition of the Snohomish River power site and the construction of a large reservoir on the Little Nisqually River in the Mount Rainier National Forest.

Engineering Bureau in the Navy.—Secretary of the Navy Daniels has asked Congress to change the name of the Bureau of Steam Engineering in the Navy Department to the Bureau of Engineering inasmuch as its duties now embrace wide fields of radio, electric and internal-combustion engineering.

California Supreme Court Upholds Commissions.—The United States Supreme Court has affirmed federal court decrees approving the rates prescribed by the California Railroad Commission to be charged by the Napa Valley Electric Company for power sold to the California Light & Telephone Company.

Government Needs Technical Instructors.—The United States Civil Service Commission announces an open competitive examination on Feb. 24 for technical instructors to fill vacancies in the Ordnance Department throughout the country. Instructors in welding at $2,000 to $2,400 a year and electrical instructors at $1,800 to $2,000 a year are among those required. Intending applicants should apply for Form 1312 to the Civil Service Commission, Washington, D. C.

"Tech" Students Have New Periodical.—The first number of the *Tech Engineering News*, "professional journal of the alumni and undergraduates of the Massachusetts Institute of Technology," has been issued, its stated object being to provide a medium for the exchange of ideas between the institute—the faculty, the undergraduates and the laboratory workers—and men of executive rank throughout the country. Hazen Pratt is the editor of this promising sheet, which will be a monthly.

Toledo Adds to Generating Capacity.—The Acme Power Company, Toledo, Ohio, is adding the second 20,000-kva. turbine to its generating equipment and contemplates another addition of the same size in the near future.

Short-Term Enlistments Still Maintained in Engineer Corps.—The Adjutant General of the War Department announces that one-year enlistments are still received in the Field Artillery, Engineer Corps and Chemical Warfare Service of the army, although recruits in other divisions must enlist for three years.

Five Million Dollars for Science and Research.—The Carnegie Corporation of New York has announced its purpose to give $5,000,000 for the use of the National Academy of Sciences and the National Research Council. It is understood that a portion of the money will be used to erect in Washington a home of suitable architectural dignity for the two beneficiary organizations. The remainder will be placed in the hands of the academy, which enjoys a federal charter, to be used as a permanent endowment for the National Research Council.

Field Mice Make Home in Bearings.—An experience reported from the Kerckhoff construction project of the San Joaquin Light & Power Corporation on the San Joaquin River, California, shows the importance of a careful examination of apparatus before its installation, even if it comes direct from the factory. A 30-hp. motor was recently needed in connection with a pump, and a new piece of apparatus was taken from the merchandise stores. It was set up and started, the bearings were oiled, and the work was otherwise carefully carried out. It seemed to be running in perfect order, but within the day the bearings burned out. In taking out the rotor and bearings it was found that about three handfuls of wheat had been deposited by field mice in the bottom of each bearing while the motor was in the warehouse.

Company Aids Wholesale "Moving" of Employees.—Seventy-five engineers from the machine works of the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., and their families were moved last month to Lester, within ten minutes' walk of the South Philadelphia works of the Westinghouse company, where the machine works engineering department has been transferred. The company has built at Lester a large number of houses which are rented to employees. Photographs of the houses were taken and sent to the engineers' families along with blueprints showing their construction and location. When each family had selected a house, transfer companies took charge of the effects, which were packed, moved to Philadelphia and placed in orderly fashion in the new abodes in record-breaking time. The tenants followed on a special Pullman train. All the arrangements were made by the company.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Assumption of Risk.—The Supreme Court of Missouri has held that assumption of risk is not a proper plea to an action founded on the negligence of a master, and also that where a servant is in imminent danger his conduct in trying to save a fellow workman shall not be attributed to him as culpable or render him guilty of contributory negligence within the meaning of the law. (216 S. W. 531.)

Parents' Rights Under Workmen's Compensation Act.—Under Section 2 of the workmen's compensation act, there can, a judgment of the New Jersey Court of Errors and Appeals holds, be no recovery by a parent for the loss of a minor employee's wages either at common law or under the act. It is immaterial whether the contract of employment was made by the minor directly, by the parent directly or by the minor as agent of the parent. (108 A. 357.)

Meaning of "Safe Place to Work."—According to a judgment of the Supreme Court of Georgia, the rule requiring a master to furnish a safe place to work is usually applied to a permanent place, or one quasi permanent, and the master is not bound to keep the place where a servant is employed in a safe condition at every moment of the work, so far as its safety depends upon the due performance of that work by the servant and his fellow-servants. (101 S. E. 392.)

Preferential Rights in Stream.—A decision of the Supreme Court of New Hampshire in Newmarket Electric Company vs. Chase declares that a preferential right in a stream is obtained by a mill owner when he erects a dam with intent to flow, and the duty to pay arises as soon as the extent of the right is determined by flowing. Payment of damages must precede the taking of private property for quasi public uses by individuals or private corporations. Since the right of a mill owner to flow lands is a mere easement and the rest of the title remains vested in the landlord, it is not very material when full title to the right of flowage passes. A mill owner is entitled to reduce the award of damages by stipulating that he will not flow the land before a certain date. If the mill owner does not take advantage of the Laws of 1911, Ch. 114, and have damages assessed prior to flowing, he becomes a trespasser and liable to pay damages as such. He may choose this course by electing to proceed under a prior statute. (108 A. 382.)

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Frederick J. Macleod, formerly chairman of the Massachusetts Public Service Commission, has resumed the general practice of law in Boston.

Thomas J. Feeney has been appointed assistant to the president of the New England Telephone & Telegraph Company, with headquarters at Boston. Mr. Feeney was formerly in charge of the company's publicity department and is a former newspaper man widely known in the New England public utility field.

Robert Ten Eyck Lozier, who for several years carried on a large practice as a consulting engineer in New York City, leaving it to become executive assistant to the consulting engineer of the naval aircraft factory at the Philadelphia Navy Yard, has returned to New York and has opened offices in the Woolworth Building. He has been retained as industrial consultant, exclusively, for a given period by the National Conduit & Cable Company, Inc. Beginning his career with the parent Edison electric light interests in New York City as far back as 1883 and having been directly associated with Mr. Edison in experimental and development work, Mr. Lozier has had an unusually wide experience with the Sprague, Bullock, General Electric and other manufacturing electrical industries, including, since the armistice, special relations with the Standard Underground Cable Company of Pittsburgh. Mr. Lozier has also enjoyed a large amount of practice in technico-financial fields, for example as examining engineer for the banking firm of Kountze Brothers. His thirty-seven years of successful business life have included all the larger aspects of administration, engineering, production and marketing, so that the era of reconstruction finds him fully qualified to meet the exacting demands of a broadening field.

ROBERT TEN EYCK LOZIER

Walter Reitz, who was formerly employed in the electrical and mechanical department of the Douglas Company, Cedar Rapids, Iowa, has been made general superintendent of the Hot Springs (Ark.) Utilities Company.

Ralph J. Patterson has been appointed commercial manager of the Twin State Gas & Electric Company, with properties operating in New Hampshire and Vermont and headquarters at Boston, Mass. Mr. Patterson is well known in the New England central-station field, especially in connection with his development of electric water heaters and commercial work on the system of the Central Maine Power Company and more recently at the Berlin (N. H.) central station of the Twin State company.

J. D. Bowles, who has become well known in public utility circles in the Middle West through his connection with the engineering staff of the Missouri Public Utilities Commission and other connections with properties of the Federal Light & Traction Company, New York, and the Douglas Company, Cedar Rapids, Iowa, is again employed by the Federal Light & Traction Company, assisting in the operation of several of its properties in the Southwestern States. Mr. Bowles' present headquarters are at Hot Springs, Ark.

Fred H. Scheel, who has been superintendent of the Joliet (Ill.) Division of the Public Service Company of Northern Illinois, has been appointed head of a permanent department which has been created to handle jointly the selling of securities of the Commonwealth Edison Company and the Public Service Company of Northern Illinois at Chicago.

B. Parks Rucker has recently reopened his consulting engineering office at Charlotte, N. C. Late in 1915 Mr. Rucker closed his office to take up special work with the General Electric Company, and in the spring of 1918 joined the engineering staff of the American Cyanamide Company as general superintendent of that company's plant at Niagara Falls, N. Y. He now resumes engineering work in the electrical power field, specializing in the design and construction of steam and hydro-electric plants and industrial plant electrifications. At present he is engaged in the building of a hydro-electric plant on the Schroon River for the Schroon Lake (N. Y.) Lighting Corporation, which will furnish light and power service to Schroon Lake, North Hudson and surrounding districts. For eight years prior to 1915 Mr. Rucker was engaged in engineering work as a consulting engineer in the South, with headquarters at Charlotte. He is a member of the A. S. M. E. and a fellow of the A. I. E. E.

James Potts, who was formerly general superintendent of the Hot Springs (Ark.) Utilities Company, has been made manager of the Rollins (Wyo.) Electric Light & Power Company.

John McNair, formerly of the Oklahoma City division of the Oklahoma Gas & Electric Company, has been appointed local manager of the Bixby-Jenks division of the Sapulpa (Okla.) Electric Company.

J. H. VanBrunt has resigned, effective Feb. 1, as vice-president and general manager of the St. Joseph (Mo.) Railway, Light, Heat & Power Company, to devote more time to his interests outside of the public utility field.

H. F. Jackson, formerly president of the Sierra & San Francisco Power Company, the properties of which have recently been leased for a fifteen years' period to the Pacific Gas & Electric Company, California, has just been elected vice-president of the latter corporation. He will also hold the position of assistant general manager, in charge of electrical construction, under John A. Britton, general manager of the company. During the war period Mr. Jackson was an active factor in the pooling of the three power interests centering in San Francisco. Within one year in this period these three combined companies delivered in excess of 1,500,000,000 kw.-hr.

H. F. JACKSON

B. C. Adams, third vice-president, treasurer and general manager of the Empire District Electric Company, Joplin, Mo., will become vice-president and general manager of the St. Joseph (Mo.) Railway, Light, Heat & Power Company, to succeed J. H. Van Brunt, who has recently resigned.

Gordon Thompson of the Electrical Testing Laboratories, New York City, has resigned to become professor of electrical engineering in the government institute of technology at Shanghai, China. Mr. Thompson has been connected with the Electrical Testing Laboratories for the last eleven years in various capacities, being at the time of his resignation engineer in charge of electrical laboratory.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Quantities of Miniature Lamps Coming from Japan

AN UNUSUALLY large amount of cheap Christmas-tree lamps were on the market during the Christmas season, and upon inquiry it was stated that the lamps were of Japanese make. An investigation was then made by the ELECTRICAL WORLD into the lamp imports for the first nine months of 1919.

During that time 1,358,743 carbon lamps, valued at $31,203, and 3,146,706 metal-filament lamps, valued at $65,966, came into the United States. The total was 4,505,449 lamps, valued at $97,169, an average of 2 cents per lamp. It is evident, therefore, that virtually all of the lamps were of the miniature type.

The following table shows the imports for the first three quarters of the year:

	First Quarter		Second Quarter		Third Quarter	
	Number	Value	Number	Value	Number	Value
Carbon-filament.....	146,160	$2,382	453,012	$10,794	759,571	$18,027
Metal-filament......	303,590	4,687	659,084	13,970	2,184,032	47,309
Total............	449,750	$7,069	1,112,096	$24,764	2,943,603	$65,336

At the Bureau of Foreign and Domestic Commerce it was stated that 85 per cent of the miniature, or Christmas-tree lamps, are from Japan. The remainder of the imports came largely from Canada and Chile.

Government Refuses Proposals for Surplus Wire and Cable

OFFICIALS in the office of the director of sales of the War Department have refused to accept any of the proposals which were submitted Jan. 13 on approximately 1,710,000 ft. of telephone cable and 854,923 lb. of copper wire.

The material, which represents virtually all of the surplus copper wire and telephone cable held by the army, has been turned over to the surplus property division and is again being offered for sale.

Among the bids which were opened Jan. 13 was one for the entire amount of the material, but War Department officials considered it too low to receive attention. Offers on all or any part of the material will be entertained.

The greater part of the wire and cable is in the Philadelphia ordnance district. The remainder is stored at various depots throughout the country. The approximate quantities and descriptions of the cable and wire were given on page 45 of the Jan. 3 issue of the ELECTRICAL WORLD.

Greater Demands Being Made on Midwest Jobbers' Stocks

LEADING jobbers in the Middle West have more goods on order than ever before in their history, and they expect this year's business to break all records. Stocks in many cases are in excess of pre-war practice, but they are almost invariably below present requirements. Manufacturers' branch and district offices have placed large orders on their factories to stock local warehouses, but the stocks are not being maintained. The demand is too great. Jobbers are being called upon more and more to perform the function of distributers. Central stations and other utilities are buying more supplies from jobbers than ever before. This is because manufacturers are unable to make quick deliveries because of the uncertainty of the trend of prices and in some cases because of the lack of sufficient capital to buy reserve stocks. The contractor-dealers, rapidly increasing in number, depend almost entirely upon the jobbers to supply their requirements. Jobbers need bigger stocks to meet the greater demands being made on them, but sufficient materials can rarely be obtained to keep existing storerooms full. Large orders which have been placed on the factories have resulted in comparatively heavy but infrequent shipments. When several orders are delivered simultaneously existing warehouse space is not always adequate. Looking to the future, that condition may be expected to occur more frequently, and there is consequently a tendency for jobbers to increase their warehousing capacity. Furthermore, some of the lines which have grown in importance during the last few years are relatively bulky and require more than the average storage space.

In addition to getting larger warehouses, the jobbers show a strong inclination to put on more salesmen, and the same is true to some extent among manufacturers. Not that any special selling effort is necessary to dispose of goods in stock, but it is felt that salesmen can be used to advantage to help keep customers attached to the house, and in the case of jobbers' salesmen, to help the new electrical dealers with their merchandising problems.

New England Market Looms Bright for 1920

A CONTINUANCE of great business activity well into the present year is anticipated by electrical supply jobbers in New England. Two points of uncertainty are prominent in frank discussions in the local trade—the possibilities of better deliveries and the future course of prices. A little more caution in buying for late shipments without price guarantees is becoming apparent among some of the older and more conservative houses. There is no general disposition to forecast any material recession in the volume of material required for distribution in this section, but here and there an oldtimer may be heard to express himself to the effect that there is at least a possibility of a turn downward in prices within a few months. One of these jobbers is now buying for no more than three months ahead. Others are buying for deliveries in early summer. In the main there is a disposition to purchase in quantity fast-moving material now running low in stocks, and to avoid accumulating heavy consignments of material which would involve large outlay and would be hard to dispose of at a profit should a general downward movement begin in prices.

It is believed by some that deliveries stand a fair chance of improving as the year progresses. This opinion, which can hardly be called unanimous, is based upon the enlargement of manufacturing facilities evident on almost every hand. New England electrical appliance producers are practically overwhelmed with orders at present, and even the makers of heavier products such as motors are embarking upon schedules of increased production. These bid fair to make a decided impression upon the market unless the present demand grows out of all bounds. Deliveries on wiring materials, with the exception of porcelain, have shown considerable improvement within the past few weeks, and much less is heard about shortages except in the case of non-metallic flexible conduit. This class of material is not coming into New England in quantities which permit prodigality in distribution, but wire, sockets, switches, and even tubes, are in better shape to meet current requirements than is sometimes believed. The demand for meters is ahead of the general supply; motors of moderate and smaller sizes are selling in amazing quantities, and a good transformer business is forecast for the spring. Business building and factory construction work in New England are running into record-breaking totals each week; the electrical contractors bid fair to buy steadily for many months to come, and there is gratifying improvement in the collection situation in these circles.

Expansion of jobbing establishments is an important evidence of business conditions in this section, and some new organizations have come into action, especially in Maine and Vermont, within the past few months. Competition to give service through better deliveries is very active, and in some cases sales show very close bids. Boston now houses nearly a dozen live and vigorously managed supply jobbing establishments, some of whom have gone into new quarters or have enlarged or refurbished their premises within the year. A tremendous business is being done in domestic labor-saving appliances, and the outlook is for a continuance of these sales well through the year.

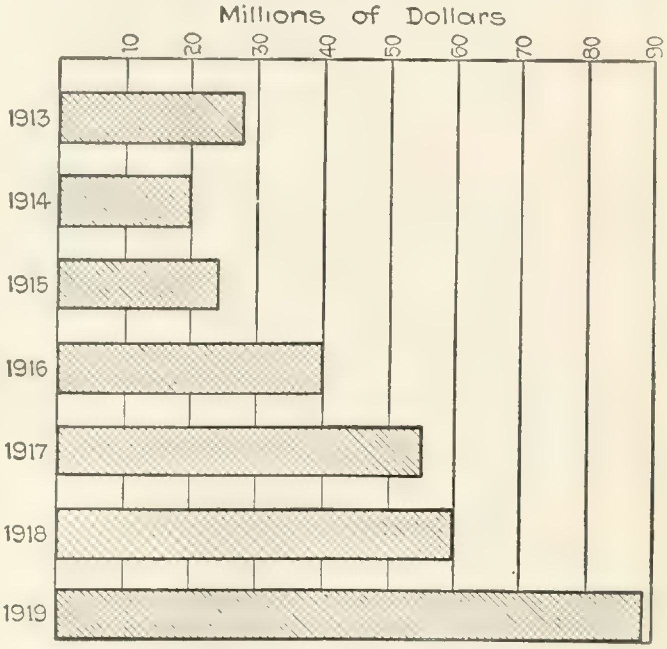
There has not been much legislation lately which seems likely to affect the volume of trade in jobbing circles, nor is any extended discussion heard of such matters pending. The movement to increase industrial welfare activity continues, and better lighting of factories, safeguarding machinery, and the provision of electric ovens and heaters for food warming tend to throw additional business to the wholesaler. Many jobbing houses are suffering from labor shortage, especially during the severe winter weather at this writing; but, by and large, relations are unusually good in the trade and between different branches thereof. The sale of the lighter appliances has fallen off considerably since the holidays, but it is expected this will pick up again in a month or two. Substantial commitments on appliances for table and boudoir service are being made in confidence, and the fixture business is thriving.

High Record for Electrical Exports Set in 1919

ELECTRICAL exports for the calendar year 1919 amounted to $89,089,711, which surpasses in value the exports of any previous calendar year. In only three items have the figures for 1919 been surpassed in any former year, namely, carbons, arc lamps and carbon-filament lamps. Especially heavy foreign sales were made in batteries, generators, insulated wire and cable, metal-filament lamps, and motors, while miscellaneous material increased almost ten million dollars.

This increase above 1918 of approximately 50 per cent in value of exports represents to some degree, of course, the higher prices that obtained during the past year. At the same time, it does represent also a good increase in volume of goods shipped. It must be remembered, however, that much of the material billed in the latter half of the year just past was booked in the early months of that year when prices were lower than at time of billing. It was not until the second quarter of 1919 that prices began to advance in any great amounts.

At the same time, exports in the first six months were at the rate of $97,000,000 for the year. During this time much material was shipped from stocks or on short delivery and represented sales at relatively low figures. Consequently it is apparent that a much larger volume of electrical material left the domestic market than in any former year, although in general prices ruled higher.



SEVEN YEARS OF ELECTRICAL EXPORTS

Because of unfavorable rates of exchange it is expected that exports during 1920 will not equal those of 1919. Of the four main foreign outlets—Canada, South America, Europe and Asia—the exchange rates of Asia, excepting Russia, and South America, are rather favorable, while those of Canada and Europe are unfavorable. Consequently it would not be surprising to find that Canada during 1920 had to recede from its present position as the single largest outlet for United States manufactures. At the same time the tendency is for domestic manufacturers to open branch factories in Canada, and this will lessen the amount of money that country will spend for foreign apparatus.

The figures in the attached table include returns for December, 1919, which were $40,000 below those for the month of November. The table shows returns for each year for the past seven years and was compiled from statistics of the Bureau of Foreign and Domestic Commerce. The chart portrays these annual sales more strikingly.

Articles	Dec., 1918	Dec., 1919	1913	1914	1915	1916	1917	1918	1919
Batteries	$233,321	$477,102	$359,123	$635,522	$1,364,999	$2,025,250	$3,624,222	$3,178,437	$5,998,337
Carbons	139,347	100,946					*736,717	1,600,920	1,391,765
Dynamos or generators	344,034	583,025	2,374,122	2,372,816	1,872,191	1,867,565	2,356,780	3,363,349	5,799,885
Fans	88,678	32,648	415,774	295,966	374,113	313,771	622,731	847,327	1,421,160
Heating and cooking apparatus	74,794	110,575					1,256,533	686,339	1,579,757
Insulated wire and cable	465,688	499,315	*1,256,865	1,321,451	2,761,609	4,343,577	7,187,951	5,604,114	8,815,212
Interior wiring supply, including fixtures	100,270	245,434	*408,253	591,136	882,981	901,657	1,405,772	1,428,615	2,319,498
Arc lamps	128	1,088	134,053	42,782	23,968	15,467	16,418	14,139	16,893
Carbon-filament lamps	13,809	16,678	254,893	88,025	150,111	124,776	187,876	102,872	202,590
Metal-filament lamps	229,903	311,308	301,791	278,061	873,862	1,420,309	2,884,675	3,369,192	4,674,317
Magnetos, spark plugs, etc	318,005	232,762					*1,757,848	2,749,705	3,034,775
Meters and measuring instruments	122,311	227,955		*157,386	657,129	884,241	1,213,278	1,887,925	2,891,307
Motors	663,216	778,039	4,886,508	3,300,839	3,279,174	4,932,831	6,484,972	8,225,197	10,635,476
Rheostats and controllers	27,850	35,836					*93,612	288,757	514,760
Switches and accessories	151,786	216,020					*1,025,003	2,195,300	3,564,772
Telegraph apparatus, including wireless	68,090	41,767	147,233	93,563	136,890	209,343	555,703	378,806	830,887
Telephones	121,935	330,223	1,659,326	1,251,788	910,562	1,813,969	2,212,237	2,687,483	3,783,398
Transformers	195,180	297,869	872,661	934,312	704,373	1,051,168	1,747,884	3,528,673	3,787,851
All others	1,829,636	2,127,070	15,126,761	8,599,468	10,316,548	19,740,151	21,107,867	17,845,376	27,827,071
Total	$5,187,981	$6,665,660	$28,197,363	$19,963,115	$24,308,510	$40,244,075	$55,478,079	$59,982,526	$89,089,711

* Figures begin with July.

Attempt to Build Good Will for the Industry

WITH the thought firmly in mind that anything it does in the interests of electrical development will help the industry and thereby help itself, the Western Electric Company has undertaken in the general magazines of the better class an advertising campaign designed to promote public goodwill for the electrical industry. The company frankly states that it is only to the extent that the whole industry prospers that it itself prospers and really serves.

The advertisements will be conducted as an educational program in behalf of the electrical industry. They do not seek to sell any merchandise. They are written editorially about the central station, the contractor, the engineer, the telephone companies, the architect, the railroad. The company states that it occupies as manufacturer and jobber a neutral zone, holding no brief for one department of the industry as against the other. But it has chosen to speak for those organized divisions of the industry which the American public recognizes as serving it.

The campaign is using only half pages, but in selecting the mediums care was taken to use those magazines which have what is generally recognized as the more intelligent and prosperous class of readers.

Metal Market Situation

There is very little activity in the copper market, the business transacted being for the most part the every-day run of small-lot sales. Producers are still holding to 19 and 19.25 cents a pound for spot and first-quarter delivery, while the outside market price is 18.50 to 18.75 cents a pound. This latter market, however, is somewhat weaker than it was ten days ago, and without doubt a lower price than that quoted could be obtained were there any chance of disposing of appreciable tonnages. For second-quarter delivery the outside market is quoting 19.25 to 19.50 cents, which is on a par with producers' prices. The latter, however, are not pressing the market to purchase for long shipment at prevailing prices as they feel that a more active market will develop before the first quarter is ended with a consequent slight rise in prices.

Buying for export has fallen off considerably, especially to European countries. There has been a noticeable decrease in cargo space to that continent noted, with the result that some steamers have been diverted from transatlantic routes to South American trade. During the past few days exchange rates have reached hitherto untouched low values. It is expected that unless this exchange condition takes a turn for the good the heavy copper exports to Europe in 1920 will fall far below what the trade believed would be attained.

The government offers for sale 3,000,000 lb. of grade A spelter now located at the United States government warehouse No. 188, East Springfield, Mass.

NEW YORK METAL MARKET PRICES

	Jan 27	Feb. 3
	£ s d	£ s d
Copper:		
London, standard spot	119 15 0	119 0 0
	Cents per Pound	Cents per Pound
Prime Lake	19.50	19.00 to 19.25
Electrolytic	18.75 to 19.00	18.50 to 18.75
Casting	18.90	18.25
Wire base	22.25	22.25
Lead, trust price	8.50	8.50
Antimony	11.12½	11.50
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Spelter, spot	9.50	9.20 to 9.30
Tin, straits	62.50	59.25
Aluminum, 98 to 99 per cent	31.50 to 32.50	31.50 to 32.50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	17.75 to 18.00	17.75 to 18.00
Brass, heavy	10.00 to 10.50	10.00 to 10.50
Brass, light	8.50 to 9.00	9.00 to 9.50
Lead, heavy	6.75 to 7.00	7.00 to 7.25
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK IN TRADE

SEVERAL factors contributed to a slight diminution of business last week. In the Middle West another coal shortage has begun to curtail output of several factories supplying the electrical trade; in the New York territory the influenza epidemic has hit the ranks of electrical contractors and supply jobbers, and in outlying districts the cold weather has temporarily stopped some building. In the Seattle district trade was quiet, while in the Portland territory it was good. The South and New England report vigorous trade.

Building, as a whole, continues at a high rate, and large amounts of new work are being laid out for the spring. An embargo on freight out of Pittsburgh for New York has badly curtailed shipments of steel products. Car shortage is holding up shipments in most districts. Factory output is not reaching the trade in quantities sufficient to be set aside as stock.

A feature in the jobbing market, very apparent in the past three weeks, is the increasing number of orders being placed with jobbbers without recourse to quotations.

NEW YORK

Jobbing business has dropped off a bit this week. The influenza epidemic has badly curtailed clerical, sales and delivery forces in addition to the wiremen actually on the job. Consequently some jobbers are having difficulty in filling orders even where they have the stock. The cold weather is another contributory cause. There is no better supply of the common run of wiring materials. Lamp stocks in the smaller wattages are building up again, although they still are below standard.

An embargo was placed on freight out of Pittsburgh for New York and Hoboken on Jan. 26 and by Feb. 5 had not been lifted. Consequently stocks of steel materials in New York warehouses are in still worse condition than a week ago.

Jobbers report increasing ordering without quotations.

Cross-Arms.—Fir cross-arm prices advanced 11 per cent on Jan. 28. Shipments are coming in to Eastern warehouses in good amounts and buying is heavy.

Line Material.—January ordering has been in good volume on all pole-line materials. Much of it has been without previously obtaining quotations. Warehouse stocks are building up.

Friction Tape.—One line of ordinary splicing tape has just advanced 5 cents to 45 cents a pound in large lots.

Lamps.—Stocks of 25, 40 and 50-watt lamps are still short but are improving. The 75-watt and 100-watt gas-filled lamp stocks are not very good.

Rigid Conduit.—Shipments are just from hand to mouth from both manufacturer and jobber. From $80 to $85 for 1000 ft. is being asked generally for ½-in. black, although as low as $75 has been quoted.

Non-Metallic Flexible Conduit.—Jobbers can not begin to supply the demand from outlying districts, and no immediate relief is in sight.

Porcelain.—Shortage in nails is holding up shipments and use of "Nail-it" knobs. Cleats, too, are short, while the supply of tubes is fair. Some remittances accompanying orders for porcelain have been returned.

Air Heaters.—Stocks are fair but deliveries are rather slow. The opinion seems to prevail that all stocks that can be acquired will be sold, and the season's hold-over will be light.

Boxes.—Reports show an increase of 10 per cent as of last week on sheet-iron boxes for small panels, cut-outs and switches. Push-button switch boxes are short.

Flexible Armored Conductor.—From $88 to $92 for 1000 ft. of No. 14 double strip is being quoted. Lock-nuts and bushings for this material are very scarce.

Wire.—There is plenty of No. 14 rubber-covered wire at $11.50 to $12 in 1000-ft. lots.

Metal Molding.—New York stocks are badly depleted because of an embargo on that city on shipments out of Pittsburgh. Prices are on a regular basis and have been holding steady.

CHICAGO

The outstanding feature of trade conditions is the uncertainty of prices, with a general trend upward. Unless deliveries can be made out of stocks, quotations in numerous lines are made on basis of delivery. Manufacturers of porcelain cannot supply the demands of manufacturers of sockets, switches, bell-ringing transformers, etc. This accounts to a large extent for poor deliveries on such items. The steadily increasing prices on porcelain are expected to be reflected in all fittings using this material. Three to five weeks' delivery is being quoted on poles and cross-arms. Weather and labor conditions have curtailed the supply of poles, and as a result stocks are very low on some sizes. The demand is excellent, and jobbers are predicting that this year will exceed all others in respect to line materials. One of the central stations in the Middle West has decided to install a number of automatic rotary converter substations. Dealers are evidently anticipating their demands for fans as manufacturers report the receipt of orders for more fans than ever before at this time of the year. A large central station in this section has placed a three-hundred-thousand-dollar order for oil and air-break switches. Building permits in Chicago for the week ended Jan. 31 amounted to $2,300,000, which shows a considerable increase over the past few weeks.

Wire.—The wire situation remains about the same. Stocks are fair, but jobbers are not out looking for business. No. 14 is quoted at $14 per 1,000 ft. in lots of less than 5,000 ft. and at $12.50 per 1,000 ft. in 5,000-ft. lots. No. 12 is quoted at $19 per 1,000 ft. in 5,000-ft. lots and $17 in 10,000-ft. lots. Weatherproof triple braid is on a 28-cent base and in quantities of less than 100 lb. is quoted as follows: No. 6, $34.25 per 100 lb.; No. 8, $35.25; No. 10, $37; No. 12, $40.75. In lots of from 100 lb. to 500 lb. the price is about $2.50 per 100 lb. less.

Poles.—Pole stocks are rather low with 7-in., 35-ft. and 40-ft. Western cedar practically off the market. Prices f.o.b. Chicago for Northern and Western cedar are as follows: Northern cedar, 6-in., 25-ft., $3.85; 6-in., 30-ft., $6.80; 6-in., 35-ft. $9.05; 7-in., 40-ft., $15.95. Western cedar, 6-in., 25-ft., $40.70; 7-in., 30-ft., $10.10; 8-in., 35-ft., $15.10; 8-in., 40-ft., $17.05; 8-in., 45-ft., $23.35; 8-in., 50-ft., $28.05; 8-in., 60-ft., $38.65.

Cross-Arms.—On Jan. 28, cross-arms advanced from 12 to 20 per cent. Washington fir arms, 3¼ in. x 4¼ in., in lots of less than 1,000 lineal feet, are quoted per 100 as follows: 3-ft., two-pin, $66.15; 4-ft., four-pin, $88.20; 6-ft., four-pin and eight-pin, $132.30; 8-ft., six-pin and eight-pin, $176.40; 10-ft., twelve-pin, $220.50.

Pole-Line Hardware.—Jobbers are anticipating an increase in price for pole line hardware.

Cleats.—The demand is for two-wire and three-wire cleats, and this particular item is stocked fairly well. Two-wire and three-wire cleats are being quoted at $34 per 1,000 in quantities of less than ⅛ bbl. and $32.50 for ⅛ bbl., with the price of barrel lots at $30.60 per 1,000.

Solder.—This is one item that is easy to obtain. Bar and wire solder is being quoted at $47.50 per 100 lb. in 10-lb. to 50-lb. lots and at $45.50 per 100 lb. in 50-lb. to 100-lb.

Schedule Material.—Schedule material of all classes remains about the same with stocks somewhat spotty. The popularity of the convenience outlet has made it difficult to obtain flush receptacles, some jobbers being entirely sold out.

Washing Machines.—The advent of the popular-priced washing machine is being watched with interest. The standard machines are now selling up to $200; and the demand is in excess of the supply.

Controllers.—Middle Western manufacturers of controllers show an uncertainty regarding future prices. The last advance was made in July, 1918. Since that time materials have advanced to such an extent that an increase in price of products seems inevitable. Sheet metal of Nos. 18, 20 and 22 gage, used for controller covers, is very short, and orders are being held up on this account.

BOSTON

Vigorous trade activity characterizes the New England electrical market this week. In some quarters business is increasing at a rate surpassing all previous records. Building operations continue to exceed greatly those of last year. Collections were very good in January, but there is a disposition among the larger jobbers to watch credits more carefully. Appliance sales fell off in January as compared with December, but in some cases the business handled last month was considerably in excess of that of a year ago. Stocks are very spotty, but current requirements are being met reasonably well. There is a tendency toward longer deliveries in motors, rigid conduit, washing machines and vacuum cleaners. There is little uniformity as to stocks among competing jobbers, and this is leading to quite a little inter-organization business. The United Electric Light Company, Springfield, Mass., is in the market for a 20,000-kva. turbo-generator. The Boston Edison company will erect an outdoor substation in Weymouth to serve shipbuilding interests and facilitate interconnections southward. Hydro-electric companies in New England are suffering from low water and existing steam plants are heavily burdened. Prices are firm, with advances registered within the past few days in washers and cleaners.

Wire.—Paper-insulated cable is in considerable demand for central-station service. Rubber-covered base holds firm at 30 cents, with weatherproof 28.5 to 30 cents and bare 23.5 to 24 cents. Deliveries just now are good on smaller sizes of wire, especially in factory consignments. No. 14 rubber-covered, double-braided wire brings $16.25 per 1000 ft., and single-braided $11.80.

Non-Metallic Flexible Conduit.—Fair stocks are reported here and there, but sales are being closely controlled. The 7/32-in. size brings $34 per 1000 ft. in coil to 1000-ft. lots, and the ¼-in. size $36.

Flexible Armored Conductor.—Conditions are easier as to supply. One large jobber has 158,000 ft. of No. 14 double-strip on the road to his warehouse for early delivery. Buyers are obliged to take either double strip or single strip as supplied. The single-strip No. 14 brings $95 per 1000 ft. in coil to 1000-ft. lots; less than coil, $100 per 1000 ft.

Metallic Flexible Conduit.—Prices are firm, with 15 per cent off list in coil lots. Stocks are only fair.

Outlet Boxes.—In common with all steel products, these are none too plentiful. The demand is good, with 3-in. round boxes quoting at 20 cents list.

Rigid Conduit.—Jobbers with close connections with steel mills are faring fairly well for the moment. Prices are firmer, ½-in. black pipe being quoted at $83.75 and ½-in. white pipe at $90 per 1000 ft. Famine conditions are feared in the future.

Motors.—Stocks are shot to pieces. Some manufacturers are refusing orders for fractional-horsepower motors. Single-phase motors are very short, twenty-two weeks' delivery being quoted on 3-hp. outfits. Recent price advances have not yet included all the larger producers. Second-hand dealers are buying new motors in order to meet the demand.

Insulating Material.—Porcelain products are harder to obtain than almost any other fast-moving material. Limited stocks, however, satisfy the most acute demands.

Appliances.—Retail sales are holding up well compare with last year. Portable lamps are being sold at reductions in some quarters to clear stocks. Ranges are quiet. Washers and cleaners are moving rapidly, and night manufacturing of the latter has begun in Massachusetts. Fair stocks of electric refrigerating outfits are being concentrated in jobbing hands, one dealer reporting $20,000 worth on hand. Price advances of about 10 per cent are noted on washers and cleaners, the copper tank outfits maintaining the lead.

ATLANTA

Business in the territory has again hit its stride, the slackening due to the holiday and inventory period being replaced by a volume of business equal to that of the early part of last December. All lines report very limited stocks of material on hand and considerable difficulty in obtaining new supplies. Little hope exists of this condition being bettered materially in the very near future. There is a growing conviction on the part of all jobbers that demands will far outrun the supply in virtually all lines during the heavy spring season.

Building permits valued at $4,473,000 were taken out in the twenty-three principal cities of the district during December, while the January permits in Atlanta alone approximate $1,500,000. The construction of an additional number of large apartments has been announced.

It is the general opinion that a raise of the re-discount rate will not work a hardship on any of the legitimate activities in this section, but it will undoubtedly check the tendency of certain parties to place heavy orders for material for speculative purposes. Car shortage is making deliveries on poles rather slow and is otherwise having an adverse effect on shipping conditions in general.

Conduit.—The jobbers report only a fair stock of the larger sizes of rigid conduit, while a shortage of ½-in. and ¾-in. still exists. The following prices prevail: 2,500 lb. to 5,000 lb., ½-in. black, $8.29 per 100 ft.; 1-in., $16.52; 1½-in., $26.29; 2-in., $36.37.

Wire.—Some stocks of wire have been accumulated, and with the exception of No. 10 and No. 12 rubber-covered, and No. 6, No. 8 and No. 10 weatherproof, jobbers are making stock shipments in limited quantities. This condition, however, cannot continue unless the poor shipments improve.

Non-Metallic Flexible Conduit.—The demand continues to exceed the supply. Local stocks are exhausted and shipments are slow. Prices are quoted, $\frac{7}{32}$-in., $30 per 1,000 ft.; ¾-in., $36 per 1,000 feet.

Flexible Armored Conductor.—There are virtually no stocks in the territory, and the best shipments promised are three to four months. Heavy orders are being placed even in the face of these slow shipments with the hope of obtaining a portion at least of the requirements. Jobbers are quoting No. 14 single strip, lots of 2,500 ft. to 5,000 ft., $102 per 1,000 feet.

Poles.—Jobbers report fair stocks of chestnut and cypress poles on railroad sidings, but car shortage is causing difficulty in delivery. There is a growing tendency to use cedar poles instead of chestnut, because of the greater ease of handling the former type. Prices quoted: chestnut, 30 ft., 7-in. tops, $7.25; 35 ft., $8.75; cedar, 30 ft., $13.50.

Cross-Arms.—Brisk movement of cross-arms and pole-line hardware is being experienced. Stocks of fir arms are reported good, with shipments sufficient to maintain reasonable stocks.

Washing Machines.—One of the large manufacturers announces a list price advance of $15. Other washing-machine manufacturers will undoubtedly make advances during the coming week. The demand for the swinging wringer type of machine exceeds the supply.

Schedule Material.—Despite brisk demands, the accumulation of stocks in the latter part of the fall enables jobbers to meet the demands with reasonable satisfaction. Fair shipments continue, but jobbers express the opinion that there will be a shortage of this material within sixty days.

SAN FRANCISCO

February rain is needed, particularly in the northern central valley, unless bad crop conditions are to result. Artificial irrigation is not a panacea this year because the power companies have not the power to care for the additional load.

Sewing Machines.—Rumors of a big raise in prices from various sources and an actual increase on some machines caused a demand that was, on the face of it, for protection and which will be reflected in sales for February and March. Dealers are well stocked. New prices, averaging $56 for the vibrating style and $74 for the rotary style, are considered by many dealers to be temporarily prohibitive.

Washing Machines.—The market for nationally advertised washing machines is considerably hurt by the efforts of certain Eastern agents to appoint dealers as district agents, give them liberal terms on carload lots and recommend that the prices be raised to the level of really high-grade machines. Coast prices on standard machines have recently increased, now standing at $150 for stationary and $160 for swinging-wringer type, family size.

Farm Plants.—Winter conditions have curtailed the demand through relaxation of sales effort, but the prospects for 1920 are very bright. Small pumping outfits are being sold in this connection. Several companies are advertising a so-called bargain or lump sum offer, allowing about a 15 per cent discount on a quantity of 32-volt devices such as washers and vacuum cleaners sold in connection with the farm plants. Not much attention has been paid to this side of the business, the average agent being contented if he can sell a plant and a string of lamps. The demand for other devices has come principally from the consumers without much solicitation. Furthermore, deliveries on 32-volt appliances have been very poor.

SEATTLE—PORTLAND

Quiet trade conditions with minimum sales volume heretofore reported still continue. Business for the week past shows no particular improvement, and from present indications the coming week's business will show no noticeable difference. This condition obtains in face of a notable increase in activity of real estate during January over the same month last year, and regardless of the amount of new construction. Building is much more active than it was at this time last year, and if more stability were reached in material prices and prospective builders could be more certain of the labor situation, the undertakings already planned for this year would keep building very active until late in the fall. However, authorities state that both of these problems are becoming less acute and the building outlook for Seattle and the Puget Sound district is decidedly encouraging.

In Portland, general business conditions are reported good, the volume running about the same or perhaps a trifle better than a year ago. The demand for washing machines continues. It is predicted that there will be an extreme shortage of practically all wiring supplies during the coming year, as manufacturers point out that part of the shortage in stocks is due to the lack of raw material in the factories. Central stations and retailers report a slight increase in range sales during the past ten days, and that casual inquiries are evolving into orders. Installations of considerable magnitude are to be made soon in two large apartment houses now under construction.

Motors.—There is unusual activity in the electrification of lumber mills, and the demand for motors for this class of work is hard to supply. Shipments from the east are extremely slow; from five to six months seems to be about the best that can be promised, and in some cases they may even exceed this time. Stocks in most lines are very difficult to get even on orders which have long been placed. In Seattle stocks are in fair shape and shipments are coming through fairly well.

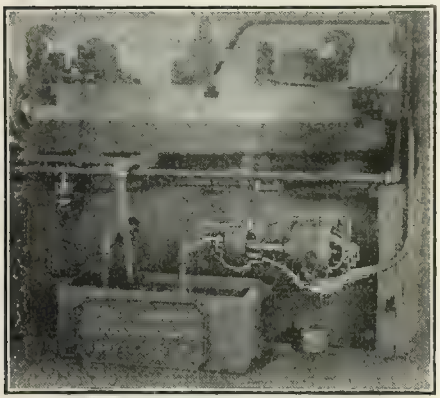
Wire.—Owing to decrease in demand, particularly from shipyards, and the fact that residence work has not fully opened up, jobbers' stocks are in fair shape.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Portable Oil Pump

A compact apparatus that can be wheeled up to a machine tool in a shop for the purpose of pumping lubricating oil to the cutting tool has been developed by the Fulflo Pump Company, Blanchester, Ohio. This machine is designed to be used on cutting machinery which only occasionally needs lubricating on the cutting tool and also in case of emergency on a machine usually equipped with a lubricating system. The total height of the machanie is 14 inches, permitting it to be rolled under shop equipment. The pump and motor are covered to protect them from liquid and dust. The motor cords may be attached to the ordinary 110-volt lamp socket.



PORTABLE OIL PUMP

Separatorless Storage Battery

The Electrolyte Storage Battery Company, Philadelphia, Pa., is offering a storage battery in which separators are not employed.

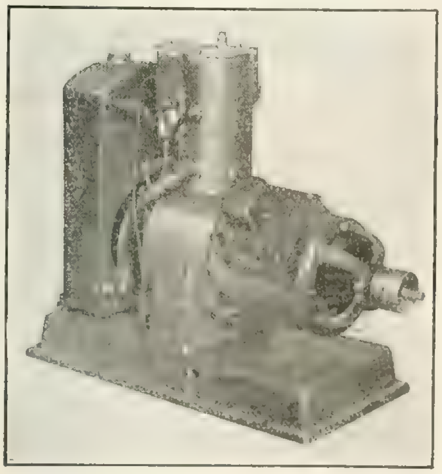
Electrically Heated Glue Pot With Automatic Temperature Control

A glue pot designed to automatically maintain its contents at the proper temperature without variation greater than two degrees has been recently developed by the Steam Electric Products Company and is now nationally distributed by the Bennage Company, 322 Euclid Avenue, Cleveland, Ohio, and distributed in the East by the New York Appliance Company, Times Building, New York City.

The glue pot proper, which has a capacity of 3 pints and is made of copper, is set in an outer kettle containing water. In the base of this kettle is the electric heating element. A special liquid which boils at the proper temperature for glue is hermetically sealed in a brass tube connected with a control gage. The pressure developed in the tube and communicated to the gage opens and closes the circuit so that the intermittent electric current maintains the proper temperature.

Farm Lighting Plant

A built-in switchboard and a water-cooling system with a cast-iron hopper are the particular features of a new farm-lighting plant which is being built by the Drury Engineering Co., Evansville, Ind. This unit is equipped with an outboard 3½-in. pulley and it is able to deliver 2.5 hp. to belt-driven equipment. It is fitted out at the same time with an 800-watt generator liberally designed for overload rating. It operates at a speed of 1100 r.p.m., which is the medium speed in the line of farm-lighting equipment being built by the Drury Engineering Company.



RADIATOR AND SWITCHBOARD BUILT-IN THE PLANT

Duplex Call Switch for Hospitals

Two single-call switches, installed on each side of a duplex receptacle and all mounted in one brass plate, make up the duplex hospital call switch recently developed and put on the market by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Each call switch has a pull chain with a linen cord extension and an "off" button which protrudes through the switch plate and serves to indicate to the attendant which patient called. The switch is said to be silent in operation and contains no exposed live parts. The two receptacles provide convenient means for connecting bed lamps, heating pads, etc.

Outdoor Service Foot Warmer

An electric foot warmer to relieve outdoor workers from the discomfort of cold feet in winter weather has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. It is waterproof and is made in one piece with feet to raise it an inch above the floor or ground. Two sizes are manufactured, one of which, measuring 14 in. x 20 in., is provided with a three-heat snap switch to regulate the power consumption to 200, 100 or 50 watts at 120 volts or to 200 watts at 240 volts. The smaller type, 12 in. x 16 in., is rated 200 watts at 120 volts. Six feet of cord with a snap switch is supplied with each warmer, the rubber-insulated cable entering the warmer through a bell-mouthed waterproof fitting.

KEEPS FEET WARM IN WINTER WEATHE

Washer of Rocker Type

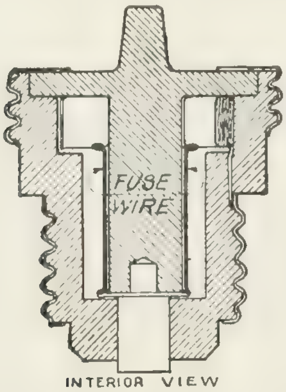
Only seventeen moving parts are included in the make-up of the "Wayne-100" rocker-type washer manufactured by the Wayne Manufacturing Company, St. Louis, Mo. Other features of the machine are oilless bearings requiring no oil pan and an easily removable tub that can be replaced if necessary because of injury, accident or wear and tear. It is claimed further that the removable-tub feature makes the machine easier to clean. The frame of the machine is of channel and angle steel welded, and the panels are of japanned sheet steel. The tub is made of copper heavily tinned inside.

Portable Electric Milking Machine

For dairies with eight to twenty cows a small electric milking machine mounted on wheels so that it may be moved easily has been developed by the Sharples Milker Company, West Chester, Pa. Two cows are milked at once. The milker may be operated from a farm-lighting plant of ¾-kw. rating.

Fuse Plug Has Six Lives

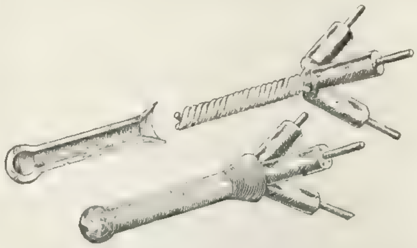
Six fuse wires which may be put in use successively after each is blown are the feature in the construction of the "6 in 1" fuse plug which is being made by the Moss-Schury Manufacturing Company, 1226 Majestic Building, Detroit, Mich. After a fuse has blown the top cap of the plug is loosened by partly unscrewing and then a new fuse is put in circuit by turning a disk to the right.



FUSE CHANGED BY TURNING DISK

Rubber Insulator for End Splices

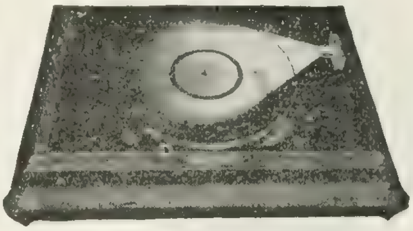
For use on end splices in outlet boxes, junction boxes and fittings and in fixtures, the Elasticap Company, Hoboken, N. J., is putting out new code rubber splice insulators, called "Elasticaps," designed to eliminate grounding and prevent short circuits. The device is like a small rubber "hood" and is slipped on a splice where No. 14, No. 16 and No. 18 wires are spliced together in two-wire or three-wire combination. The first issue, or house-wiring size, will correspond in color to the usual rubber insulation on wires and will be known as the "2 No. 14 size."



RUBBER CAP COVERS BARE WIRE ENDS

Talking Machine Light

A four-volt dry battery-equipped light for mounting directly on the side of a talking machine has been developed by the Standard Accessory Corporation, Milwaukee, Wis. The lamp may be kept lighted permanently or may be controlled by means of a spring switch which when released cuts off the light.



LIGHTS RECORD AND NEEDLE

Notes on Recent Appliances

Storage Battery Cell Tester

H. B. Shontz Company of 157 West Fifty-fourth Street, New York City, has now placed on the market a storage battery cell tester which shows by comparative readings of a volt-ammeter the condition of each cell of a storage battery.

Pull Switch

The Luminous Unit Division of the St. Louis Brass Manufacturing Company of St. Louis, Mo., is making a pull switch for its Brascolite reflectors.

Telephone Cable Terminal

An air-tight cable compartment containing a telephone-cable terminal has recently been brought out by the Reliable Electric Company of 411 South Sangamon Street, Chicago, Ill.

"Usalite" Flashlights

The United States Electric Manufacturing Corporation of 116 Duane Street, New York City, has placed on the market its "Usalite" flashlight which is claimed to have special constructive features.

Fish Wire

Hatheway & Knott, Inc., of 120 Liberty Street, New York City, agents for the Rattan Manufacturing Company of New Haven, Conn., has announced a flat, flexible, spring wire which can be obtained in several sizes.

Current Top

The "Notherlite" current top, which fits between the parts of a two-piece attachment plug and receives either an Edison base lamp or a plug cap is being made by the Esler Electric Manufacturing Company of Marion, Ind.

Sockets and Rosettes

Two weather-proof sockets, a rosette and a receptacle, have been placed on the market by the Crescent Electric Company of Mansfield, Ohio.

Heating Devices

A table stove, an electric heater and a blue-steel electric oven are products being distributed by the Electrical Sales Company, People's Gas Building, Chicago, Ill., for the Bestov Manufacturing Company of 1801 Twentieth Avenue, Seattle, Wash.

Electric Gas Lighter

The Safety Gas Lighter Corporation of Roanoke, Va., has introduced an electric gas lighter for use in hotels, restaurants and residences.

"Silver Star" Washer and Wringer

The Star Washing Machine Manufacturing Company of 549 Quincy Street, Chicago, Ill., has placed on the market an electric clothes washer with a swinging reversible wringer.

Searchlight

A commercial searchlight for use on either land or sea has recently been brought out by the Sperry Gyroscope Company, Manhattan Bridge Plaza, Brooklyn, N. Y.

Display Case

The Viking Sign Company, Inc., of 560 Seventh Avenue, New York City, has brought out a sign with illuminated letters for show windows and stores.

Coronaless Aerial System

A high-tension coronaless aerial system for use with X-ray tubes has been placed on the market by the Engeln Electric Company of Euclid Avenue and Forty-sixth Street, Cleveland, Ohio.

Bristol Recording Instruments

A line of strip chart electrical recorders, including ammeters, voltmeters, wattmeters and frequency meters, furnished for switchboard mounting, wall mounting or for portable service have been brought out by the Bristol Company of Waterbury, Conn.

Fabricated Pole Extension

S. W. Hull & Company of 3729 Prospect Avenue, Cleveland, Ohio, has placed on the market a fabricated extension made of steel angles with lace bar reinforcing.

Lamp Dimmer

The Anylite Electric Company of Fort Wayne, Ind., has added the "Uno" thread to its light controller.

Fire Pump

A motor and gasoline-engine driven fire pump has been brought out by the Lea-Courtney Company of Newark, N. J.

Battery Drill

An improved drill for use in making battery connections has been introduced by Edward Gustafson of the Electric Shop, Centerville, S. D.

Dimmer Bank

The Cutler-Hammer Manufacturing Company of Milwaukee, Wis., has brought out a dimmer bank using artistic colored lighting effects such as are produced in theaters for assisting in the display of women's apparel in prominent New York department stores.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE ILG ELECTRIC COMPANY, Chicago, is erecting a new two-story building, reinforced concrete, to cost $300,000.

CARL F. BRENNAN and A. C. McQUILLEN have associated to do electrical engineering, designing and construction work. Their office is at 348 Keyes Avenue, Watertown, N. Y.

THE LIONEL CORPORATION, Irvington, N. J., will erect a new two-story structure, 34 ft. x 33 ft., at its plant on Twenty-first Street.

THE HEMCO ELECTRIC COMPANY, 246 Third Avenue, New York City, has prepared plans for improvements and alterations to its plant to cost $12,000.

F. W. SINRAM, for several years general manager of The Van Dorn & Dutton Company, Cleveland, and president of the American Gear Manufacturers' Association, was elected president of The Van Dorn & Dutton Company at the last meeting of the board of directors of that company. Franklin Schneider at the same time was elected vice-president of the company. He is also president of The Van Dorn Electric Tool Company of Cleveland.

F. W. SINRAM

USE OF HEATING DEVICES IN GENERAL ELECTRIC PLANT.—The General Electric Company apparently does not wish to belong to the class of "barefooted cobblers' children," for it has just completed a canvass of its Schenectady plant, showing no less than 1,524 electrically heated appliances in use. This plant employs about 23,000 persons. A summary of this canvass shows 165 ovens, 216 furnaces for tempering, annealing, etc., 62 high-current machines, 87 melting pots, 195 hot plates, 93 glue pots, 9 oil-tempering baths, 13 arc-type furnaces, 360 soldering irons and small hand devices and 324 small miscellaneous devices. These devices carry a total load of 12,154.5 kw. Of this load 5,341 kw. is connected to ovens and the smaller heating devices and 6,813.5 kw. to the arc-type furnaces and high-current machines.

STEINMETZ MOTOR CAR CORPORATION FORMED.—The Steinmetz Motor Car Corporation, with executive and sales offices in the Ziegler Building, 512 Fifth Avenue, New York City, has been chartered under the laws of the State of Maryland with a capital of $2,000,000, to manufacture a new type of lightweight electric delivery truck and an improved electrical industrial car for use in manufacturing plants. Both cars are the invention of Dr. Charles P. Steinmetz, chief consulting engineer for the General Electric Company, Schenectady, N. Y. Dr. Steinmetz will act as consulting engineer to the Steinmetz Motor Car Corporation and is a member of its board of directors. The company has acquired a manufacturing plant at Baltimore, Md. The officers of the corporation are: A. Robert Elmore, president; J. P. Story, Jr., vice-president and treasurer; Nelson H. Truett, secretary. The board of directors includes: Herbert A. Wagner, president Consolidated Gas, Electric Light & Power Company, Baltimore, Md.; William F. Ham, president Washington Railway & Electric Company, Washington, D. C.; Lindsay Hopkins, banker, director American Hide & Leather Company; Guy Scott, president Continental Trust Company, Washington, D. C.; J. P. Story, Jr., of Story & Cobb, Washington, D. C., and Charles P. Steinmetz. The principal feature of Dr. Steinmetz's truck is said to be the elimination of excessive weight.

THE ELECTRICAL ENGINEERS' EQUIPMENT COMPANY suffered a loss by fire at its general offices, 710 to 714 West Madison Street, Chicago, on the night of Jan. 13. This did not affect the company's manufacturing, stock and shipping departments at 711 to 715 Meridian Street. The factory is running at full capacity, so there should be no delay in the shipment of orders now in production. Regular deliveries can be promised on new orders. All mail should be addressed to 711-15 Meridian Street, Chicago, until further notice.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., is devoting new floor space to the industrial electric heating department. This is in addition to the space formerly used for manufacturing household electric appliances such as flatirons, toasters, table stoves, etc., which, the company states, have been discontinued. The industrial heating line, which now is being expanded, includes such products as the electric space heater, soldering irons, linotype-pot heaters, metal-melting pot, chocolate warmers for candy factories immersion water heaters, circulation water heaters, tailors' irons and heater units for application to all types of machinery.

M. R. EVANS and J. B. HARRIS, JR., have resigned from the Pittsburgh Transformer Company, Pittsburgh, Pa., the former as sales manager and the latter as Pittsburgh district manager of the company, to become associated under the name of Harris & Evans, district managers, Real Estate Trust Building, Philadelphia. They will operate a joint district office of the Moloney Electric Company of St. Louis, the Delta-Star Electric Company of Chicago and the Simplex Wire & Cable Company of Boston, and will handle the business of these companies in the Philadelphia district, which includes the eastern part of Pennsylvania and the States of New Jersey, Delaware and Maryland.

ARTHUR H. ABBOTT, for the last eight years district transformer specialist of the General Electric Company, New England territory, has resigned to become sales engineer of the Blake Electric Manufacturing Company, with headquarters at 1 Rowe's Wharf, Boston. Mr. Abbott is a well known sales engineer in the New England electrical field. He was educated at the Massachusetts Institute of Technology, graduating in 1907 from the electrical engineering course. For two years prior to the completion of this course he was employed in the testing department of the Schenectady works of the General Electric Company. In 1907 he entered the Pittsfield works of the same company, remaining for about five years in the transformer engineering department. In 1911 he was transferred to the Schenectady works and spent eighteen months in the power and mining commercial department, going to the Boston office in 1912. In his new work Mr. Abbott will pay particular attention to the sale of General Electric transformers, motors, outdoor substation and other equipment to industrial plants, to the sale of electrical specialties to central stations, and to the problems of construction and maintenance for both classes of customers. Mr. Abbott assumed his new duties Feb. 2.

GANNETT, SEELYE & FLEMING, INC., engineers, Harrisburg, Pa., have opened a branch office in Memphis, Tenn., at No. 262 Randolph Building. This engineering company is engaged in all classes of work including electrical developments, appraisals and operation of public utilities. It expects to make the new office in Memphis the center for all work in the Southwest.

THE STANDARD UNDERGROUND CABLE COMPANY'S St. Louis office, E J. Pietzcher, manager, on Feb. 1 was moved from the Security Building, where it has been established since 1897, to the Arcade Building.

THE IRONTON ELECTRIC COMPANY, Ironton, Ohio, has filed papers with the Secretary of State increasing the authorized capital from $150,000 to $500,000. The company manufactures electrical appliances.

THE JOHNS-PRATT Company, Hartford, Conn., has received the Underwriters' Laboratories "listing as standard" of its Noark renewable fuses in all sizes from 3 amp. to 600 amp. on 250 volts and 600 volts.

THE NEW YORK LIGHTING FIXTURE MANUFACTURING COMPANY, New York City, has filed notice with the Secrtary of State of an increase in its capital from $10,000 to $25,000 for business expansion.

JOHN K. MARTIN has retired from the sales organization of the Gleason-Tiebout Glass Company as of Jan. 1, 1920, after rounding out a connection with the glass industry that commenced on Jan. 1, 1869—fifty years of practically continuous service. In that year the New England Glass Company opened a branch salesroom in Philadelphia, and Mr. Martin, then a very young man, was employed as an assistant to the manager, J. K. Dunham. He also continued in the employ of that company in Philadelphia when S. G. Boughton was manager of the office. A few years later Mr. Martin became a traveling salesman for Gillinder & Sons, with which firm he remained for about ten years. He then left the glass industry, but soon returned to it and became a representative for James J. Murray & Company of Philadelphia, remaining with that firm until the decease of its head. About that time the National Glass Company decided to take up the manufacture of glass for the gas and electric lighting trade, and Mr. Martin was given charge of that line for the company, remaining with it for about two years. On Jan. 1, 1904, he became a representative of the Gleason-Tiebout Glass Company in the Middle West and later in New York City until the present time.

JOHN K. MARTIN

THE CANADIAN ENGINEERING AGENCY, INC., 115 Broadway, New York City, announces that the above-named company has been appointed and the Pearson Engineering Corporation has ceased to act as purchasing agent for the following companies: Ebro Irrigation & Power Company, Ltd., Cataluna Railways, Ltd., and allied companies, Mexico Tramways Company, Mexican Light & Power Company, Ltd., and allied companies, Rio de Janeiro Tramway Light & Power Company, Ltd., Rio de Janeiro and Sao Paulo Telephone Company, Société Anonyme du Gaz Rio de Janeiro and allied companies, Sao Paulo Tramway Light & Power Company, Ltd., and Sao Paulo Electric Company, Ltd., and allied companies. Louis J. Hirt is the consulting engineer for and Walter P. Plummer is in charge of the purchasing department of the Canadian Engineering Agency, Inc.

Supply Jobbers' Notes

CHARLES A. LEGROS, for the past eleven years with the Stuart-Howland Company, Boston, has been appointed store manager of the United Electric Supply Company, Boston.

W. P. NASER, formerly Chicago manager of The Trumbull Electric Manufacturing Company, has been appointed general manager of the Northern Electric Company, Minneapolis, Minn. The executive and main offices are in Minneapolis, with a branch office in Duluth.

WESTERN ELECTRIC ASSIGNMENTS TO HANDLE STEAMSHIPS AND STEAM RAILROADS.—E. R. Morgan has been assigned at the Boston house to handle the New England territory; William Lancaster at the Richmond house to handle the territory which includes Virginia and North Carolina; R. D. Eves at Cincinnati to handle the territory including Kentucky, Tennessee, southern Indiana, southern Ohio and the western part of West Virginia.

THE STERLING ELECTRIC COMPANY, Minneapolis, Minn., advises through its president, W. H. Vilett, that at the beginnng of the year 1919 it set out to do $1,000,000 worth of business. At the end of eight months that amount had been reached, and, with four months to go, the company set the bogey at $1,500,000. At the end of the year this amount had not only been reached but surpassed, for a total business of $1,800,000, which was nine times the amount of business the company did in 1913. Its October, 1919, sales alone amounted to $221,000.

THE INLAND ELECTRICAL COMPANY, Chicago, has contracted with the Crystal Washing Machine Company, Detroit, Mich., for $1,000,000 worth of washing machines to be delivered during the year 1920. The Inland Electric Company has formed a special sales organization and has acquired more storage space for handling this business. It will distribute these machines through the northern half of Illinois and through Wisconsin. The company is planning an extensive advertising compaign in this territory.

THE NORTHWESTERN ELECTRIC EQUIPMENT COMPANY announces that since Jan. 1 it has limited its stock of automobile electric supplies and accessories to Gould storage batteries, parts and supplies, Tungar rectifiers, General Electric lead-burning outfits and Fostoria automobile lamps. The battery department will be enlarged and extended to cover a more complete line of batteries to fit all makes and models of cars, as well as parts and supplies for all kinds of storage batteries. Automobile lamp stocks will be larger.

Foreign Trade Notes

CHINAS ELECTRICAL IMPORTS FROM THE UNITED STATES.—Of the $4,930,000 of electrical materials and fittings imported into China in 1918, 20 per cent came from the United States.

THE INTERNATIONAL ELECTRICAL EXPOSITION AT BARCELONA, SPAIN.—A fund has been provided in equal shares by the municipality and the state to erect permanent buildings and grounds which shall be known as the Exposicion Barcelona and which may be used from time to time for exhibitions of a national or international character. The first opening will take place in the latter part of 1920 or in 1921, when there will be held an international exhibition of electrical manufactures and a general exhibition of manufactures of Spain only. The exposition will include generating apparatus of all kinds, apparatus of all classes for storing, transporting, transforming and distributing the energy, and all apparatus, machinery, tools and other articles actuated by electrical energy. Based on the foregoing, the exhibits will be divided into twelve groups as follows: (1) generation, transformation and accumulation of energy; (2) transmission and distribution; (3) apparatus and methods of investigation, demonstration and measurement; (4) electric lighting and electricity in the home; (5) applications to the manufacturing industries; (6) traction and electrochemical maintenance; (7) telegraphy, telephony and radio-telegraphy; (8) applications of electricity to medicine and hygiene; (9) electrochemistry and electrometallurgy; (10) electricity as applied to agriculture; (11) application of electricity to the exploitation of the subsoil; (12) electro-technique (engineering, installation, etc.). For further information, application should be made to Sr. D. Joan Pish, Commisaro de la Exposicion Barcelona, Spain, Plaza Cataluna, 9.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

Electricians in Australia (No. 31,083) desire to secure agencies for the sale of storage batteries and generators and motors up to 4 horsepower; also any electrical goods.

An organization for the construction of new hotels in a city of France (No. 30,870) proposes to construct in the near future a hotel of 420 rooms and desires to get in touch with American firms interested in the export of interior furnishings, such as electric lighting, ventilation appliances, washing and drying machinery, elevators, telephone installation and insulating material.

A general agency is desired by an engineer in Belgium (No. 30,813) for the sale of machinery and equipment of all kinds for electric plants, railroads, manufacturing plants and machine shops. Quotations should be given c. i. f. Antwerp. Correspondence may be in English.

A commercial agent in Czechoslovakia (No. 30,633) desires to purchase and secure an agency for the sale of electrical measuring instruments, electrical meters, installation material, telephone equipment, bells, etc. Payment, United States Currency. Correspondence may be in English.

A Spanish merchant (No. 30,646) established in the United States, having representatives in Spain, is about to visit that country and desires to secure agencies for the sale of electrolytic copper wire, iron plates, motors, generators and electrical appliances.

A firm in Italy (No. 31,133) desires to secure an agency for the sale of telephonic and telegraphic apparatus and electrical supplies. A full list and description of what is required may be had on application to the Bureau and its district offices. Correspondence may be in English.

A company in England (No. 31,209) desires to secure agencies for the sale of electric vacuum cleaners and all kinds of labor-saving devices for the home. Quotations should be given c. i. f. English port or f. o. b. New York.

An agency is desired by a commercial agent in Switzerland (No. 31,227) for the sale of electrical instruments and apparatus. Quotations should be given c. i. f. Genoa. Payment in Italian currency, account current, within 30 to 60 days. Correspondence should be in Italian, French or German.

A commercial agent in Spain (No. 31,228) desires to secure agencies for the sale of electrical supplies. Quotations should be given c. i. f. Spanish ports. Payment preferred 30 days from shipment. Correspondence should be in Spanish or French.

A commercial agent from Bolivia (No. 30,891) will be in the United States for the next few weeks for the purchase, from manufacturers only, of electrical goods and supplies. Correspondence should be in Spanish.

A municipality in Colombia (No. 30,899) is in the market for electric torches for fire department equipment. Quotations should cover an equipment for a city of 120,000. Correspondence should be in Spanish. Catalogs are requested.

A company in South Africa (No. 30,900) desires to secure agencies from manufacturers of domestic electrical appliances, such as cookers, toasters, irons and kitchen stoves. Payment cash against documents in New York.

A trading company in Denmark (No. 31408) desires to secure an agency on commission for the sale of electrical supplies and steam turbines. Quotations should be given c. i. f. Copenhagen or other Scandinavian port. Payment, letter of credit in United States.

A busines man in Norway (No. 30,853) desires to secure an agency for the sale of electrical apparatus, telephone, telegraph and alarm service. Quotations should be given c. i. f. Norwegian port. Payment through banks.

Trade Publications

ANCHORS.—"Scrulix" anchors are described in pictures in a recent folder by W. N. Matthews & Brother, St. Louis, Mo.

FIXTURES.—The National X-Ray Reflector Company, Chicago, is distributing catalog F on X-Ray fixtures for indirect lighting.

RADIO EQUIPMENT.—An eighty-three-page catalog on radio equipment has been issued by The Wireless Specialty Apparatus Company, Boston, Mass.

FARM LIGHTING PLANT.—The perfection Storage Battery Company, Fortieth Street and Rhodes Avenue, Chicago, has prepared an illustrated folder on its new unit-type electric light and power plant.

TRACTORS.—The Industrial Truck Company, division of the Cowan Truck Company, Holyoke, Mass., has issued bulletin No. 14 describing industrial electric tractors.

FIRE PROTECTION APPLIANCES.—A list of the fire protection appliances which it has approved has been issued by the Inspection Department of the Associated Factory Mutual Fire Insurance Companies, 31 Milk Street, Boston, Mass.

CHARGING EQUIPMENT. — "Insuring Full Return on Truck Investments" is the title of a new 8½-in. x 11-in. four-page descriptive leaflet known as Publication 806, printed by the Cutler-Hammer Manufacturing Company of Milwaukee and New York.

RECEPTACLES AND PLUGS.—Automatic valve-closed watertight electrical plug receptacles and attaching plugs are covered in bulletin B, published by the Conneaut Metal Works Company, Conneaut, Ohio.

ELECTRIC FURNACES.—"It Pays to Rotate" is the title of a bulletin issued by the Booth Electric Company, 53 West Jackson Bulevard, Chicago, in which furnace tests made by the Commonwealth Edison Company in a brass melting furnace are noted.

FUEL SAVING.—"Saving Fuel Automatically and Scientifically in the Boiler Room" is the title of a new twenty-four-page booklet published by the Northern Equipment Company, Erie, Pa., based on matter prepared for the United States Fuel Administration during the war.

COMPRESSORS, DRILLS, VALVE GRINDERS.—Electric air compressors, portable electric drills and electric valve grinders are the subject of a new catalog which the Black & Decker Manufacturing Company, of Towson Heights, Baltimore, Md. has published.

New Incorporations

THE DAN VALLEY POWER COMPANY of Walnut Cove, N. C., has been chartered with a capital stock of $50,000 by H. L. Mitchell and associates. The company proposes to build a hydroelectric power plant at Walnut Cove.

THE MINIER (ILL.)) ELECTRIC LIGHT & POWER COMPANY has been chartered with a capital stock of $15,000. George Peine is one of the incorporators.

THE PINE VILLAGE (IND.) LIGHT & POWER COMPANY has been incorporated by Melvin Akers of Pine Village and others. The company is capitalized at $10,000 and proposes to construct and operate an electric light and power system in Pine Village.

THE GADSDEN (ALA.) RAILWAY, LIGHT & POWER COMPANY has been incorporated with a capital stock of $1,000 to supply electricity for lamps, heaters and motors, by C. A. Bingham and others.

THE SMITH-FRIED ELECTRIC COMPANY of Greenville, Tenn., has been incorporated with a capital stock of $10,000 by L. H. and M. S. Smith, and J. M. and H. W. Fried.

THE STANDARD SUPPLY COMPANY of Stockholm, Me, has been incorporated with a capital stock of $30,000 to supply electricity for lamps and motors in Stockholm and to do a general merchandising business. The officers are: Allen Quimby of Portland, president; Paul A. Cyr, treasurer, and S. J. Antworth, clerk, both of Stockholm.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

New England States

BOSTON, MASS.—Rapid progress is being made by the New England Telephone & Telegraph Company, 50 Oliver Street, on the new two-story addition to its telephone plant at Cambridge, about 35 ft. x 35 ft. The structure will cost $70,000.

WEST SPRINGFIELD, MASS. — The Gilbert & Barker Manufacturing Company, manufacturer of pumps, oil-burning systems, gas generators, etc., is planning for extensive additions to its local plant for increased capacity. Plans are being prepared for the construction of a total of six new buildings at the works, including a re-inforced-concrete iron and brass foundry, about 400 ft. long; addition to the sheet metal works, about 160 ft. x 229 ft.; extension to zinc galvanizing department; the construction of a new warehouse building; addition to existing storage structure, and the erection of a large addition to the power plant for works service. The project is estimated to cost $1,000,000, including machinery and equipment. McClintock & Craig, 33 Lyman Street, Springfield, are architects for the company.

ANSONIA, CONN.—The Ansonia O. & C. Company, manufacturer of elastic webbings, etc., contemplates the erection of a new factory and power plant, the project being estimated to cost about $50,000.

HARTFORD, CONN.—Bryant & Chapman, Woodland and Homestead Avenues, will build a new power plant at their establishment. Plans for the structure have been prepared.

Middle Atlantic States

BROCKPORT, N. Y.—The Great Atlantic & Pacific Tea Company is contemplating the enlargement of the power plant at the local works, recently acquired, formerly occupied by the Dailey, Udell Canning Company.

ENDICOTT, N. Y.—A large new three-story factory and boiler plant will be erected by the International Time Recording Company, North Street, to provide for increased capacity. The structure will be about 50 ft. x 200 ft., and, including machinery and equipment, is estimated to cost close to $450,000. Plans are now being drawn.

JAMESTOWN, N. Y.—The Crescent Tool Company, 200 Harrison Street, will build a new forge shop and power plant at its works for increased operations. Preliminary plans for the proposed structures are now being prepared. Cundall, Powell & Mosher, 80 West Genessee Street, Buffalo, are architects and engineers.

NEW YORK, N. Y.—Considerable new electrical and mechanical equipment will be required in connection with the construction of the new candy-manufacturing plant of the Advance Novelty Candy Manufacturing Company, 511 East Seventy-second Street, to be built at 138th Street and Willow Avenue. The proposed new works are estimated to cost about $500,000.

NEW YORK, N. Y.—The Cunard Steamship Corporation, 24 State Street, is arranging plans for the construction of a total of eight double-deck concrete and steel piers, about 150 ft. x 1,000 ft., in connection with the establishment of its preposed new freight terminal at Weehawken, N. J. Complete freight-handling and other transportation machinery will be installed, and it is understood that large quantities of electrical equipment will be required. The project, when completed, is estimated to cost in excess of $25,000,000.

NEW YORK, N. Y.—The New York Edison Company, Irving Place and Fifteenth Street, will build a new transformer and storage battery building at 420-423 East Sixth Street. Plans for the structure have been prepared.

ROCHESTER, N. Y.—City Council has taken bids for the construction of the proposed new municipal garbage disposal plant, estimated to cost $650,000. Considerable electrical and mechanical equipment will be required.

SOLSVILLE, N. Y.—The Solsville Electric Light Company will build a new addition to its local plant for increased operations. Plans for the structure are being prepared.

NORTH TONAWANDA, N. Y.—In connection with the construction of the proposed new addition to the plant of the Herschell-Spillman Company, manufacturer of pleasure automobiles, contract for which has been awarded, considerable electrical and mechanical equipment will be required, including motors for individual drive, etc. The proposed plant is estimated to cost about $200,000.

SYRACUSE, N. Y.—The H. H. Franklin Company, 302 South Geddes Street, manufacturer of automobiles, has had plans prepared for the construction of a large new power and heating plant at its works, to cost in the neighborhood of $200,000. The company is arranging its expansion program for 1920, which includes the construction of new buildings to provide a total of about 500,000 sq.ft. of additional manufacturing space, as well as a new seven-story warehouse building to cost $700,000.

SYRACUSE, N. Y.—Plans have been prepared by the Syracuse Lighting Company for extensive improvements and additions to its plant and system, for largely increased capacity. The company has made application to the Public Service Commission for permission to issue notes for $150,000, the proceeds to be used to cover a portion of the proposed expansion program. The new work includes the installation of a quantity of new equipment at the company's Fayette Street substation, to cost about $143,850; installation of cable in subways extending from Solvay to Fayette Street and from Fayette to Fulton Street, $75,000; new equipment in the Solvay substation; $141,440; betterments in the Fulton Street steam station, $45,630; purchase of new meter-room testing equipment; extensions in street-lighting and general distribution system, including the installation of new meters, transformers, etc., $120,000, and miscellaneous improvements in station and distribution system, $18,000. The company is also planning for improvements in the gas plant, to include the installation of additional condensing facilities and new purification apparatus, to cost about $35,000.

ELIZABETH, N. J.—Notice has been filed with the Secretary of State by the Consumers Ice & Cold Storage Company of an increase in its capitalization from $100,000 to $250,000, for general business expansion.

FREEHOLD, N. J.—In connection with the construction of the new municipal electric power plant and heating system on Main Street by the Board of Chosen Freeholders of Monmouth County, contracts have been let for all miscellaneous work, including plumbing, heating, roofing, etc., to facilitate the early completion of the structure, which is estimated to cost $40,000. George W. Henderson, Main Street, Avon, N. J., is the general building contractor.

LAKEHURST, N. J.—Arrangements are being made by the Federal Bureau of Yards and Docks, for the construction of a new electric power plant and distribution system (Specification 4128) at the local government site, estimated to cost close to $550,000. C. W. Parks is chief engineer.

NEWARK, N. J.—In connection with the construction of the proposed new local plant of the Greater New York Metal Bed Company, 661 Morgan Avenue, Brooklyn, N. Y., to be located on Elizabeth Street, near Meeker Avenue, plans have been prepared for the erection of a power plant for general works service. The new plant is estimated to cost about $200,000.

PERTH AMBOY, N. J.—The City Council contemplates the installation of a new "white way" type electric street-lighting system on Madison Avenue, extending from Jefferson to Market Street.

PHILLIPSBURG, N. J.—The Town Council contemplates improvements and extensions in the electric street-lighting system. Electric service for operation is supplied by the Pennsylvania Utilities Company.

TRENTON, N. J.—The City Commissioners are contemplating extensions and improvements in the electric street-lighting system, including the installation of a "white way" type to replace the present arc-lighting system, estimated to cost about $38,000.

UNION HILL, N. J.—Considerable refrigerating machinery and equipment will be required in connection with the construction of the proposed new three-story brick ice manufacturing plant addition, 85 ft. x 100 ft., at the plant of the Consumers' Hygiene Ice Company, 320 Fulton Street, to cost about $60,000.

ALTOONA, PA.—The Penn Central Light & Power Company, Altoona, J. H. Sharer, superintendent, is engaged in extending the lines from Ninth Street, Altoona, to the Martz schoolhouse location, a distance of 1 mile.

BLOSSBURG, PA.—Plans are being prepared by the board of managers of the Blossburg hospital for the immediate construction of a one-story brick, steel and concrete power house and laundry building at the institution.

HAUTO, PA.—Work has been inaugurated by the Lehigh Navigation Electric Company on the proposed enlargements and extensions in its local electric light and power station, approximately to double the present capacity. The company's plans include the installation of a quantity of new equipment, including two new turbo-generators, about eighteen new boilers and auxiliary apparatus, the entire project, when completed, being estimated to cost in the neighborhood of $3,000,000.

PHILADELPHIA, PA.—In connection with the improvements at the filtration plant at the Queen Lane waterworks, contract for which has been awarded by the Department of Works at a price of $376,467, considerable electrical and mechanical equipment will be required.

PITTSBURGH, PA. — The Duquesne Light Company, Chamber of Commerce Building, has arranged for the construction of two new substations, one to be located at Junction Park, Rochester, Pa., and the other at Ambridge, Pa. The structures are estimated to cost $30,000 and $20,000 respectively.

SCRANTON, PA.—A new two-story brick and reinforced-concrete power plant, about 116 ft. x 200 ft., will be erected at the local plant of the Klots Throwing Company, 25 Madison Avenue, New York. Plans for the structure, which is estimated to cost about $50,000, have been prepared by Lockwood, Greene & Company, 101 Park Avenue, New York.

WERNERSVILLE, PA.—Ground has been broken by the board of trustees of the Asylum for the Chronic Insane for the proposed new one-story power plant at the institution, estimated to cost about $25,000. The structure will be about 50 ft. x 60 ft.

BALTIMORE, MD.—Plans are under consideration by the Eastern Rolling Mills Company, Baltimore Street, for the rebuilding of its electric plant, recently destroyed by fire with loss of about $35,000.

North Central States

GREENVILLE, MICH.—The R. J. Tower Electric Company contemplates the installation of a new and larger generator in its plant. S. L. Tower is manager.

HOLLAND, MICH.—The Board of Public Works contemplates the installation of a 1500-kva. Allis-Chalmers turbine in the municipal electric plant. William Winstrom is secretary.

L'ANSE, MICH.—The Council is contemplating improvements to the municipal electric light plant, including reinforcing flume pipe and raising dam 3 ft. J. E. Everton is superintendent.

MARCELLUS, MICH.—The installation of two new generating units in the municipal electric and water plant for power and twenty-four-hour service is under consideration by the Village Council. Frank L. Knight is superintendent.

PLAINWELL, MICH.—The Eesley Light & Power Company contemplates the installation of a 700-kva. Allis-Chalmers generator and vertical wheel. J. F. Eesley is president and manager.

STURGIS, MICH.—The Board of Public Works is considering either the installation of an auxiliary unit, 500-kw. or 750-kw., Diesel oil engine or steam, in the municipal electric plant or the erection of a 16-mile transmission line to connection with the system of the Indiana & Michigan Electric Company at Constantine, Mich. J. S. Flanders is manager.

THREE RIVERS, MICH.—The municipal electric light and waterworks department is considering the erection of an additional circuit on its transmission system. O. O. Johnson is city manager.

PRAIRIE DEPOT, OHIO.—D. M. Scott, owner of the Scott's Electric Service, is planning to erect transmission lines into the country districts, covering 3 or 4 miles.

RICHWOOD, OHIO.—The Richwood Light, Heat & Power Company is contemplating securing service from the transmission service of the Columbus, Delaware & Marion Railway Company and extending its transmission lines to Essex and Magnetic Springs. Edward A. Schamb is secretary and manager.

SANDUSKY, OHIO.—The Sandusky Gas & Electric Company is installing additional equipment at its plant, increasing the output by 5000 kva. C. B. Wilcox is manager.

KENDALLVILLE, IND.—Improvements are contemplated to the municipal electric light plant, including the installation of a new boiler and erection of a chimney. S. E. Dickinson is manager.

NEW CASTLE, IND.—The City Council is contemplating the installation of a new street-lighting system, the erection of transmission lines and also the installation of a fire-alarm system. W. L. Younce is manager of the municipal electric plant.

NEWCASTLE, IND.—The city board of education will erect a $300,000 high school building.

ORLEANS, IND.—The stockholders of the Orleans Electric & Power Company and the Orleans Water Company have petitioned the Indiana Public Service Commission for authority to merge into the Orange County Public Service Company, with $70,000 common stock, $5,000 preferred, and to issue $50,000 in bonds. The present capitalization of the Orleans Electric & Power Company is $35,000 and the company has property worth $50,000. The Orleans Water Company has $35,000 capital stock and has property worth $53,000.

ROCHESTER, IND.—The United Public Service Company is considering increasing the generating capacity of its plant. Charles A. Davis is manager.

SOUTH BEND, IND.—The Atkins Safety Automatic Gate Company has increased its capital stock from $100,000 to $200,000.

TERRA HAUTE, IND.—The Hoosier Rolling Mill Company will erect a plant for the manufacture of merchant and structural steel, which will cost, when completed, between $2,000,000 and $3,000,000.

VEVAY, IND. — Improvements, involving an expenditure of about $13,000, are contemplated to the municipal electric light plant.

MARENGO, ILL.—The Marengo Public Service Company is considering the erection of several miles of farmer lines and possibly the erection of a transmission line to two towns. Robert T. Fry is vice-president and manager.

MARSHALL, ILL.—The Marshall Ice & Power Company contemplates the erection of an electric transmission line to West Union. G. C. Hallauer is owner and manager.

NOBLE, ILL.—The Noble Electric Light & Power Company contemplates the installation of a 25-hp. unit complete and also 2300/230/115-volt transformers. H. T. Flanders is president and manager.

ST. CHARLES, ILL.—A new switchboard is being installed in the municipal electric light plant. New transmission lines into the farming district, about 1½ to 2 miles, will be erected. George Allen is superintendent.

VERMONT, ILL.—The installation of an oil engine and generator in the municipal electric light plant is under consideration. Nothing definite has been decided upon. P. J Tingley is superintendent.

MILWAUKEE, WIS.—Ground has been broken for the proposed Lakeside power plant of the Milwaukee Electric Railway & Light Company, which will have an ultimate capacity of 200,000 kw. The initial installation will provide for an output of 40,000 kw., and two additional sections of 80,000 kw. will be added later.

STOUGHTON, WIS.—The municipal electric light department is considering the erection of additional rural transmission lines. G. W. Gander is general superintendent.

LARIMORE, IOWA. — The Larimore Light & Power Company is considering the erection of 8 miles of 2,300-volt transmission lines into the farming districts. J. F. Smith is owner and manager.

MAQUOKETA, IOWA.—Iowa Electric Company is planning the extension of electric service in rural districts near Toronto, Iowa.

TRAER, IOWA.—The Iowa Railway & Light Company contemplates the erection of an electric transmission line from Belle Plaine to Clutier and installing a distribution system in the latter town.

BETHANY, MO.—The installation of an engine and boiler in the municipal electric light plant is under consideration by the Board of Public Works. J. F. Slinger is manager.

BOONVILLE, MO.—The Boonville Light, Heat & Power Company contemplates some small line extensions. T. W. Long is manager.

ST. LOUIS, MO.—Plans are under consideration for the erection of a new plant for the Nation Lamp Division of the General Electric Company at Union and Brown Sts., to cost with equipment about $500,000. George W. Patterson of St. Louis is engineer. Headquarters of the company are at Nela Park, Cleveland, Ohio.

SELIGMAN, MO.—Thomas R. Gilliam, vice-president and general manager of the Silver Lake Mining Company of Seligman, has announced that the company has let the contract for a one-million-dollar plant to be built on its mining property one-half mile east of Seligman. The contract was awarded to an Oklahoma syndicate.

SWEET SPRINGS, MO.—Voting on $15,000 in bonds is contemplated for the purpose of enlarging and improving the city electric light and power plant.

UNIONVILLE, MO.—The Board of Public Works contemplates the installation of new boilers in the municipal electric plant, a series street-lighting system and rebuilding of all the electric lines. M. Flynn is superintendent.

WINDSOR, MO.—The Windsor Light & Power Company contemplates changing its entire plant to alternating current and extensions to its transmission lines. R. F. Williams is secretary and manager.

LEBANON, KAN.—The installation of a 200-hp. engine in the municipal electric light plant is under consideration. I. V. Arnold is superintendent.

LYNDON, KAN.—The installation of a 250-hp. generating unit in the municipal electric plant and the erection of a new transmission line is under consideration by the light and water department. Charles W. Rockey is superintendent.

OSAWATOMIE, KAN.—The installation of a 250-kw. steam driven generating unit, directly connected, in the municipal electric light plant is under consideration by the light and water department. B. L. Prier is manager.

WELLINGTON, KAN.—The installation of a 750-kva. turbo-generator unit and switchboard in the municipal electric light plant is under consideration. Ross Perry is superintendent of public utilities.

Southern States

MEBANE, N. C.—Plans and specifications have been made by the Durham Hosiery Mills, Durham, N. C., for a hosiery yarn mill. Electricty will be used for 10,000 spindles with a weekly capacity of 6,000 lb. The architect-engineer is J. E. Sirrine of Greenville, S. C.; the contractor, Aberthaw Construction Company of Atlanta, Ga.

ST. GEORGE, S. C.—Contemplated improvements to the municipal electric light plant include the installation of a crude-oil engine and two transformers. J. Olin Horne is the secretary.

FOLKSTON, GA. — Bonds to the amount of $10,000 have been voted for the construction of a municipal light and water system.

SANDERSVILLE, GA.—In March or April $30,000 bonds will be voted on for proposed city improvements. These include rebuilding the light and water plants, paving the public square and purchasing an auto fire engine.

MURFREESBORO, TENN.—The installation of new equipment is under consideration by the Murfreesboro Light & Power Company. The plans include a 300-hp. waterwheel, a 225-kw. generator with switchboard equipment and three 75-kw. transformers. J. C. Beasley is manager.

LANGDALE, ALA.—A two-story and three-story addition to their plant for cotton-cloth manufacture will be erected by the West Point Manufacturing Company. The addition, which is for opener room and warehouses, will be 540 ft. x 104 ft. and of brick mill construction. The contractor is the West Point Iron Works, West Point, Ga.; the architects, L. W. Robert & Company, Candler Building, Atlanta, Ga.

ROCK MILLS, ALA.—A proposed addition to the Wehadkee Yarn Mills, to be 74 ft. x 78 ft. and of brick mill construction, will cost about $70,000. Electric power will be used for the 2,856 spindles with a weekly capacity of about 30,000 lb. W. S. Freeman is the secretary-treasurer and general manager.

GEORGETOWN, MISS.—A company for the purpose of establishing electric light and water system and creamery and ice plants has been organized by A. Behrens.

BROUSSARD, LA.—The city is planning for a municipal electric light system Bonds to the amount of $8,000 will be voted on Feb. 24. L. J. Morvant is the mayor.

CLAREMORE, OKLA.—The installation of a 312-kva. electric generating unit in the municipal electric plant is under consideration by the municipal light & water department. H. F. Sprangel is manager.

NORMAN, OKLA.—Bonds to the amount of $125,000 have been voted for the construction of a municipal electric light plant.

TAHLEQUAH, OKLA.—The construction of an electric light power house to cost $16,442 has been undertaken by the city. A. M. Byrnes, of Fayetteville, Ark., is the contractor.

TULSA, OKLA.—Plans have been made by the Public Service Company for a new generating station 70 ft. x 100 ft. x 165 ft. The building, which is to be divided into three sections, will be of reinforced-concrete, steel and brick fireproof construction and will be equipped with boilers, steam turbo-generators, electrical switches, busbars and other electrical equipment. The total cost will be about $1,000,000.

BROWNWOOD, TEX.—The construction of a municipal electric power plant to furnish street lights and operate the waterworks pumping station is under consideration. E. R. Brashear is the manager.

MARSHALL, TEX.—The installation of two boilers, two turbine engines and other machinery is contemplated by the Marshall Electric Company in enlarging its plant. The estimated cost is $85,000.

WACO, TEX.—A three-story concrete and iron fireproof building, 210 ft. x 215 ft. and 210 ft. x 200 ft., will be constructed by the Miller Cotton Mills at an estimated cost of $300,000. A $20,000 electric plant for 150-hp. electric drive will be installed as well as 7,500 spindles and 200 looms, amounting to $200,000. Byron Miller is the president.

Pacific and Mountain States

SEATTLE, WASH.—The Board of Public Works plans the purchase of a huge traveling crane for use by the city lighting department at the extenson to the Cedar Falls power house on Cedar River. The crane will have a lifting capacity of 50 tons and will cost about $6,000. It will be operated by electricity.

MUKILTEO, WASH.—The Mukilteo and Seaview Improvements Clubs are considering plans for improvements to the lighting and power service in the city.

BEND, ORE.—Construction work at the steam plant of the Bend Water, Light & Power Company, Bend, is progressing rapidly, and it is expected the plant will be ready for power production by April 1. The original estimate of cost, $100,000, will be considerably exceeded. Two boilers, each composed of four units, will be placed.

ROSEBURG, ORE.—The application to the Public Service Commission by the Douglas County Light, Heat and Water Company for increased rates on light and power has led to the making of tentative plans to install a municipal lighting system.

HELENA, MONT.—The city is seriously considering the establishment of a hydro-electric plant near Rimini to generate power for operating the street-lighting system of Helena. With wood pipes the project will cost $125,000; concrete pipes, $175,000, and steel pipes, $225,000. It is understood the matter will be submitted to the voters shortly.

Canada

VANCOUVER, B. C.—Baynes & Horie have been awarded the contract for a new factory of the Canadian Carbonate Company to be erected in the Kitsilano district. The cost of the building, together with the necessary machinery to be installed, will approximate $70,000.

VANCOUVER, B. C.—Charles Royal of the Empress Stock Company has announced plans for the building of a new theater on Howe St. The cost of the proposed building is given as $300,000.

TORONTO, ONT.—The King Edward Hotel Construction Company will begin the construction of a $2,000,000 addition to the King Edward Hotel in February.

Miscellaneous

MILAN, ITALY.—It is reported that a company has been formed by Italian and South American capitalists for the purpose of making electrical installations in Brazil, Peru, Bolivia and other South American countries. The company is capitalized at 5,000,000 lire (about $750,000) and has as its president Albert Pirelli.

Directory of Electrical Associations

Printed in the First Issue of Each Month

Alabama Light and Traction Association. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

American Association of Engineers. Secretary, C. E. Drayer, Nepecnauk Bldg., 63 East Adams St., Chicago, Ill.

American Electric Railway Association. Secretary, E. B. Burritt, 8 West 40th St., New York City.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, Bethlehem, Pa.

American Institute of Consulting Engineers, Inc. Secretary, F. A. Molitor, 35 Nassau St., New York City.

American Institute of Electrical Engineers. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country. Midwinter convention, New York City, Feb. 18-20; annual convention, June 22-25.

American Physical Society. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

American Society for Testing Materials. Secretary-treasurer, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society. Secretary, H. C. Forbes, 29 W. 39th St., New York City.

Arkansas Utilities Association. Secretary, W. J. Tharp, Little Rock, Ark.

Associated Manufacturers of Electrical Supplies. General secretary, C. E. Dustin, 30 East 42d St., New York City.

Association of Edison Illuminating Companies. Secretary, Preston S. Millar, Electrical Testing Laboratories, New York City.

Association of Iron and Steel Electrical Engineers. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

Association of Municipal Electrical Utilities of Ontario. Secretary, S. R. A. Clement, 190 University Ave., Toronto.

Association of Railway Electrical Engineers. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern, Railway, Chicago, Ill. Annual meeting, Chicago, Ill., Oct. 28-31.

British Columbia Association of Electrical Contractors and Dealers. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C. Annual meeting, Vancouver, B. C., Oct. 19.

Canadian Electrical Association, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St., East, Toronto, Ont.

Colorado Electric Light, Power and Railway Association. Secretary-treasurer, F. O. Safford, Denver Gas & Electric Co., Denver, Col.

Conference Club. Secretary, Sullivan W. Jones, 19 West 44th St., New York City.

Commercial Section, N. E. L. A. Secretary, R. H. Tillman, Baltimore, Md.

Eastern New York Section, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

Electric Hoist Manufacturers' Association. Secretary-treasurer, W. C. Briggs, Shepard Electric Crane & Hoist Co., New York City.

Electric Furnace Association. Secretary, Dr. C. G. Schluederberg, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Electrical Manufacturers' Club. Secretary, F. L. Bishop, Hartford Faience Co.

Electrical Supply Jobbers' Association. General secretary, Franklin Overbaugh, 411 South Clinton St., Chicago, Ill.

Electrical Manufacturers' Club. Secretary, F. L. Bishop, Hartford Faience Co.

Electrical Supply Jobbers' Association, Atlantic Division. Secretary, E. Donald Tolles, 52 Broadway, New York City.

Electrical Supply Jobbers' Association, Pacific Coast Division. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

Electrical Trade Association of Canada. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

Electric Power Club. Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

Electric Vehicle Section, N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York City.

Empire State Gas and Electrical Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York City.

Florida Engineering Society. Secretary, J. R. Benton, Gainesville, Fla.

Illinois State Electric Association. Secretary-treasurer, R. V. Prather, Springfield, Ill.

Illuminating Engineering Society. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

Indiana Electric Light Association. Secretary, Thomas Donohue, Lafayette, Ind.

Industrial Electric Heating Association. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

Institute of Radio Engineers. Secretary, Alfred N. Goldsmith, College City of New York, New York.

International Association of Municipal Electricians. Secretary, C. R. George, Houston, Tex.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria Street, Westminster, London, S. W., England.

Iowa Section, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

Jovian Order. Jupiter (president), Arthur J. Binz, Houston, Tex.

Kansas Public Service Association. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

Michigan Section, N. E. L. A. Secretary, Herbert Silvester, Ann Arbor, Mich.

Minnesota Electrical Association. Secretary and treasurer, Meyer Barnert, St. Paul, Minn.

Mississippi Electric Association, affiliated with the N. E. L. A. Secretary, E. S. Myers, Vicksburg, Miss.

Missouri Association of Public Utilities. Secretary-treasurer, F. D. Beardslee, 315 N. 12th St., St. Louis, Mo.

National Association of Electrical Contractors and Dealers. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin. Annual convention, Baltimore, Md., Oct. 6.

National Association of Electrical Inspectors. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

National Electric Light Association. Executive assistant to president, M. H. Aylesworth, 29 West 39th St., New York City. Annual convention, Pasadena, Cal., May 18-21.

National Electrical Credit Association. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

National Fire Protection Association. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

Nebraska Section, N. E. L. A. Secretary-treasurer, B. H. Conlee, Nebraska Gas & Electric Co., Beatrice, Neb.

New England Electrical Credit Association. Secretary, Alton F. Tupper, 1 State St., Boston, Mass.

New England Section, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

New Mexico Electrical Association. Secretary-treasurer, Charles E. Twogood Albuquerque, N. M. Annual meeting, Albuquerque, N. M., February.

New York Electrical Credit Association. Secretary, Franz Neilson, 120 Broadway, New York City.

New York Electrical Society. Secretary, George H. Guy, 29 West 39th St., New York City.

Northwest Electric Light and Power Association, affiliated with N. E. L. A. Secretary, W. E. Herring, 860 Stuart Bldg., Seattle, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

Oklahoma Utilities Association. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City. Annual meeting, Oklahoma City, Feb. 10-13.

Pacific Coast Section, N. E. L. A. Secretary, A. H. Halloran, Rialto Bldg., San Francisco, Cal. Annual meeting, Hotel Del Monte, April 7-9.

Pennsylvania Electric Association, State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

Public Service Association of Virginia. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

Public Utilities Association of West Virginia. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

Radio Club of America. Secretary, T. J. Styles, 1112 S. Curtis Ave., Richmond Hill, Queens Borough, N. Y.

Rocky Mountain Association of Municipal Electricians. President, Lawrence Stone, Denver, Col.

Society for Electrical Development, Inc. General manager, J. M. Wakeman, 29 West 39th St., New York City.

Society for the Promotion of Engineering Education. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

South Dakota Electrical Power Association. Secretary-treasurer, L. V. Schneider, Salem, S. D.

Southeastern Section, N. E. L. A. Secretary-treasurer, Charles A. Collier, Georgia Railway & Power Co., Atlanta, Ga.

Southern California Electrical Contractors and Dealers' Association. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

Southwestern Electrical and Gas Association. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

Southwestern Society of Engineers. Secretary, C. E. Barglebaugh, 721 First National Bank Building, El Paso, Tex.

Technical and Hydroelectric Section, N. E. L. A. Secretary, W. C. Anderson, 29 West 39th St., New York City.

Toronto Electrical Contractors' Association. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

Tri-State Water and Light Association. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C.

Vermont Electrical Association. Secretary-treasurer, A. B. Marsden, Rutland, Vermont.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

Western Society of Engineers, Electrical Section. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

Wisconsin Electrical Association. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis. Annual meeting, Milwaukee, Wis., March.

Record of Electrical Patents

Notes on United States Patents

(Issued Jan. 20, 1920)

1,328,263. Machine for Assorting and Counting Paper Money. John P. Buckley and Allan E. Lard, Washington, D. C. App. filed July 12, 1916. Magnetic brake and electrically operated register.

1,328,269. Signal System for Controlling Street Traffic; Benjamin W. Davis, Chicago, Ill. App. filed Oct. 30, 1914. Combines clear and danger signal by push-button system.

1,328,288. Spintherometer for Radiotelegraphic Plants; Algeri Marino, Venice, Italy. App. filed Dec. 20, 1917. Oscillatory discharge of condensers.

1,328,311. Method of Operating Flaming-Arc Lights for Projectors; Preston R. Bassett, Brooklyn, N. Y. App. filed Dec. 18, 1916. Cored carbons used.

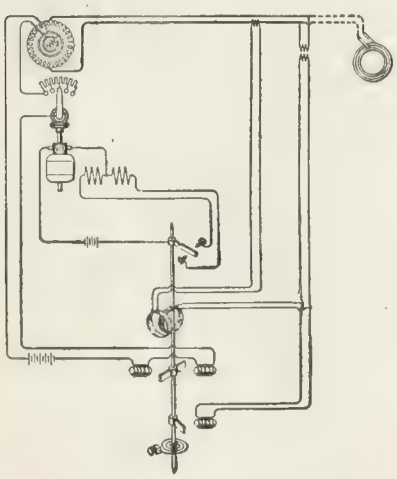
1,328,321. Electric System; John L. Creveling, White Plains, N. Y. App. filed April 4, 1916. Automatically maintains translating devices by storage battery.

1,328,326. Electric Circuit; Peter Cooper Hewitt, Rongwood Manor, N. J. App. filed June 25, 1913. Minimizes impedance effects in telephone circuits and long lines.

1,328,327. Electric Circuit; Peter Cooper Hewitt, Ringwood Manor, N. J. App. filed June 25, 1913. Inserts at intervals resistances varying when transmitting variations of energy.

1,328,336. Artificially Cooled High-Frequency Coil; Edwin F. Northrup, Princeton, N. J. App. filed April 18, 1919. Increases current-carrying capacity and improves insulation.

1,328,357. Method of and Means for Sealing Storage-Battery Connectors and Posts; Fred W. Barhoff, Hartford, Conn. App. filed April 7, 1919. Terminal posts are chambered downward and provided with external flanges at top.



No. 1,328,465—System of Power Transmission

1,328,358. Means for Sealing Storage-Battery Covers in Cells; Fred W. Barhoff, Hartford, Conn. App. filed April 7, 1919. Rubber tube inflated with fluid expands and packs joint.

1,328,359. Method of and Means for Sealing Terminal Posts in Storage-Battery Covers; Fred W. Barhoff, Hartford, Conn. App. filed April 7, 1919. For quick disassembling.

1,328,374. Electrical System; Hayner H. Gordon, Washington, D. C. App. filed Dec. 4, 1916. Ignition-system high-tension circuits energized from common transformer with single primary winding.

1,328,392. Grid Plate for Storage Batteries; Paul B. Rabe, Chicago, Ill. App. filed April 30, 1919. Exposes maximum surface of compound carried to electrolyte.

1,328,393. Storage Battery; Paul B. Rabe, Chicago, Ill. App. filed April 30, 1919. Grids and spacers on single support.

1,328,394. Storage Battery; Paul B. Rabe, Chicago, Ill. App. filed April 30, 1919. Dispenses with spacers.

1,328,420. Separator; Rufus N. Chamberlain, Chicago, Ill. App. filed Sept. 12, 1918. Thin separator conserves space.

1,328,454. Electric Signaling Device; Ralph R. Root, Cleveland, Ohio. App. filed Feb. 8, 1915. Vibrating automobile horn.

1,328,457. Overload Device; Arthur R. Sanborn, Schenectady, N. Y. App. filed Oct. 26, 1916. Electromagnetic automatic release for motor.

1,328,465. System of Power Transmission; Robert Treat, Schenectady, N. Y. App. filed March 4, 1918. Predetermined phase relation between current and voltage supplied to synchronous dynamo-electric machine.

1,328,466. Cigar Lighter; Tycho Van Aller, Schenectady, N. Y. App. filed Oct. 19, 1917. Resistance coil heated to incandescence.

1,328,467. Universal Motor; Alfred F. Welch, Fort Wayne, Ind. App. filed Jan. 4, 1918. For alternating-current or direct-current operation.

1,328,473. Means for Controlling Alternating Currents; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed April 20, 1918. Electromagnetic apparatus for high-frequency currents.

1,328,495. X-Ray Apparatus; William D. Collidge, Schenectady, N. Y. App. filed July 15, 1918. Diagnostic and therapeutic X-ray work.

1,328,501. Control of Electric Motors; John Eaton, Schenectady, N. Y. App. filed Dec. 8, 1916. For reversing motors on machine tools.

1,328,513. System of Control; Rudolf E. Hellmund, Swissvale, Pa. App. filed March 14, 1917. Predetermined speed during regenerative period irrespective of grade or curve variations.

1,328,514. System of Control; Rudolf E. Hellmund, Swissvale, Pa. App. filed May 26, 1917. Automatic control of railway motors.

1,328,515. System of Control; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 7, 1917. Speed control during both acceleration and regeneration.

1,328,516. Cigar Lighter; Maurice A. Hemsing, Davenport, Iowa. App. filed June 24, 1918. Jump-spark mechanism.

1,328,519. Reactance Shunt for Commutator Machines; John I. Hull, Schenectady, N. Y. App. filed July 18, 1916. Minimizes flow of harmful currents caused by self-excitation of commutator machine.

1,328,520. Alternating-Current Dynamo-Electric Machine Adapted for Synchronous Working; Louis J. Hunt, Sandycroft, Wales. For operating at two different pole numbers, either separately or in cascade.

1,328,525. Alternating-Current Motor; William C. Korthals-Altes, Schenectady, N. Y. App. filed Feb. 14, 1918. Two rotor windings of induction motor form a mechanically single two-layer winding constructed with coils whose pitch gives a balanced winding.

1,328,546. Electric Fuel Heater; Ludwig Reichold, Pittsfield, Mass. App. filed July 30, 1919. Located in intake pipe of internal-combustion engine.

1,328,552. Apparatus for Making Sulphuric Acid; Harry V. Welch, Los Angeles, Cal. App. filed Oct. 1, 1918. Sulphur dioxide and oxides of nitrogen subjected to heat and humidification.

1,328,575. Method for Synthetic Production of Cyanides and Nitrides; Axel Rudolf Linblad, Stockholm, Sweden. App. filed Oct. 18, 1918. Incompletely closed furnace used.

1,328,581. Candle Socket; Harry J. Morey, Syracuse, N. Y. App. filed Feb. 27, 1918. Socket and casing held by sheet-metal stamping.

1,328,597. Electrical Vacuum Apparatus; Moritz Schenkel, Carlottenburg, near Berlin, Germany. App. filed Sept. 6, 1916. For mercury-vapor arc rectifiers.

1,328,610. Method of and Means for Controlling High-Frequency Alternating Currents; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Jan. 21, 1916. For wireless signaling systems.

1,328,620. Sounding Chamber for Thermic Telephones and Other Apparatus; Pieter de Lange and Robert Aernout van Lynden, Utrecht, Netherlands. App. filed Nov. 4, 1915. Closes outside of auditory passage.

1,328,631. Controlling Means for Electric Motors; Leonard Kebler, Bronxville, N. Y. App. filed Feb. 3, 1917. Starting panel with circuit breaker and a starting rheostat.

1,328,666. Metallurgical Process; William E. Greenawalt, Denver, Col. App. filed Aug. 5, 1918. Extracts copper by use of sulphurous and sulphuric acids.

1,328,687. Insulator Support; Bentley A. Plimpton, Victor, N. Y. App. filed Oct. 31, 1917. Allows for expansion and contraction.

1,328,712. Method of Melting Brass and Similar Scrap; Walter R. Clark, Bridgeport, Conn. App. filed May 6, 1918. Maintaining surface of charge at a predetermined temperature.

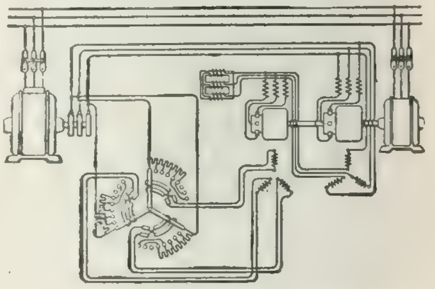
1,328,713. Electric Furnace; Walter R. Clark, Bridgeport, Conn. App. filed May 6, 1918. Channel below bath for heating and circulation.

1,328,714. Method of and Means for Melting Brass and Similar Scrap; Walter R. Clark, Bridgeport, Conn. App. filed June 13, 1918. Preheated before feeding into furnace.

1,328,720. Combination Terminal Block and Lightning Arrester; Roy Connell, Buffalo, N. Y. App. filed June 20, 1919. Grounds high-potential discharges.

1,328,723. Electric Heater; James M. Curless, Chicago, Ill. App. filed July 28, 1917. Treats insulating compounds.

1,328,732. Insulator Pin; Rhinehart W. Harms, Chicago, Ill. App. filed May 8, 1915. Strong bolt support readily taken down or adjusted.



No. 1,328,519—Reactance Shunt for Commutator Machines

1,328,736. Electrically Operated Typewriter; Ernest Hausberg, Charles City, Iowa. App. filed March 11, 1916. Applied to typewriter of usual design.

1,328,769. Sealing-Wax Applier; Carroll K. Spencer, River Forest, Ill. App. filed Jan. 16, 1919. Melted sealing wax flows from container.

1,328,774. Electrical Attachment Plug; William C. Tregoning, Cleveland, Ohio. App. filed Feb. 6, 1913. Screw member rotated without twisting connection.

1,328,783. Attachment Plug; Reuben B. Benjamin, Chicago, Ill. App. filed Nov. 5, 1915. Plug inserted in sockets without removing shade.

1,328,784. Binding Terminal; Reuben B. Benjamin and Ernst G. K. Anderson, Chicago, Ill. Terminal fits in sheet-metal chamber and is locked by binding screw.

1,328,785. Electrical Receptacle; Reuben B. Benjamin, Chicago, Ill. App. filed April 19, 1917. Number of lamps and pull-switch mechanism for controlling circuits.

1,328,797. Means for Controlling Alternating Currents; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Nov. 26, 1915. Construction of magnetic amplifiers.

Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 75 New York, Saturday, February 14, 1920 *Number* 7

When the Public Owns Stock

WHEN public utilities were operated for maximum profits and minimum service and the "public-be-damned" kind of public policy was in force, unpleasant complaints, unfavorable verdicts in damage suits and wrangles with city officials were the order of things. Nowadays, when the public owns stock and "service" is the governing policy in operation, it is different. The harangues of the politician are scoffed at, the regulating commissions listen to arguments in favor of a fair rate of return to the common people to whom they are responsible, and the stock-holding juryman weighs evidence carefully when it touches his own pocketbook and there are prospects of reducing his ability to pay his lighting bills with his dividends. When the public owns stock the public utility has a friend at court.

Delayed Deliveries

THE delays in deliveries and the acceptance of orders by manufacturers for deliveries far in the future are causing a great deal of explaining these days and placing the facilities of the manufacturer in an unfavorable light. While it is true that the volume of business now piling up in certain lines, particularly in contracting supplies and motors, is calling for a material expansion in manufacturing facilities, the problem of obtaining raw materials is a very serious cause of the slowness of deliveries. In many cases electrical manufacturing plants are able to turn out all the apparatus that available material will permit, and until the stocks of raw material depleted by the war are replenished and the outputs of mills producing sheet steel and tubes, drawn copper and the like are greatly increased, the long deliveries on orders can be little relieved. These are conditions which call for careful estimates of future demands and a great deal of patience.

N. E. L. A. Organized for Service

PRESIDENT BALLARD before starting on his homeward journey to the Pacific Coast last Saturday announced that his recommendation to the executive committee of the National Electric Light Association to departmentalize the activities at headquarters had been favorably received. The new plan is to reorganize the work of the main office at New York City into departments similar to those of an operating company. Two new departments are therefore proposed, one to consider engineering problems and another to handle publicity. Each of these divisions will be in charge of a man familiar with the work involved and be conducted along lines similar to the three departments already existing and devoted to committee service, company service, and finance and accounting. It is also proposed to reorganize the control of association affairs through the executive committee so that the different sections of the country shall be represented according to the volume of business done. This places the N. E. L. A. work on a service basis and gives the geographic idea a new meaning. When the matter comes up for final approval at the Pasadena meeting in May in its present form or some better one it should be unanimously adopted. This is a big idea—one that will give to the geographic sections just what they have been looking for and a service they could not render themselves without a great deal of duplication. The details of the plan, now in the hands of a special committee, are looked forward to with a great deal of interest.

The Pacific Coast Spirit

TWO years ago last December the California electrical co-operative campaign was launched to preach the gospel of co-operation both within the industry and to the public. The results of this effort to date have been inspirational. For the year 1920 the sum of $27,000 is being subscribed jointly by contractor-dealers, central stations, jobbers and manufacturers. This sum is made available for expenditure under the guidance of an advisory committee consisting of representatives from all four branches of the industry who meet once a month and discuss campaign operations. Four field agents are employed to go throughout the district, studying merchandising methods and lending a hand here and there in their betterment.

On another page of this issue some of the tangible results of this campaign are set forth that are proving of great present-day benefit to the central station. But the greatest result of this work cannot be expressed in tangible figures. The California co-operative campaign today lends its influence in searching out and holding before the industry new and healthy ideals of electrical service. As a result a better and more enlightened public sentiment prevails, and among all branches of the industry a helpful, co-operative spirit exists that spells value beyond measure to the future growth and prosperity of our industry.

At the present time the California idea is being investigated by a national committee appointed by President Ballard of the National Electric Light Association. This committee has in its membership representatives of all branches of the industry. It will report its findings at the Pasadena convention of the association in May. While it is true that local conditions in other sections of the country will unquestionably require some modification of the California plan, findings of this committee will be generally applicable. The main thing to guard against is not to embrace in any proposed campaign too big a section or community at a time; in other words, so big a section of country that personal contact, both within the industry and with the public at large, cannot at all times be maintained. In addition to this, autonomy, or rather self-determination, for the district in which the campaign is inaugurated should be practiced in the highest degree. When all branches of the industry thus feel that the problem is for them to solve together, a certain spirit will come into the work that will make success spontaneous.

Increase of Electrical Equipment

TODAY both the central-station operator and those who supply him are between two fires—the evident need of meeting unusual demands for output and the formidable cost of doing so. Judged by old standards, the situation is abnormal and a little precarious. How shall it be met? To the discussion of this question A. W. Berresford contributes some very judicious suggestions in our current issue. Their wisdom will at once appeal to the reader, and to them we would merely add a brief word of forecast and warning. The war has done far more than to produce extraordinary temporary demands, sudden shifts of front in industrial activity and a wild orgy of inflation from which the world is drunk and dizzy. It has wrought as well changes in purpose and outlook that are likely to have permanent effects. Not the least of these is in our own particular field of electrical industry. The time is now here when manufacturing activity must depend far more than ever before on power and machinery to fill the place of labor the world over—labor decimated by war's destruction and demoralized by war's madness. Mankind must get the maximum of production with the minimum of human effort, that such effort may be conserved for the thousand tasks not yet within the reach of machinery. For this reason we believe that the lessons of electrical equipment taught by the war will not be forgotten and that increases must go swiftly on in plant and shop until there shall be a new balance struck between labor and necessity that will lead to production in the half-deserted fields, leaving the tasks of the shop to those who watch over the almost sentient steel and the all-persuading switch.

Protection Against Line Surges

IT IS a familiar fact that surging in its various unpleasant varieties on transmission systems is an ever-present problem and sometimes becomes very unexpectedly a serious impediment to continuous operation. Lightning is bad enough, but it is confined to certain seasons and can be dealt with by means of ground wires and electrolytic lightning arresters with at least a fair degree of success. Surging, however, often manifests itself at unprotected spots and to very unexpected degrees. Wherever on a power transmission system there is, so to speak, a partial discontinuity in the electro-dynamic conditions there is a chance for sudden rises of voltage which if conditions are favorable may prove very mischievous. Our readers will therefore be particularly interested in the article by C. E. Bennett in this issue on a species of surge valve which he has developed to meet these abnormal voltages. The general scheme is a very simple one—a horn-gap connection to ground through an automatically interrupted resistance. The horn gap is set much closer to the normal maximum line voltage than would be the case with the lightning arrester, and in so far suggests the branch circuit to ground from an arrester which has long been in use. The specially striking feature of Mr. Bennett's development is the means taken for providing a resistance which automatically breaks the circuit and then restores itself to its original condition. The sketches published with the article show admirably just how this is accomplished.

Simplicity is a marked characteristic of this device, and, judging from the oscillogram, it is exceedingly effective, breaking the circuit in a tenth of a second or so and very quickly resetting the surge trap for further use. The same apparatus also operates as a lightning arrester, tending then to produce a break-down of the dielectric strength of the liquid and ground the circuit, followed at once by normal functioning of the apparatus and the interruption of the discharge. The automatic break undoubtedly gains effectiveness from being in series with a permanent gap and evidently might be conveniently used with a series of horn gaps or non-arcing cylinders, or as a shunt to earth at some point of such a series. The practical question of attention does not appear to be a serious one as the break is quick enough greatly to lessen the danger of smashing the tube or seriously damaging its insulating powers. A change in the electrolyte, or for that matter the tube length, readily varies the ground resistance, and obviously the stability of the resistance in use can easily be tested by measurement between the electrode and the case. Altogether the device looks very promising, and it should provide a ready means for getting rid of surges, one of the very considerable annoyances of practical power transmission.

Quality Versus Cheap Products in Oriental Markets

AN EMINENT authority on world trade, Julian Arnold, United States commercial attaché at Peking, China, in a recent public address in San Francisco directed attention to an important feature of our present commercial policy abroad which reflects decided credit upon the methods of American business leaders. Commenting on the export efforts of a leading American electrical manufacturing concern, Mr. Arnold stated that this company, though conducting a substantial and ever-expanding busines in China, is in no wise lowering the standards of its products, keeping them as high as those prevailing in this country. That this policy has proved successful, he said, is evidenced by the confidence displayed in these electrical wares by the Chinese, who appreciate quality as well as people of other nations.

It is a noteworthy fact that American "quality products," such as high-class electrical machinery, are able to hold a good share of the trade in the Oriental field, which is sometimes disparaged as "a cheap market." American goods are accomplishing this despite the keen competition and underselling of the manufactured products of Japan and other countries. The maintenance of a consistent quality standard on which dependence may invariably be placed is what makes this condition possible. It is gratifying to have an authoritative statement regarding this adherence to American manufacturing tradition in our world trade, and better still to know that the electrical industry is once more leading the way. Best of all, this sound policy is getting the business.

Improvements in Substations and Distribution

WE WONDER what the central-station man of five-and-twenty years ago would have said if he had been assured that his ordinary generating station would presently be working at 13,000 volts and his distribution from substations at 4,000 volts or more. Our account this week of the new Kansas City substations gives a vivid idea of what has really happened. There are many details to which attention may well be directed. Not the least among them is the use of the three-phase, four-wire distribution at rather higher voltage than usual, the pressure between phase wires being 4,400 and from phase wire to neutral 2,540. This means a possible saving of more than 20 per cent in copper above the more usual figures and a corresponding gain in other particulars, a gain all the more important since the fundamental lighting distribution is on derived single-phase circuits. There is probably some reason for this in prior history, since in using the three-phase, four-wire scheme the tendency is to have the courage of one's convictions and carry it through, at least for the chief circuits, clear up to the secondaries.

In the substation arrangements some interesting and useful modifications have been introduced. The 13,200-volt feeders connecting the several substations with the power plant are not tied together, but each delivers energy to its own set of transformers, so that if a cable goes up it is automatically cleared at the generating switchboard with a minimum disturbance of the system. There is also additional security in the form of a reserve cable feeding a reserve bus upon which any set of transformers can be thrown. These reserve buses are of unusual construction, being of stranded, insulated cable installed in fiber conduit and hung from the basement ceiling, with provision for the ready installation of additional cables. In the 4,400-volt bus structure with its necessary provision for many connections a very convenient method of construction was devised. The various compartments are formed of standardized concrete sections cast beforehand to shape and assembled on a concrete base which is cast in place. It is like building up skillfully planned blocks on a table. After everything is in place, smoothly adjusted and fitted, the main retaining wall is cast in place. The plan simplifies construction admirably, and molding the parts in advance gives plenty of flexibility in design.

Thermal Conductivity of Coil Wrappers

IN THE practical service of dynamo-electric machines, especially in large sizes, the limitations to output are found ordinarily in the temperature attained at the hottest spots of the armature conductors in the coil windings. The temperature attained in these windings for any given current strength carried depends upon the thermal conductance of the insulation. If this thermal conductance were very large, the heat would escape from the conductors into the armature, with an indefinitely small temperature elevation above that of the laminated core slots. It would then only be necessary to measure, by thermometer, the temperature in this laminated mass of core body, and the hottest-spot temperature would be identical therewith. On the other hand, the smaller the thermal conductance of the insulation, or the greater its thermal resistance, the greater will be the drop of temperature incident to the flow of heat through it, and the greater will be the temperature elevation of the hottest spots above the surrounding walls of the core slots. It is thus a matter of considerable practical importance to determine the amount of the thermal conductance of the insulating material and the rules which govern it.

The laws of thermal resistance bear a remarkable analogy to those of electrical resistance and may be expressed by an equation like that of Ohm's law. The thermal resistance in a slab of material varies directly as the length of path, inversely as the cross-section, and directly as the thermal resistivity. The geometrical relations of the armature conductors resting in the slots determine the mean length and mean cross-section of the thermal conducting path within fairly narrow limits, so that the thermal resistivity of the material becomes an important residual factor. The lower this resistivity, or the greater the conductivity, the lower will be the temperature drop between the conductor and the external surface. A premium is thus automatically established upon a maximum of dielectric strength with a maximum of thermal conductivity in the insulating material, which must also possess, of course, the necessary mechanical strength and pliability.

Dr. T. S. Taylor describes in an article on page 368 the nature and results of laboratory tests made to measure the thermal conductivity of coil wrappers used in dynamo-electric machines. As the article points out, the numerical values obtained must be expected to vary over a considerable range, owing to the absence of complete uniformity in physical and chemical conditions.

An interesting feature of the report is the appearance of a temperature coefficient of thermal conductivity. It seems that this is positive and about 0.001 per degree centigrade. If this is substantially constant over the ordinary range of temperature, then it may be inferred that the conductivity of the insulation, under rated load temperatures, is about 5 per cent greater than when the machine starts cold.

Dangers of Deferring Maintenance

AN EPIDEMIC of accidents resulting in interruptions to service has broken out in many large and small electric central-station companies. Electrical and mechanical weaknesses are the immediate causes of these troubles, and these weaknesses have developed because the usual program of maintenance and replacement was deferred owing to the war and to the subsequent hesitation over buying apparatus for replacement at high prices. But if the good name of the public utility service is to be safeguarded, this condition of affairs must be remedied at once. Outages and accidents must be reduced. It is better, even at present prices, to replace inadequate or obsolete equipment than to defer the usual maintenance program longer. Hence the immediate future should see many plants thoroughly inspected with the object of marking for rapid replacement apparatus likely to fail. Reliable service must be maintained at any cost. Service is the shibboleth of the industry, and proper maintenance not only makes for increased reliability of service but pays as well. It would be just as unreasonable to expect a full day's work from a weak and starving man as it is to depend for service on crippled equipment.

John W. Lieb

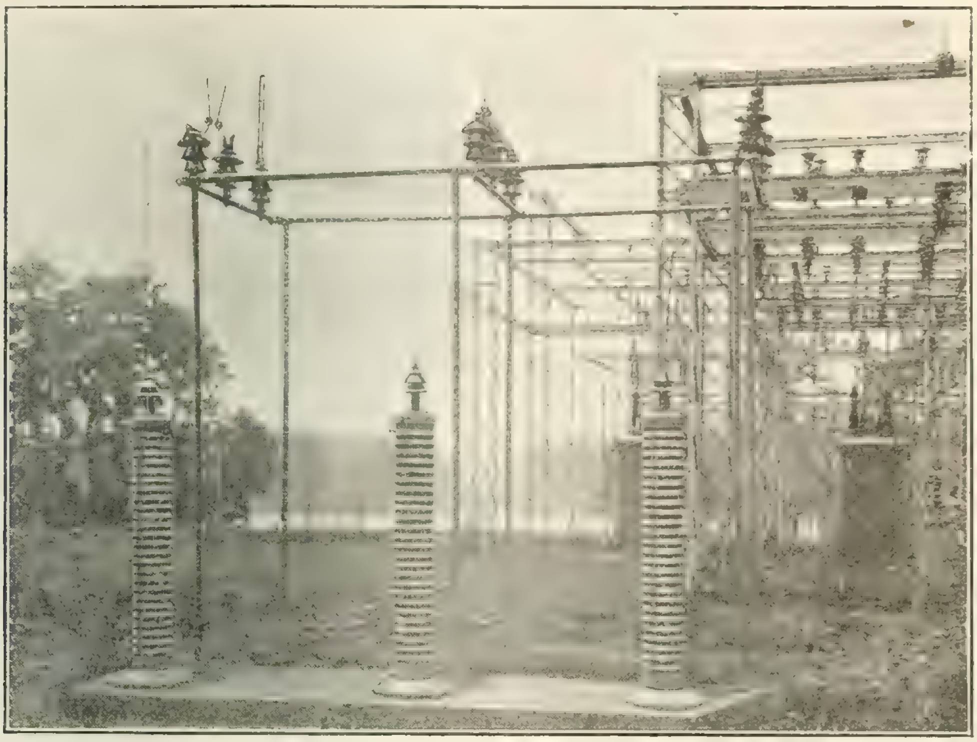
An executive-engineer whose services to the industry date from the establishing of central-station service in New York City

WHEN the famous Pearl Street station was started in New York City on Sept. 4, 1882, John W. Lieb held the position of electrician, secured through rare experience in conducting tests on the Jumbo generators in that station. Later he was chosen to carry this knowledge of the Edison system to Italy, where he supervised the introduction of underground systems for the Italian Edison Company. In 1894 he returned home to become assistant to the first vice-president of the Edison Electric Illuminating Company, continual promotions leading him to his present office—that of vice-president of the New York Edison Company. Merely to recount these facts, however, gives no real idea of Mr. Lieb's relation to the electrical industry. His wide influence and untiring activity are better indicated by the unremunerative offices he has held, which include the presidency of the Association of Edison Illuminating Companies, the National Electric Light Association, the American Institute of Electrical Engineers, the New York Electrical Society and the Edison Pioneers. In the N. E. L. A. he has been a directing and controlling force, serving since 1914 as a member of the public policy committee and acting as the representative of the association in the National Industrial Conference Board. When the United States entered the war the leaders of the industry found a new outlet for Mr. Lieb's energy. Together with the others he grasped at once the important part the central station would have to fill in the struggle and the necessity for preparedness. Throughout the war he was chairman of the National Committee on Gas and Electric Service, and under his guidance, with the co-operation of other strong minds, the utilities rendered a loyal and absolutely essential service to the war industries that impelled national recognition. He is a man with both the power to conceive and the energy to execute plans of action, one of an outstanding group of men who are continually setting new standards for the electrical industry. On Thursday of this week Mr. Lieb celebrated his sixtieth birthday.

Protecting from Abnormal Voltages

Construction and Operation of a Surge Arrester Designed to Protect Generating and Transmission Systems from Abnormal Potentials Caused by Lightning, Switching, Arcing Grounds, Etc.

By C. E. BENNETT
Special Engineer Georgia Railway & Power Company



A SURGE ARRESTER INSTALLATION ON THE LINES OF THE SOUTHERN POWER COMPANY AT CHARLOTTE, N. C., OPERATED AT 44,000 VOLTS DELTA-CONNECTED. THIS IS THE COMPANY'S MAIN DISTRIBUTION STATION IN THAT DISTRICT, IN THE HEART OF ITS SYSTEM

SEVERAL years ago experiments were undertaken by the writer with the object of developing a lightning arrester—or, more accurately, a surge arrester—which would offer a high degree of protection to transformers and other station apparatus without incurring heavy maintenance charges for the arrester itself. The electrolytic arrester was, of course, available, with the ideal discharge characteristics which this apparatus affords; but equipment was desired which would be low enough in first cost to be available for small substations and still be free from troubles previously experienced on the horn gap and resistance type of arrester ordinarily used for small installations. As the result of a large number of experiments and field tests, a surge arrester has been developed in various sizes to meet all practical requirements for any service up to 110,000 volts.

This surge arrester is designed on the principle of using water as the medium to absorb and dissipate the energy of the discharge and automatically extinguish the arc. While intended primarily to relieve direct or induced potentials from lightning disturbances, it has been found that the equipment is equally efficient in relieving surges from any other cause, such as switching, arcing grounds, flashover of insulators and like occurrences.

The apparatus consists essentially of a horn gap and a resistance element mounted as a complete unit. The horn gap is connected directly to the line, while the resistance element or liquid surge arrester is connected between the horn gap and the ground. This liquid surge arrester consists of a metal tank filled with a water solution or electrolyte of proper density, with a heavy porcelain or glass tube mounted therein, as shown in Fig. 1, so that the long column of water inside the tube serves as the resistance element.

As shown in Fig. 1, the tube inside the tank is open to the electrolyte at its lower end, the upper end extending above the electrolyte and through the top and above the tank. The electrolyte entering the bottom of the tube comes to the same level as that in the tank surrounding the tube. Extending from the top of the tube and connected to the horn gap is a metallic conducting rod, the end of which is slightly submerged and in contact with the electrolyte inside the tube. The metallic tank of the apparatus is connected to the ground circuit and forms the ground electrode of the apparatus. The electrolyte, in addition to its other more important functions, serves as a primary limiting resistance to ordinary line discharge across the arrester.

ADJUSTABLE DISCHARGE RATE CONFORMS TO LINE CAPACITY AND LOADING

The water resistance of this liquid surge arrester functions as an automatic circuit breaker whenever current is discharged through it. Its internal resistance is so graduated for different voltages that the highest possible discharge rate is secured for any impulse or excessive potential which may be superimposed upon the lines connected to it, but is such that the subsequent flow of dynamic current following a discharge to ground will not disturb the operation of the system. The exact resistance of each unit may be changed as desired by simply changing the density of the solution.

In most cases the requirements are for an equipment which will discharge waves of excessive potential, but in some cases large current capacity is also needed. For service on power-house busbars it is advisable to have a surge arrester of large current capacity to meet the conditions caused when an oil switch opens under heavy overload or short circuit. When the abnormal rush of current from generators to the point of overload is interrupted instantaneously by the oil switch, the excessive potential and currents will then be discharged through the arrester instead of causing the usual trouble at the switch. The arrester in this case acts as a relief valve, protecting the switch from injury.

The surge arrester of the design under discussion provides a high-capacity discharge path from each phase to ground, and its tapered discharge provides additional protection. In removing such a discharge the arrester carries a maximum current during the first few cycles, and as the arc is drawn out the current is uniformly reduced until it is finally extinguished in approximately one-tenth of a second. The oscillogram shown in Fig. 2 is from an actual test made to show the flow of dynamic current which followed a discharge, with the horn gaps set for 25 per cent over line voltage, the gaps being short-circuited to cause the discharge. The tapered action of the discharge is shown in this oscillogram.

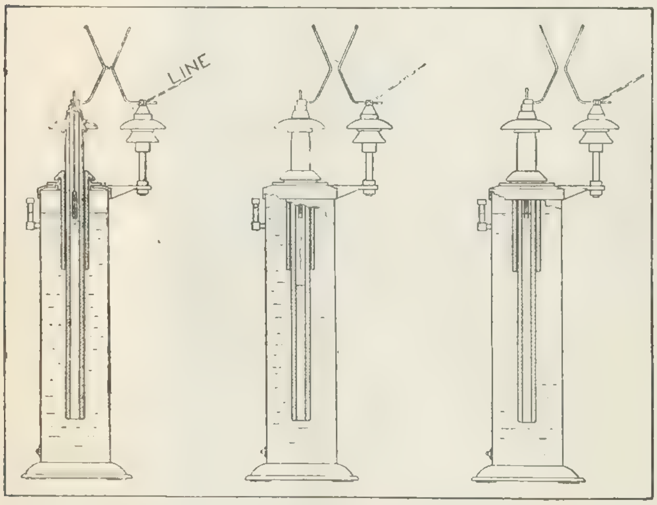


FIG. 1—DETAILS OF CONSTRUCTION AND THREE STEPS IN THE CYCLE OF OPERATION OF THE SURGE ARRESTER

At the instant of discharge the steam formed by the electrode comes in contact with the water column. The steam in expanding creates a pressure which immediately drives the column of water downward, drawing out the arc inside the cold tube, as shown in the center illustration of Fig. 1. This automatically extinguishes it within a few cycles without causing any interruption to service on the line. When the arc is extinguished the water immediately rises, being drawn upward very rapidly by the vacuum formed, and the arrester is restored to normal condition as shown in the illustration at the right in Fig. 1. To prevent unnecessary evaporation the main body of the liquid is covered by a thin layer of oil. A suitable gage is provided so that the liquid can be readily observed and more water can be added easily if necessary.

The cross-section views of a 33,000-volt equipment in Fig. 1 show the cycle of operation of the surge arrester. The sphere or horn gap is set usually to between 15 and 25 per cent above normal line votage. If the potential rises above this value, the gap fires and automatically drains the line of the abnormal potential through the interrupter.

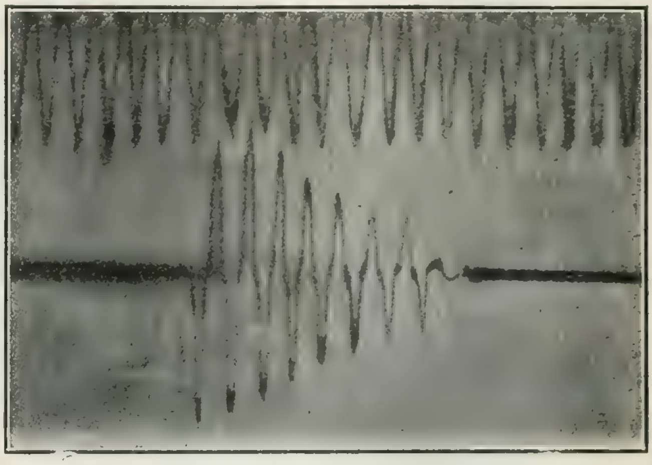


FIG. 2—OSCILLOGRAM SHOWING NORMAL DISCHARGE OF SURGE ARRESTER FROM AN ACTUAL TEST MADE WITH THE HORN GAPS SET FOR 25 PER CENT OVER LINE VOLTAGE, THE GAPS BEING SHORT-CIRCUITED TO CAUSE THE DISCHARGE

In discharging a lightning disturbance the action of the liquid interrupter is somewhat different from its behavior on line disturbances caused by normal operation. The liquid or electrolyte contained in the interrupter has a certain definite dielectric value. The potential of the lightning flash is so high and so suddenly applied that the dielectric strength of the liquid is broken down and the liquid punctured, giving a free path through the liquid of small resistance directly to the ground. The generated or line current immediately follows, but before it has reached any great value the dielectric strength of the liquid is automatically re-established, having healed and closed the opening or path caused by the lightning discharge, and the appartus then works as under normal discharges as follows:

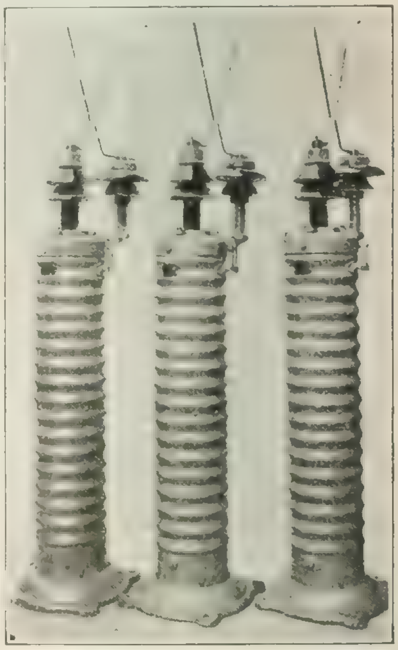


FIG. 3 — A SET OF SURGE ARRESTERS FOR OPERATION ON A THREE-PHASE SYSTEM AT 38,000 VOLTS

The line current having once crossed the sphere or horn gap passes through the stem of the upper electrode and into the electrolyte at the contact between the upper electrode and the electrolyte inside the tube. This rapidly causes the production of a heated vapor which in turn produces sufficient pressure in the chamber above the electrolyte to cause the electrolyte to recede from its contact with the upper electrode and to draw an arc between that electrode and the surface of the electrolyte, this arc being greatly attenuated by the continued receding of the surface of the electrolyte within the tube. The arc is then extinguished within the tube of the interrupter and on the external air gap.

The extinguishing of the arc within the interrupter takes place almost instantaneously, under normal conditions. Its operation is accomplished by the application of two fundamental principles, the first being obviously the attenuation or drawing of the arc and the second being the more active principle and considerably more complex. To grasp the action or application of this second principle, it must be remembered that the tube is submerged in a liquid of high heat absorbing and conducting capacity, the electrolyte being principally composed of water. This serves rapidly to convey and absorb the heat of the arc generated within the tube by keeping the tube cold, the heat being conducted through the tube into the liquid surrounding it, and the heat is also absorbed by the production of steam within the tube. A marked amount of heat energy becomes latent during the steam-producing operation. The arc is then extinguished in a similar manner to that of any other flame. The water or electrolyte is in direct contact with the arc, giving it an atmosphere of steam through which to pass. The steam, in addition to its own energy consumption during its formation, provides a medium for the heat transference to the tube. The tube, being of porcelain or glass, provides a path of high heat-conducting capacity to the cold electrolyte surrounding it. In this manner a chamber is established in which the arc is attenuated, because it is too cold for the arc to be maintained, the heat of the arc being more rapidly absorbed than it is propagated. Therefore the basic principle of the operation of this apparatus is one involving the thermodynamics of its action.

PRINCIPLES ON WHICH ARRESTER OPERATES

An arc when once formed is largely maintained by the volatilization of the metallic terminals from which the arc is sprung. In this apparatus only one terminal is metallic, the other being the surface of the water. The metallic or conducting vapor from the other terminal is immediately condensed, because of the comparatively cold, heat-energy-absorbing medium through which it passes, and it therefore does not increase the conductivity of the arc path. All of these heat-absorbing operations assist in extinguishing the arc flame, and as every action is nearly instantaneous the arc is almost immediately interrupted after once forming within the tube of the interrupter.

The upper end of the tube is nearly closed, a small vent hole being left in the tube cap the function of which is to restore the position of the surface of the liquid within the tube. If the vent is not included, the surface of the electrolyte will rise above the normal position. A certain amount of vapor or air having been expelled

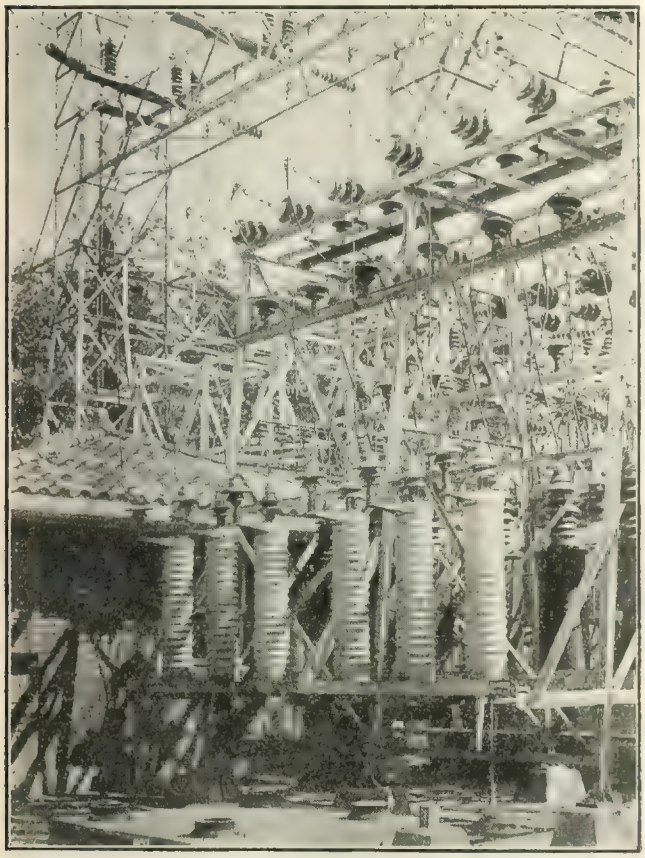


FIG 4—TWO SETS OF THREE-PHASE SURGE ARRESTERS INSTALLED AT THE NORCROSS (GA.) SUBSTATION OF THE GEORGIA RAILWAY & POWER COMPANY OPERATED AT 38,000 VOLTS Y-CONNECTED

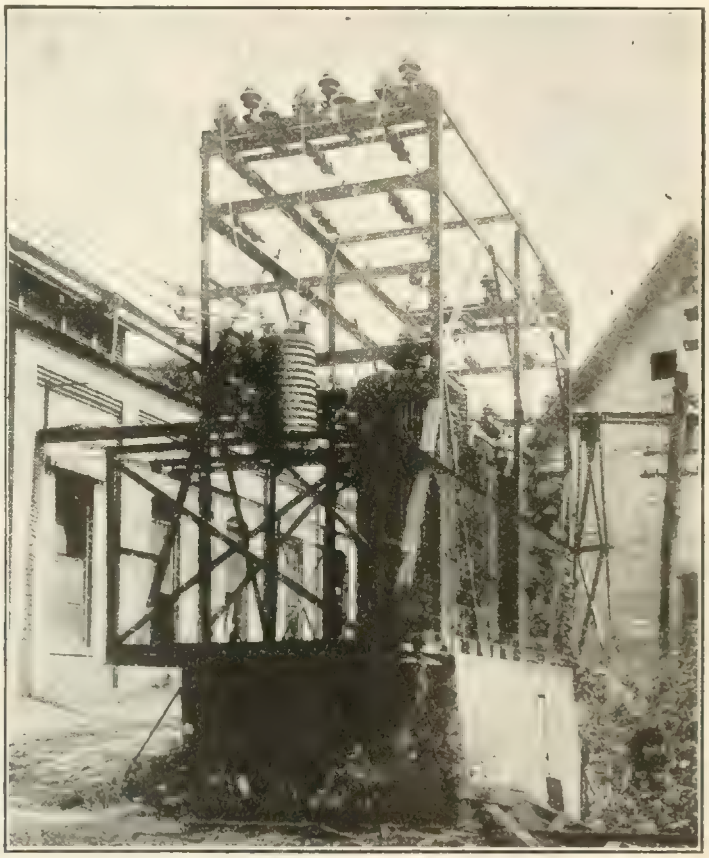


FIG. 5—A THREE-POLE, 19,000-VOLT Y-CONNECTED SURGE ARRESTER INSTALLATION AT A SMALL SUBSTATION ON THE TRANSMISSION SYSTEM OF THE GEORGIA RAILWAY & POWER COMPANY

in the operation of the interrupter, the space previously occupied by this air or vapor is filled with steam. The condensation of this steam takes place almost instantaneously following the interruption of the arc, and a partial vacuum is established in the expansion chamber above the surface of the electrolyte. This vacuum, plus the difference in hydrostatic head between liquid within the tube and that surrounding it, serves to immediately re-establish the contact between the upper electrode and the electrolyte by causing the electrolyte to rise quickly within the tube. The apparatus is thereby reset for a succeeding discharge.

The mere attenuation of an arc within the tube or in the presence of air or a similar gas, or a vacuum, does not have a great tendency to interrupt the arc path. This is particularly true of arcs sprung in air or in other gas, or in vacua which are not surrounded by a tube.

The arc drawn by a horn gap is usually blown out by air movement, this air movement supplying to a small extent the cooling operation which tends to extinguish the arc during its attenuation. If the terminals of a horn gap are sufficiently heated by the passage of the arc, the arc once blown out by air movement will re-establish itself across these heated terminals and the operation of blowing it out will be repeated. If the arc is drawn in a vacuum, it will continue until the current flow is interrupted from some external cause or until the terminals are melted.

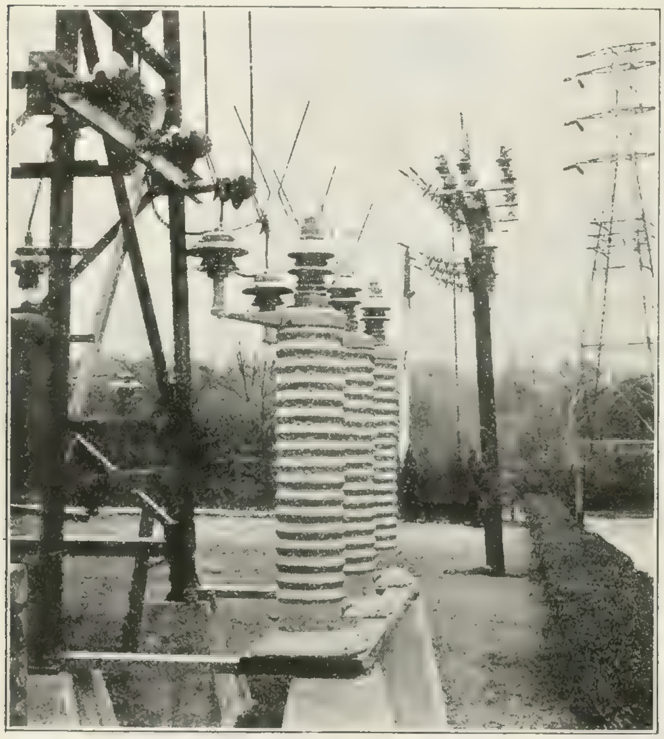


FIG. 6—AN INSTALLATION OF SURGE ARRESTERS ON 38,000-VOLT CIRCUITS AT THE BOULEVARD SUBSTATION IN ATLANTA OF THE GEORGIA RAILWAY & POWER COMPANY

These conditions are recited to bring out the fact that the almost instantaneous extinguishing action of the arrester is due solely to the heat-absorbing action, the attenuation of the arc in the tube only serving to bring the arc path into greater contact with the cooling action of the medium surrounding the arc and the tube.

Many tests have been made under abnormal conditions to determine the real capacity of the equipment, and the results have been highly satisfactory. Units have been connected to the line with the horn gaps set at less than line voltage. Under these conditions, as soon as one arc is broken another is re-established, and the result is a continuous stream of discharge. No surges on the system are caused on account of the tapering way in which each discharge is interrupted. The only result is to evaporate a small amount of water. Other tests have been made with solutions of such low resistance that the mechanical reaction has overturned the tank. Even under these conditions electrical operation was found normal and no damage was done to the arrester, nor did the service on the system suffer any interruption.

For regular service a high discharge rate is preferable as this gives high-voltage surges a low-resistance pass to ground. In certain locations a discharge of 100 kw. or 200 kw. at line voltage is undesirable, and for such locations the water solution can be readily varied, so that a discharge at line potential will not impose a load of more than 25 kw. or 50 kw. on the system. The arrester may be readily used on a voltage lower than its rating by simply adjusting the horn gaps and using a more dense solution of water. In this way a 44,000-volt equipment can be used to protect 6,600-volt apparatus, and later it may be easily readjusted for the higher voltage.

Designs of surge arresters are now in operation for voltages of from 2,300 to 110,000, and two other types will soon be placed in operation, one for 140,000 volts and the other for 1,500 volts direct current street-railway service. A small electric heater is used to prevent freezing of these arresters in cold weather.

For use on power-house busbars the arresters are designed to discharge 500 kva. to 1,000 kva. at line voltage. Such an equipment acts as a safety valve on the system for any high-voltage surge caused by switching disturbances or similar troubles, with the result that the damage which is caused by heavy overload conditions or by short circuits on overloaded lines is very largely reduced.

Byllesby Customers Took $3,387,100 Preferred Stock

THE six electric and gas companies under Byllesby management, which sold their preferred stock direct to the public served by them during 1919 distributed $3,387,100 par value of such stock during the year, there having been 5,700 separate sales. This was an average of almost $600 par value per sale. At Louisville, Ky., the sales represent a period of only about forty-five days, the offering being first made about the middle of November. At a number of the properties there were no special drives or selling campaigns, while the San Diego company has had no preferred stock available for sale for several months.

Results for the year for the various companies were as follows:

Company	Number of Sales	Par Value Preferred Stock
Northern States Power Company	4,314	$2,479,700
San Diego Consolidated Gas & Electric Co.	212	287,900
Louisville Gas & Electric Company	494	224,700
Arkansas Valley Railway, Light & Power Company	305	183,500
Oklahoma Gas & Electric Company	278	151,600
Western States Gas & Electric Company	97	59,700
	5.700	$3,387,100

Thermal Conductivity of Coil Wrappers

Test Specimens Are Wrapped Upon a Heating Element According to Standard Coil Specifications —By Measuring the Power Required to Heat the Insulation and the Temperature Rise the Thermal Conductivity May Be Determined

By T. S. TAYLOR

Research Laboratory Westinghouse Electric & Manufacturing Company

IN ORDER to deal with the dissipation of the heat generated in electrical machinery, it is very important to know the value of the thermal conductivity of the insulation surrounding the coils. It is entirely possible to measure this quantity for those components of the insulation by a direct process such as was done by the author for a large number of materials.* However, one cannot make absolute use of these values when the materials are put in the form of coil wrappers, for the reason that the method above cited attempts to avoid discontinuities and air pockets entirely, while in coil wrappers this would be entirely impossible. Neither can accurate assumptions be made as to the rôles played by insulation, air pockets and discontinuities in the forming of a coil wrapper. Consequently it seemed highly advisable to measure the thermal conductivity of coil wrappers made up according to the specifications used when they are being constructed for actual machines. The work herein described was undertaken with this object in view. Since the difficulties encountered in making conductivity measurements on coil wrappers *in situ* are considerable, it seemed that reliable data could be secured by making measurements of the thermal conductivity of the insulations when wrapped according to the usual specifications about heaters having dimensions of the same order of magnitude as the coils, provided that the heater with the surrounding insulation was placed in an iron box imitating the slots in electrical apparatus. After making numerous attempts to construct a suitable apparatus, it was found that the one described below and illustrated in Fig. 1 was entirely satisfactory.

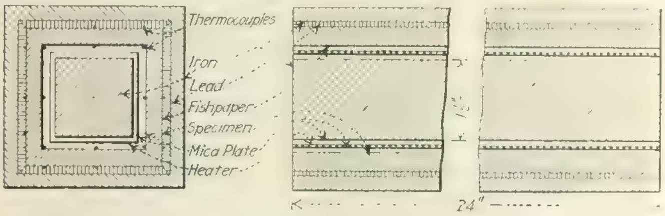


FIG. 1—SECTIONS SHOWING MOUNTING OF INSULATION ON HEATING ELEMENT TO GIVE EQUI-TEMPERATURE SURFACES

METHOD OF MOUNTING INSULATION ON THE HEATING ELEMENT

The core of the heater was an iron bar 1½ in. x 1½ in. x 24 in. (3.8 cm. x 3.8 cm. x 61 cm.). This was used in order to insure the rigidity necessary when having the insulations wrapped about the heater. A layer of special heater mica $\frac{1}{16}$ in. (2 mm.) thick was pressed over the iron bar, and the heater wire, No. 21, constantan, was wound around the bar over the mica so as to have eight turns to the inch. The space between the turns of wire was filled with asbestos cement, and then a second layer of $\frac{1}{16}$-in. mica plate and thin sheet asbestos was put over this. The heater thus constructed was placed in a form, clamped securely and thoroughly dried out by sending current through the heater wire. The outer surface of the mica plate over the heater wire was raised to a tempeature of about 250 deg. C. so that any subsequent heating while under test would make no additional changes due to further drying out of the materials in the heater insulation. After the heater was thoroughly dried out, small thermocouples, eight in all, composed of 0.005-in. (0.013-mm.) copper and constantan wire were placed as shown in Fig. 1 at the mid-section of the heater. Two thermocouples were placed on each side of the heater, one at the center of the side and another near the edge. The thermocouple wires were run out along the bar its entire length, all the copper wires to one end and the constantan wires to the other end. A cap was placed over the ends of the thermocouple wires, after they were coiled up together at each end in order to protect them from injury during subsequent handling of the heater. The insulation to be tested was wrapped about the heater according to the desired specifications by those well accustomed to doing such work.

After having the insulation put on the heater a layer of 0.007-in. (0.018-mm.) fish paper was wrapped over the insulation for those cases where this was the usual practice. Thermocouples were attached to the fish paper at positions corresponding to those under the insulation and after placing a layer of cotton tape for insulation purposes around the whole it was inclosed in a lead sheath and then forced into an iron box of such dimensions as to make it fit quite tightly. The lead sheath was put about the heater, etc., in order to secure a nearly constant temperature surface.

TAKING TEMPERATURE MEASUREMENTS

The iron box containing the heater was set up in the open. After straightening out the thermocouple wires and joining them to suitable switches, the ends of the apparatus were covered loosely with felt so as to prevent any great loss of heat from its ends. A cold junction was inserted in the thermocouple circuits so that the temperature could be measured at each position by means of a thermocouple potentiometer. The energy for the heater was supplied by means of a storage battery, the current being measured by means of an ammeter previously calibrated. Readings of the ammeter were checked up frequently by measuring the potential drop through a standard low resistance placed in series with the heater by means of the potentiometer. The total potential drop through the heater was determined by measuring the drop through a definite portion of a standard high resistance placed in parallel with the heater. The energy consumed per unit length of the heater could then be very readily calculated from these determinations. This assumes that the fall per unit length of the heater wire is constant and that the winding was quite uniform. This cannot be in error

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*"Thermal Conductivity of Insulating and Other Materials," *Physical Review*, 1919; *Electric Journal*, 1919.

since the heater wire was constantan. Furthermore, the iron core would tend to equalize any temperature differences that might arise. This method further assumes that the flow of heat at the middle of the apparatus was at right angles to its length and that whatever heat was lost from the ends of the bar had no influence upon the temperature at the middle of the bar. That this latter case is true is without question since there was but very little heat dissipated through the well-insulated ends, and furthermore the heater was of such length that a temperature could exist near the ends differing considerably from that in the middle and not change the temperature at the middle, the same amount of heat being generated per unit length of the heater throughout its entire length.

It was found quite satisfactory to assume that the iron box surrounding the apparatus constituted an equi-temperature surface when placed in the open in the room. The ordinary variations in room temperature were insufficient to affect this when care was taken to avoid useless air currents. Before taking a set of measurements of the energy consumed per unit length of the heater and the mean temperature drop through the insulation, sufficient time was allowed for heating up in order that temperature equilibrium could be established. The average drop in temperature through the insulation was determined by taking the difference between the temperature as measured by the eight thermocouples on the outside of the insulation and the eight thermocouples on the inner side of the same. In addition to having this drop in temperature through the insulation, its mean thickness as determined from average measurements over the heater before and after the wrapper was put on, and the heat generated and passing through unit length of the wrapper, it is necessary to know the shape factor for the heater before being able to calculate the thermal conductivity of the wrapper.

The shape factor, which is the ratio of the area to the thickness, is calculated as follows: We assume, as an experiment proved to be true, that the inner and outer surfaces of the insulation under test were equi-temperature surfaces and did not differ from regular figures. Let $2a$ and $2b$ be the dimensions of the apparatus just under and over the wrapper under test. Let x be the distance of the surface A as measured from the center of the bar perpendicularly to one side. H is the total heat flowing through the insulation per unit length of heater. Now, the flow of heat $dH = (A/dx)kdt$, where k is the thermal conductivity of the material, dt the change in temperature, dx the thickness of the element and A the area through which the heat is flowing. This area A is the area of the surface per unit length of the heater at a distance x from the center as shown in Fig. 1 and is consequently equal here to $8x$.

$$\text{Therefore } H = \frac{\int_{t_2}^{t_1} kdt}{\int_a^b \frac{dx}{8x}} = \frac{8k(t_1 - t_2)}{\log b/a}$$

But $H = Sk(t_1 - t_2)$ and hence the shape factor $S = \frac{8}{\log b/a}$ per unit length of heater. The thermal conductivity of the material is then readily seen to be given by

$$k = \frac{H \log b/a}{8(t_1 - t_2)}$$

$$= \frac{IE \log b/a}{8(t_1 - t_2)} \text{ watts/unit length/deg. C./sec.}$$

I and E represent the current in the heater and the potential drop per unit length of the heater respectively

Preliminary Heating to Remove Moisture

Upon first heating up a newly applied wrapper it was found that its thermal conductivity changed considerably with continued heating but finally settled down to a definite value so long as the mean temperature did not exceed that used in the initial heating. Hence, in order to secure consistent results, it was found necessary to dry out the sample thoroughly by giving it a long preliminary heating at a temperature considerably in excess of that for which it was guaranteed. A preliminary heating of sixty hours at an average temperature of 210 deg. C. was found adequate to dry out the wrapper thoroughly, so that subsequent heatings to the guaranteed temperature, 135 deg. C. to 150 deg. C., produced no further change in the thermal conductivity. The statement in the table concerning the 11,000-volt treated cement paper and mica hand wrapper shows the behavior of all freshly prepared wrappers during the preliminary heating.

Thermal conductivity measurements were made in the manner outlined above for various coil wrappers and of voltage requirements from 4,500 to 13,200. Considerable difference was found to exist between the values obtained for different samples of the same material and voltage requirements. Such differences are due to the fact that there are many uncontrollable factors entering to influence the final value attained by a given wrapper. This would not be the case if it were possible exactly to duplicate the conditions arising in the construction and curing out of the wrapper. In the first place, the wrapper is a more or less conglomerate preparation, and there is little chance of being able to secure homogeneity in its composition. The conditions under which it is manufactured even before being formed on the coil preclude this. To duplicate the distribution and surface area of the air pockets and contact surfaces which arise during the forming and drying out of the wrappers is entirely out of the question.

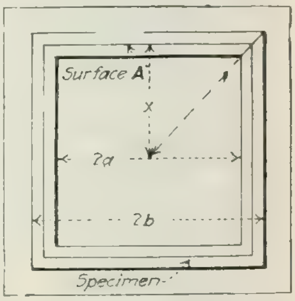

FIG. 2 — DIMENSIONS USED IN MATHEMATICAL DISCUSSION

The large variations in the value of the thermal conductivity are due chiefly to these latter causes.

Some Difficulties in Determination of Temperature Coefficients

The results given in the table on page 370 are typical. Three or more significant figures are given for each case in order to give some little significance to the temperature coefficient where it seemed possible to calculate it. For those cases having no temperature coefficient it is quite likely that the increase in the thermal conductivity of the material forming the wrapper is counterbalanced by the increase in the thermal resistance of the sample as a whole due to the increase in the imperfectness of contacts between the constituents as the temperature increases. To calculate the most probable value of the thermal conductivity for a given wrapper from results such as are given in the table would require an exceedingly large number of tests on different samples of the same wrapper. This procedure is scarcely advisable since it is by no means possible to control conditions so that any given sample can be exactly duplicated.

While the results herein given for a given wrapper do not agree closely with each other, they do present quite interesting facts. In the first place it is evident that whatever influence the insulating wrappers may have upon the temperature of electrical machinery cannot have ascribed to it a definite value which can be used in all cases. It is seen that the thermal conductivity of a given material in the form of a wrapper may differ as much as 50 per cent. It may be better than it is usually assumed to be, and on the other hand it may not be nearly so good. In the former case the effect will be on the safe side, but in the latter the opposite is true. The influence of air films and imperfect contacts produced during the forming of the wrapper and its drying-out process is quite noticeable. The average value of the thermal conductivity of treated cement paper and mica hand wrappers is approximately 0.00030 cal./cm./deg. C./sec. The value* found by the author for the sheet material when air pockets and films were practically avoided was 0.00045 cal./cm./deg. C./sec. These facts show quite clearly the futility of designers holding too closely to definite figures in regard to the values of the thermal conductivity of the wrappers as they now exist in practice. This will not be the case, however, when it is possible to make coil wrappers having definite characteristics instead of variable ones such as appear from the results given by the present work.

THERMAL CONDUCTIVITY OF COIL WRAPPERS

Wrapper	Temp. Deg. C.	Number of Thicknesses	Conductivity k. Cal./Cm./Deg. C./Sec.	Watts/in./Deg C./Sec.	Temp Coeff
6600-volt hand wrapper.	30		0.000234	0.00248	
Treated cement paper and mica	30-140	5	0.000261	0.00237	0.0010
6600-volt hand wrapper..	30		0.000228	0.00242	
Treated cement paper and mica	30-160	5	0.000257	0.00273	0.0019
11,000-volt hand wrapper.	30		0.000375	0.00399	
Treated cement paper and mica*	30-150	9	0.00396	0.00421	0.0010
11,000-volt hand wrapper.	30		0.000290	0.00308	
Treated cement paper and mica	30-160	9	0.000306	0.00325	0.0008
11,000-volt hand wrapper.	30-160	9	0.000270	0.00287	None
Treated cement paper and mica. Same wrapper impregnated with 260 deg. gum	30-160	9	0.000300	0.00319	None
13,200-volt hand wrapper.	30		0.000403	0.00427	
Treated cement and mica.	30-160	11	0.000419	0.00446	0.0006
13,200-volt hand wrapper.	30		0.000208	0.00221	
Treated cement paper and mica	30-160	11	0.000235	0.00250	0.0010

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*Physical Review, 1919; Electric Journal, 1919.

TAKE an interest in the things which are interesting to the whole, remembering that money is not everything, remembering that the keynote of life is service, and that there is a greater opportunity for service in our homes and abroad than ever has been before. We should not be true to the memory of those we serve today, if we did not attempt to carry on the great principles for which they died and for which our Constitution stands.—JOSEPH B. MCCALL.

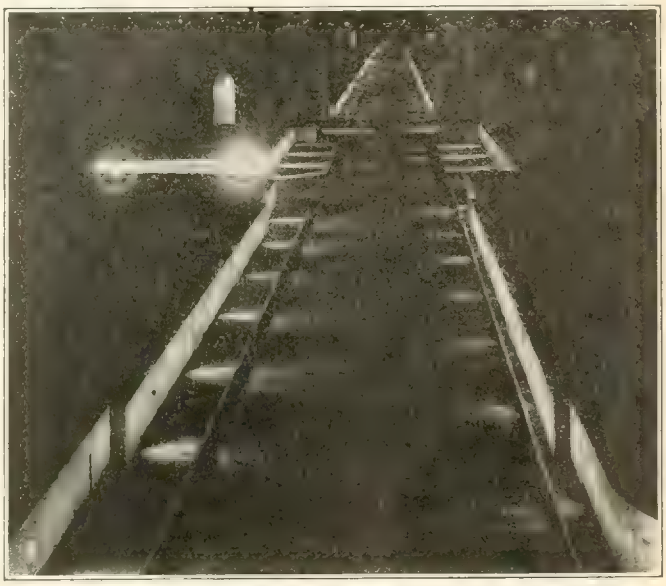
Mounting Units for Lighting Dam

Roadway Evenly Illuminated by Use of Boxes Containing Headlight Lamps Set Into Parapet Wall 26.5 In. Above Roadway

THAT roads can be lighted without the use of poles has been demonstrated by the installation of low-mounted lighting units to illuminate the roadway across the Kensico Dam, built across the Bronx River about 3 mi. (4.8 km.) north of White Plains, N. Y. The roadway is brick-paved, 26 ft. (8 m.) wide, is bordered on one side by a sidewalk about 4 ft. (1.2 m.) wide, and it runs between cut-stone parapets approximately 4 ft. (1.2 m.) in height.

The openings in the stonework for the lighting units are approximately 13½ in. (35 cm.) square and 15 in. (40 cm.) deep. The center of each opening is 26½ in. (67 cm.) above the surface of the roadway, and the openings are approximately 37½ ft. (11 m.) apart on each side of the roadway, with a staggered arrangement of spacing.

A cast-metal frame with a hinged door which can be locked was made to fit in this opening. A sheet of vertical prismatic glass is held in the door by three vertical and three horizontal cast-in bars, each ¼ in. (6 mm.) wide and ½ in. (13 mm.) deep.



ADEQUATE ILLUMINATION WITHOUT GLARE IS OBTAINED WITHOUT FIXTURES

Six-volt, 108-watt gas-filled headlamps are used for the illumination, but as these lamps have a comparatively short life on normal operating conditions, only 5.5 volts is applied to them in order to reduce the maintenance cost.

In distributing the light so that it would not be objectionable from the standpoint of glare, it was found necessary to make each unit throw sufficient light on the opposite parapet wall to relieve the contrast between the light source and the adjacent wall. Thus satisfactory results have been obtained with an energy consumption of approximately 5 watts per running foot (16.5 watts per m.) of roadway. This installation, which was made by the Lord Electric Company, was described in a paper which C. A. B. Halvorson and A. B. Day presented before the thirteenth annual convention of the Illuminating Engineering Society in Chicago.

Estimate of the Cost of Hydroelectric Equipment

Unit and Total Data Based on 1918 Reproduction Costs in Vermont Appraisal Afford Interesting Comparisons

IN connection with the proposed consolidation of several hydroelectric properties in Vermont an exhaustive appraisal was prepared recently in which the reproduction cost of the new equipment installed as under 1918 conditions was set forth. From analysis the unit and total probable costs of various plant structures of interest to the hydroelectric engineer are frequently apparent.

Although the data are somewhat irregularly set forth, their suggestiveness under the present scale of construction costs renders them of unusual interest, and they are printed in the following table for the use of engineers who are concerned in particular with hydroelectric work on a small or moderate scale. If the data are not final, they none the less afford ground for interesting comparisons.

1918 REPRODUCTION COSTS OF HYDROELECTRIC SYSTEM EQUIPMENT

Power-plant building, brick, concrete and masonry foundations, 60 ft by 142 ft. by 18 ft	$34,500
Log crib dam, 100 ft. long, 12 ft. high, 445 cu.yd. at $5.60	2,492
Canal wall, stone masonry, 107 ft. long, 150 cu.yd. at $6.00	900
Frame gatehouse, 11 ft. by 32 ft. by 9 ft., peak-shingled roof, erected on canal wall abutments	200
Garage and machine shop, brick on concrete foundation, 49 ft. by 28 ft. by 13 ft. wood roof, concrete floor	3,800
Power-plant building, brick and concrete structure, 73 ft. by 41 ft. by 28 ft., with transformer room extension, 18 ft. by 15 ft. by 18 ft.; dispatcher's room with brick partitions, 9 ft. concrete basement, with heavy concrete columns supporting generator-room floor, concrete wheel-fit arches and foundation, steel-roof trusses, slate roof	36,000
Operators' frame dwelling, two stories and basement, eight rooms at power-house site	4,500
Frame storehouse, sheet-metal covering, 12 ft. by 16 ft. by 9 ft. to eaves, peaked roof, felt-paper covering, wood floor, at power-house site	125
Frame garage, 12 ft. by 16 ft. by 8 ft., tar-paper covering over board sides	75
Brick fire hose house, 8 ft. by 6 ft. by 10 ft. concrete base, with hydrant and 250 ft. of 2½-in. hose	290
Concrete spillway dam; spillway 110 ft. long, 30 ft. high, 45 ft. long at base, concrete abutments, forebay and headworks	22,000
Earth and wood dam, 35 ft. long, 10 ft. high, rubble-stone masonry abutments	1,000
Rock tunnel, cement-lined, 8 ft. by 8 ft., 300 ft. long, no supports	7,000
Two two-ply leather belts, 36-in. wide by 92 ft. long, at $865	1,730
300-kv.-a., a.c. generator, 2300 volts, 164 r.p.m., 60 cycles,. direct-connected to water-wheel jack shaft, erected	5,400
500-kw. synchronous converter, 900 r.p.m., 600 volts, d.c., erected	5,850
3.5-kw. motor-generator battery-charging set, d.c. generator, 125 volts, direct connected to Fort Wayne, 5-hp., 220-volt induction motor, 1200 r.p.m. erected	486
15-kw. belted exciter, 675 r.p.m., 125 volts, erected	405
Two-ply leather belt for above, 4 in. wide, 30 ft. long	20
Three 500-kv.-a. water-cooled transformers, 44,000 to 2,300 volts, single-phase, 60 cycles, erected on wooden platform, complete with piping	6,000
Three 250-kv.-a. oil-insulated, self-cooled transformers, 2300 to 425 volts, single-phase, 60 cycles, erected on concrete foundation outdoors	3,220
Three 5-kw. oil-insulated, self-cooled transformers, 2300/110/220 volts, single-phase	225
23-kv.-a. automatic potential regulator, 2300 volts, 60 cycles, single-phase, erected	896
43.5 kw. constant-current tub transformer, 6.6 secondary amp., erected	985
Marble panel for above with 4-amp. stab switches, and one 100-amp., three-pole, 2300-volt oil switch, erected	105
5-ton traveling crane, 25-ft. span, hand-operated, erected	1,250
Two 1000-kv.-a. transformers, 44,000/13,000/2,300 volts, single-phase, 60 cycles, self-cooled, erected	8,860
Three oil circuit-breakers, type, 300-amp., 45,000 volts, three-pole, solenoid-operated, complete with relays, remote-control included in tower-house switchboard, erected on pipe framework, supported on concrete foundation	4,695
Four current transformers, 60/120 amp., ratio 12/24:1, 45,000 volts, erected	880
Twenty-seven disconnecting switches, 300 amp., 45,000 volts, outdoor type, insulator base, erected on pipe frame	864
Three sectionalizing disconnecting switches, 300 amp., 45,000 volts, line type with horn-gap break, erected	138
One outdoor-type, three-phase, 45,000-volt lightning arrester with horn gaps, erected	170
7½-in. wire-mesh fence on pole stubs, 10 ft. by 8 in. top, painted, 300 linear ft., erected	135
Three 750-hp. Pelton-Francis turbines, 22-in. double discharge, 120-ft. head, horizontal type, spiral casing, 600 r.p.m., with steel draft tubes, erected	14,850
One 75-hp. Pelton-Francis exciter turbine, 14-in. single discharge, 1000 r.p.m. horizontal casing, steel draft tube, erected	910
Two oil-pressure governors, erected	2,430
One oil-pressure governor, with motor control	1,900
Steel surge tank 100 ft. high, 6½ ft. diameter, enclosed in double 2-in. plank casing with 4-in. air space	3,750
Erected, concrete foundation	270
Steel penstock, 6-ft. diameter, 900 ft. long, on rock foundation, earth-covered	33,170
Steel receiver and connections, 70 ft. long	1,140
Motor-operated floodgate, d.c. motor. 19.35 amp., 115 volts, 900 r.p.m., operating 48-in. Chapman valve through bevel gear and pinion, with control panel, erected	1,305
2-ft. drainage gate valve, for penstock, erected	225
Wooden gates, 4 ft. by 4 ft., wood stems, lever, hand-operated (each)	75
Foreboy headgate valve, 7-ft. diameter, hand-operated, erected	450
Three 550-kv.-a. generators, 11,000 volts, three-phase, 60 cycles, direct-connected, 600 r.p.m., installed	18,975
Two 40-kw., 125-volt exciters, 1000 r.p.m.	1,260
One four-cell aluminum lightning arrester, 44,000 volts, erected	1,500
Six hand-operated oil switches, 300 amp., 11,000 volts, three-phase, enclosed in brick cells	1,500
14,000 linear ft. wood stave pipe, 60-in. diameter	168,000
3,000 linear ft. steel pipe, 60-in. diameter	72,000
90-ft. stand pipe, 14-in. diameter	9,000

DISTRIBUTION EQUIPMENT

	Each
Chestnut poles, 35 ft. by 6 in. top	$6.50
Two-pin wooden cross-arms	.35
Four-pin wooden cross-arms	.45
Six-pin wooden cross-arms	.60
Eight-pin wooden cross-arms	.80
Ten-pin wooden cross-arms	1.15
Wood side brackets, painted	.05
Insulators, 2300 volts, double-petticoated	.08
Pole guys	4.00
No. 4 and No. 6 bare iron wire, per pound	.10
Copper wire, bare	.275
Installing services	2.50
Series sheet-lighting fixtures, 20-in. radial wave reflectors, 60 cp., 66 amp. incandescent lamps, installed	6.20
Novalux bracket fixtures, ¾-in. gooseneck, parabolic reflector, 60-hp. lamps, 6.6 amp., erected	4.50
Novalux pendant fixture, series type, 400-cp., type C, 15-amp. lamp, erected on center-span suspensions	25.50
Ditto, with 20-amp. type C lamps	27.00
Ditto, with 15-amp. type C lamps, erected on 10-ft. iron mast arms	20.10
Transformers, factory costs (2300—110—550v.):	
7.5 kw	63.36
10 kw	74.60
15 kw	106.92
20 kw	132.12
75 kw	320.40
100 kw	385.20
400 kw. (44,000-440 volts)	1,600.00
Delivery and erection ninety-seven transformers	2.50

Meters, factory prices:

	(110 Volts)	(220 Volts)
5 amp., single-phase	7.32	8.22
10 amp., single phase	8.55	9.45
15 amp., single-phase	9.45	10.58
20 amp., single-phase	10.70	11.70
25 amp., single-phase	11.70	12.83
30 amp., single-phase	12.50	.....
40 amp., single-phase	13.50	
50 amp., single-phase	15.98	17.33
75 amp., single-phase	18.45	19.18

5 amp., three-phase, 110 volts	$25.20
10 amp., three-phase, 110 volts	26.10
15 amp., three-phase, 110 volts	27.00
5 amp., three-phase, 220 volts	27.90
10 amp., three-phase, 220 volts	28.80
15 amp., three-phase, 220 volts	29.70
25 amp., three-phase, 220 volts	31.05
50 amp., three-phase, 220 volts	35.10
75 amp., three-phase, 220 volts	38.25
100 amp., three-phase, 220 volts	40.50
150 amp., three-phase, 220 volts	44.55
300 amp., three-phase, 220 volts	93.50
5 amp., three-phase, 440 volts	35.20
1500 amp., three-phase, 440 volts	66.20
200 amp., three-phase, 550 volts	53.55
One Graphic-power-factor meter with transformers	185.30
2-amp. excess indicators (factory)	6.00
10-amp. excess indicators (factory)	12.00

Economical Construction for Bus Compartments

Kansas City Substations Have 13,000-Volt Buses Consisting of Three-Conductor Cables in Fiber Ducts and Protected by a Wall of Concrete 4,400-Volt, Compartments Are Built of Pre-cast Concrete Units

THE new substations of the Kansas City (Mo.) Light & Power Company embody some striking designs in bus construction, and the building dimensions are thereby reduced to a minimum. These buildings, of reinforced concrete, are 46 ft. by 57 ft. (14 m. by 17 m.) and two stories high. One station has transformers installed to step down 12,000 kva. from 13,200 volts, three-phase, to 4,400/2,540 volts, three-phase, four-wire, for distribution on thirty-six single-phase lighting feeders and two three-phase power feeders. The other two substations have a transformer capacity of only 6000 kva. at present, but are designed for an ultimate capacity of 12,000 kva. The 13,200-volt buses are disposed in fiber conduit after the fashion of underground cable systems. Compartments for the 4,400-volt buses are made of concrete shapes which are cast beforehand and readily put together at the right time.

The 13,200-volt feeders connecting the different substations with the power station are not tied together at the substations, but each feeder delivers power to its own individual set of transformers at the substation. The capacity of the transformers is so chosen that when they are carrying their normal load the 400,000-circ.mil three-conductor cable supplying them is also carrying its safe normal load. In case of a cable failure the current-limiting reactors in the power-station end of the feeder limit the current flow to a value which will cause no undue disturbance as in other parts of the system, while a simple overload relay trips the cable free from the busbars.

Each substation has a 13,200-volt bus to which any set of transformers may be switched. These busbars are fed by a reserve cable which will be extended by a loop system to serve any one of several different substations.

These reserve 13,200-volt buses are hung from the basement ceiling underneath the 13,200-volt oil switches. Instead of the usual bar construction the buses are made of 400,000-circ.mil (200 sq.mm.) stranded insulated cable which loops up to the oil-switch terminals (see Fig. 2). The cables are run through fiber conduit. The ducts extending out of the bed are wrapped with rough jute rope free from oil or tar, after which they are covered with two coats of one-to-one cement mortar, built up as shown in Fig. 2. The lugs are wrapped with varnished cambric to a thickness of 0.5 in. (12 mm.). The conduit is aligned in such manner that additional cables can be installed to make direct connections with the oil-switch studs.

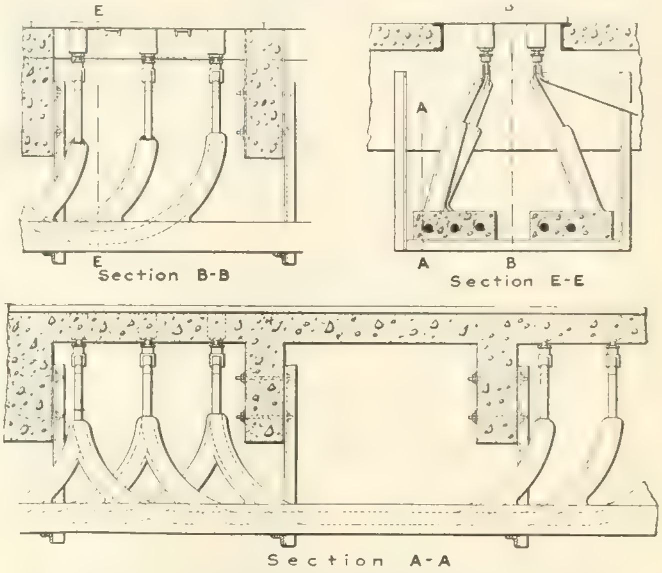


FIG. 2—13,200-VOLT BUSES IMBEDDED IN CONCRETE

This drawing shows the principle of looping in, which is in common use for wiring, applied to 13,200-volt bus construction in the new substations of Kansas City (Mo.). Stranded insulated cable of 400,000 circ.mil. (200 sq.mm.) is employed, run through 2.5-in. (65-mm.) fiber conduit. A concrete bed 19 in. (48 cm.) wide and 7 in. (18 cm,) thick is poured around each bus. The ducts extending out of this are wrapped with 0.25-in. (6-mm.) clean jute rope on 0.75-in. (20-mm.) centers. Then one-to-one cement mortar is applied in two coats around them to form smooth tubes with an outside diameter of 4.5 in. (11.5 cm.).

In the 4,400-volt bus structure another new method

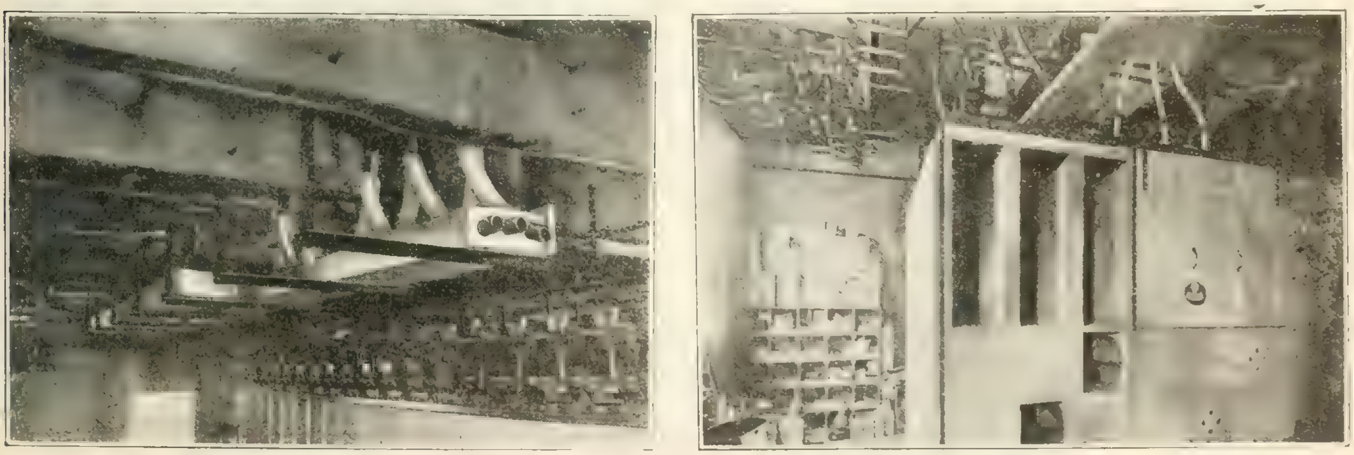
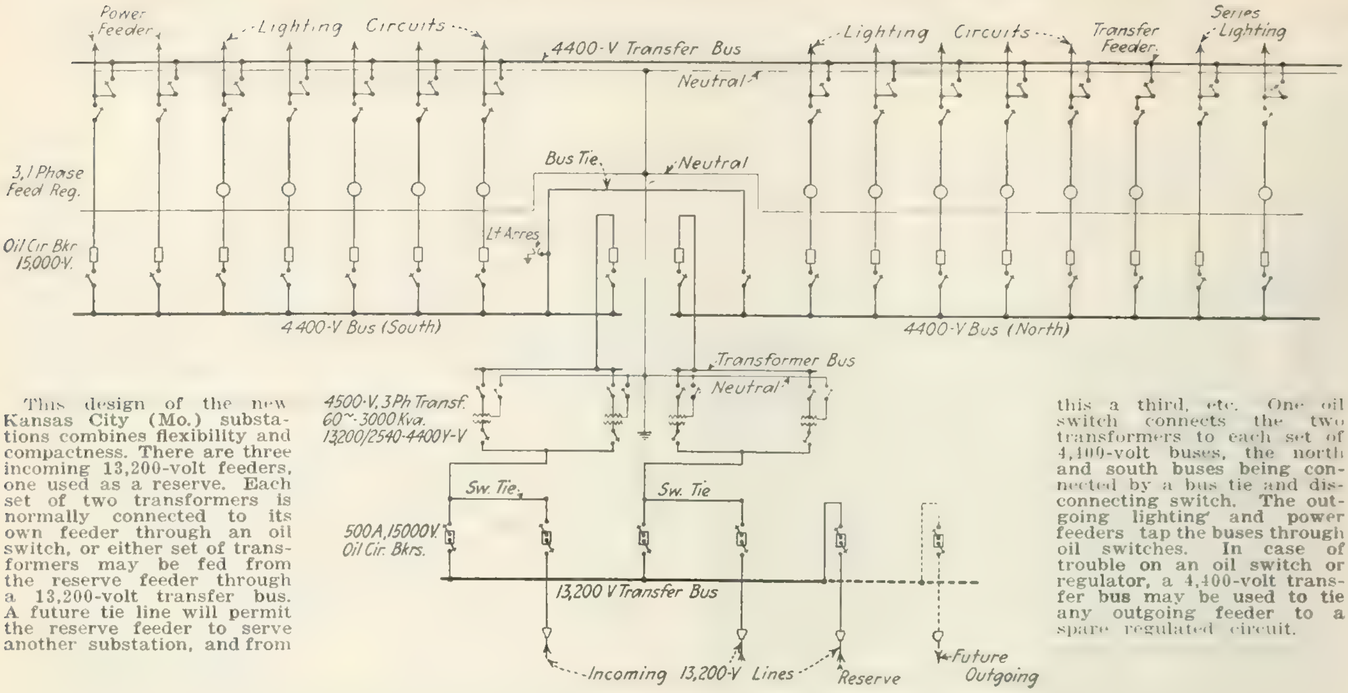


FIG. 1—GENERAL VIEW OF CABLE BUS AND PRE-CAST COMPARTMENTS IN PLACE



This design of the new Kansas City (Mo.) substations combines flexibility and compactness. There are three incoming 13,200-volt feeders, one used as a reserve. Each set of two transformers is normally connected to its own feeder through an oil switch, or either set of transformers may be fed from the reserve feeder through a 13,200-volt transfer bus. A future tie line will permit the reserve feeder to serve another substation, and from this a third, etc. One oil switch connects the two transformers to each set of 4,400-volt buses, the north and south buses being connected by a bus tie and disconnecting switch. The outgoing lighting and power feeders tap the buses through oil switches. In case of trouble on an oil switch or regulator, a 4,400-volt transfer bus may be used to tie any outgoing feeder to a spare regulated circuit.

FIG. 3—SUBSTATION TRANSFER BUSES TO INSURE CONTINUOUS SERVICE

Economical Construction for Bus Compartments

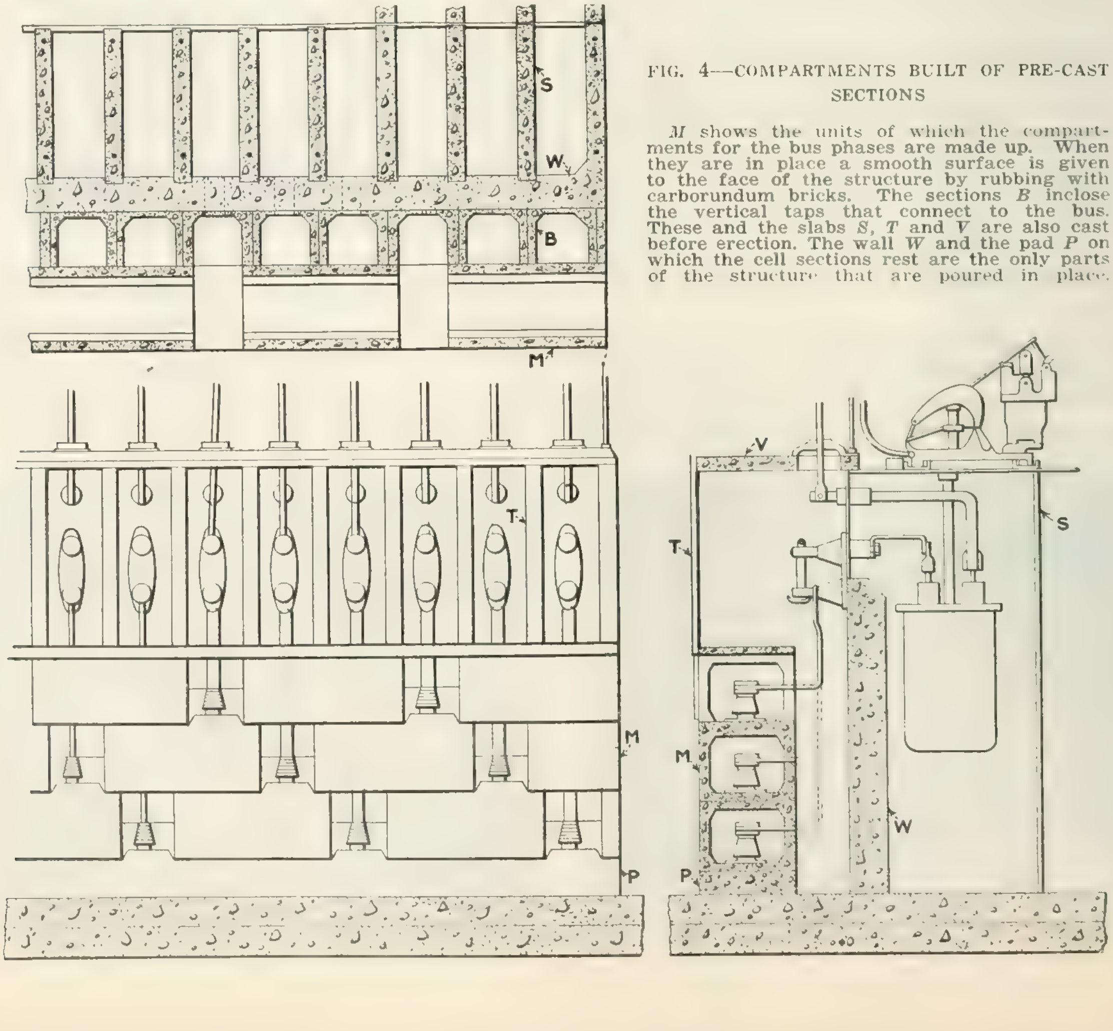


FIG. 4—COMPARTMENTS BUILT OF PRE-CAST SECTIONS

M shows the units of which the compartments for the bus phases are made up. When they are in place a smooth surface is given to the face of the structure by rubbing with carborundum bricks. The sections *B* inclose the vertical taps that connect to the bus. These and the slabs *S*, *T* and *V* are also cast before erection. The wall *W* and the pad *P* on which the cell sections rest are the only parts of the structure that are poured in place.

of construction was used. The bus compartments and the compartments for the connections leading from the bus to the disconnecting switches are built up of pre-cast concrete sections (*M* in Fig. 3) laid on the concrete pad (*P*) which is poured beforehand. At the points on the buses at which the connections are taken off openings are left between the concrete sections of the corresponding layer. When the entire structure is in place a smooth surface is given to the whole by rubbing with carborundum bricks. The sections for the vertical connection taps (*B*, in Fig. 3) are in the shape of a trough stood on end with the open side toward the bus. Also the vertical slabs between the connection taps and between the oil switches (*S* and *T*, Fig. 3) are cast before erection. The pad (*P*) and the wall (*W*) are the only parts of the structure that are poured in place. As the pre-cast units are set up before pouring the wall, very little construction for forms is required.

These blocks and slabs may be molded by fairly cheap labor while the building is being erected. When the building is ready it is quicker and cheaper to install the blocks and slabs than to set up forms and pour concrete or to make the compartments of brick.

Sargent & Lundy of Chicago, Ill., designed and supervised the construction of the substations and have applied for patents on the bus construction described herein.

Piece Work Reduces Cost of Motor Repairs

Records of Piece-Work Prices Paid in Steel Mill for Rewinding Direct-Current Armatures and for Making New Commutators—Segregated Costs Given for Completed Jobs

ONE of the Pennsylvania steel mills equipped throughout with direct-current equipment has reduced the man-hours required to rewind motor armatures to about one-third the time taken on day work. This has been accomplished by winding and taping the armature coils, insulating the core, placing the coils in the armature and connecting the coils to the commutator, on a piece-work basis. Some operations such as stripping the armature, taking off the commutator, repairing the commutator insulation, replacing a few bars, turning up the commutator, banding the armature, and testing are still done on day work. This is because the bending and stripping are done by helpers and the other operations mentioned are too uncertain to be placed on a piece-work basis. However, in making new commutators or refilling an old commutator shell with new mica and copper, the work is all done on a piece basis as is also the turning of new shafts and bearings.

Table I gives the piece-work allowances for some of the different direct current armatures used in this particular plant. The time required to rewind armatures depends more upon the make and type than upon the horsepower. This is due to mechanical features which make some types more difficult to rewind than others. As a result it is sometimes necessary to readjust the piece-work allowance higher or lower, depending upon conditions.

The workmen naturally objected to the introduction of the piece-work system, especially as the first allowances were based on about two-thirds of the old day-work time. The men made so much money, however, on these allowances that the prices were further reduced until they are now based on about one-third of the day-work time schedule. The men have been treated fairly, however, and reference to Table II will show that most of the armature winders are able to make $1 per hour, and the helpers, where they are employed, earn 50 cents per hour at the piece-work rates.

Copper for new commutator bars is purchased in 6-ft. to 10-ft. (1.8 m. to 3 m.) lengths which have been rolled to the proper angle and thickness. The milling of commutator copper mentioned in Table I, therefore, includes cutting this copper into bars of the proper length, milling the ends of the bars to receive risers and cutting up risers from strip copper. Slotting bars means slotting the ends to receive the leads. This is done on some commutators which do not have risers. Making the commutator shell consist of turning up the cast-iron shell or bushing which holds the bars and mica together. On some armatures the shell is made from rolled round steel instead of from cast-iron but in either case it must be turned up complete with end rings having the proper bevel. The assembling of the commutator includes the assembling of the independent bars and mica segments, turning the *V* in the end of the

TABLE I—PIECE-WORK PRICES PAID FOR REWINDING 220-VOLT DIRECT CURRENT ARMATURES AND MAKING NEW COMMUTATORS IN 1919

Milling Commutator Copper Slotting Ends of	Crocker-Wheeler, 40-S-40-Hp	Crocker-Wheeler, 15 D-S-15-Hp DCC Wire	Crocker-Wheeler, 15 D-S-11-Hp Heavy Asbestos Covered Wire Used	Crocker-Wheeler, 35 D-CC-42-Hp.	Crocker-Wheeler, BW-8-15-Hp Armature	Westinghouse, 5 K-S-11-Hp	Westinghouse, 8-K-25-Hp	Pawling & Harnischfeger, 10 x 6, 12-Hp	Westinghouse, 1-K-2-Hp	Pawling & Harnischfeger, 11 x 8, 16-Hp	Pawling & Harnischfeger, 14 x 12, 36 Hp
Milling commutator copper..	$7.00	$6.00	$6.00	$11.50	$2.40			$1.60		$1.60	$2.30
Slotting bars ..		.			1.24			1.65		1.65	1.22
Making commutator shell	6.74	4.70	4.70	7.00	6.15			6.00		6.00	
Assembling commutator..	10.70	10.70	10.70	17.00	7.25			6.15		6.15	6.74
Making coils.....	7.06	6.30	6.30	9.84	6.30	$4.92	$6.95		$5.37		..
Winding armature { Winder...	9.84	7.70	11.77	9.84	11.98	5.77	6.95	15.78	6.00	16.58	31.00
Winding armature { Helper...	.	..	.		.	..		7.89		8.29	15.50
Turning new shaft and nut..	.	3.00	3.00	..	2.68	1.92	.	.	.	3.10	4.75
Turning bearings		..	......	.	..	.44	..		.. .	.74	

TABLE II— COST OF REWINDING 220-VOLT D.C. ARMATURES AND OVERHAULING COMMUTATORS IN 1919

No.	Manufacturer	Frame No	Type	Hp.	Rating	R p m	Amps	Day Work		Piece Work		Aux. Labor		Material	Overhead	Total Cost	Remarks
								Hr.	Amt.	Hr.	Amt.	Hr	Amt				
1	C-W	22MT	S	22	Int.	700	82	10¼	$4.82	14¼	$14.50	24	$4.38	$8.00	$11.85	$43.55	
2	C-W	201	CC	13	Const.	500	50	12	5.78	17	17.12	29	5.22	17.37	14.06	59.55	......
3	C-W	20K	S	20	Int.	490	80	19¾	9.75	17¾	17.65	37	6.66	17.05	17.03	68.14	New shaft
4	C-W	40	S	40	Int.	750	152	19¼	9.37	16¾	16.90	36	6.48	21.21	16.37	70.33	Changed from ring to form wound
5	G-E	.....	CO 1807	15	Int.	600	60	15	5.79	11	11.07	25	4.68	11.82	10.77	44.13	......
6	C-W	15D	S	15	Int.	800	59	15	7.79	13	12.81	28	5.04	14.60	12.82	53.06	Changed from ring to form wound
7	C-W	15D	S	11	Int.	580	42	9½	4.46	18¼	18.07	27	4.99	27.11	13.76	68.39	Asbestos wire in armature
8	C-W	15D	S	15	Int.	800	60	6½	2.98	18¾	14.00	24	4.75	15.28	10.71	47.72	......
9	C-W	35D	CC	42	Int.	900	147	20	10.00	20	19.68	40	7.20	29.52	18.44	84.84	Mica undercut
10	C-W	5F	CC	5	......	900	19	3½	1.48	11½	11.35	15	2.70	9.12	7.77	32.42	Commutator cleaned
11	C-W	BW	S	15	Int.	600	60	10¾	5.23	17¾	18.28	28	5.13	17.56	14.32	60.52	
12	WE&M	5K	S	11	Int.	700	46	5	2.49	12¼	10.69	17	3.10	10.11	8.14	34.53	
13	WE&M	8	K	25	Int.	575	96	11¼	5.04	14	13.90	24	4.46	10.65	11.70	45.75	
14	P&H	10x6	Crane	12	Int.	575	50	7	3.54	32	23.67	38	6.82	6.60	17.01	57.64	
15	WE&M	1	K	2	Int.	900	[illegible]	6	3.05	17½	11.37	17	3.06	3.56	8.74	29.78	
16	P&H	11x8	Crane	16	Int.	550	65	9¼	4.32	33½	24.87	43¼	8.65	10.65	18.92	67.41	
17	P&H	14x12	Crane	30	Int.	500	115	8¾	4.27	32	31.00	72¼	14.45	21.06	32.61	118.89	......
										32	*15.50						

* Helper.

commutator, and assembling all on the shell ready to be placed on the armature shaft.

Armature coils are wound on a form at the winder's bench and not on a machine. The piece-work operations of making coils includes winding, stretching, dipping in varnish, drying in oven, taping the coils and tinning the leads. The armature winding operation for which the piece-price was set consists of cutting out core insulation, placing it in position, placing the coils in their proper places, connecting up the leads to the commutator, and soldering them in position. The armature tester working at a day rate then tests the finished armature. If any trouble develops the armature winder must do his work over again without any extra pay. This system has resulted in careful work and experience has shown that armatures rewound on a piece-work basis give just as satisfactory service as when they were repaired on day-work.

The actual cost of rewinding a number of different armatures is shown in Table II. The labor is divided up into piece-work, day-work and auxiliary. The work done under the two first headings has already been described. The auxiliary labor includes the time of store-room attendants, sweepers, clerks, etc. This class of labor averages from 17 cents to 20 cents per hour, for all the work done on any particular job. The overhead expense is taken as 50 per cent of all the electric repair shop labor, charged to the job.

Use of Radio by Transmission Companies

Employed by Georgia Railway & Power Company to Transmit Information from Dispatching Headquarters to Surrounding Stations as Well as to Construction-Department Trucks in the Field

By G. A. ILER
Superintendent operation, tests and repairs, Georgia Railway & Power Co.

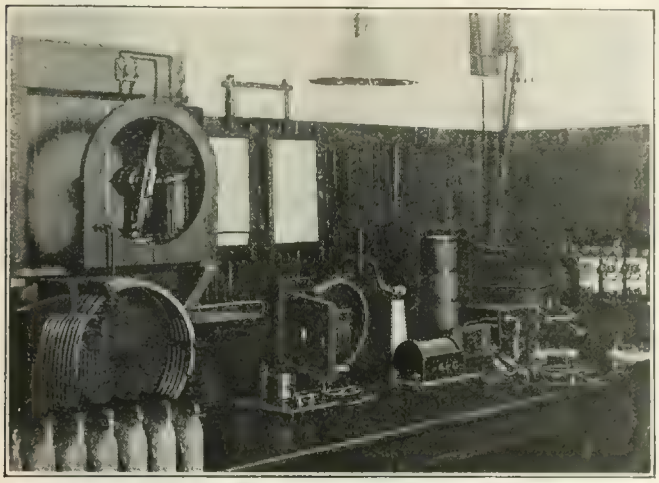
AS THE number of plants interconnected into one system grows and the load on the system enlarges it becomes increasingly important to maintain reliable communication between different parts of the system. This problem sometimes becomes difficult when communication is held by wire if there is a sleet or wind storm that breaks the conductors. In an attempt to avoid these interruptions the Georgia Railway & Power Company, Atlanta, began the use of radio-telegraph signals in 1914 for transmitting information from dispatching headquarters to the surrounding stations. While this work had not progressed very far when the World War started, five 1-kw. wireless stations had been placed in service and two 5-kw. stations were ready to begin service at the time when the United States government prohibited all wireless activities excepting that of the army and navy.

One of the most interesting applications of radio communication to the central-station field was the equipment of construction-department trucks with radio-receiving antennæ and other communication apparatus so that instructions might be received by the construction crew while they were still in the field at a considerable distance from wire communication. For this purpose, however, it was found that the radio-telegraph was not very satisfactory, but the experiments with radio-telephone were so satisfactory that the company is going to adopt that method of communication for instructing construction crews in the field in the near future.

During the use of radio apparatus there were several instances of where this method of communication was invaluable in handling an emergency. One time telephone communication to one of the large dams was interrupted, and there was no way of controlling the amount of water to be released from the large reservoir. If it had not been for the radio-telegraph a large amount of water would have been wasted. At another time a 1-kw. radio station was dismantled and carried over 100 miles to another station, erected, and communication established with headquarters inside of 24 hours. This experiment indicated what could be done in case wire communication should be interrupted by storms, etc., at some future time.

The company has also found that by having radio stations in several plants it is able to detect the approach of electrical storms a long time in advance, and in this way plants can be prepared to utilize water from heavy rains before the water spills over the dams, and they can also have their equipment in readiness to handle sudden loads caused by darkening of the skies.

It is also quite feasible to use wireless telegraph equipment in connection with a special detector to operate sectionalizing switches and disconnecting switches that may be located many miles away from an attendant. One way to utilize radio for this purpose would be to have automatic relays installed at each switching point that will respond to certain code signals the same as apparatus used by John Hays Hammond, Jr., in the wireless control of torpedoes. One of the greatest drawbacks in handling high-tension switches with radio control has been to construct a relay sensitive enough to be operated by a wirelsss detector, and also to construct a detector sufficiently sensitive to stay in tune all the time and operate this relay. However, due to the developments during the war, even these problems seem quite possible of solution. Unfortunately, however, the radio manufacturers are not aware that such apparatus is needed for these particular purposes.


MAIN WIRELESS PLANT AT ATLANTA WHICH CAN REACH ALL OTHER STATIONS IN THE MOUNTAINS

The type of apparatus used by the Georgia Railway & Power Co. included a 1-kw. Clapp-Eastman sending outfit which was "loose-coupled" and employed a rotary spark gap, with a fairly high-pitched tone, and producing a wave length of about 200 meters. This outfit gave a sending range of 100 miles (160 km.) in any kind of weather. The receiving outfit included a DeForest automatic detector in connection with a one-or two-step amplifier, as occasion required. Owing to the high-pitched tone of the sending apparatus and the use of amplifiers, signals could be heard very distinctly despite static disturbances which usually manifest themselves as a very low-pitch cracking noise of considerable volume. When static was so bad that signals could not be read sufficiently accurate, a code of signals was adopted among the operators so that the necessary switching information could be given through very simple radio signals. All signals that were sent out giving switching instructions had to be repeated and an O. K. received by the sender to prevent errors.

Most of the apparatus was used in mountainous country, where radio apparatus is particularly at a disadvantage. One of the difficulties which was anticipated was that the near high-tension lines would affect the signals; however, no such effect was observed when the aerial was erected at right angles to the transmission line. Where more than one transmission line enters the power house the aerial should bisect the angle formed by the two lines to prevent any high-tension transmission interference. At some of the stations radio communication was maintained successfully within 50 ft. (15 m.) of 110,000-volt transmission lines carrying 60,000-kw. indicated load.

Since the war the Allies have withdrawn censorship on the apparatus used in France for radio telephones, so that it is possible that central stations will be able to solve many of the problems which this company encountered before the war. For instance, the different governments have perfected a radio-telephone equipment which is all that could be desired, having any range that would ever be needed by high-tension transmission companies, either with portable or permanent sets. It is obtainable in portable or permanent sets, the portable sets being very light in weight, quickly erected, and adapted to be carried on motor trucks. This outfit would enable a construction crew to keep in touch with load dispatcher's headquarters. However, as there is no way for the load dispatcher to call a truck station of this type, it would be necessary for the truck driver to listen for the load dispatcher at predetermined fixed intervals. In this way the dispatching office would not have to call the truck driver to gain his attention.

To instruct radio operators, classes were formed at several of the power houses where they could study the equipment in actual service under the leadership of a trained radio operator. This method, coupled with the enthusiasm that usually goes with any radio work, soon produced quite a number of fairly good radio operators. Having been trained in power plants under operating conditions, these men were much more valuable than if they had been merely instructed in radio equipment and operation to the exclusion of station operation. During the training the men were required to keep log books showing all communications sent and received, the amount of load carried, water-gage reading, weather conditions, etc. Quite an amount of competition developed between the operators, each one striving to receive messages the fastest.

AERIAL CONSTRUCTION ON TOP OF THE REPAIR SHOP

Industrial Lighting Codes

In Force in Six States Now—Fairly Uniform in Essential Features—Need of Glare Limits That Will Improve Diffusion in the Same Manner as Intensities Have Helped Production—Outlook Encouraging

By G. H. STICKNEY
Illuminating Engineer Edison Lamp Works

THE DISTRIBUTION OF ILLUMINATION IN THIS PLANT CONFORMS WITH THE SPECIFICATIONS OF STATE CODES NOW IN EXISTENCE BUT A GREATER INTENSITY COULD BE USED WITH BENEFICIAL RESULTS FROM INCREASED PRODUCTION

INDUSTRIAL lighting codes are now in force in six states, two having been added to the list in 1919. Thus the progress toward nationalization has been more rapid than most similar movements, and if the usual experience is repeated, we may expect a much more rapid spread in the next few years, especially among the important industrial states. The list now includes Pennsylvania, New Jersey, New York, Wisconsin, Oregon and California. Adoption in Ohio and several other states where committees are at work may come at any time.

Legislation of this type needs to be carefully drawn to be effective and to insure fairness. There is always a danger of favoring or of imposing unnecessary hardship on one or more of the classes affected, for example, either the employer or the employee.

In legislation drawn without enginering advice fundamental factors are liable to be overlooked or misunderstood. Fortunately for all concerned, the leadership in this movement was taken by the Illuminating Engineering Society, and the best available knowledge of the art was applied in a patriotic and disinterested way. It has, therefore, been possible to avoid these pitfalls.

The effectiveness of the codes was clearly indicated in the papers recently presented by the representatives of the several state industrial commissions at the Chicago convention of that society. In no state was there reported any real opposition on the part of industrial or labor interests, while, on the other hand, instances were cited where manufacturers had expressed to the commissions' engineers their appreciation of the knowledge imparted concerning the economic value of good lighting.

In fact, the commissions seemed to have no difficulty in convincing manufacturers that their own interests required considerably higher intensities of lighting than the safety standards specified in the codes. Even in those states where the inspection forces are not adequate to give individual attention to plants throughout the state, marked improvements in lighting have been observed, which apparently have resulted from the educational influence of the codes and other commission activities. In this connection it must be remembered that the purpose and authority of the codes is limited to insuring safety. Therefore the rules specify only what is necessary to prevent eye strain and to enable one to see objects well enough to avoid accidents. It is not possible at the present time to require in such regulations the higher standards of good practice, which lead to better manufacturing economy and larger production.

One of the hopeful features of the lighting code progress is the fact that in essential points a uniformity has so far been maintained by different states. An ultimate uniformity should be the goal sought. What is good lighting in Pennsylvania is good in New York, and there should be little or no variation in the regulations.

The codes do not pretend to be in a final state. Changes and improvements may be expected as we have more experience in applying them, as we acquire more knowledge of the factors of good lighting, and, still further, as conditions change.

Probably the first need will be a more definite specification as to glare limits. At present much has to be left to individual judgment. An instrument is needed which will measure degree of glare and do for diffusion what the foot-candle meter is doing for intensity. It is obviously impossible to give numerical glare limits at the present time.

While the intensity steps seem to be about right, there has been considerable discussion as to the best method of presenting them—whether long definite lists of processes or short general lists shall be used. The more definite list is certainly to be preferred, if practicable, and is especially desired by inspectors. An ideal condition would be to have a table listing each process of manufacture with intensity and glare-limit values. The difficulty of providing a dictionary of intensity values is that the same nominal process is carried on with widely varying degrees of fineness, so that in one shop a considerably higher intensity is necessary for eye conservation than could be fairly demanded of another carrying on the same process but on a coarser scale.

It is hoped that education toward the higher "productive" intensities will generally solve the problem, without recourse to a long and complicated list. Such a list would tend to overemphasize the intensity factor as compared to diffusion and, further, would imply an accuracy to the limits which the variations mentioned do not seem to warrant.

On the whole, the code situation seems to be very encouraging. Codes are being adopted in other states as rapidly as could be expected. They are bettering working conditions. Instead of imposing a hardship on manufacturers, they are proving beneficial in educating them to better operating economy. There is a good prospect of improving the regulations which are made in the future, rendering them even more definite and effective.

Electrical Manufacturing Plant Capacity

Large Volume of Business from Domestic as Well as Foreign Buyers Makes Increased Facilities Necessary for Companies That Cannot Otherwise Meet the Demands Upon Them

Measuring the different influences for and against plant expansion under present conditions, A. W. Berresford, president of the Associated Manufacturers of Electrical Supplies and vice-president and general manager of the Cutler-Hammer Manufacturing Company, gives his conclusions. He believes that extension—well considered and conservative in each instance—is warranted.

MANY electrical manufacturing companies are finding that expansion of their plants and organization is necessary if they are to meet with reasonable promptness, the unprecedented demands for apparatus and supplies. Several years of little or no expansion because of war conditions explain in part why expansion is necessary now; and to this is added the tremendous public and industrial demand which followed the armistice and still shows no signs of abating.

Not all of the manufacturers in every line of electrical apparatus and supplies feel that the construction of new plant is required now. In some branches it is estimated that the release of the companies from the necessity of providing for war essentials will enable them to meet all commercial demands for their products. Nevertheless, the growth of business is receiving careful consideration in all quarters. So well able is the manufacturing part of the industry to finance requirements that it is believed confidently that plant expansion will take place wherever it is desirable to meet enlarging markets for products.

That action has been taken by large as well as many of the smaller electrical manufacturers to increase their physical plant facilities and their personnel correspondingly is an indication that these companies calculate on still greater requirements from consumers. They find their support for this conclusion in the orders from every section of the country and the reports from sales representatives that delivery dates pushed months into the future do not dismay buyers. The business is there and it is based primarily on country-wide activity in nearly all industries and on the extraordinary prosperity of the public. It receives additional impetus from the unusual demand from many foreign countries.

Some of the conditions which are accepted as justifying the construction of more plant facilities are the great demand for supplies for the large amount of new building which is going on throughout the country. The scarcity of dwellings and office buildings and the extensive factory construction in various other industries which are maintaining activity on the intensified plane of the times are evidences of a continuing market.

In planning to construct additional building capacity the electrical manufacturers are of course confronted by the abnormal present level of costs. Costs which are excessive as compared with pre-war figures have to be paid not only for labor and materials entering into the buildings but also for the manufacturing machinery which is a part of the completed plant. The high level of these costs would naturally lead them to hesitate if it were not for the pressure for their products which in some cases is leading to delays in the delivery of goods substantially beyond the usual time. One manufacturer gave as a particular reason for expansion the fact that deliveries had fallen behind to such a degree that it was felt to be inadvisable to ask customers to accept the inevitable long delays.

Careful consideration has been given to the subject of plant expansion by A. W. Berresford, president of the Associated Manufacturers of Electrical Supplies and vice-president and general manager of the Cutler-Hammer Manufacturing Company. As the demand for increased production in the field of electrical supplies is especially active the members of this association are among the manufacturers who are interested in the matter of larger manufacturing facilities. At the request of the ELECTRICAL WORLD Mr. Berresford discussed the subject.

"Decision as to increase in manufacturing facilities under present conditions and the extent to which such increase is warranted, if at all," said Mr. Berresford, "should be based on what proportion of the present admittedly abnormal demand is legitimate, and, further, to what extent reasonable expectation would indicate that such increased facilities may be continuously employed."

As no method of obtaining accurate data on either of the above conditions is available, Mr. Berresford said that the judgment of the individuals responsible in each specific instance must be the deciding factor. He thinks that probably no error of importance would result from assuming a present demand 100 per cent in excess of the pre-war needs. A considerable portion of this is due to the restriction of construction during war times, and, while legitimate, it cannot be considered permanent.

"If it be assumed that during three years of the period between 1916 and 1919 inclusive there was a probable reduction in ordinary applications of say 20 per cent," Mr. Berresford added, "and if an effort is now being made to make up this entire deficiency, this would account for approximately 60 per cent increase; and if we assume a normal annual increase rate equivalent to that prevailing in general business—approximately 6 per cent—this would add approximately 20 per cent. For want of a better basis, therefore, it seems fair to divide the assumed 100 per cent increase somewhat as follows:

	Per Cent
Normal expectable increase	20
Accumulation increase	60
Abnormal increase	20

"Assuming facilities operating at essentially full capacity at the beginning of the period, there would be indicated an eminently safe extension of 20 per cent, and if there be added sufficient in addition to care for say one-third of the accumulated demand, a further addition of 20 per cent would be indicated, making a total of 40 per cent over pre-war facilities.

"There would appear to be a reasonable expectancy of continuous operation of such increased facilities, in that, on the basis of providing for only one-third of the accumulated demand, three years would be required to supply this demand, and during those years the 6 per cent factor of general business increase would again be operative, making a total of 40 per cent addition to the pre-war standard of production, which is the amount proposed for the increase of facilities."

While Mr. Berresford recognized that all of the above is admittedly founded on assumption and speculation, he felt that the assumptions and results do not appear unwarranted.

"The adverse elements," he continued, "are obviously the high comparative cost of addition to both plant and equipment and the difficulty of predicting the period of continuance of active business under conditions which contain such a multitude of uncertain elements. It would seem, however, to be unduly conservative, and certainly contrary to business and human instinct, to make no effort to profit reasonably by the present conditions and in the end the general rate of increase should absorb the increased facilities. I believe therefore that extension—well considered and conservative in each instance—is warranted.

"In the case of the Cutler-Hammer Manufacturing Company such an increase, approximately 30 per cent, is in process. The company, however, has been fortunate in securing properties already constructed and adjacent to those it now operates, thus eliminating, in part at least, the cost of present-day building operations."

Some important additions to plant capacity are planned by various manufacturing companies in the industry.

The General Electric Company is adding units to existing groups of buildings in different localities. It has also expanded in another striking way through the acquisition of several of the smaller manufacturing companies or of a financial interest therein. Instances of these purchases are the newly acquired interest in the Trumbull Electric Manufacturing Company and the Radio Corporation of America. These cases are, of course, more than purely physical expansions of plant. They involve an implied addition in the personal elements of manufacturing plant. They mean an increase in the working personnel and in the management forces. So far as the plants in which an interest is thus acquired are located at other places than those of the existing establishments, they also serve to decentralize the labor forces. This latter factor is an advantage in itself, for it provides for the company concerned additional communities from which labor may be attracted.

The Westinghouse Electrical & Manufacturing Company is in the position of having provided for a large increase in its manufacturing facilities at Essington, Pa., during the war. Establishment of works at that point was designed to lead in time to a development equal to that at East Pittsburgh. The plans of the company underwent a change as a result of the entrance of this country into the war. With the signing of the armistice it was thought that the release of the facilities needed in war work would provide the necessary plant capacity for commercial needs. For instance, the plant at Springfield, Mass., which was acquired in connection with the Russian rifle order, is now used in the manufacture of small motors. It is understood that additional plant is to be constructed to meet the requirements of an expanding demand.

Among the developments designed to increase the manufacturing facilities is a plant under construction by the Western Electric Company, Inc., at Norfolk, Va. Submarine cable will be made at this plant.

From the foregoing it is clear that certain increases in manufacturing plant are made necessary by the very active conditions in the industry.

There is one factor which possibly may affect the situation and that is the labor one. It has undoubtedly affected it already. When labor is less efficient in production, more physical plant is required per unit of labor to attain the desired output. Conversely, the more efficient the labor, the less plant is needed.

Labor has been notoriously inefficient and a result is seen in the higher level of costs in nearly all commodities. Efforts to encourage greater production by labor are being made throughout all industries and to the extent that workers co-operate in these the strain on manufacturing physical resources will be relieved.

Books Received

APPLIED SCIENCE FOR METAL WORKERS. By W. H. Dooley. New York: The Roland Press Company. 480 pages, 207 illustrations.

APPLIED SCIENCE FOR WOOD WORKERS. By W. H. Dooley. New York: The Roland Press Company. 458 pages, 206 illustrations.

Readers' Views and Comments

Forces Acting on Disconnecting Switches

To the Editor of the ELECTRICAL WORLD:

SIR: With reference to Julian Loebenstein's article in the ELECTRICAL WORLD for March 17, 1917, page 504, on the forces tending to open switches on short circuit, I have had occasion to study the subject under discussion and feel constrained to write and point out the very serious error contained therein. This error might easily cause designers to go astray in calculating for the design of switchgear.

(1) In the formula given in the article, viz.,

$$T = \frac{kI^2A}{3}\left(\log \frac{AL}{B\,(L + \sqrt{A^2 + L^2})} + \frac{L}{\sqrt{A^2 + L^2}}\right)$$

the logarithm is obviously to the base e, whereas Mr. Loebenstein takes it to be to the base 10. This, of course, materially affects the tables and curves.

(2) The method of arriving at the formula is by means of Ampère's "action at a distance" method, one which has been the source of contention amongst mathematicians for a considerable time. It would be useless for me to enlarge on these discussions, and I will merely quote from Jean's "Electricity and Magnetism," page 443:

" . . . so that we are almost compelled to give up all attempts at explaining the action between the circuits by theories of action at a distance. We accordingly attempt to construct a theory on the hypothesis that the forces result from the transmission of stresses by the medium. This, in turn, compels us to assume that the energy of the system of currents resides in the medium."

Following out this line of argument, I have tackled the problem by considering the self-induction of a closed rectangle which, using the symbols contained in the above-mentioned article, is:

$$4\left(L \log_h \frac{2AL}{M\,(L + \sqrt{A^2 + L^2})} + A \log_h \frac{2AL}{M\,(\mathrm{A} + \sqrt{A^2 + L^2})} + 2\,(\sqrt{A^2 + L^2} - A - L)\right)^*$$

where A and L are the sides of the rectangle and M is the G. M. D. of section of the conductor. For a circular conductor $M = 0.7788 \times$ diameter, "$\log_h$" is the logarithm to the base e).

The rate of change of induction due to the slight opening of the switch is proportional to the torque on the blade, and we finally arrive at the result that

$$\text{Torque} = KI^2A\left(\log_h \frac{2AL}{0.8\,B\,(L + \sqrt{A^2 + L^2})} + \frac{\sqrt{A^2 + L^2}}{L} - 1\right)$$

If I is in amperes, A and L in inches and B is the semi-blade width in inches, and the torque is in pounds feet, $K = 0.187 \times 10^{-8}$.

If we consider that A is the blade length and L the length of the leading-in busbars, this formula is only strictly true when L is infinite, because we are considering a closed rectangle, whereas in practice only three sides exist. If, however, the arithmetical values are worked out, it will be found that for $A = 12$ the torque is practically constant for values of L over 12 in.

As a matter of interest the torque in pounds-feet is given in the table below for values of L between 12 and infinity:

$I = 20{,}000$ amp., $A = 12$, $K = 0.1817 \times 10 - 8$.

$B = 1$ in.	B 0.5 in.	$B = .1$ in.	$B = 0.01$ in.
25	32	45	67

It will be seen that these values are very much higher than those given by Mr. Loebenstein, and it is contended that his figures are far too low. He compares his results with those obtained practically from General Electric Company switches, but assumes:

(a) That the blade is 0.1 in. Now B is semi-blade *width*, not *thickness*, and as the switch blade is usually at least 1 in. wide, B should be taken as at least 0.5 in. and not 0.1 in. Presumably Mr. Lobenstein has confused the terms width and thickness.

(b) That the maximum value of the current should be taken and not the root mean square. This surely is incorrect, as in all alternating-current calculations (vide dynamometers, etc.) values for the torque are based on the R. M. S. values.

A good check on the above figures is found in the case of the General Electric 1,200-amp. switch referred to by Mr. Loebenstein. It is fitted with a clip for short-circuit currents of 20,000 amp., and in their case the mechanical torque to open the switch was found to be 32.5 lb.-ft. (compare figure of 32 above).

In the case of the 600-amp. switch 14,000 amp. was specified. This in the formula above gives 15.4 lb.-ft. (compare with mechanical torque of 16.25 lb.-ft. required to actually open the switch).

L. B. W. JOLLEY.

Research Laboratories of General Electric Company,
London, Eng.

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*See Winkleman's "Handbuch d. Physik. Elek. II," p. 595.

Ordering Correct Size of Furnace Electrodes

To the Editor of the ELECTRICAL WORLD:

SIR: In calculating the proper size of electrodes for electric furnaces account should be taken of many different conditions under which the electrodes work in addition to the amount of current carried. An electrode may be theoretically large enough for the current rating and still a larger size might be used more economically. In ordering electrodes from the manufacturer, in addition to the current rating, the transformer rating, the secondary voltage and the approximate power factor should be given. The character of the lining, whether it is acid or basic, should be stated. The kind of material charged and the ultimate product of the furnace should be included. A furnace operating on light scrap is much easier on electrodes than one handling heavy scrap. Another condition which must not be omitted is the position of the electrodes. When they operate in a horizontal position provision must be made for special joints which are not needed with vertical electrodes. Only with information on all these points can the electrode manufacturer accurately determine the best electrode for the particular installation.

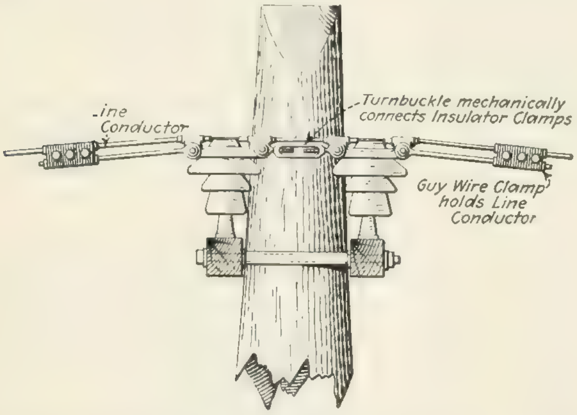
Acheson Graphite Company, A. B. OATMAN,
Niagara Falls, N. Y. Sales Engineer.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Preventing Line Failures at Railroad Crossings

IN THE report of the joint committee on specifications for electric light power supply and trolley lines crossing steam and electric railroads which was presented before the American Electric Railway Association, the accompanying drawing was given as an illustration of a typical wood-pole insulated construction for crossings. The object of this particular design is to arrange the tie wires, clamps and other fastenings so that the conductors will be held under maximum load regardless of shattered insulators or wires burned or broken at the insulator. This is accomplished by means of a turnbuckle, two guy clamps and two short pieces of guy wire. The turnbuckle holds the two insulator clamps and can be adjusted to various distances between cross-arms. To the other side of the insulator clamps are attached two short guy wires, which are connected to the conductor by means of a guy-wire clamp. In this way a complete mechanical connection is obtained for a distance of 12 in. (30 cm.) on each side of the cross-arms.


ine Conductor
Turnbuckle mechanically connects Insulator Clamps
Guy Wire Clamp holds Line Conductor

COMPLETE MECHANICAL CONNECTION INSURES AGAINST FAILURE OF CONDUCTOR

Effect of Engine Speed on Generator Operation

THE voltage at which direct-current generators are designed to operate and the speed proper for that voltage are always shown on the nameplate of the machine. Sometimes machines must be operated at higher or lower voltage, and if the difference in voltage is considerable (over 6 per cent) adjustment by means of the field regulator may not give good operation. This trouble was encountered in a 250-volt generator designed for 150-r.p.m. where operation at 220 volts was desired. The shunt-field current was 7 amp. and the shunt field had 900 turns per pole, or 6,300 ampere turns. The series field had eight turns per pole, and the full-load current of 600 amp. gave 4,800 series ampere turns per pole. The series ampere turns (4,800) at full load were therefore 43 per cent of the total of 11,100 per pole when operated at full speed and voltage.

As 6,300 ampere turns (shunt alone) was sufficient to give 250 volts at no load, it was too much for 220 volts, and adjustment by field rheostat to about 5¼ amp., or 4,700 amp. turns per pole, was necessary to give the desired no-load voltage. This required nearly all the resistance that the field regulator contained.

This shunt field being weak, the addition of 4,800 ampere turns per pole due to full-load current in the series, which now supplied 51 per cent of the total field, brought the full-load voltage to more than desired, and the series current had to be partly diverted through a shunt.

It would have been much easier and better to adjust the engine governor to give a speed of 132 r.p.m., leaving the electrical adjustments as they were designed to be, and this was afterward done.

There is another seriously bad effect due to weak shunt field. When a sudden application of load occurs, such as that encountered in starting an elevator, the quick change in armature current causes a drop in voltage for a very short time until the series field has time to respond to the increased current. If the shunt field is relatively weak, and the drop of voltage over the series field due to the "kick" of load is a high percentage of the total, the effect of a sudden load is more noticeable and may be seen in lamps supplied from the bus.

This cannot be overcome by adjusting the series field shunt, and if such conditions are found the only satisfactory remedy is to operate the machine at the right speed for the busbar voltage.

Difficulties in Operating Motor-Generator Set Inverted

WHEN a motor-generator set in an industrial plant was operated so as to deliver alternating-current energy considerable trouble was met because of the machine increasing in speed as load was applied. Ordinarily this machine operated with the alternating-current unit as a motor and the direct-current and delivering energy in parallel with a plant consisting of 250-volt direct-current generators driven by turbines. Some of these machines are three-wire, and the motor-generator set had a split-series field. In operating the alternating-current unit as a motor and the direct-current end as the generator no difficulty was met, but when operating inverted it was impossible to keep the machine on the line. The series field was cut out and the motor run as interpole shunt motor. With the field rheostats all cut off the natural speed of the motor is 670 r.p.m. Because the machine was to be connected to a 60-cycle line it was necessary to raise the motor speed to 720 r.p.m. by weakening the field. This weakening of the field made the shunt field quite weak, and the interpole had a compound effect, opposing the shunt field and increasing the motor speed as the load increased. The interpole strength was adjusted for correct commutation. It was not advisable to decrease it as sparking would probably follow. In order to prevent the set from taking more than its share of the load, it was, of course, necessary to make its speed variation with load the same as that of machines with which the alternating-current end was to be paralleled.

It was suggested that one way to make this set operate correctly was to use a Tirrill regulator and a separate exciter for the generator in order to keep the voltage constant. This would have failed because the division of load between alternators in parallel depends upon the driving force applied to their shafts and not to any considerable extent upon the field current in the alternating-current rotors.

The remedy in this case was obtained by changing connections so that the series field of the direct-current end was in circuit when the unit was operated inverted. The series field held the speed down as the load came on. Reversing switches were connected in each half of the split series field so that the polarity of the series field was correct and yet could be easily changed back for normal operation. The regulation was checked by trial on a water rheostat so that the alternating-current generator could be operated at full load without being in parallel with the other machines.

Recording Status of Insulation

FOR keeping in constant touch with the condition of the insulation on the 20,000-volt transmission tie line which connects the Silver Lake steam plant of the Pittsfield (Mass.) Electric Company with the system of the Southern Berkshire Power & Electric Company at Lee, Mass., a curve-drawing ammeter has been successfully utilized. Energy at Pittsfield is generated at 2,400 volts, two-phase. It is then raised to transmission pressure by T-connected transformers, and the neutral point of the latter is grounded through a current transformer to which a General Electric curve-drawing ammeter is connected. In case of a ground on the line, which causes unbalancing, the ammeter pen registers the disturbance as a cross-line on the chart. Under normal conditions a continuous circle is drawn by the pen on the chart, which thus can be used day after day until abnormal conditions arise.

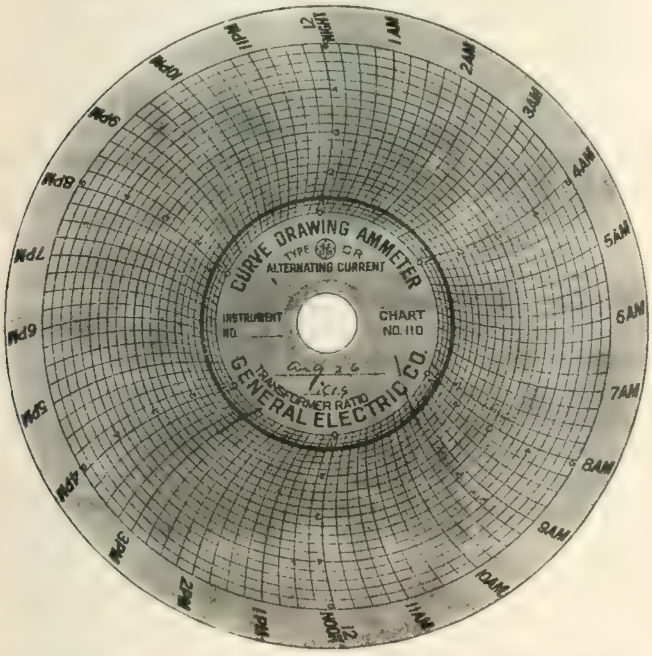


FIG. 1—SAMPLE OF THE CHART MADE BY THE AMMETER

In Fig. 1 it will be seen that an oil circuit-breaker opened at 9:15 a.m., owing to grounding, and that another temporary disturbance occurred at 3 p.m. These records serve not only as operating history, but when swinging grounds or partial grounds occur, which might cause a shut-down if allowed to remain, the pressure of the continuous chart aids in calling attention to unusual conditions and has not infrequently enabled continuous service to be maintained. The information bearing upon this matter was furnished by G. E. Whitlesey, superintendent of construction, Pittsfield Electric Company.

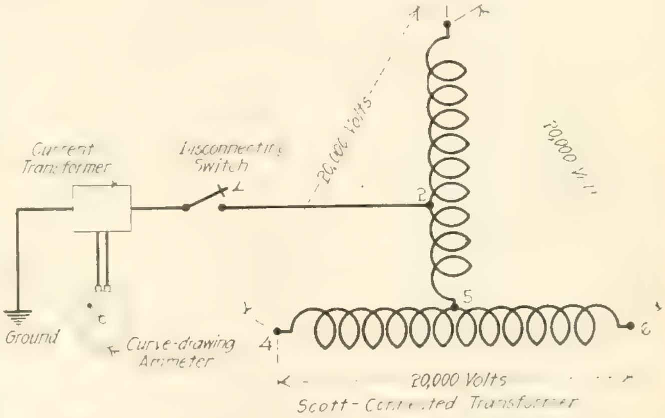


FIG. 2—METHOD OF CONNECTING CURVE-DRAWING AMMETER TO REGISTER LINE DISTURBANCES

Low Exciter Voltage Causes Control Trouble

THE importance of a reliable source of direct current for control must not be underestimated because serious trouble may result from its failure. This was illustrated recently in a power plant where several feeder switches are installed at some distance from the switchboard and the energy for the control bus is normally supplied by storage batteries. When any repair work is done on the batteries the switch in the figure is used to connect the control bus to an exciter bus rated at from 80 volts to 120 volts for normal load conditions. At one of these times the operator failed to raise the exciter voltage before switching over on the exciter bus, but intended to do so immediately by adding resistance from the generator field rheostats. Before he had an opportunity to do this a short circuit on one of the feeders operated the overload relay, which in turn energized the feeder circuit-breaker trip coil with a potential of about 85 volts. The switch, which never before had failed to open with 110 volts, now failed to open. The operator after finding out which feeder the short circuit was on tried to open the switch with the remote control pull button, but this could not be done because the relay kept the trip coil energized. The voltage regulator had raised the exciter voltage to 135 in an effort to keep the alternating-current bus voltage normal, but even this high voltage failed to open the switch when the trip coil plunger could only push on the latch and was not able to strike a blow.

The operator could have opened the generator switches, thereby shutting down a section of the plant or the whole plant, to clear the short circuit, but this was not absolutely necessary. He could have opened the switch between the exciter and the control bus and have closed it again instantly. This procedure would strike the hammer blow on the feeder switch latch, since the relay contacts remain closed until the short circuit is isolated. It is advisable to be ready to open and close this control bus switch rapidly in any similar emergency, as a succession of these hammer blows will usually open a switch even if the control voltage is low.

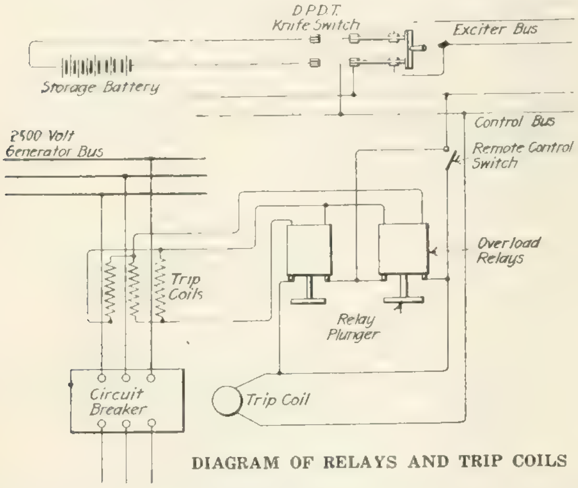


DIAGRAM OF RELAYS AND TRIP COILS

It was stated that the operator intended to raise the exciter voltage by turning in resistance on his generator-field rheostats. This would not disturb the alternating-current voltage regulation as the voltage regulator would compensate for this. L. W. Wyss.

Iron Mountain, Mich.

Rules for Operating Remote-Control Switches

When a station operator has learned to operate oil circuit breakers he usually does not study the matter further. Nevertheless, in order to insure correct operation of these switches they should be thoroughly understood. Some things that should be remembered are as follows: When synchronizing the remote-control switch handle should not be held in the closed position any longer than is necessary to close the switch, because there is a possibility that a loose connection or poor contact may prevent the switch from closing immediately; then, if the remote control switch handle is held in the closed position, the switch may close after the generators are out of synchronism. Moreover, if the control voltage were low and the handle held too long, the switch might not latch in the closed position. This might lead to serious results when synchronizing. If the control switch is held just long enough to close under normal conditions, it will open immediately in case it does not latch closed, thereby preventing trouble.

When opening a switch it is useless to hold the remote-control handle in the open position longer than about half a second, because the switch is usually unlatched by the "hammer blow" of the trip-coil plunger. If the switch does not open at the first hammer blow, it should be operated again.

Service Quickly Resumed After Substation Fire

The speed with which the loads served by the East 105th Street substation of the Cleveland (Ohio) Illuminating Company were switched over onto other sources of supply after a disastrous fire starting at 4:30 p.m. Dec. 31 typifies the value of the company's flexible distribution system. Although the flames melted the lead sheaths on cables, ignited the insulation on the conductors, and spread to the 2,300-volt distribution switchboards and street-lighting panels, destroying control circuits, damaging minor apparatus, cracking panels, etc., almost all of the loads had been transferred to other stations by 11 p.m. the same night. The problem of clearing the substation from all outgoing and incoming circuits was particularly difficult because the dense smoke made it impossible for the operator to determine whether the control apparatus worked or not.

The trouble was caused when a transformer bank having both high-tension and low-tension oil switches in the open position was being transferred through knife selector switches from a dead to a live bus. Two of the selectors had been closed and the third was being closed when an arc started caused by a defective bushing in the bus side of the third phase of the high-tension switch. This broke down to the grounded frame of this pole and ignited the insulation on the lead-in conductors as well as the oil inside the switch tank of this phase, the flames spreading as mentioned above. The fact that the switch was a triple-pole, 11,000-volt oil switch with each pole in a separate pocket prevented other oil being ignited.

The location of the defective bushing was such that the bus had to be killed to clear trouble at this point. While the arc was severe, there was sufficient resistance in circuit to limit the current flowing over the individual transmission cables feeding this station to a value below that required to trip the switches at the generating end. These switches were tripped by the operator at the generating station, however, as soon as he received telephone notice of the trouble, and steps were taken to transfer the loads to other stations.

After the fire was extinguished it was found expedient to cut out all cables that had been racked under the operating room ceiling, and to save the time required for splicing, those undamaged portions in ducts in the station walls were also removed. The mechanisms of a number of oil switches were found damaged by the heat, and these were replaced from stock.

Instruments were tested, the majority being found in operating condition and correct in calibration, although they showed signs of being exposed to intense heat. The high-tension structure and station transformers were also tested and found to be in good condition.

As soon as cables could be installed and tested they were connected one at a time to the various distribution circuits. By the next day five circuits were operating, and by midnight of that day a total of eight general lighting circuits and six street-lighting circuits were in good condition. Twenty-five hours later service was restored to all circuits, which comprised twenty-nine lighting and power circuits, in addition to the railway substation's load and that of a large industrial plant fed from the 11,000-volt distribution cables.

H. W. Wallau,
Electrical Engineer.

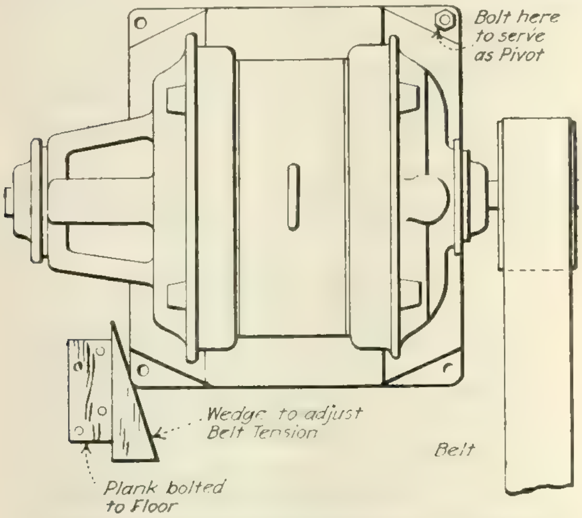
Cleveland (Ohio) Electric
Illuminating Company.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Motor Installation for Temporary Drive Not Bolted to Floor

When a motor driving a machine by means of a belt is to be installed for use over a short period of time, the method shown here has been used with good results. The adjustment of the motor in relation to the driven machine is very simple and can be accomplished in a short time. Only one corner of the motor base is bolted to the floor. This in itself saves considerable time in making the installation. Diagonally opposite the bolted corner, a plank is attached firmly to the floor. The wedge is then inserted between the plank and the motor base as shown, so that the motor position can be adjusted until the belt travels on the center of the pulley.



ONE BOLT AND WEDGE HOLDS MOTOR IN POSITION

Large Industrial Plant Maintenance Methods

By adhering to the rule that long successful operation of motors and control apparatus is more economical from a production point of view than a low first cost, the Gillette Safety Razor Company has maintained almost continuous operation for a number of years. Spare parts are kept in stock to provide for any emergency. When new motors are received, if no extra bearings are on hand these are immediately ordered. To have in stock bearings to fit every motor in service is thought by the company to be the cheapest insurance for continuous operation.

Equal in importance with this practice is that of careful and regular inspection, which will contribute greatly to keeping the motors on the line. In the Gillette plant the night electrician cleans, removes and replenishes oil wells and tests each motor with a gage at least once every six months. Motors are inspected as to the proper amount of oil each Monday by the foreman of the electrical department, who is responsible for their external cleanliness.

For quick or emergency connections 100-amp. bulldog clamps are available with 6 ft. (1.8 m.) of flexible auto cord connecting one pair. Three pairs are on hand so that a defective switch or compensator can be shunted if necessary.

The cost methods in this plant are as follows: Repair work is charged on the workmen's daily time card, each department having a designated number. The letter R following this number indicates repairs. If new apparatus is installed, the letter P is indicative. Stock is kept in the electrical department storeroom, and its cost is recorded on a card index file and charged to the job when finished. A large job has a special ticket, and the workmen charge their time on their cards to this number. When the job is completed a list of stock is tabulated and charged off, and the card is sent to the office marked "finished," with the head of the department's signature.

I. H. Gaskin,
Electrical Engineer.
Gillette Safety Razor Company,
South Boston, Mass.

Home-Made Tools for Electrical Repair Shop

At the repair shop of the American Electric Service & Maintenance Company, Springfield, Mass., the set of home-made tools illustrated herewith is used to facilitate rapid work. These devices are as follows: (1) Paper cutter, (2) wedge driver, (3) wedge driver, (4) tapered slot or lamination straightener, (5) tape reel, (6) wedge driver and (7) tape hook.

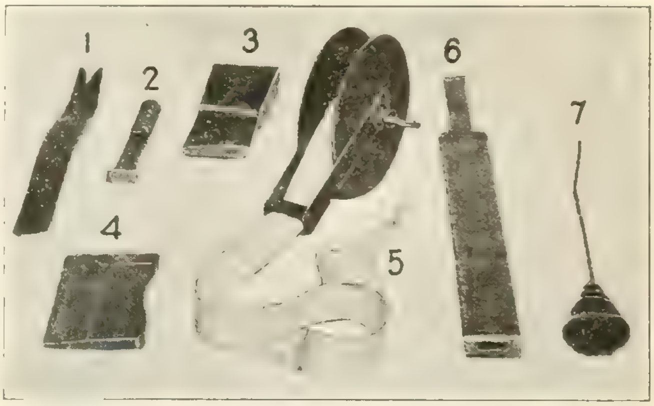


FIG. 1—TOOLS USED IN MOTOR REPAIR SHOP

The paper cutter (1) is 6 in. long, $\frac{5}{8}$ in. wide and $\frac{1}{32}$ in. thick (15 cm. x 15 cm. x 0.8 mm.), with a slight offset in its central portion to facilitate prying and a V-shaped slot at the end to enable protruding paper to be easily cut down to the slot level. The wedge drivers (2 and 3) are of convenient shape for work within the stator frames of motors and generators, and the tapered slot or lamination straightener (4) is a handy tool 4 in. long, 2 in. wide and ⅜ in. in maximum thickness (10 cm. x 5 cm. x 9 mm.), with tapered surface from right to left, making it more convenient to smooth out slot interiors applying the coils. The tape reel (5) provides an easy means of keeping tape out of the way when working around the bench, the brass circular sides being 3 in. (7.5 cm.) in diameter and provided with a U-shaped clamp with rods at the upper end throuugh which the tape is fed. A wing screw enables the movement of the reel to be adjusted for the correct amount of friction required to pull out the tape. With this reel only enough tape to handle the immediate requirements of the job is fed forward, and there is no rolling about of loose tape as from an ordinary unwinding reel.

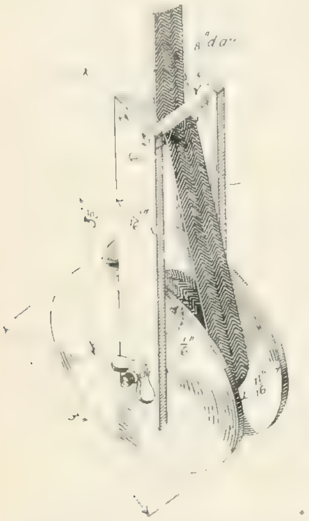


FIG. 2—DETAILS OF EFFICIENT TAPING REEL

The wedge driver (6) is essentially an extension hammer which fits into a slot and which can be forced forward from without in such a way as to bring effective working pressure upon tightly embedded wedges in order to remove them or to force them into final position. It consists of a ½-in. x ⅛-in. (1.3-cm. x 3-mm.) steel tongue running in a steel holder bar 9 in. (23 cm.) long. The tongue is driven forward in proper alignment by placing a driver bar in the tool and hammering from the outer end. The tape hook (7) is 5 in. (13 cm.) long with an additianal 1¼-in. (3.1-cm.) bend at the end and is convenient in handling such material.

Characteristics and Uses of Air-Drying Insulating Varnishes

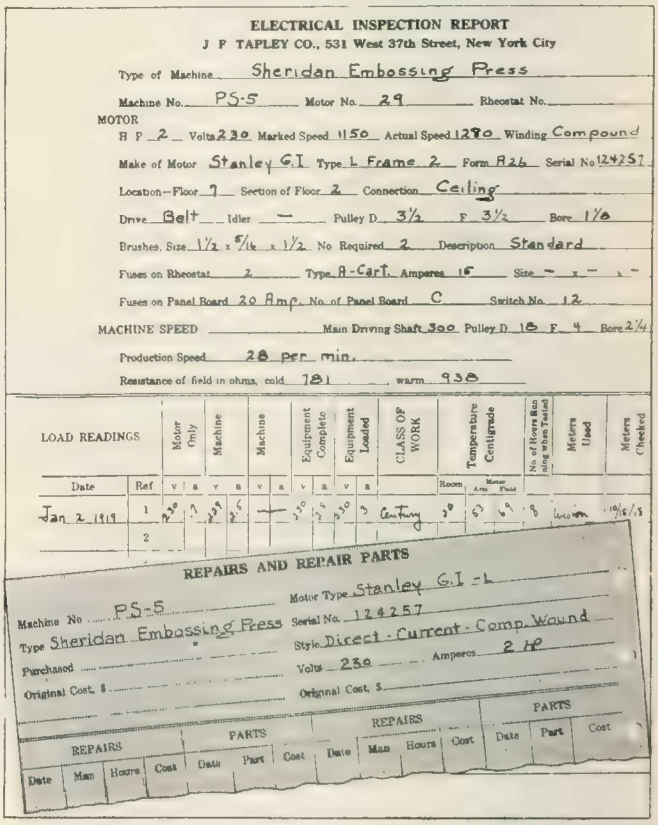
THERE are two different types of air-drying varnishes—those made with a benzine solvent and those made with an alcohol solvent. The latter are commonly called spirit varnishes or finishing varnishes. The benzine solvent air-drying varnishes are not oil-proof. The alcohol solvent varnishes are made from materials which are insoluble in oil and are therefore oil-proof. They dry much more quickly and are harder, but are not equal in elasticity and heat resistance to the benzine solvent varnishes.

The physical characteristics of varnishes of the same color and having the same baking time are not necessarily the same. Electrical apparatus is subject to many different conditions of usage, and it is necessary that the varnish be strongest in those particular characteristics which will be most needed. For example, a street-railway motor is exposed to the action of rain and snow on steep grades, and during periods of heavy traffic it is overloaded with resultant heating. A varnish to be successful on such a motor must be extremely water-resisting and must possess the longest possible life under heat. An automobile-starting motor armature which operates at a speed of from 10,000 r.p.m. to 12,000 r.p.m. requires a varnish possessing extreme mechanical strength and binding and cementing properties. Other characteristics, while important, are subordinate to these. In choosing a varnish for any particular work the usage to which the equipment will be subjected should be taken into careful consideration.

Electrical Inspection Report for Direct-Driven Machines

IN ORDER to maintain inspection and maintenance records of motors in the book-manufacturing plant of J. F. Tapley, New York City, the accompanying forms have been adopted to record the testing and repairs of all of the motors in the shop. The results of the periodic tests which are made on the motor are tabulated so that inefficient operation can be instantly recognized by a comparison of the data obtained in different tests. Load readings of current and voltage are taken in the test, together with the temperature conditions of the motors. Accuracy in the test is assured by recording the meter numbers and the date on which they were last checked. In addition to the comparison of tests of the motor, a check can be obtained by the motor specifications, which are also listed on the front of the sheet.

The entire expense of the motor since it was installed is recorded on the opposite side of the inspection report.



ELECTRICAL INSPECTION REPORT
J F TAPLEY CO., 531 West 37th Street, New York City

Type of Machine Sheridan Embossing Press
Machine No. PS-5 Motor No. 29 Rheostat No.
MOTOR
H P 2 Volts 230 Marked Speed 1150 Actual Speed 1280 Winding Compound
Make of Motor Stanley G.I Type L Frame 2 Form A26 Serial No 124257
Location—Floor 7 Section of Floor 2 Connection Ceiling
Drive Belt Idler — Pulley D 3½ F 3½ Bore 1⅛
Brushes, Size 1½ x 5/16 x 1½ No Required 2 Description Standard
Fuses on Rheostat 2 Type A-Cart. Amperes 15 Size — x — x —
Fuses on Panel Board 20 Amp. No. of Panel Board C Switch No. 12
MACHINE SPEED Main Driving Shaft 300 Pulley D 18 F 4 Bore 2¼
Production Speed 28 per min.
Resistance of field in ohms, cold 781, warm 938

LOAD READINGS		Motor Only		Machine		Machine		Equipment Complete		Equipment Loaded		CLASS OF WORK	Temperature Centigrade			No. of Hours Running when Tested	Meters Used	Meters Checked
Date	Ref	v	a	v	a	v	a	v	a	v	a		Room	Motor Arm	Motor Field			
Jan 2 1919	1	230	7	229	2.6	—		230	2.9	230	3	Century	20	63	69	8	Weston	10/15/18
	2																	

REPAIRS AND REPAIR PARTS

Machine No PS-5 Motor Type Stanley G.I -L
Type Sheridan Embossing Press Serial No. 124257
Purchased Style Direct - Current - Comp. Wound
Original Cost, $ Volts 230 Amperes 2 HP
Original Cost, $

REPAIRS				PARTS			REPAIRS				PARTS		
Date	Man	Hours	Cost	Date	Part	Cost	Date	Man	Hours	Cost	Date	Part	Cost

FRONT AND BACK SIDE OF ELECTRICAL INSPECTION AND MAINTENANCE REPORT

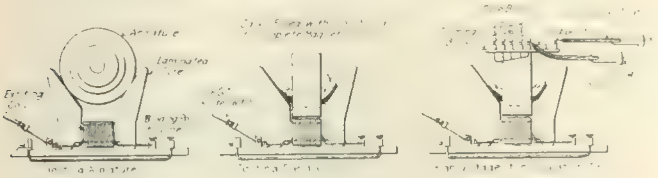
Here the original cost of the driven machine as well as the driven motor.

As repairs are made on the motor their cost is listed under this cost as shown. The recording of data of the kind, while it entails considerable work, is invaluable in that it allows the determination of the motor maintenance necessary and in that it gives a good idea of whether or not the motor is operating correctly. Many times this information will show that the machine is incorrectly motored, and the result of a correction made in a few such instances will pay for the entire cost of the testing and clerical work. R. E. PETERS, Works Engineer.

New York, N. Y.

Armatures and Field Coils Tested by Transformer Action

MANY motors and generators, after being repaired or rewound, are oftentimes put back into service still at fault, with a consequent loss of time and money, all through the lack of suitable testing apparatus. There are nearly as many different kinds of testing devices as there are repair shops, some being better than others.



DEVICE USED FOR THREE DIFFERENT PURPOSES

The apparatus described below has given excellent service for a number of years, although it is simple and inexpensive.

A laminated core is built to a thickness of about 4 in., (10 cm.) and is mounted on a board with a switch and screw binding post to connect to the line. If it is to be used on 220 volts, 60 cycles, 180 turns of No. 10 D.C.C. wire should be used on the exciting coil; if voltage is 110, ninety turns of No. 7 or two No. 10 wires in parallel should be used. As it is impossible to design a core which will fit all armatures, two strong canvas sacks filled with iron filings are used between the armature and the core.

In order to test armature for grounds, a fairly high alternating-current voltage should be used, depending on the class of apparatus repaired. For a breakdown voltage up to 2,400 volts a coil is wound with 4000 turns of No. 21 D.C.C. wire, taps being brought out at 1,000, 1,500, 2,000, and 3,000 turns, which will give approximately 600; 1,000, 1,200, 1,800 and 2,400 volts respectively. The core after being wound should be dipped in a good insulating varnish, baked and mounted on a strong, light board with the various binding posts. It should then be calibrated with a voltmeter and posts with their respective voltages plainly marked. The test leads should be well insulated and brought to handles.

During testing the armature is placed as shown, the binding posts are connected to the line, and the switch is closed. Short circuits are located by the heat they develop, and also by the attraction of the tin explorer, which is used to explore around the armature. It will be noticed that when two commutator bars are bridged by the explorer a spark is produced. When an open circuit is encountered the spark is greatly increased, while a short circuit is indicated by the absence of spark. The region of sparking on commutators varies as to the type of winding of armature under test.

To test field coils, place them as shown with the sacks filled with filings to complete the magnetic circuit. If there is a short circuit in the coil, it will be indicated by heat or smoke or by placing a light strip of tin on the upper inside of coil under test. If the coil is short-circuited the strip will be attracted.

To make a voltage breakdown test on an armature commutator or complete motor, place the high-voltage coil in the same position as when testing a field coil. The terminals with the voltage desired are connected to the test leads and used as illustrated.

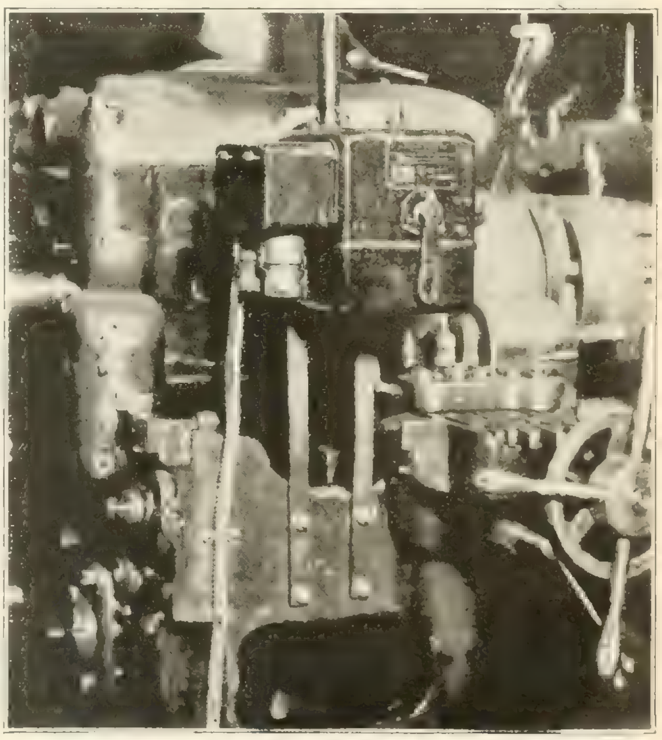
Care should be taken when testing a field coil with a large number of turns, or when using the high-voltage coil, not to let the bare leads come in contact with any exposed part of the body. Such an accident might have fatal results. ANTHONY J. MORRONI.

Washington, D. C.

Solving a Difficult Problem in Switch Mounting

IN ELECTRIFYING a Jones & Lamson two-spindle, heavy-duty turret lathe the mounting of the starting switch presented a serious problem in a Massachusetts factory on account of the movable head with which this machine tool was equipped. It was desirable to have this switch within easy reach of the operator without placing it in his way. As shown in the accompanying photograph, a simple and efficient scheme for doing this was adopted. The switch, a Westinghouse No. 815, was attached to the main frame of the lathe by two 1-in. x $\frac{7}{16}$-in. (2.5-cm. x 11-mm) strap irons fastened to the frame with four $\frac{5}{16}$-in. (8-mm.) bolts.

The three-phase leads serving the motor in this case were brought down to the switch from overhead in a straight run of vertical $\frac{3}{4}$-in. (18-mm.) conduit, and the feed to the motor, three No. 10 wires, was carried from the switch in armored flexible conduit. A careful survey of the tool showed no place so satisfactory as that illustrated for the mounting of the switch, taking everything into account.



CONVENIENTLY LOCATED LATHE CONTROL WITH CIRCUITS IN RIGID OR FLEXIBLE ARMORED CONDUIT

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Effect of Attractive Retail Store on Public Good Will

A LARGE sum of money has been spent by the Milwaukee Electric Railway & Light Company to remodel the room in which its customers transact most of their business with the company. This was done in recognition by the company of a duty which it believed rested upon it to establish a proper standard for electrical merchandising and to place such commodious and convenient quarters at the disposal of its patrons that their business could be handled in the most expeditious and efficient manner. The results which have been obtained not only by the sale of merchandise but also in the creation of favorable public sentiment toward the company have amply justified the expense.

The room, which is approximately 115 ft. long x 40 ft. wide x 18 ft. high (35 m. x 12 m. x 5.5 m.), had previously been used as a salesroom. However, all the old fixtures have been removed and the room was entirely refurnished and redecorated. The walls have been paneled with quarter-sawed oak to a height of 9 ft. (2.7 m.) Handsome showcases with looking-glass backs and interior illumination have been installed. Other fixtures have also been put in to harmonize and to give the whole an imposing appearance.

The convenience of customers and salespeople has been carefully provided for in the arrangement and by the installation of elevators and pneumatic tubes. Ample space has been provided for the sale and demonstration of all electrical household appliances. Arrangements have been made for the sale and exchange of lamps, for taking service applications, and for taking in the money at a special cashier's cage placed in an easily accessible position.

NEW APPLIANCE SALESROOM IN MILWAUKEE

This view shows one end of the customers' room recently remodeled by the Milwaukee (Wis.) Electric Railway & Light Company. The lamp counter is behind and to the right of the cashier's cage which is shown in the center of the photograph. The service application counter is at the opposite end of the room.

Costs of Changing to Alternating Current

By E. J. Tracy, Jr., St. Louis

THE cost in June, 1919, of changing over a railroad-car building plant which generated its own direct-current power to operate on central-station alternating-current power is given in the table herewith. The figures are carefully estimated, costs based upon data collected for the purpose from installations that were changed in five different sections of the country. The connected motor load in the car works is 3,500 hp. and the average load 1,800 kw.

The new arrangement will embrace a building for the alternating-current substation with concrete foundations, brick walls, fireproof windows and doors and concrete roof. The over-all measurements are 20-ft. by 25 ft. by 30 ft. (6 m. by 7.5 m. by 9 m.). The roof will support three 13,200/440-volt, 750-kva., single-phase, 60-cycle transformers. Two sets of motor-generators, of

200 kw. and 100 kw. respectively, will be installed for lighting and for operating hoists, cranes, small drills and variable-speed motors by direct current. New electrically driven compressors will replace the steam compressors. Most of the steam hammers can be changed readily for operation by air. There will be ten tablet boards for power with about thirty circuits each and the present lighting tablet can be used. New feeders from 500 ft. to 1,000 ft. (150 m. to 300 m.) long to six or eight buildings will be run.

ESTIMATED COST IN CHANGE FROM DIRECT TO ALTERNATING CURRENT

Building	$4,000	
Three 13,000-volt, 750 kva. transformers	9 000	
One indoor 13,000-volt T.P.S.T. oil switch	500	
Indoor choke coils, insulators, busbar and disconnecting switches	800	
One bank of electrolytic arresters	1,000	
One 200-kw. and one 100 kw. motor-generator	12,000	
Five-panel switchboard	1,500	
Instruments	400	
Miscellaneous and labor at 60 cents per hour	3,700	
Total cost of substation		$32,900
Alternating current motors, 3500 hp. at $20 per hp		70,000
Changing and wiring 180 motors, at $75 each—average size about 20 hp		13.400
New feeders, six to eight buildings, 500 ft. to 1,000 ft		10,000
4,000-cu.ft. air compressor and 75-hp. motor		10,500
Ten tablet boards		8,000
Miscellaneous items, 10 per cent		14,500
Total		$159,300
Salvage from direct-current motors at $5 per hp		$17,500
Salvage from old feeders		2,000
Total salvage		$19,500
Total net cost		$139,800
Interest and depreciation, 1 per cent per month		1,400
Cost per hp. of connected load		40

These figures give a total estimated net cost of $139,800, or about $40 per horsepower of connected load after deducting the salvage.

Winter Revenue for Curbside Outlets

AT LONDON, Ontario, the Public Utilities Commission has installed at the curbside on principal streets several outlets such as shown in the accompanying illustration. At these outlets connections can be made for electric heaters by automobile owners to prevent freezing of radiators and water-circulating systems when cars are parked along the curb. E. V. Buchanan, general manager at London, Ont., has proposed the installation of such outlets throughout the downtown section, each outlet to be protected by a locked cabinet and keys rented to automobile owners at $5 per year. A record will be kept of the owners' car numbers so that inspectors passing along the streets can detect any user of the service who has not made the required deposit.

AUTOMOBILE ELECTRIC HEATER CONNECTED TO CURBSIDE OUTLET TO PREVENT FREEZING OF RADIATORS

The Electrical Co-operative Campaign in California

Review of Results Obtained in Two Years and Plans for 1920 in Which Central Stations and All Trade Groups Take a Part

THE California electrical co-operative campaign, instituted in December, 1917, has in little more than two years built up a strong organization with an efficient staff constantly employed in directing its activities. The purpose of the campaign, to unite the efforts of the various branches of the industry, has been successfully attained, for a state-wide propaganda is now being conducted to educate the general public in affairs electrical. with particular emphasis on the utilization of electric household appliances. That those interested in the maintenance of the campaign consider its achievements worthy of added encouragement is shown by the fact that the tentative budget for 1920 provides for expenditures of about $27,000, whereas the 1918 budget was for $8,700. This expansion indicates true confidence in the value of the campaign's continuance. It should be noted that the annual budget gives no complete idea of the money expended in furthering this movement, for members of the advisory committee, who meet monthly in different parts of the state, serve without pay and meet their own traveling and other expenses. The funds to pay for co-operative advertising, not handled directly through campaign headquarters, no doubt aggregates half a million dollars yearly.

From the outset the central stations have taken a leading part in the activities of this organization. They have contributed liberally to the expenses of the campaign, and it is estimated that of the total funds available in 1920 approximately one-third will come from this source. Of the total amount spent for advertising in the "electrical sections" possibly one-fourth is the outlay of the central stations, with practically all the remainder coming from contractor-dealers.

Upon the advisory committee, which is the directorate of the campaign, the power companies are accorded representation of three members out of the ten, the others representing the electrical manufacturers, jobbers, contractors and dealers. The chairman of the committee is Lee H. Newbert, head of the commercial department of the Pacific Gas & Electric Company. A. W. Childs, superintendent of sales for the Southern California Edison Company, and A. Emory Wishon, assistant general manager San Joaquin Light & Power Company, are other central-station members of this committee.

Above all, the object of the campaign and the thought that has animated it from the beginning is expressed in its slogan, "Better service to the public." The improvement in service sought was not merely in kind but in scope. It was felt that it was not enough that the central stations should take steps to improve, wherever possible, their service to the public; it was deemed essential that there should be general improvement in every branch of the industry.

Especially was it considered desirable that the contractor-dealers should undertake aggressively the work that had in part been assumed by the central station—the sale and installation of labor-saving devices. The contractor-dealer was looked upon as the logical salesman of the industry, the vital point of contact with the public. With proper encouragement, declared the campaign leaders, he could proceed with confidence to enlarge the scope of his business, reach out for new opportunities, improve the appearance of his place of business and introduce better merchandising and accounting methods.

Accordingly the campaign stands squarely behind the sales activities of the contractor-dealer. The confidence thus inspired in the contractor-dealer, who realizes now fully that the central stations and other interests are backing him in his efforts, does not fail to arouse a more friendly feeling everywhere in the industry. There is also manifested a reciprocal desire on his part to understand and interpret to his customers the central-station problems and viewpoint. In this way several rough points, long existent, in the relations of the contractor-dealers and the central stations are gradually being smoothed out.

The results to date have been gratifying. In 1919, out of a total of 400 dealers, 212 either had new stores or completely remodeled their stores. The number of absolutely new establishments was seventy-nine; the new locations counted seventy, and sixty-three dealers made very extensive alterations in their places of business. Many who had before no show windows to display their goods have made the necessary changes, and attractive window displays are no longer the exception.

In addition to attaining increased store sales, a considerable number of dealers have, at the urging of the campaign committee, placed solicitors in the field to stimulate sales still further. In December, 1919, there were 167 solicitors actively engaged, all sent out by dealers, whereas a year ago it is estimated that there were perhaps twenty-five in the entire state. Two years ago there were practically no solicitors employed by dealers, though the central stations had a few. The employment of many new outside solicitors by dealers seems to point very definitely to profitable business returns from their efforts. Electrical contractors have also contributed to the general forward movement by urging upon builders the inclusion in their wiring plans of additional outlets, especially baseboard outlets, to permit the more ready use of electrical appliances.

Co-operative Newspaper Advertising

Another feature of the campaign is co-operative newspaper advertising. A full page each week in many of the metropolitan papers is now devoted to contractor-dealer advertisements, accompanied by a central-station advertisement. In many cases there have been entire "electrical sections," of great advantage to the advertisers. The central-station advertisement is usually the keystone of the arch—holding often a preferred position on the page. The doctrine of electrification of the household is conveyed with full adequacy by the contractor-dealers, and the central stations address the public on topics of broad policy. This co-operative advertising has not resulted in larger advertising appropriations by the power companies, but the contractor-dealers have increased their space manyfold.

Full-page advertisements by the electrical industry are not restricted to papers in the large cities. Many daily and weekly journals in the rural communities have fallen in line. Altogether, it is conservatively estimated that there will be 6,000 full pages of electrical advertising in newspapers of California in 1920. The campaign employs specially commissioned field agents to work up interest in the "section idea" in various parts of the state, but when they enter the territory of a power company to organize these sections they invariably consult the management of that company so that they may work in harmony with its well-established publicity policies.

Much prominence has of late been given by the press of the state to news items of interesting happenings in the electrical field, and trade journals of the industry have also freely devoted their space to wider publicity for the co-operative movement. A special press service for circulation among the editors of California is issued regularly under the direction of the publicity committee of the Pacific Coast Section, N. E. L. A., which works in conjunction with the campaign organization in this very important enterprise. I. W. Alexander, of the San Joaquin Light & Power Corporation, is chairman of this committee.

Newspapers Liberal with Space

As to the value of thus sending out news material, one eloquent fact is revealed. In newspapers where "electrical pages" have appeared the news space devoted to happenings of the industry reaches about 20 per cent of the advertising space utilized, whereas in other newspapers it amounts to only 5 per cent. Many newspapers have published editorials in which the friendly attitude predominates, and agitation for municipal ownership has virtually disappeared.

The sales results of the 1919 campaign activities are now being tabulated by a special committee of the organization, headed by D. E. Harris, vice-president and sales manager of the Pacific States Electric Company. The complete figures will unquestionably show a considerable gain in the sales of electrical household appliances over those of 1918. At the Christmas season, for instance, dealers reported increase in sales of from 25 per cent to 100 per cent over last year.

All this sales activity has, of course, indirectly benefited the central stations, as it has also benefited the jobber and the manufacturer. The public's interest, above all, has never been lost sight of, for it is well understood that only by a careful conservation of the rights of the public can the industry continue to grow and prosper. These rights of the public are superior electrical service from the central stations, high-quality merchandise at fair and uniform prices from the dealers, adequate wiring and first-class workmanship from the contractors, and, through these latter, prompt delivery on orders from the manufacturers and jobbers.

How Picture Post Cards Promote Good Will in San Joaquin Valley

THE post cards on sale on drug-store revolving racks usually reflect the community's pride in its objects of interest. A series of a dozen views of the San Joaquin Light & Power Corporation's property which have recently been made into post card form, are therefore an evidence of the good will with which the company is regarded through the San Joaquin Valley district which it serves. The psychological effect of this form of advertising is in all respects favorable. Not only do men and women become familiar with the extent and importance of the company's holdings, but in purchasing the cards they feel that they are buying pictures of one of the community's show places. On the address side of each card is a brief description supplementing the title printed on the face of the picture.

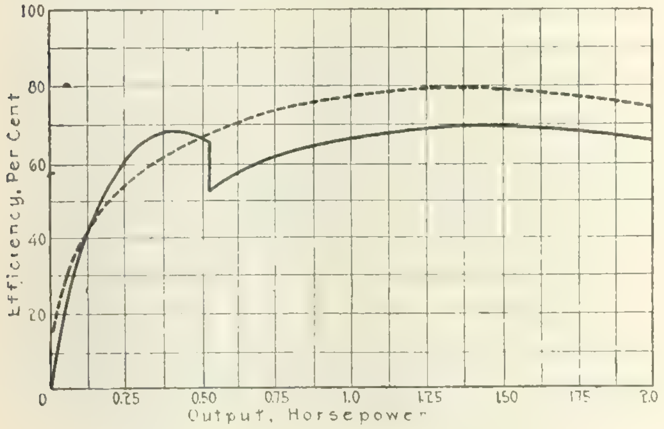
Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Excitation of Alternatives with Salient Poles.—M. DE CONINCK.—Some time ago the author published (*Lumière Electrique*, 1915) a new diagram for the calculation of the necessary excitation ampere turns in a synchronous generator. The same theory now appears in a slightly modified and more complete form. Methods are outlined for determination of the equivalent ampere turns of the armature reactions and of the inductive drop due to apparent leakage inductance, which latter is shown to vary with the power factor. The scheme does not require a knowledge of the voltage curve for reactive load and is said to give more accurate results than the usual methods.—*Revue Générale d'Electricité*, Oct. 11, 1919.

Synchronized Induction Motor—F. KEITH D'ALTON.—In this paper it is shown how the rotor of an induction motor may be modified so that the machine will automatically synchronize itself and will show considerable stability in operating as a synchronous motor. Characteristic curves of a small squirrel-cage induction motor were first obtained and then the rotor was formed into one with salient poles by cutting four wide grooves in the rotor core. Efficiency curves of the motor operating as a synchronous motor and as an induction motor are shown in the illustration. It is noticeable that at about 0.512 hp. the motor pulls out of synchronism and operates as an induction motor with greater air gap. The power factor of the motor is necessarily lower with this increased air gap.—Toronto *Electrical News*, Oct. 15, 1919.



SYNCHRONOUS OPERATION OF A SQUIRREL-CAGE INDUCTION MOTOR

The dotted lines indicate induction-motor characteristics

Lamps and Lighting

High-Power Electric Searchlamps in the War.—MARIUS GROSJEAN.—In the last two installments of this article a great number of illustrations are given, showing various types of large searchlamps, as used by the French army in the war. The arc lamps are either mounted on special trailer trucks, or on automobile chassis for portability, while the largest units of semi-stationary types are erected on small railway trucks, the motor-generators being built as independent units. Several systems for control at a distance of the direction of the beam of light are described and also some methods for ascertaining parallelism between a telescope and the axis of one or more searchlamps.—*Revue Générale d'Electricité*, Oct. 11 and 18, 1919.

Reflecting Power of Stellite and Lacquered Silver.—W. W. COBLENTZ.—The reflecting power of stellite varies somewhat in the visible spectrum, depending upon the homogeneity and upon the exact composition of the alloy. Measurement on lacquered-silver mirrors, made before and after exposure to ultra-violet light, shows that, owing to photochemical action in the lacquer, the silver is turned brown in color, thus reducing the reflecting power.—*Scientific Paper No. 342, U. S. Bureau of Standards*, Sept. 11, 1919.

General Lighting and Safety Orders.—The paper gives a digest of the general lighting safety orders issued by the Industrial Accident Commission of California. These became effective Dec. 1, 1919.—*Journal of Electricity*, Jan. 1, 1920.

Records of Lamp Service in a Large Park System.—C. H. SHEPHERD.—The lamp record system used by the electrical department of a large park system not only gives interesting facts on the life of lamps but also indicates apparatus trouble on the system.—*Electrical Review*, Dec. 20, 1919.

The Sheringham Daylight.—A device has been developed by George Sheringham to imitate very closely the daylight described as white diffused light from a north window. In this apparatus the light from an electric bulb (or other source of artificial light) is thrown on to a shade, on the under side of which is a color design worked out in accordance with the light absorption curve of the colors employed as determined by the Abney color patch apparatus. In effect, a portion of the red and yellow rays is absorbed, and the blues and violets are thus apparently reinforced.—London *Electrical Review*, Dec. 12, 1919.

Generation, Transmission and Distribution

Centralization and Conservation in Power Supply of Central Massachusetts.—F. L. HUNT.—The author brings out the economies that can be effected by the use of power from large central stations equipped with up-to-date machinery and the economical use of water power. He shows that by closing down 121 isolated plants and using central-station supply nearly 400,000 tons of coal were saved in one year in this particular instance.—*General Electric Review*, November, 1919.

Hydro-Electric Power and Its Use for Industrial Purposes. — ERIC A. LOF. — The development of electrochemical and electrometallurgical industries has in the last few years created a demand for electric power in large blocks. Other industries, such as the manufacture of paper and wood pulp, farming and agricultural work, irrigation, etc., require electric power in constantly increasing quantities. To meet these demands the development of our water-power resources should be encouraged by the enactment of suitable legislation. —*General Electric Review*, November, 1919.

Annual Report of Hydro-Electric Power Commission.—A complete report of the activities of the Hydro-Electric Power Commission of Ontario for the year ended October 31, 1918. The report is divided into five parts, consisting of (1) legal proceedings, (2) transmission systems, (3) operation of the systems, (4) construction work of the commission, (5) general activities of the commission. There are 315 pages in the report and an abundance of illustrations.—*Report Hydro-Electric Power Commission of Ontario*, Toronto, 1919.

Water-Power Resources of British Columbia.—A comprehensive report issued by the Commission of Conservation of Canada showing that the Province of British Columbia has water-power sites aggregating 3,000,000 hp.—*Electrical News*, Nov. 15, 1919.

Electrical Characteristics of Transmission Circuits—V.—WILLIAM NESBIT.—In this number of the series the author deals with the effect of harmonies in the wave of voltage on long lines where the wave lengths of the harmonics may be not far from the lengths of the lines. He also deals with the heating of conductors suspended freely in air.—*Electric Journal*, December, 1919.

Traction

New Passenger Locomotives for St. Paul Rocky Mountain Division.—In this article are given particulars of the new passenger locomotives constructed by the Westinghouse Electric & Manufacturing Company. These locomotives have a capacity of 4,200 hp. for one hour without excessive heating. The normal starting drawbar pull is 100,000 lb. (22,000 kg.) The data for the locomotive may be summarized as in the table printed here. The description of the locomotives includes a discussion of the regeneration system employed for this service.—*Electric Railway Journal*, Jan. 3, 1920.

DATA FOR ST. PAUL PASSENGER LOCOMOTIVE FOR ROCKY MOUNTAIN DIVISION

Normal trolley voltage	3,000
Total weight	275 tons
Weight on drivers	336,000 lb.
Weight on leading trucks	66,000 lb.
Weight on trailing trucks	41,000 lb.
Total wheelbase	79 ft. 10 in.
Driving wheelbase	16 ft. 9 in.
Maximum rigid wheelbase	16 ft. 9 in.
Diameter of drivers	68 in.
Diameter of leading truck wheels	36 in.
Diameter of trailing truck wheels	36 in.
Locomotive capacity at 23.8 m.h.p. (one hour rating)	4,200 hp.
Locomotive capacity (continuous) at 80 per cent of above	3,360 hp.
Normal starting tractive effort	100,000 lb.
Normal speed on level track	55 m.p.h.
Capacity of steam boiler, per hour	4,000 lb.
Capacity of water tanks	25,500 lb.
Capacity of oil storage tank	750 gal.
Cab length	78 ft. 0 in.
Total over-all length	88 ft. 7 in.

Installations, Systems and Appliances

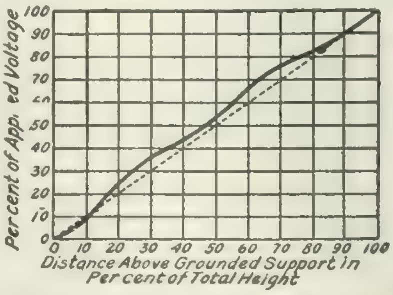
The Production of Electro-Medical Apparatus in Great Britain.—CUTHBERT ANDREWS.—The scope of this article is to show the general lines along which the British X-ray industry has advanced and to review the wide field which is now covered by electro-medical apparatus.—*Beama Journal*, October 1919.

Electrical Equipment Used in Precipitation of Material from Smoke and Gases.—This article deals with the apparatus used in electrical precipitation, shows how results are accomplished, enumerates the different fields of application and describes specific application of equipment to the work.—*Electrical Record*, November 1919.

Electrical Furnace as an Adjunct to the Cupola.—GEORGE K. ELLIOTT.—After explaining the difficulties encountered in attempting to superheat iron in a cupola, the author points out the advantage of obtaining high temperatures in melting and states why he believes the electric furnace is the ideal supplement to the cupola. He shows the advantage of the electric furnace as a refiner and explains how sulphur may be reduced and also how the excessive loss of manganese is avoided. —*American Machinist*, Dec. 11, 1919.

Electric Mine Hoists.—G. HACAULT.—In spite of the many improvements effected on the steam engine during recent years, electric drive for mine-hoists has proved superior, because of its great reliability, high economy and excellent adaptability to control at a distance. In this article various ways of arranging hoist drums and suspension cables are described, and a number of other mechanical and electrical details such as gear reductions, controllers, reversing switches and resistances are considered. The Brown-Boveri brake system is demonstrated. The service brake is put into action by a small auxiliary motor, which pulls the brake lever by means of friction coupling and screw drive. This electric brake system is said to take much less power than a corresponding compressed-air brake since the auxiliary motor consumes very little power except when applying the brake. Depth indicators, tachographs and various safety devices are also dealt with, and a schematic diagram is given showing a complete installation.— *Revue Générale d'Electricité*, Oct. 18 and 25, 1919.

Interchangable Bushings for High-Voltage Apparatus.—EUGENE D. EBY.—Some of the more important features of design and performance of the filled-type bushings are dealt with in this article. For high-altitude service the puncture strength of the bushing is not affected nor the strength of the insulating surface of the lower end of the bushing, which is entirely submerged in the oil. Installations at high altitudes, particularly those exceeding 4,000 ft. (1,200 m.) are supplied with high-altitude bushings whose upper section has been lengthened to increase the striking distance corresponding to the decrease in the dielectric strength of air at the high altitude. At high temperature air also decreases in dielectric strength. Thus a temperature of 40 deg. C. corresponds to a difference of 4,000 ft. in altitude. In order that the bushing shall not deteriorate under the voltage stress of normal service, the insulating surfaces should be entirely free from corona at all normal voltages and preferably also of double normal voltage or those voltages which may ap-



UNIFORM SURFACE DISTRIBUTION OBTAINED

pear occasionally on the line. To accomplish this a potential distribution is necessary which is uniform along the external insulating service of the bushing. This distribution is accomplished in the filled-type bushing by features of design involving the use of a metal sleeve btween porcelain shells within the bushing. This uniform distribution means uniform surface efficiency, so that the flashover voltage is proportional to the striking distance through the air from the top terminal to the grounded support. The ratings of bushings are therefore directly proportional to their linear dimensions. Corona within the tank is entirely suppressed by the use of grounded metal, which forms the central portion of the external shell of the bushing. The upper end of the sleeve is flanged to form a support upon the cover of the tank; the lower end extends below the surface of the oil. Thus all of the exposed surface of the bushing within the tank is at ground potential, and there can be no difference of potential along this surface and consequently no corona or static discharge on the bushing in the air space above the oil.—*General Electric Review*, November 1919.

Electric Logging.—R. E. Gray.—The writer gives experience in logging operations in the West in which it was found economical to build special transmission lines for logging and to remove this line for use elsewhere after timber has been completely logged off. Motor and incidental difficulties encountered are also described in the paper.—*Journal of Electricity*, Dec. 1, 1919.

Electrophysics and Magnetism

The Influence of Chemical Composition and Thermal Treatment Upon Magnetic Properties, Specific Resistivity and Density of Iron Alloys.—E. Gumlich and P. Goerens.—In a long series of articles the authors report upon the results of experimental investigations into the properties of pure iron alloys which have been carried out in Germany for ten years or so under the co-operation of several scientific institutions and metallurgical concerns. Most of the measurements were made at the Reichsanstalt, hand in hand with metallographical studies conducted by Wüst and Goerens. Suitable samples with systematically varying percentages of C, Si, Al and Mn were carried through certain thermal and magnetical cycles, and extensive sets of data for each condition of the material were obtained. By extrapolation from the curves for the several series of alloys there were obtained, as probable averages, the following data for pure iron: Specific gravity, 7.876 gram/cm.^{3}; specific restivity, 0.0994 ohms/m., mm.^{2} at 20 deg. C.; temperature coefficient, 0.00573 per 1 deg. C.; magnetic saturation, 21,620 max./cm.^{2}. The effects of annealing upon the magnetic properties of commercial transformer plate were thoroughly investigated, the results leading to the conclusion that the annealing causes a decided deterioriation, the effect being worse the higher the temperature. During the first few hours, however, a net improvement is obtained, due to mechanical softening of the material and expulsion of gases, and there effects preponderate over the deterioration due to the annealing. Maximum improvement was observed in from four to twenty-four hours, and 785 deg. C. (1,440 deg. F.) appeared to be the most favorable annealing temperature.—*Elektrotechnische Zeitschrift*, June 26 and July 3, 10, 17 and 24, 1919.

Electrochemistry and Batteries

Electrical Treatment of Sewage by the Landreth Process.—A brief description of the Landreth direct-oxidation process for the treatment of sewage, in which both electricity and lime are employed.—*Chemical and Metallurgical Engineering*, Dec. 31, 1919.

Units, Measurements and Instruments

New Method of Measuring the Resistance of the Ground.—Shiro Sano.—A new method has been devised for measuring the resistance of grounds consisting of earth plates buried in the earth. In this method, as devised by the author, the disturbing effect of the earth current is completely nullified and thus a great source of error is eliminated. The method is, moreover, essentially a nullifying method and hence has peculiar merits. The writer describes the method in detail and also discusses the nature of earth currents.—*Sibley Journal*, September 1919.

Telegraphy, Telephony and Signals

On the Theory of Radio-telegraphic and Radio-telephonic Receiver Circuits.—J. F. J. Bethenod.—Proceeding from a theory of the approximate rectifying detector, the most advantageous proportioning of the constants of the secondary circuit of a receiver is obtained. The constants of the most desirable telephone winding and the value of the most suitable telephone shunting condenser are then derived. — *Proceedings Institute of Radio Engineers*, October 1919.

Internal Action of Triode Valves.—W. H. Eccles.—A mathematical investigation of the fundamental processes involved in the triode valve.—*London Radio Review*, October 1919.

Miscellaneous

Protective Signs on High-Tension Lines.—G. Dettmar.—Ever since 1906 the question of indicating to airplanes the position of transmission lines carrying dangerous voltages has had much consideration in Germany. It has been proposed to paint the poles in vivid colors, to put signs of enameled iron plate on top of the poles, etc. The author criticises in detail the varous suggestions made and concludes that none of the proposed systems appears to be practicable.—*Elektrotechnische Zeitschrift*, Sept. 11, 1919.

Thermal Expansion of Insulating Material.—Wilmer H. Souder and Peter Hidnert.—In the paper data are given on the thermal expansion of some of the more important insulating materials. In most cases the expansions are too irregular to justify the use of the general quadratic equations. A knowledge of the thermal behavior of these materials is essential before assembling them in certain types of apparatus subjected to wide temperature variations. The most striking peculiarities are: (a) the wide range in the values of the coefficients of porcelain from 1.6 to 19.6 millionths per unit length per deg. C. (b) the three varieties of expansions for porcelain, namely, straight-line, concave and convex expansion curves; (c) the shrinkage and the loss in weight of the phenol and similar compounds when subjected to excessive heat treatment; (d) the permanent growth and variations of different marbles when subjected to heat treatment; (e) the negative coefficient of expansion of marble at low temperatures.—*Scientific Paper, No. 352, of the Bureau of Standards*, Dec. 27, 1919.

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

Snowstorms and the influenza in several sections of the country have greatly diminished buying of electrical materials. Construction forces, sales and clerical forces were hard hit by sickness, and deliveries, both local and interstate, have been tied up for several days. Stocks of raw materials are held up in several instances by the snows, and factory output on some steel materials for the electrical industry has suffered. Car shortage is playing havoc with steel mills, and the non-delivery of coal and coke is requiring the banking of several furnaces. Labor, too, at the coking furnaces is inadequate were there sufficient cars to move a greater output.

Upward price changes of 10 per cent were applied to schedule material and attachment plugs last week, and flexible armored conductor advanced $5 per 1,000 ft. Premiums of as high as $30 per 1,000 ft. have been paid to get rigid conduit from some manufacturers' warehouses. Pipe supply is extremely short, but hope is entertained of better shipments by March. Boxes, too, are short. Through increased capacity in the porcelain works, a better supply of wiring porcelain is expected in the spring.

Building in general is progressing well, and new building plans continually being filed show the development expected along those lines as the year progresses. Collections are good.

Bi-monthly turnovers of lamp stocks were held to be impracticable by the midwinter meeting of the Atlantic Division of the Electrical Supply Jobbers' Association.

The General Electric Company has floated $15,000,000 in twenty-year gold debenture bonds to retire notes maturing July 1, 1920.

Among important items of construction news are the proposed building of a 33,000-volt line from Stonington to Pawcatuck, Conn., by the Eastern Connecticut Power Company; the intended expenditure of $2,000,000 for two central power plants by the Cambria Steel Company; the application to the California State Water Commission for the diversion of water from the Tuolumne River for power and irrigation purposes in the Modesto district, dams, power houses and distributing system to cost $16,000,000; the plan to complete the Cedar Falls (Wash.) power plant to a capacity of 18,000 kw., bringing the total cost of the plant to $3,500,000; the projected expenditure of $2,000,000 in improvements to the Pacific Power & Light Company's system, and the commencing of the construction of a 60-mile, 66,000-volt transmission line from Winnipeg to Portage la Prairie, Manitoba.

Public Service Commissioner Nixon has been assured by the federal Railroad Administration that no more coal cars consigned to public utilities in New York City will be diverted, and the fuel crisis in that city is thought to be over.

In the revision of the National Electric Safety Code of the Bureau of Standards, which is now approaching completion, the rules on guarding live and moving parts, grounding conduit and frames and marking neutral conductors, as contained in Part 3, will be considerably changed.

A protest has been made by the National Electric Light Association against the practice of the federal Bituminous Coal Commission of charging public utilities higher prices for contract coal, in order to meet the higher wages, on the ground that the utilities are prohibited from passing this increase on to the consumers.

Before a joint meeting of the Boston Sections of the A. I. E. E. and A. S. M. E. the advantages of turbines rated at 30,000 kva. and more were questioned by Farley Osgood of the Public Service Company of New Jersey.

An unusual system of street lighting, designed to provide for a summer resort more elaborate illumination in the busy season than in the winter time, has been designed by W. D'Arcy Ryan for Saratoga.

Herbert C. Hoover, who will be inaugurated as president of the American Institute of Mining and Metallurgical Engineers on Feb. 17, will at that time present a plan for the better working of the bituminous-coal industry.

The members of the Congressional conference committee on the water-power bill are now free to begin their sittings and are expected soon to do so.

The seventy-third anniversary of the birth of Thomas A. Edison was the occasion for congratulations to him from all parts of the world. A luncheon at the West Orange works was given by the Edison Pioneers, and the employees met Mr. and Mrs. Edison at a ball.

The unusual shortage of water in California due to the long drought still threatens curtailment of power. In the southern part of the state, however, conditions have been improved by a general heavy rain on Feb. 8 and 9.

Since the first of the year fourteen prominent electric light, heat and power companies have offered short-time note and bond issues to the public totaling $43,768,000. Of these securities eight bear interest at 7 per cent.

The results of a detailed study of farm-line standardization have been embodied in a report to be made at the June meeting of the Iowa Section, N. E. L. A., by its farm-line committee.

At a meeting of the Institute of Radio Engineers F. M. Ryan, J. R. Tolmie and Roy O. Bach reported having held two simultaneous radiotelephone conversations over a distance of five miles. The conversations could have been increased to five had there been enough apparatus on hand.

The annual report of the Brooklyn Edison Company for 1919 shows a net income after deductions for interest and reserve of $1,806,413, as compared with $1,593,559 last year, and a surplus of $318,007, as compared with $97,809.

The Pennsylvania Water & Power Company reports a gross income for 1919 of $1,823,006 and a net revenue of $766,406, of which $509,700 was paid in dividends.

In the Maryland plant of the Bethlehem Steel Company there are now 2,169 motors on the electrical system, representing a total connected load of 117,850 hp., according to R. B. Gerhart, superintendent of the electrical department.

A public hearing by the advisory committee of the National Fire Protection Association will be held in New York on March 23 and 24 to consider numerous changes in the National Electrical Code recommended by the electrical committee, some of them of much importance.

Extensive additions to its facilities, involving interconnections between generating and distributing systems in West Virginia and Kentucky, are being made by the Kentucky & West Virginia Power Company.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

Edison Hard at Work on Seventy-Third Birthday

ON WEDNESDAY of this week Thomas A. Edison celebrated, with his employees and old time associates, his seventy-third birthday, which found him in splendid health.

At his arrival at the works in West Orange, N. J., in the morning there was an impromptu reception and welcome in the works by the employees. He was met at the gates by the older men, some of whom had been associated with him for almost forty years. Mr. Edison received a large number of gifts.

In his customary fashion "the old man" escaped from the gathering and was soon found hard at work in his laboratory.

At noon The Edison Pioneers met at the works for their annual meeting and luncheon.

All of the employees met Mr. and Mrs. Edison at night at a big ball held at the Orange armory.

Higher Prices on Contract Coal to Utilities Cause Protest

A PROTEST has been made by the National Electric Light Association against the practice of charging public utilities higher prices for contract coal, in order to meet the higher wages, on the ground that the Fuel Administration would not permit this advance to be passed on to the consuming public.

President R. H. Ballard and Executive Manager M. H. Aglesworth addressed the protest on Feb. 5 to Henry M. Robbins, chairman of the United States Bituminous Coal Commission, stating that certain coal operators were justifying higher coal prices because of contracts existing on Oct. 30 providing for automatic increases in price where miners' wages were raised. The letter stated that it was the understanding of the N. E. L. A. that when the wage adjustment was agreed upon it was expressly provided that the increased wages would not be passed on to the public in higher coal prices.

Attention was directed to the fact that the electric light and power companies are regulated by state and municipal authorities and are not permitted to earn more than a fair rate of return upon their valuation. As a result increased operating expenses must be borne by the consuming public.

No answer had been received by the N. E. L. A. to this letter by Tuesday.

It is understood that the Attorney-General has taken the position so far that prices of coal fixed by the government do not apply where contracts made prior to Oct. 30 exist between the coal operators and public utilities. In that case it is a matter between the two parties to the contract to determine whether or not the 14 per cent increase in miners' wages shall be charged to the utilities

In any event it was the intention of the N. E. L. A. executives to point out to the Bituminous Coal Commission that increases in coal prices to public utilities must necessarily be borne by the consuming public.

Hoover to Offer Bituminous Coal Plan

HERBERT C. HOOVER is about to announce a constructive plan for the better working of the bituminous-coal industry. Upon his inauguration as president of the American Institute of Mining and Metallurgical Engineers on Feb. 17 Mr. Hoover and Horace V. Winchell, the retiring president, will present a plan dealing with practically every problem of the bituminous situation, which it is announced will be discussed by prominent government officials and bituminous-coal operators. Members of the A. I. E. E. attending the midwinter meeting of the Institute next week are invited to participate.

The scope of the plan presented by Mr. Hoover comprises the causes of intermittency; how and when the irregularities occur; the actual number of days worked by the men during each season of the year; a possible alteration in the wage basis; actual wages received by workers during each season of the year and the question of storage in all its phases and as to all possible places for storage, such as at the mine, at the industrial plants, etc.

The following formal papers will be presented on the fundamentals of the problem, on which it is expected a satisfactory solution may be based: "Problems of the Coal Industry," by Van H. Manning, director of the United States Bureau of Mines; "Fluctuation of Production of Coal," by George Otis Smith, director United States Geological Survey; "Storage of Bituminous Coal and Its Possibilities of Stabilization," by H. H. Stoek, University of Illinois, Urbana; "Transportation as a Factor in Irregularity of Coal Mine Operation," by G. W. Reed; "Stabilizing the Market," by Eugene McAuliffe, president Union Colliery Company.

Way Now Clear for Water-Power Bill Conference

WITH the conclusion of the Congressional conference on the railroad bill it now will be possible for the conferees to begin the consideration of the water-power bill. Owing to the fact that several of the conferees selected to thresh out the differences between the Senate and the House on the water-power bill also were members of the conference on the railroad bill, it has been impossible to have even a preliminary meeting on the water-power bill. Since the work on the railroad bill has been exceedingly confining, it is probable that intensive work on the water-power bill will be deferred for a week or so in order that an opportunity may be given the conferees to catch up with the work in their offices.

Power Companies Pay High Rates For Money

FOR the past few months the money market has been soaring, and public utilities which have planned immediate financial betterments have had to pay an unusually high rate of return to investors. Since the first of the year some fifteen prominent electric light and power companies have offered either note or bond issues to the investing public, totaling $43,768,000. The Union Light, Heat & Power Company of Covington, Ky., issue of $2,150,000 first mortgage 7 per cent five-year gold bonds is the only one to be offered at par. The Blackstone Valley Gas & Electric Company of Pawtucket, R. I., is offering twenty-year gold bonds bearing 5 per cent interest, at 10 points below par. On the average, however, public utility securities bearing an interest rate of 6 or 7 per cent are being offered at from half a point to ten points below parity, yielding a return of about 8 per cent to the investor.

The more prominent issues since the first of the year are as follows:

Company	Amount of Issue	Period	Class of Security	Rate of Interest	Offered at
Baton Rouge Elec. Co.	$300,000	3-year	Gold notes	7	98½
Philadelphia Suburban Gas & Electric Co...	1,680,000	3-year	Gold bonds	6	97
Little Rock Elec. Co	1,000,000	1-year	Gold notes	7	99½
Portland, (Ore.) Railway, Lt. & Pwr. Co.	2,000,000	1, 2 and 3-year	Gold notes	7	—
Republic Ry. & Lt. Co	1,444,000	3-year	Gold notes	7	97¼
San Joaquin Light & Power Co..........	494,000	———	Preferred stock.	6	94½
So. Calif. Edison Co...	7,500,000	25-year	Gold bonds	6	96
Blackstone Valley Gas & Electric Co.......	500,000	20-year	Gold bonds	5	90
Union Light, Heat & Power Co	2,150,000	5-year	Gold bonds	7	100
Wisconsin - Minnesota Light & Power Co..	600,000	1-year	Gold notes	7	99½
General Gas & Elec. Co	4,250,000	10 year	Gold bonds	6	—
Vermont Hydro-Electric Corporation	1,350,000	———	Gold bonds	6	94⅝
Consumers' Power Co	5,000,000	10-year	Gold bonds	7	98
Consumers' Power Co.	3,000,000	2 to 7 years	Gold debentures	7	—
Philadelphia Elec. Co.	12,500,000	2-year	Gold notes	6	97¼

Diversion of Public Utility Coal Cars Ordered Stopped

AS A RESULT of representations made last week to Washington the federal Railroad Administration has assured Public Service Commissioner Lewis Nixon of New York City that no more coal cars consigned to public utilities would be diverted. It was reported in these columns last week that the public utilities in and around New York City were threatened with a coal shortage which to a certain degree was the result of diversion by the Railroad Administration of coal plainly marked for public utility service.

In the past week the coal supply has been satisfactorily increased and the threatened shortage has, temporarily at least, been overcome.

Although an unusual amount of snow has fallen in the past week, the temperature has been moderate and consequently less severe ice conditions in the harbor have had to be contended with. As a result it has been possible to dock and unload more coal barges.

Curtailment of load is threatened on the system of the United Electric Light Company, Springfield, Mass., unless the diversion of coal by the railroads is greatly reduced. The United company has 200 carloads on the way, but points out that seizures have been occurring, nothwithstanding numerous official telegrams stating that coal destined for public utilities would not be molested. There is at present a shortage of hydroelectric power in central New England, and the larger steam stations are being heavily drawn upon.

Bi-Monthly Lamp Stock Turnover Impracticable, Jobbers State

LAMP stock turnovers and unsatisfactory margins of profit in certain lines were uppermost in the discussions at the midwinter meeting on Monday of the Atlantic Division of the Electrical Supply Jobbers' Association held in New York at the Commodore.

The main topic of the morning session was the report of the lamp committee, given by F. S. Price, the chairman. His subject was: "Is it practicable for jobbers to obtain the turnovers on lamps as now required by lamp manufacturers in their new rider?" From letters Mr. Price has received from jobbers it appears that they believe six turnovers a year are not practicable. At the same time, the lamp manufacturers are willing to go further and consider what the jobbers think would be a fair rate of turnover. The work of the lamp committee was commended in a resolution.

During the discussion the "new thought" idea, as represented by the Conference Club, was mentioned, and W. L. Goodwin was asked to explain the underlying features of this movement.

George W. Provost, Pittsburgh, outlined the state of the iron and steel market today, bringing out the fundamental reasons for the present shortages. Frank A. Merkel outlined the purposes of the new publication, the *Jobbers' Salesman.*

E. W. Rockafellow, general supply sales manager of the Western Electric Company, led the afternoon session in a discussion as to whether or not electrical heating devices constituted a profitable line for jobbers. Remarks from jobbers and manufacturers attested the unprofitableness of the sales of these appliances to all concerned, except retail jobbers, under present methods of distribution. The division recommended a conference between its heating-device committee, the licensees and licensors in connection with the cost of warehousing, distributing and retailing heating devices.

Further resolutions called the attention of the division's outlet-box committee to the unsatisfactory conditions of the outlet-box industry today and recommended to manufacturers of schedule material the doubling of list prices to do away with plus discounts.

At the close of the session A. M. Little, president of the Mohawk Electrical Supply Company, Syracuse, N. Y., was elected chairman of the division.

Clearing House on Chicago Code Changes

Some electrical manufacturers have complained that the department of electricity of the city of Chicago has incorporated in its working code numerous changes without giving sufficient notice to the manufacturer whose product is affected. In order to assist in remedying this condition, J. W. Collins, secretary of the Electrical Contractors' Association of the city of Chicago, 506 West Washington Street, has established his office as a clearing house for information of this character. Mr. Collins has announced that he will be pleased to notify any manufacturer selling goods in Chicago of proposed code changes which will affect their products if they will file with him a request for such information.

New National Electric Safety Code Requirements

Marking Neutral, Grounding Frames, Use of Safety Switch Above 150 Volts and Inclosed Elevator Wiring Are Among Changes

RULES on guarding live and moving parts, grounding conduit and frames and marking neutral conductors will be considerably changed in Part 3 of the National Electric Safety Code of the Bureau of Standards. Suggestions from every possible source are being used to revise the code before the next edition is printed. Part 3 is now probably in its final shape. This part is devoted to electrical utilization equipment operated at 25 volts to 750 volts and accessible to other than qualified operators.

As a result of the changes the rules on guarding now require that a screen or inclosure be placed around all dangerous equipment which is less than 8 ft. (2.4 m.) above the floor. This equipment includes bare wires of any voltage, open insulated wiring above 300 volts and live parts of motors and switchboards. Fuses and circuit breakers must be so guarded that an arc from them will not burn an operator. A screen must be used to protect operators from mechanical injury by moving objects such as an oil-switch handle. Metal parts on the top of railway cars shall be insulated or guarded. If it is necessary for an operator to enter any of the inclosures, the screens must be of insulating material or be substantially covered with such material.

Grounding the neutral wire and the metal equipment that carries no current is now ordered instead of recommended. The length of conduit, armored cable and metal raceways allowed to be installed ungrounded was set at 15 ft. (4.5 m.).

Another safety measure that is ordered is marking the neutral or grounded conductors and terminals or so arranging them that they can be readily identified. Connecting cords for attaching to portable devices with cases designed to be grounded shall be constructed for easy identification of the grounded conductor. Regarding the size of neutral conductors, the rule now states that they must be sufficiently large to carry the maximum current to which they can be subjected, but this does not necessarily mean as large as the outside conductors, as was formerly approved.

The ruling on fusible switches for over 150 volts now states that the switch must operate so that before the fuses can be touched they must have been disconnected from the line. This voltage limit was formerly 300.

All sizes of separately excited direct-current and series motors, motor-generators and converters must now be provided with speed-limiting devices unless connected to such a load as will safely limit the speed or unless the machine is always under manual control of a qualified operator. Another change states that motor starters (except auto starters) which disconnect all supply wires need not have a disconnecting switch.

Some additions were made to the rules on electric cranes and elevators. Among them is a paragraph stating that in an elevator shaft all circuits except the flexible leads to the elevator must be run in metal conduit or armored conductor securely fastened and grounded, that all live parts must be inclosed, that no other circuit shall have an outlet in the shaft, that 750 volts is the maximum allowed, and that signals must be operated at not over 300 volts. Another rule requires travel-limiting switches for cranes and elevators, and a limit of 4 ft. (1.2 m.) above the floor is required in rooms where inflammable gas is present. Protection against reverse-phase operation of elevators and cranes is required by another addition to the rules.

The rules of the Industrial Lighting Code prepared by the Illuminating Engineering Society are recommended for all shops and factories. More specific changes applying to lighting theaters and public halls require that exit and other lights shall be on separate circuits from the stage lights and general house lights and shall be controlled from the front of the house.

Advantages of Units Rated at 30,000-Kva. and More Questioned

IN A FRANK discussion of the advantages of moderate-sized steam turbines from the operating standpoint, Farley Osgood, general manager Public Service Electric Company, Newark, N. J., declared before a large meeting of the Boston Section of the A. I. E. E. and A. S. M. E. on Feb. 3 that the use of 30,000 kva. rating and upward imposes substantial burdens from the maintenance point of view and may impair the service standards unless turbines are selected with a sharp eye upon their relation to the sales policies of public utilities. The speaker pointed out that the art of turbine design cannot advance unless some experimental failures are endured, but that closer co-operation is desirable between manufacturers and operators.

An analysis of forty-four systems, Mr. Osgood pointed out, showed that 16 per cent of the station capacity was in individual units. The 11.8 lb. of steam per kilowatt-hour water rate of the 30,000-kva. turbine is, of course, a decided gain over 12 lb. to 14 lb. in 25,000-kva. units and 16 lb. in 5000-kva. sizes, but many other points besides economy need consideration, especially continuity of service. Units of 20,000 kva. and 25,000 kva. were favored. Twice as long, it was pointed out, may be required to open and examine a 35,000-kva. unit as a 25,000-kva. set under present conditions, and the operating man needs to get away from special tools, special inspectors and maintenance. Wider separations between wheels and disks were urged. Simple auxiliary equipment, half motor-driven and half steam-driven, was advocated, with direct-connected exciters and adequate spare excitation capacity, steam-driven. Four boilers per unit and a maximum of twenty-four boilers per plant were favored.

A vigorous defense of the larger units was made at the meeting by Nicholas Stahl, general engineer Narragansett Electric Lighting Company, Providence, R. I., who cited the production without a shut-down, of 30,000,000 kw.hr. in the past fifty-one days by a 45,000-kva. set at Providence. The use of larger boilers was also favored on account of labor economies and the higher type of personnel secured for a given outlay. The speaker said that the co-operation obtained between electric railways represented in the American Electric Railway Association and manufacturers of car and other equipment might well be emulated in central-station manufacturing relations.

C. F. Mosher, superintendent of stations, Turners Falls (Mass.) Power & Electric Company, emphasized the importance of fixed charges in relation to station load factor, and R. E. Dillon, assistant superintendent generating department, Boston Edison Company, illustrated the importance of carrying through complete estimates of different equipment combinations before selecting apparatus. R. H. Rice, manager Lynn Works, General Electric Company, affirmed the desire of the manufacturers to co-operate in every possible way with the turbine purchaser, pointing out that the results of heat treatment are not materially uncertain provided that steel manufacturers adhere to specifications. He stoutly defended the development of units designed to show increasing fuel economy. E. H. Sniffen, manager of the power department of the Westinghouse company, also expressed co-operative intentions and hoped that turbine development might be affected somewhat apart from pure commercialism in future.

Closing, Mr. Osgood urged conferences over proposed new designs between manufacturing and operating interests.

Inter-connections in Kentucky and West Virginia Coal Fields

IMPORTANT and extensive additional facilities are being provided by the Kentucky & West Virginia Power Company for interconnecting generating and distributing systems in the southern West Virginia and eastern Kentucky coal fields. To do this the company has acquired the Logan County Light & Power Company, Logan, W. Va.; the Tug River Power Company, Sprigg, W. Va., and the Kentucky River Power Company, Hazard, Ky., to supply electricity to the various coal mines in the section referred to.

The power plant at Logan, with a capacity of 15,000 kva., will be enlarged by installing two 15,000-kw. turbines. Plant facilities will be increased to correspond, and energy will be stepped up in voltage to transmit over an 88,000-volt line to Hazard mine, a distance of 75 miles (120 km.). Construction has already been started on this line, and it will be completed as far as Pikeville, Ky., in 1920.

At Sprigg a 3,000-kw. turbine and corresponding apparatus are being installed.

At Hazard the boiler room will be extended and a 3,000-kw. turbine will be installed. The 44,000-volt and 33,000-volt distribution lines in each district will likewise be extended. At Pikeville, Ky., a 10,000-kva. step-down substation will be installed on the 88,000-volt transmission line and 44,000-volt distributing lines extended to serve all the coal companies in the Big Sandy River field. It is probable that a 20,000-kw. steam electric plant will be built at this point.

The work outlined will extend over a period of two years. The officers of the Kentucky & West Virginia Power Company are R. E. Breed, president, and George N. Tidd, vice-president, both of New York. The company is managed and operated by H. T. Hartman, vice-president, Land Title Building, Philadelphia.

General Electric Sells $15,000,000 of Debentures

THIS week the General Electric Company floated a fifteen-million-dollar twenty-year 6 per cent gold debenture bond issue to secure funds to pay $15,000,000 notes maturing July 1, 1920. The issue was quickly oversubscribed by investors at 94½, giving a yield of about 6½ per cent. The bonds are redeemable at the option of the company at 105.

The growth of the General Electric Company in the past few years has been very large. Sales billed rose steadily from $85,522,070 in 1915 to $230,750,010 in 1919. Last year's billing topped the 1918 record by $14,000,000. Net income available for interest charges in 1915 was $12,307,995 and in 1919 was $38,685,067.

The preliminary balance sheet of the company as of Dec. 31, 1919, showed assets, after deducting current liabilities, in excess of $217,000,000

Public Hearing on Proposed Code Changes

Numerous Changes Recommended by Electrical Committee of National Fire Protection Association that Deserve Wide Consideration

NUMEROUS changes in the National Electrical Code have been recommended by the electrical committee of the National Fire Protection Association, and a public hearing by the advisory committee will be held in the rooms of the New York Board of Fire Underwriters, 123 William Street, New York, March 23 and 24, at which a vote will be taken on the proposed changes. Several recommendations stand out above all others. Among them are (1) the recognition of varnished cloth for open and conduit wiring where it is permanently dry or corrosive vapors exist; (2) the omission of insulating joints and canopy insulators from straight electric fixtures when they are permanently grounded and under certain other conditions; (3) the prohibition of grounded two-wire direct-current systems unless exposed to leakage or induction from high-voltage circuits; (4) the compulsion to ground alternating-current secondaries unless they are entirely unexposed to the aforementioned leakage and induction; (5) the freedom to use short runs of metallic conduit and the like without grounding; (6) raising the division point between low potential and high potential to 750 volts; (7) requiring inclosed externally operated service switches except where switches are under competent supervision; (8) the prohibition of voltages higher than 2500 for direct operation of motors except in central-station buildings. Parts of the 1918 Code referring to the protection of motors (particularly Rules 8b and 8c) have been revised almost in total. New sections have been added on elevator wiring and isolated light and power equipment for less than 50 volts.

In addition, greater thicknesses of insulation have been recommended for 1,500-volt to 3,500-volt rubber-covered cables, and stranding has been standardized. In view of the expected use of varnished-cloth-insulated wire brief specifications are given. Where distribution circuits originate in an attended station a ground detector must be employed unless the system is permanently grounded. When generators or motors operate at potentials above 750 volts their frames must be grounded except where this is impracticable. In such cases the frames must be permanently and effectively insulated and isolated from grounded surfaces by covers, cages, insulating mats, etc.

Grounding is covered quite extensively in the proposed changes. Aside from the features mentioned, the recommendations (1) prohibit the use of any part of a metallic conduit as part of the ground conductor; (2) prevent the interconnection of ground conductors for wire runways with circuit ground conductors or a grounded circuit conductor except when the former is grounded at three or more services; (3) require that grounds must have a capacity not less than one-fifth that of the grounded conductor at the point attached. Each ground on alternating-current secondaries after the first three must not be smaller than No. 10 copper wire, but need not be larger than No. 1/0. If heaters are operated at pressures above 150 volts to ground, they must be permanently grounded.

SPECIFICATIONS REGARDING MOTOR PROTECTION ARE CONSIDERABLY REVISED

In the recommendations on motor protection the electrical committee proposes putting an automatic cut-out in each conductor and specifies the number of overload trip coils that must be used with circuit breakers with different systems. Except under expert supervision the breakers must be supplemented by fuses. Alternating-current starters may be used for breakers under certain conditions. Continuous-rated motors protected by automatic cut-outs set for over 10 amp. must be protected by running fuses or breakers having a current capacity of 110 per cent of the name-plate rating. Short-time-rated motors must be protected by fuses, time limit breakers or instantaneous breakers rated according to values given in a table. Small motors may be grouped under the protection of a single fuse provided that the group demand does not exceed 660 watts. Conductors to motors must have a capacity equal to 110 per cent of the name-plate rating and must not be fused above this capacity. Breakers may be set for not more than 30 per cent higher values unless protected by fuses. Switches controlling motors must indicate whether they are open or closed, while devices cutting out protective apparatus during starting must automatically return to the off position when released. When switches are installed without protective devices they must have one pole in each ungrounded circuit.

Recommendations are also given for installation in hazardous places such as lacquer and varnish rooms.

When multiple-conductor service leads are installed where they may come in contact with awnings and the like they must be inclosed in conduit. Elsewhere they must be supported at least 6 in. (15 cm.) from adjacent woodwork and 12 in. (30 cm.) from overhanging combustible material unless protected. Service wires must not be smaller than No. 10 soft copper or No. 12 medium or hard-drawn copper. With approved racks or brackets exterior wiring not protected by cut-outs can be supported not more than 9 ft. (2.7 m.) apart and 2 in. (5 cm.) from surface over which they run. Power and communication wires on the same poles must never be on same crossarms and must be at least 24 in. (60 cm.) apart vertically for 300 volts and not less than 30 in. (76 cm.) for higher voltages.

RULES ON ELEVATOR WIRING ADDED

The recommendations on elevator wiring, which include eleven sections, refer chiefly to placing motor disconnects in sight of the motor, grouping wiring between the motor and controller, flame-proof coverings for conductors to main-circuit resisters, covering flexible or traveling cables, permission to omit grounds on conduit or armored cable attached to elevators, incasing signal wiring, placing spark-emitting devices at least 4 ft. (1.2 m.) above the lowest floor level, and incasing conductors in elevator shafts.

Regarding wiring standards and systems the committee recommends that all conductors of No. 6 and larger must be stranded for conduit work. A table is given showing the size of conduits for different numbers and sizes of wire and cable for various systems. When sockets are located where flexible cords are not liable to be attached up to 4,000 watts may be dependent on final cut-out. In such cases Mogul sockets and No. 12 wire must be used. Tables on clearances for dry or excessively hot places and locations exposed to dampness and injurious fumes are given.

Recommendations are also given on car-house wiring, outlet boxes, cabinets and cut-out boxes, use of flexible cords, ground clamps, wiring to motors operating at 500 volts or more, and theater and garage wiring.

An attempt is being made to reconcile the National Electrical Code with the National Electrical Safety Code, but fundamental differences exist regarding insulating joints and voltage limits.

Fifteen Million Dollar Street-Lighting Program for Chicago

RECOMMENDATIONS have been made to the Chicago City Council by William G. Keith, commissioner of gas and electricity, that the voters of the city be asked to approve a fifteen-million-dollar bond issue to provide for the installation of 85,000 new 100-cp. electric street lamps and for the rehabilitation of the present system. The details of the plan are as follows:

Installation of 500 miles of new street lighting with 34,666 100-cp. lamps; along street car lines, two lamps to each trolley pole; cost, $5,546,560.

Displacement of 9,500 gas and gasoline lights in 376 miles of street with 26,068 100-cp. electric lamps; cost, $4,170,880.

Installation of lamps immediately south of Jackson Boulevard, from the river on the north to Twelfth Street, and from the river on the west to Lake Michigan; cost, $525,000.

Displacement of 6,000 600-cp. aërial lights in 350 miles of streets with 24,266 100-cp. lamps; cost, $3,882,560.

Changing 8,600 100-cp. lamps from high-tension circuits to the group system; cost, $215,000.

Installation of safety island lights at 500 intersections of streets; cost, $175,000.

Erection of warehouse and garage to take the place of three structures now in use; cost, $485,000.

Multiplex Radio-Telephony Possible

TWO radio-telephone conversations through a single antenna over a distance of five miles was the accomplishment reported by F. M. Ryan, J. R. Tolmie and Roy O. Bach at the Feb. 4 meeting of the Institute of Radio Engineers, held in New York City. The paper was read by Mr. Ryan, who is now connected with the Western Electric Company in radio research work. Mr. Ryan said that as many as five telegraph messages were being sent or received simultaneously with a single antenna, and that as many telephone conversations could have been carried on had there been sufficient apparatus at hand. The method used was that of a number of radio frequencies with a series antenna circuit. The calculations of the circuit were also shown. The meeting was conducted by the president, J. V. L. Hogan.

Standardization in the German Industry

Mechanical and Electrical Manufacturers to Unite on All-German Systems of Standards for Parts, Details and Types

WITH industrial and commercial conditions getting back more and more to a normal state, German engineers are planning a great campaign for rebuilding peace-time industry and re-establishing foreign trade relations. An important point in this campaign, as it is being mapped out just now, is a system of standards for the electrical and mechanical industries, intended to be universally accepted among German producers and consumers and aiming to increase the industrial overall efficiency and to cut unnecessary cost items in production.

Upon suggestion from the Department of Interior Economy, the Verein Deutscher Ingenieure has formed a standardization committee, called the Normenausschuss für die Deutsche Industrie, usually referred to as "Nadi." This committee and its associated twenty-five sub-committees for different industrial branches are working out a most far-reaching system of standard specifications, not only for materials, stock dimensions and semi-finished products, but also for spare parts of various kinds and even further for complete units of machinery.

The standardization work is divided into three groups—dimensional and detail, type, and specialization. The dimensional work is concerned with the establishment of standard forms and dimensions for all sorts of machine elements and parts of apparatus, etc., such as screws, bolts, washers, and so on, and in the electrical industry fuses, lugs, porcelain pieces, switchboard supplies, etc. Thus the existing ten screw systems have been by one stroke reduced to two, all parts having agreed to use only German standard metric threads for screws up to 6 mm. ($\frac{1}{4}$ in.,), the Whitworth system being also allowed above this dimension. In the electric signaling industry the standardization work has begun from the very bottom. A great number of preliminary standard drawings of such small parts as screw connectors, contact springs, lugs and insulating washers have been circulated for criticism and are now back for final action. Several such standard drawings are reproduced in the *Elektrotechnische Zeitschrift* of Sept. 4 and 18, 1919.

The aim of the type standards work is to unite all manufacturers on certain lines and certain types of standard machinery. The types are to be defined by rating, voltage, speed, etc., and also by size of shaft, base dimensions and similar data, because of the bearing upon the interchangeability of makes and upon the question of reserve equipment. In the case of electric railway motors it is even intended to establish standards so exacting that a damaged motor may be directly replaced by another of any make whatever, without any electrical or mechanical adjustment work. A start has been made on transformer standardization, so far, of sizes up to 100 kva., inclusive. One normal line of seven sizes has been agreed upon and also one five-step line for agricultural use. Not only are primary and secondary voltages fixed, but also efficiency, core losses and coil losses, and even details such as arrangement of bushings and inlets and outlets for oil. The specifications also take up definite figures for short-circuit reactance drop, so as to insure satisfactory parallel running of the future standard transformer units, irrespective of make.

In the past German industry has been ruled by financial combinations. All makers of a certain article were united for the purpose of controlling prices of their own product, if necessary by aid of dumping, and on the other hand, by means of systematic bargaining, to lower prices of necessary raw material and supplies. The industrial bureaucracy thus had of old a strong foot hold in Germany, and it is now intended to kill even such internal competition as the old system fostered, putting in its place specialization and co-operation on the basis of "Nadi's" standards. The plan is, therefore, to weld the entire German industry into one giant concern, organized under control of the government, ruled by committees under the national engineering societies, and systematically co-operating to cut costs, increase efficiency, and, in avoiding waste due to internal competition to direct its energy to competition in the world markets.

Fear of Oil Shortage Limits Adoption of that Fuel

ALTHOUGH oil has many advantages as a fuel, the uncertainty as to the future of the fuel-oil supply is preventing many operators from changing over their coal-burning plants to burn oil. This is a summary of opinions given at the annual meeting of the American Society of Heating and Ventilating Engineers, New York City, Jan. 27-29. The three main causes of this uncertainty are (1) the fact that the actual amount of oil that can be taken from the wells is definitely limited, (2) the uncertainty of the policies of the government of Mexico, from which country comes practically all our fuel oil, and (3) the shortage of boats for transportation. Among the papers prepared on this subject were: "Oil as a Fuel for Boilers and Furnaces," by H. H. Fleming; "Oil Fuel," by F. W. Staley; "Fuel-Oil Equipment," by John P. Leask; and "Oil Fuel Versus Coal," by David Moffat Myers.

Street-Lighting System for Busy and Off Season Use

AN UNUSUAL system of street and park lighting has been designed for Saratoga, N. Y., a village of 15,000 population which is a thriving summer resort four months of the year but cannot well afford an expensive system the year around. The new system, therefore, which was designed by W. D'Arcy Ryan of the General Electric Company, provides for two kinds of lighting each suitable for the time of the year that it is used.

Ornamental poles, some with one and some with two globes, in each of which will be two lamps, one a 1,000-cp. "Mazda" and the other a 250-cp. "Mazda," are proposed. In the base is a relay box.

For lighting in the busy summer season the 1,000-cp. lamps will be used until midnight, after which the 250-cp. units will be used. The change is regulated from the power house.

During the remainder of the year the 250-cp. units supply the required illumination.

Work on installing this system is expected to begin next month so that it will be in readiness for use this summer.

Water-Power Attracts New Industries to Community

IN ITS tenth annual report the Pennsylvania Water & Power Company gives a "statement of condition" as of Dec. 31, 1919, which shows total assets of $21,305,091. Of this $17,538,226 represents plant, property and power development. The gross revenue for the year was $1,823,006 and the net revenue $766,406, of which $509,700 was paid in dividends.

Charles E. F. Clarke, the president of the company, dwells on the value of hydro-electric power as emphasized in the last few years, pointing out how new industries are attracted to a community where there is a large supply of unused energy to draw upon. The small labor force required for the operation of a water-power plant and its freedom from the problem of obtaining an adequate supply of fuel, with the attendant difficulties of transportation and the steadily mounting prices, are great factors in the growing popularity of hydro-electric installations. The president also announces that operating expedients growing out of the necessities of war conditions led to considerable development in the technical details of handling the combined operation of steam and water-power generating plants.

Brooklyn Edison Company Reports Successful Year

THE annual report of the Brooklyn Edison Company for 1919 shows that the company met successfully the difficulties and problems of the readjustment period. An extensive new-business campaign resulted in power contracts for upward of 67,000 hp., many of which were made with firms previously served by private plants Contracts were signed for wiring more than a thousand buildings where gas had hitherto been used. The company had 125,524 customers on Dec. 31, an increase of 26,262 over the year previous.

The financial results for the year show a total revenue of $10,850,114, as compared with $8,854,302 in 1918; a net income after deductions for interest and reserve of $1,806,413, as compared with $1,593,559, and a surplus after the payment of dividends of $318,007, as compared with $97,809.

Boston Edison Buys Land for New Super-Power Station

WITH the intention later of erecting thereon a super-power station, the Edison Electric Illuminating Company of Boston, Mass., has purchased a 21-acre tract of land in Weymouth, opposite the works of the Fore River Shipbuilding Company and situated on tidewater. The company's main generating station at L Street, now rated at about 115,000 kw., can be enlarged by the addition of another unit of 30,000 kw. or 40,000 kw. rating before it will be necessary to build the proposed new station. It is therefore unlikely that construction will begin for a year or two.

The company's load is growing very rapidly, more than 25,000 kw. in connected load having been added since Nov. 1, 1919, and there is every indication that more than 60,000 kw., in new business will be taken on by summer, including that already mentioned. Interconnection with the central stations to the north and south of Boston is steadily developing, and the recent tie-in of the Edison company with the New England Power Company marks a further step toward wider service in central New England. At the new site in Weymouth ample coal-storage and condensing-water facilities will be enjoyed, and there are opportunities for the development of a large industrial load.

Bond Offering of the Consumers' Power Company

THE National City Company is offering $5,000,000 general and refunding mortgage ten-year 7 per cent gold bonds, Series A, of the Consumers' Power Company and $3,000,000 7 per cent serial gold debentures. The former are being offered to yield more than 7.28 per cent and the latter to yield about 7.75 per cent.

The bonds mature Jan. 1, 1930, and the debentures mature serially Feb. 1, 1922 to 1927, inclusive. The former are being offered to reimburse the company for the retirement of certain underlying bonds and capital expenditures previously made as well as to provide for future construction. The debentures are being sold to provide the company with a substantial working capital as well as to reimburse the treasury for the retirement of underlying issues.

Dr. Humphreys Heads Consulting Engineers

AT A MEETING of the Council of the American Institute of Consulting Engineers on Jan. 20, Dr. Alexander C. Humphreys, president of Stevens Institute of Technology, Hoboken, N. J., was chosen president; S. Whiery, consulting civil engineer, vice-president, and F. A. Molitor, secretary and treasurer.

Alexander Crombie Humphreys, who is of Scotch birth, was graduated in 1881 from the Stevens Institute of Technology. His work was largely in gas engineering. He was senior member of the engineering firm of Humphreys & Glasgow, of London and New York, from 1892 until 1908, and in 1910 reorganized the New York firm as Humphreys & Miller. Dr. Humphreys became president of Stevens in 1902. Dr. Humphreys is widely known for his published articles on depreciation and engineering accountancy, appraisals and methods.

DR. A. C. HUMPHREYS

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Investment and Return.—In granting an increase in rates to the Washington Railway & Electric Company, the District of Columbia Public Utilities Commission announced its adherence to the opinion it had expressed before, that until conditions created by the war become more normal, rates for service which will yield a return of 6 per cent are reasonable and in no sense confiscatory.

Rate Differentials.—The Pennsylvania Public Service Commission has dismissed a complaint against an increase in rates for gas made by the Philadelphia Suburban Gas & Electric Company, in which the contention was made that lower rates for the larger consumers caused the smaller users to bear a greater burden than would be the case were all the gas sold at the same rate irrespective of the consumption together with a ready-to-serve charge. The commission said: "The practice of public service companies selling large quantities of gas, water and electricity at what might be termed 'wholesale' rates, whereby the unit of cost to the consumer is lessened, has long been recognized by both commissions and courts as being beneficial alike to the companies and all their consumers and does not constitute unjust discrimination."

Discrimination in Favor of Large Consumers.—The Wisconsin Railroad Commission has investigated the rates of the Coleman-Pound Light & Power Company on the complaint of stockholders. It developed that an illegal rate of 2 cents per kilowatt-hour on energy used for power purposes in a mill had been in force for four and one-half years before the rate was filed with the commission as applicable to all installations of 20 hp. or more, but no complaint had been made by other consumers. It was contended by officials of the utility that increasing the rate to the mill would result in the loss of this consumer. During the year ended June 30, 1919, the utility purchased 98,500 kw.-hr. at a net cost of $1,341.33. The mill used 45,270 kw.-hr. Excluding this amount, the consumption of all other consumers would not exceed the annual minimum of $1,200 provided for in the contract between the utility and the Wisconsin Public Service Company. For this reason it was held that the loss of the mill business would result in burdening the other consumers with that portion of this energy cost now carried by the mill. In its decision the commission said: "The fact that the utility has earned a fair return upon its reported value during the past four years with a low rate to the mill would indicate that with the rate applicable thereto increased, the rates to other consumers might be equitably lowered. If operating conditions were normal at this time, some adjustment would appear advisable in the rates for commercial service. In our opinion, however, in view of the uncertainty regarding further increases in the cost of electrical energy to the producing company, we should not be justified in reducing the rates in the commercial schedule. It is ordered that the Coleman-Pound Light & Power Company discontinue the power rate applicable to consumers having installations of 20 hp. or over and substitute therefor the following schedule: Minimum charge, 50 cents per month per horsepower of connected load; energy charge, 2½ cents per kw.-hr.

Protection from Competition.—The Mackay Light & Power Company having asked the Idaho Public Utilities Commission that the Ashton & St. Anthony Power Company be restrained from furnishing electric service to the municipality of Arco, a place within the territory allotted by the commission to the complainant company, the commission pointed out that the public utilities act was amended in 1917 so as specifically to exempt municipal corporations from the jurisdiction of the commission. The commission, however, went on to say: "The Ashton & St. Anthony Power Company, being a utility under the control of the commission, will not be permitted to invade the territory of a rival utility by hiding behind the law exempting municipal corporations from the jurisdiction of the commission. Further, the commission will not approve any provision by which the village of Arco may purchase from said defendant electrical energy in excess of the amount required for use within the corporate limits.

Theory of Rates.—In deferring decision on an application for increased rates made by a telephone company until such time as improvements contemplated by the company shall be completed, the Missouri Public Service Commission said: "The actual fair value of investment at the time used and useful in the business of furnishing service to the public is the true basis for calculating proper rates. Intent to increase the plant value through improvement, although partially completed, cannot be accepted by this commission as a basis for the purpose of fixing rates. The installation must be made and put into service at the disposal of the subscribers before the increased rates can be based thereon. Should the commission accept the expert testimony relating to proposed improvements or improvements in course of construction, offered as representing the value of the plant, as such rate-making basis, any company might file an application to increase rates, predicated upon the theory of what it intended to do at some future time."

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

New Mexico State Electrical Association.—The annual convention will be held at Albuquerque on Feb. 16, 17 and 18.

Oklahoma Utilities Association.—The annual convention will be held next week, Tuesday, Wednesday, and Thursday, at Oklahoma City.

Pittsfield Section, A. I. E. E.—On Feb. 19 a paper on "Thunder," by M. Humphrey, will be presented before this section of the Institute.

Electrical Supply Jobbers' Association.—The twelfth annual meeting of the Electrical Supply Jobbers' Association will be held at Del Monte, Cal., on May 12, 13 and 14.

Wisconsin Contractor-Dealers.—The next convention of the Wisconsin State Association of Electrical Contractors and Dealers will be held at the Republican House, Milwaukee, March 24 and 25. John A. Piepkorn, 108 Sycamore Street, Milwaukee, is secretary of the association.

American Physical Society.—A regular meeting of this society will be held in Fayerweather Hall, Columbia University, New York, on Saturday, Feb. 28, possibly with sessions also on Feb. 27 if the length of the program should make this necessary. The meeting next in order will be held at Washington on April 23 and 24.

Practical Demonstration of Way to Locate Faults in Feeders. — Methods of locating faults in underground and overhead distribution systems were explained at the Cleveland meeting of the transmission and distribution committee, Ohio Electric Light Association, by James Vahey, Boston, and C. N. Rakestraw, Cleveland, on Jan. 22. The methods were demonstrated by locating a faulty feeder in one of the Cleveland Electric Illuminating Company's substations and tracing the trouble to its source.

Empire State Gas and Electric Association.—The electric meter section of this association will meet in the McAlpin Hotel Annex, New York City, on Wednesday, Feb. 25, at 10 a.m., when papers will be presented as follows: "The Warren Master Clock," by D. P. Burleigh, General Electric Company; "Recent Instrument Developments," by R. T. Pierce, Westinghouse Electric & Manufacturing Company; "Demand Meter Maintenance Methods," by E. E. Hill, New York Edison Company; "Labor-Saving Methods for Meter Testing in the Laboratory and on Consumers' Premises," by E. A. LeFever, Buffalo General Electric Company.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

New Bond Issue for Southern California Company.—An issue of $7,500,000 general and refunding 6 per cent bonds, series of 1919, is being offered by the Southern California Edison Company at 96 and interest to yield more than 6.30 per cent.

Chinese and American Engineers Organize in Peking.—The Association of Chinese and American Engineers was recently formed in Peking with an initial membership of forty engineers, among them well known Americans. More than one-half of the important engineering positions in China are said to be held by Chinese educated in America.

Standard Gas & Electric Earnings.—H. M. Byllesby, president of the Standard Gas & Electric Company, reports the best year in its history with a net revenue of $2,960,896 and a balance, after interest, dividend and amortization charges, of $962,546. The utility, oil and other properties of the company are all in highly satisfactory condition, the president says.

A Rapidly Expanding Electric Utility.—The switchboard output of the Trumbull Public Service Company, operating in and around Warren, Ohio, for 1919 was about 72,000,000 kw.-hr., with a maximum demand of 22,500 kw., which compares with 5,693,426 kw.-hour, and 1,550 kw. seven years ago. The Trumbull company is a subsidiary of the Cities Service Company, operated by Henry L. Doherty & Company.

New Addition to Vancouver Station.—The British Columbia Electric Railway Company, Vancouver, B. C., has just put into operation the third unit in its Lake Buntzen No. 2 plant. This unit is of 13,500 hp. and is driven by Doble wheels operating under a 400-ft. head. The generator was built by the Canadian General Electric Company. The waterwheel and generator itself were installed previously, and now the pressure pipe has been installed and the unit placed in operation.

Electricity Dooms Dutch Windmills.—The windmills of Holland, which still follow the original pattern invented long before the discovery of America, are said to be rapidly disappearing to give place to steam and electric plants. Sometimes a whole group of these windmills disappear and one central electric station is built to furnish in regular measure the energy that formerly fluctuated according to the weather. When the windmills burn down as frequently happens, no one thinks longer of rebuilding them.

Interconnection Proves to Be a "Fifty-Fifty" Proposition.—Figures for the year ended June 30, 1919, show a total of 21,383,700 kw.-hr. interchanged over the circuits of the United Electric Light Company of Springfield, Mass., and the Turners Falls (Mass.) Power & Electric Company. A remarkable feature of this successful interconnection, of which a pictorial idea was given on page 343 of the ELECTRICAL WORLD for Feb. 7, is that the amount of energy sold by each company to the other is almost exactly half the total, the Turners Falls company selling 10,537,600 kw.-hr. to the United Electric and purchasing 10,846,100 kw.-hr. from it.

Standard American Export Practice Grows in Favor.—Under the auspices of the National Foreign Trade Council, nine foreign trade organizations of the United States recently held a conference to promote the standardization of export quotations and export practice. In a booklet issued as a result of this conference special emphasis is laid on the fact that misunderstandings can best be avoided if the seller will formulate a written statement of the general conditions under which his sales are to be made and will see that the foreign buyer possesses these terms of sale when considering a quotation. The items which may be included in such a statement deal with delivery, delays, partial shipments, shipping instructions, inspection, claims, damage and payment. If all contingencies are thus covered by carefully considered conditions of sale, the conferees maintain, disputes will largely be prevented.

Lease of Sierra & San Francisco Power Company Approved.—The Sierra & San Francisco Power Company was represented by its president, H. F. Jackson, and its attorney, Warren Gregory, in the hearing before the California Railroad Commission for approval of its lease for fifteen years to the Pacific Gas & Electric Company. The lease was desired in order that the Sierra & San Francisco company might obtain stronger financial backing. Mr. Gregory said that in September of last year the company found itself unable to dispose of $1,000,000 of first mortgage bonds authorized by the commission and in consequence it was increasingly difficult to make necessary extensions. The Sierra & San Francisco company claims a value of $17,500,000 for the property involved in the lease, the terms of which are as follows: Rental for the year ending Dec. 31, 1920, $50,000; rental for the year ending Dec. 31, 1921, $500,000; rental for the year ending Dec. 31, 1922, $100,000; rental for each of the remaining years covered by the lease, $150,000. In addition to selling electrical energy to the United Railroads and other consumers in San Francisco, the Sierra company distributes water for mining, agricultural, manufacturing and domestic purposes in Tuolumne County. The application was approved by the Railroad Commission.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

One-Man Street Cars.—The United States Supreme Court holds, in the case of Sullivan vs. City of Shreveport, La., that an ordinance requiring every street car to be operated by a conductor and motorman, subject to penalty for violation, is presumed a lawful exercise of the police powers for public safety, and notwithstanding a contested claim for the safety of a one-man car, cannot be held unconstitutional, in the absence of a showing of a clear case of arbitrary conduct on the part of the local authorities. (40 S.C.R. 102.)

Eminent Domain. — The Supreme Court of North Carolina has declared that where a telegraph company constructed its line over lands in which plaintiff owned the fee, subject to a railroad company's easement for a right-of-way, plaintiff is entitled to a reasonable compensation for the additional burden, and in the absence of a showing as to the relations between the telegraph company and the railroad company, such compensation cannot be cut down on the theory that the railroad company might in the future appropriate the entire right-of-way and thus oust the telegraph company. (101 S. E. 390.)

Obligation of Employer Who Collects Sick Fund from Employees.—Where an employer deducts monthly a portion of employees' wages for the purpose of accumulating a fund with which to care for employees who become sick he holds the fund in trust for the contributing employees, according to the decision of the Court of Civil Appeals of Texas, and assumes no personal responsibility to an employee who falls ill other than a proper and faithful administration of the trust fund. In the absence of a hospital of his own or a custom of furnishing hospital service, he is bound to furnish such service only if there is an unexpended portion of the trust fund. (216 S. W. 674.)

Fixing Amount of Damages.—A verdict for personal injuries made upon the theory that plaintiff was entitled to a sum which properly invested would yield him an amount annually equal to his past or expectant wages during his life, leaving the principal undiminished at his death, was clearly excessive and erroneous, it is declared by the Supreme Court of Appeals of Virginia, because it left out of consideration the facts that the plaintiff's earning capacity, while lessened, was not wholly destroyed and that, he being forty-two years of age, his earnings from manual labor would naturally diminish as he grew older. (101 S. E. 415.)

Men of the Industry

Changes in Personnel and Position
Biographical Notes

Howard M. Turner, consulting engineer, Boston, and recently with the Turners Falls (Mass.) Power & Electric Company, has been appointed lecturer on water-power engineering at the Harvard Engineering School, Cambridge, Mass.

E. M. Carr, who was superintendent of the municipal electric lighting plant at Columbus, Ind., has resigned to accept a position as superintendent of the municipal plant at Logansport, Ind.

P. M. Downing, heretofore chief engineer of the Pacific Gas & Electric Company, has been elected vice-president and will be in charge of electrical operation for that company. Mr. Downing's professional career has been coextensive with the development of hydro-electric power in California. He was born in Newark, Mo., Nov. 27, 1873, but went to California with his parents at the age of four. After his preparatory schooling he entered Stanford University with the first class enrolled, Oct. 1, 1891, and was graduated in 1895. After two years' experience as dynamo tender and inspector of street-railway equipment, he entered the employ of the Blue Lakes Water Company, becoming operating superintendent of plant. This plant, established in 1897, was among the first hydro-electric installations in California. Mr. Downing subsequently has had long and valuable experience with several electric power companies in California as local manager and superintendent of substations and lines. Entering the service of the Pacific Gas & Electric Company, he became operating engineer and two years later was appointed engineer of operation and maintenance, his duties involving the construction of all high-voltage lines. As chief engineer of the electric department he has had charge of construction, operation and maintenance of all water systems, generating stations (both hydro-electric and steam), transmission and distribution lines, substations, street-railway and steam-heating distribution. He was a member of the inductive interference committee appointed by the California State Railroad Commission in 1913 to investigate and recommend remedial measures for reducing interferences to telephone circuits paralleling power circuits. He is a member of the American Institute of Electrical Engineers and is chairman of the engineering committee, Pacific Coast Section, National Electric Light Association.

P. M. DOWNING

J. C. Clark, associate professor of electrical engineering at Stanford University and last chairman of the San Francisco Section, A. I. E. E., is on his sabbatical year's leave and is doing special research work for the General Electric Company in San Francisco.

W. L. Davis, auditor of the Lehigh Valley Transit Company and affiliated companies, with offices at Allentown, Pa., has recently been appointed to the same position with the Lehigh Valley Light & Power Company and its affiliated companies. Mr. Davis will retain his connection with the railway company.

E. Steck has recently severed his connection with T. C. Keller, coal operator, Chicago, where he had charge of the design and installation of mechanical and electrical equipment in various coal mines, to join the engineering staff of C. A. Chapman, Inc., engineers and constructors at Chicago. Mr. Steck was graduated from the engineering department of the University of Michigan in 1901, and has been associated with the Western Electric Company in Chicago and Philadelphia, the Fort Wayne Electric Works at Fort Wayne, Ind., Dodge & Day, engineers of Philadelphia, and the Westinghouse Electric & Manufacturing Company in its Chicago office and as manager of its Duluth office.

Harold D. Sammis, since June 1913 connected with the California Railroad Commission in various capacities, has resigned to accept the secretaryship of the Public Service Commission of the State of Nevada. The resignation became effective Feb. 1.

William R. McCann, who was purchasing officer for the Emergency Fleet Corporation during the war, has become associated as electrical engineer with Stone & Webster, Inc., of Boston. Mr. McCann has had wide experience in the field of electrical engineering, first as designer for the Commonwealth Edison Company, Chicago, then as first assistant mechanical and electrical engineer on the construction of the Panama Canal, and later as valuation engineer of the Illinois State Public Utilities Commission at Springfield, Ill.

John B. Miller, chairman of the board of the Southern California Edison Company, has been appointed convention chairman of the National Electric Light Association, which is to meet at Pasadena, Cal., May 18 to 21, 1920. The long and useful activities of Mr. Miller in the electrical industry make this recent appointment on the part of President Ballard one of unusual promise. Mr. Miller was born in Port Huron, Mich., Oct. 23, 1869. In 1894 he went to southern California to engage in the amalgamation of a number of small light and power companies and in the development of water power for long-distance transmission. From this work have grown the great consolidated power activities of the Southern California Edison Company, of which he is now the head. Mr. Miller is connected with a number of other large business organizations, among them being the Pacific Mutual Life Insurance Company, and during the war period he was head of the Red Cross work for all national activities west of the Mississippi River. He is a member of a number of prominent clubs of the West, notably of the Pacific Union and the Bohemian Club in San Francisco and the Racquet and Tennis Club, New York City, as well as the Delta Kappa Epsilon college fraternity.

J. B. MILLER

Obituary

Theodore B. Ford, formerly a member of the Connecticut Public Utilities Commission, died at his residence in Bridgeport, Conn., Feb. 2. He was born in Taunton, Mass., fifty-one years ago and had been prominent for many years in the engineering and contracting field.

William B. Starrett, assistant day manager of the American District Telegraph Company, Boston, died at Dedham, Mass., Feb. 2. He was fifty-eight years of age and was a native of Edgecomb, Me.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Transformer Purchases Tending Toward Standardized Types

THE value of transformer standardization is probably unrealized outside a few well-informed circles, but it is said on good authority that in the past year orders for standard distribution transformers have increased from 75 per cent of the total to 85 per cent, which means that special designs are called for in only 15 per cent of the sales, compared with 25 per cent a year ago. In other words, there has been a reduction of 40 per cent in about a year in the ratio of special transformer purchases to the whole. It should also be borne in mind that of the 15 per cent special orders a large proportion is scheduled for foreign trade, so that in the United States transformer standardization has attained a most satisfactory status, saving millions of dollars yearly to the electrical industry.

Acceptance of standard transformers has become so general that objections to doing away with special orders in cases where standard types will serve are seldom encountered. Insistence upon special equipment, or its specification on account of local necessities, may increase the cost to the purchaser from 5 per cent to 25 per cent or even more, according to conditions. Deliveries may be increased by twelve to fifteen weeks as against stock shipments in favorable cases. Standard transformers can be used in many cases where special units are first called for, but in the remaining 15 per cent of cases, representing the final purchase of specials, it is doubtful if much room exists for a change to the standards. Manufacturing costs are not at present seriously affected, speaking generally, by the special orders placed, whereas the entire industry is benefiting from the increased use of the standard units. Mass production is being realized, and the savings accomplished on standards have also been effective in reducing the cost of getting out specials.

The call for special transformers is on the whole independent of type and capacity and is confined chiefly to users of non-standard voltages. In the power transformer field standardization cannot accomplish as much as where the sales volume in commodity units is greater, but even here good results are being realized by adhering as far as practicable to established designs.

Market Virtually Bare of Conduits and Porcelain

AN EXTREMELY acute situation exists now in the wiring materials market, and while hope is held out for relief in the supply of pipe and boxes there is little expectation that the situation with regard to flexible conduits and porcelain will clear in the near future. Insulated wire is the one outstanding exception; the manufacturers, while well booked up on wire, are making good shipments and jobbers have plenty of No. 14.

Supplies of rigid conduit and outlet boxes in all hands are very low, and where they exist they are badly broken. Big building depends upon pipe for its electrical construction, and if that material is not available that building generally must stop. Little relief can be expected from open wiring because porcelain cleats are scarce, and although some large stocks of knobs have been reported, there are no nails with which to put them up. Loom, too, is very scarce. Little need be said of armored conductor. While there is a steadily flowing supply of this conductor, it is in such small quantity in comparison with the demand for it that as shipments come in, jobbers can do nothing but deal out a portion on each order at hand.

The steel mills are badly handicapped in their supplies. Car shortage has materially reduced deliveries to them of coal and coke and has held up their shipments of finished products so that their storage space in some cases is taxed to the limit. Recently much semi-finished steel in transit has been held up by snowstorms. Manufacturers expect, however, that the pipe and box situation will ease up with a clearing of traffic and should be in better shape in another month. The inability to produce more steel strip, on the other hand, with present capacity holds forth little hope for any betterment in the armored-conductor market until the demand subsides—or more capacity is installed.

Building reports almost without exception predict a large amount of building this spring and summer. Heavy buying of structural steel is reported from day to day. Rigid electrical installation is now badly handicapped by shortage of materials but a way for a certain distance out of the woods is shortly expected. It is apparent that building needs will not be satisfied unless production of the raw, semi-finished and finished materials now so badly lacking is stimulated in a marked degree.

Westinghouse Additions at Lester to Cost $5,000,000

NEW buildings and equipment to cost $5,000,000 will be put up at Lester, Pa., near Philadelphia, by the Westinghouse Electric & Manufacturing Company. Contracts for the construction have been let to Westinghouse, Church, Kerr & Company, who will start the work at once. An erecting shop, 130 ft. x 300 ft. with balcony; a machine shop for large work, 130 ft. x 750 ft. with balcony; a three-story warehouse, 40 ft. x 600 ft. and a one-story machine shop, 130 ft. x 500 ft., make up the buildings. It is believed the buildings will be ready for occupancy by July 15, 1920. When completed the entire plant will provide work for from 4,000 to 5,000 men, there being 3,000 men now employed.

Lists on Standard Porcelain Have Just Been Doubled

LIST price on standard porcelain, except tubes, have been doubled as of Feb. 10. The supply of wiring porcelain is not increasing at the present time, but it is stated by a prominent authority in the trade that there should be more of it available in the spring and early summer. Factory capacities are being increased so that by that time some of them will be able to turn out up to 50 per cent more than they can today. Labor conditions in the molding industry are such that only about 60 per cent of possible capacity is now being produced. Orders are being booked well into the second half of the year, while the quickest shipments that can be made on new orders are from four to five months.

Good Market Foreseen in Industrial Heating Units

The growth of industrial heating business, outside of its application to steel furnace work, throughout 1919 has been noticeable, having been estimated at $1,100,000. This is an increase of about 20 per cent over 1918 sales. Approximately $2,000,000 worth of control and equipment was sold for steel furnace work. The last four months of the year, however, show heavier business than the previous months. The application of electric heating in industrial work is really so little utilized that an estimate of an increase of 20 to 25 per cent in 1920 would seem to be rather low. One manufacturer has only recently announced the discontinuance of production for stock of standard domestic heating appliances and the concentration from now on of his energies on industrial electric heating. He expects his 1920 industrial heating business to be three times his 1919 business.

Manufacturers are up to capacity on current orders and in some cases are a month behind in shipments. One month is a fair shipping schedule, with six weeks as a long shipment. Little stock is available.

Steel-furnace equipment takes a much longer shipping schedule, three months being required to fill orders for control and accessories for furnace capacities up to, say, 500 kva. On larger capacities the shipments are running up to four and five months.

The market for steel-furnace equipment was overbought in 1918, so that the demand was light in 1919. At the same time, an estimate for 1920 sales has been made, placing them 50 per cent over those of 1919. If sales in 1915 were represented by the unit 1, those in 1916 have been given as 2, while in 1917 they increased rapidly to 4. Over the 1918 war period they continued to 6, but in the next year, with steel demand slackened and little new electric steel-furnace work going on, sales dropped to 3. The 50 per cent estimated demand, therefore, would bring sales by the end of 1920 to the unit 4½. At the present time the demand is good and gives promise of meeting the estimate.

Should Schedule Material Lists Be Doubled?

SCHEDULE material prices advanced last week about 10 per cent. Supply jobbers in the East are in favor of the plan of doubling list prices, which was started last spring by the General Electric Company (ELECTRICAL WORLD, March 8, 1919), but manufacturers as a whole are not sold on this idea at the present time. Jobbers want to get away from the necessity of plus discounts, because, they claim, it carries confusion and mistakes in quoting and billing. The underlying idea of a discount is a subtraction and not an addition.

It is difficult to say right now what course manufacturers will take, but at present they are of an open mind. At least one manufacturer of schedule material has just issued a new catalog, and others are on the press and are about to be issued. Of course, it would be a simple matter for the manufacturers to mail out riders advertising that list prices had been doubled and that discounts would be changed in a certain ratio, were the plan adopted. The doubling of list prices would naturally have a psychological effect upon the ultimate consumer, although the ultimate consumer has little to do, as a rule, with list prices of this material. It is more often part of a wiring job or a component part of lighting fixtures and does not enter as a separate item.

Transformer Stocks Uneven in Very Active Market

VIGORORUS activity characterizes the transformer market, and manufacturers are maintaining with difficulty somewhat uneven stocks. Orders have been coming in steadily for the past three or four months, and production is just about keeping pace with deliveries. Distribution and power transformers are both in great demand. Labor is fairly plentiful, but there is a decided scarcity in insulating materials of the higher grade. On distribution transformers, roughly listed from 200 kva. downward, deliveries range from immediate shipments to about twenty weeks, factory stocks being rather spotty. Transformer steel is scarcely up to normal in supply; cast-iron radiators for self-cooling units are short, and there is a disturbing lack of fuel in some shops remote from the coal fields.

High wages and extremely costly raw materials are disquieting features of the situation from the manufacturer's standpoint. A severe shortage of the Egyptian yarn used in insulation now handicaps the maker of transformers. This long fibered, space-saving material is very hard to get even at $4.60 a pound, compared with a pre-war price of 80 cents. Some anxiety is being manifested as to the future supply of fiber, but the situation cannot be called serious as yet. Labor costs exert a constant upward pressure, accompanied by local readjustments or "rounding out" and particularly by increased office expenses to compensate for advances in shop wages. It is expected that transformer steel will cost more before long, and the upward tendency in copper costs is another factor which is putting a decided strain upon present transformer prices. These, by the way, are about 50 per cent above the pre-war level, but if prices had followed labor and material costs closely during the past six years the quotations of the day would easily exceed those of early 1914 by 100 per cent. Several factors have held transformer prices far below the advances recorded in other commodity markets. Unwillingness to profiteer on the part of the leading producers of electrical apparatus is one. Intensified effort to increase the efficiency of production is another. A third and very important factor is standardization. Without this last prices must have risen substantially beyond present figures.

Navy Department Has Surplus Cable and Accessories for Sale

MORE than $200,000,000 worth of equipment which has been declared surplus for navy needs, including large quantities of cable, copper wire and electrical accessories, is being offered for sale by the United States Navy. Virtually all of this material is new. Among the surplus material is approximately 2,000,000 ft. of cable, which the navy will sell at a fixed price. In addition there are 3,500 boxes of connection wire, 20 to 60, and 180,000 ft. of No. 14 duplex wire. Large quantities of electrical accessories at the various naval bases on the Atlantic Coast and the Great Lakes have also been declared surplus by the navy and are being offered for sale. Inquiry concerning the material may be made of Commander C. G. Peterson, director of the board of sales, division of supplies and accounts, United States Navy, Washington, D. C., and proposals for any part or all of this material will be received by sales boards at supply stations in New York, Philadelphia, Norfolk, Charleston, S. C., Boston and Great Lakes Naval Station.

Detailed description of some of the surplus material is as follows:

1,493,000 ft. No. 14 duplex lighting and power cable.
61,000 ft. No. 14 BX, two conductor commercial armored cable.
218,829 ft. No. 14 BXL, two-conductor cable.
88,000 ft. No. 14 BXL, four-conductor cable.
65,000 ft. No. 14 duplex BX wire.
112,471 ft. No. 14 duplex BX leaded wire.
100,000 ft. No. 14 BX leaded four-conductor cable.
15,000 ft. No. 18 BX, four-conductor commercial armored cable.
350,000 tungsten 40-watt and 60-watt lamps.
3,500 electric fans.
125,000 fuses, 6 amp. to 25 amp.
2,000 switches.
Two transformers, 100 kva., 2200-volt primary, 220-110-volt secondary, 60-cycle, single-phase. Specification 17-T-3 and Standardization Rules of the A I. I. E; manufactured by Westinghouse.

Much Hydro-Electrical Machinery Demanded Abroad

The great increase in the price of coal throughout the world has made fuel economy a most pressing problem. Reports reaching the National Foreign Trade Council denote a tremendous and continued opportunity for the American electrical manufacturing industry in supplying the needs of these countries which are now forced to develop their electrical power to the utmost.

Large railroad electrification projects are soon to be carried out in Italy and South America. In the former country 800,000,000 lire will be spent for electrification of 6,000 km. of railroads. Portugal will probably follow in Italy's footsteps. Many of the South American countries are studying this problem, and Bolivia has just declared as public domain the watersheds of the rivers having sufficient power for that purpose. Throughout Chile many power plants are being built.

In France a bill recently passed both houses and has become law for the canalization of the Rhône from Lake Geneva to the Mediterranean. The swiftnss of the current of this river will be modified by means of a series of locks and dams, the latter being utilized to generate electric energy and for irrigating purposes. Nineteen large generating stations are to be provided which will furnish electric energy rendering from 12,000 hp. to more than 70,000 hp. per station. It is estimated that the river is capable of generating energy equivalent to 760,000 hp. or 4,848,000 kw.-hr. annually, which is equal to a saving of nearly 500,000,000 tons of coal. Two hundred thousand kilowatts of the energy generated is reserved for the use of consumers in Paris at the price of 2 cents per kilowatt (locally generated energy now costs 10 cents). The remaining 560,000 hp. will be utilized by metallurgical, electrochemical and other industries in the Rhône Valley for electric traction on the Rhône, for the electrification of a portion of the Paris, Lyons & Mediterranean Railway, pumping irrigation water, etc. The cost is estimated at 2,000,500,000 francs

Metal Market Situation

THE copper market is quiet and really is rather strong. Producers are quoting nominally at 19.25 cents a pound for February and March delivery, but it is believed in the trade that this figure would be shaded one-eighth or one-quarter if any large order should present itself. The large ordering for the first quarter, however, has been completed, and part of the second quarter is booked.

The outside market is quoting around 18.62½ cents for nearby copper. Offers have been made by this market to sell large amounts at an attractive figure, but there is considerable doubt that the would-be seller had that amount. It seemed to be, rather, an attempt to pull down the market.

There is a better supply of lead available for February, and the demand is good. Future buying is being done with caution because of the prevailing prices. On Feb. 7 the American Smelting and Refining Company raised its lead quotation one-quarter cent to 8.75 cents a pound. This is the eighteenth consecutive advance that has taken place since its low price of 5 cents of last May.

Copper producers have apparently held to a conservative course in regard to prices. During the two months of December and January, when it is estimated 700,000,000 pounds of the red metal were sold, the price rose very little. Consequently, in the recurring cycle of activity and quiet in the market, it is expected that when the buying movement sets in again for second quarter and beyond, there will not be a big advance in price.

NEW YORK METAL MARKET PRICES

	Feb 3	Feb. 9
Copper	£ s d	£ s d
London, standard spot	119 0 0	121 15 0
	Cents per Pound	Cents per Poun
Prime Lake	19.00 to 19.25	19.00
Electrolytic	18.50 to 18.75	18.50 to 18.62½
Casting	18.25	18.00
Wire base	22.25	22.25
Lead, trust price	8.50	8.75
Antimony	11.50	11.50
Nickel, ingot	43.00	43.00
Sheet zinc, f. o. b. smelter	12.50	12.50
Spelter, spot	9.20 to 9.30	9.00 to 9.10
Tin	59.25	58.00
Aluminum, 98 to 99 per cent	31.50 to 32.50	31.50 to 32.50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	17.75 to 18.00	17.00 to 17.50
Brass, heavy	10.00 to 10.50	10.00 to 10.50
Brass, light	9.00 to 9.50	9.00 to 9.50
Lead, heavy	7.00 to 7.25	6.87 to 7.12½
Zinc, old scrap	5.00 to 5.25	5.00 to 5.12½

THE WEEK
IN TRADE

WITH the exception of the Southern and Midwestern localities, the electrical jobbing business, and all business in general, has suffered greatly in the past week from the effect of epidemics of sickness and from snow. There has been a heavy diminution in the ranks of all classes of workers, while snows have tied up local as well as interstate traffic and transportation and have stopped for the time being much building construction. Jobbers' stocks are suffering from need of replenishment, and steel mills are suffering from the lack of coal and coke because of car shortages.

Particular shortages are found in all kinds of conduits, and premiums of as high as $30 per 1,000 ft. have been paid for pipe in New York City. Porcelain is extremely low and outlet boxes can be obtained only with difficulty. In the spring, however, it is expected that pipe and porcelain supplies will be better.

Building continues good in the South and West, and plans are going through in good shape. Collections are good.

Of the price advances in the last week the most important are in schedule material, attachment plugs and flexible armored conductor. List prices on standard porcelain have been doubled by at least one important producer.

NEW YORK

The jobbing trade is still suffering from the effects of the influenza epidemic and the cold weather, while heavy snows have added another burden. Over the latter part of last week transportation was almost entirely suspended. Little material came in to stocks and few deliveries were made. Much more or less exposed construction was stopped, thereby somewhat diminishing the demand for trucking. Clerical and sales forces are still depleted. In New York City the Mayor's ruling stopping other than necessary trucking on Monday further cut down deliveries in order to use trucks and men in snow removal. Shipping is badly tied up at piers.

Several price changes went into effect the first week of February, notably 10 per cent increases in schedule material and attachment plugs and an increase in flexible armored conductor of $5 per 1,000 ft. Premiums as high as $30 per 1,000 ft. are being paid to obtain pipe. The list prices of porcelain have been doubled.

Lighting Fixtures.—Under present heavy buying, shipments on the higher class fixtures are from two to three months. Shipments on glassware are much longer, running in some cases to June.

Heating Appliances.—Extreme shortage still exists, that of flatirons being especially acute. Heavy ordering for all the year's requirements shows that these appliances are no longer seasonal goods.

Fans.—Jobbers are ordering in good quantities.

Schedule Material.—A general price advance of approximately 10 per cent was effective Feb. 3 and 4. Announcements from manufacturers were dated back and no protection was granted as a general policy. Orders by wire under former prices were accepted by salesmen but returned by the manufacturer.

Attachment Plugs.—On Feb. 1 and 2 a price advance of about 10 per cent became effective.

Flexible Armored Conductor.—A price advance of about $5 per 1,000 ft. became effective Feb. 5. No relief in supply is expected until the output of steel strip can be increased or the demand for the finished conductor decreases. Several mills are on price at delivery basis.

Rigid Conduit.—Premiums up to $30 per 1,000 ft. have been paid to obtain shipments from some manufacturers' warehouse stocks. The stocks, however, are very limited. In these cases jobbers' prices for ½-in. black pipe are around $110 to $115 for 1,000 ft. Jobbers' stocks are out in some cases.

Outlet Boxes.—Acute shortage exists but will be somewhat relieved when much raw material now held up in transit by snow conditions is permitted to reach the manufacturers. Better supply is expected in another month if weather conditions permit movement of raw materials and coke.

BOSTON

The New England electrical trade was greatly upset by last week's blizzard and is just emerging from the tie-up. The volume of trade was cut down 30 to 50 per cent. Many employees in all branches of the industry are ill. Deliveries are practically at a standstill with the exception of a moderate volume of local shipments within city limits. Collections were hard hit; one large jobber received no remittances for four days. Mail service was throttled by the storm. Much business, however, was done by telephone. Carloads of electrical freight were held dead in the yards and incoming and outgoing shipments are virtually shot to pieces. Prices are firm with a sweeping advance Monday of about 10 per cent on schedule material except fuse plugs. Stocks are very irregular, showing little change from last week. The enormous demand for motors cannot be filled short of three or four months. The January business of a representative jobber was double that of January of last year.

Oil Circuit Breakers.—There is a good movement as the result of central-station buying.

Wire.—Prices are steady. A substantial demand exists and there are reasonably good stocks.

Appliances.—Business was greatly curtailed by the storm. Jobbers' stocks of electric tableware are looking better. On Monday jobbers were almost overwhelmed by delayed mail orders.

CHICAGO

The volume of business handled by jobbers shows no signs of diminishing. Uncertainty of prices as well as of delivery is still the outstanding feature. A general advance of approximately 10 per cent was announced on Feb. 4 for all schedule material. In some cases prices have been withdrawn on rigid conduit, flexible armored conductor, flexible non-metallic conduit, flexible metallic conduit, outlet boxes and sectional switchboxes. Jobbers are buying this material where they can get it and at a price of delivery. Credit is good with collections at about forty days for January. This was an increase over December because of the volume of clean-up business of the last of the year. In January, 1918, collections were about fifty-three days. Lamp manufacturers report the largest volume of business ever recorded at this season of the year. It is not certain whether this is due to the actual demand or to overstocking by agents. The heating appliance trade in hot plates and ranges is particularly brisk. It is reported that range manufacturers will be sold out by May 1 if not before that time. The building up of the hot-plate trade has been partly because of the installation of hot plates in apartment buildings as a part of the standard equipment. East St. Louis is to have a two-million-dollar hotel. Building permits issued in Chicago for the week ended Feb. 7 amounted to $1,300,000. A number of projects of from $250,000 to $500,000 were initiated during the week.

Wire.—Prices on both rubber-covered and weatherproof remain the same as last week. Deliveries are fairly good in the standard sizes of code wire.

Furnaces.—Electric brass furnaces are moving in increasing number. The Booth Electric Furnace Company recently reported the sale of twenty of their rotating type in sizes ranging from 250 lb. to 2,000 lb.

Lamps.—Lamp deliveries are slow on all types and sizes but more especially on the common-standard lamps.

Cable.—Because of the shortage of steel tape parkway cable is hard to obtain in sizable orders. Deliveries at best are sixty to ninety days. Submarine steel armored cable is quoted on a five-month delivery basis. High-voltage cable, insulated with rubber or cambric, can be had on a ninety-day delivery. Prices are normal with no change reported since Dec. 1.

Farm-Lighting Sets.—Deliveries on Delco farm-lighting sets are being made out of stock to Middle Western dealers. The 750-watt size is quoted at $545 and the 3-kw. size at $1,620.

Lock-Nuts and Bushings.—Stocks are in fairly good shape on all sizes. The ½-in. lock-nut is quoted at $1 per 100 in lots of 5,000, and ½-in. bushing at $2.40 per 100 in lots of 5,000.

Schedule Material.—Stocks are somewhat spotty and deliveries are uncertain. A general advance of about 10 per cent has been announced, and conditions are rather unsettled in this class of material.

Hot Plates.—Two-burner hot plates are quoted at $34 list, with a discount of 25 per cent; three-burner plates at $45 less 25 per cent.

Ranges.—The Hughes No. 50 is quoted at $178 list with 25 per cent off. The demand for ranges has been excellent with every likelihood of manufacturers being sold out within a short time.

Heating Appliances.—Stocks of percolators, flatirons, etc., are being ordered in numerous cases for the next holiday season. Jobbers do not expect to be limited in their business by small stocks, as they were this last season. There is also a strong demand for water heaters.

ATLANTA

The recent increase in the price of materials apparently has not served to check any building operations either under way or projected. Despite the difficulty of obtaining lumber, brick and other building materials, the permits for Atlanta for January totaled $1,750,000. Some observers are predicting that many of the building operations as projected cannot be carried through on schedule time as the inability to obtain the necessary materials will act as an automatic check. Larger contractors are reporting the labor situation somewhat easier than has been the case for a number of months past, probably owing in no small measure to the difficulty in obtaining building material.

With the end of the oil-mill season at hand, a number of oil mills adjacent to hydro-electric lines throughout the section are taking steps to change over their mills from mechanical to electric drive.

General business conditions throughout the territory continue bright, and collections are reported unusually good. Jobbers report difficulty in obtaining all lines of material that depend upon the supply of raw steel products.

Wire.—There is an improvement in the wire situation throughout the territory. Very fair stocks of both rubber-covered and weatherproof are reported by jobbers, the only scarcity being reported in weatherproof, sizes Nos. 6, 8 and 10. The demand continues brisk while fair shipments are reported. Prices remain steady, rubber-covered being quoted at 28 cents base and weatherproof at 29 cents base.

Schedule Material.—A general price increase in schedule material of approximately 12½ per cent to 15 per cent is announced. With the exception of porcelain, stocks throughout the territory are reported fair, with shipments coming through within reasonably short periods.

Stamped Steel Boxes.—Prices to jobbers on this article were withdrawn Feb. 4. Stocks in the territory are reported very poor in the face of a brisk demand and poor shipments.

Vacuum Cleaners.—A price increase of 7 per cent has been announced. The brisk demand will rapidly deplete the present good stocks, however, unless shipments show some improvement.

Renewable Fuses.—Jobbers report a growing popularity of all sizes of renewable fuses. The prospect is that fair stocks will be maintained on account of comparatively good shipments. Stocks of plug fuses, however, are reported low. Prices, plug fuses, lots of 100 to 500, up to 30 amp., 6.3 cents each.

Lamps.—The peak of the winter demand for lamps has been reached without any serious shortage having been experienced. The type C lamps, including white Mazdas, continue to grow in popularity. Stocks and shipments throughout the territory are reported to be in satisfactory shape.

Conduit.—There is little or no change in the conduit situation. The outlook for any improvement in the present situation in the very near future is rather poor. Prices quoted, if in stock, in lots less than 2,500 lb., black, ½-in., $8.72; 1-in., $11.57; 1½-in., $27.67; galvanized, ½-in., $9.23; 1-in., $12.26; 1½-in., $29.32.

Dry Batteries.—Unusually brick demands continue. Local stocks are reported in fair shape but shipments are reported somewhat slow. Jobbers' prices are: For 12 to 49, $41 per 100; 50 to 124, $38 per 100; more than 125, $35 per 100.

SEATTLE-PORTLAND

A noticeable increase in demand for schedule material, particularly for residence construction, has been reported by both jobbers and dealers during the past week. The sale of domestic appliances has been a little lighter because of the decrease in general shopping as a result of the outbreak of influenza in the city. Jobbing houses are experiencing considerable difficulty in obtaining certain materials, and a feeling of uneasiness exists regarding a continued supply of necessary commodities. This applies particularly to domestic appliances, house-wiring devices and fractional sizes of motors. It is believed that this condition will be maintained for at least six weeks or more, when it is expected business will witness the peak. Every effort is being made to accumulate sufficient stocks to supply, in a measure at least, the anticipated spring demand. Orders are being placed months in advance. Deliveries are lengthening. Prices, with but few exceptions, show no change.

Spokane jobbers and dealers report business fairly active. Retailers are busy with clearance sales. Collections are good. Stocks are low. Portland district states that wholesale and retail trade is good and collections are fair. Demand for woodworking machinery is strong. Throughout the entire Northwest each week brings announcements of increasing residence construction. This condition is not confined to the large cities but is prevalent throughout the smaller towns in the district. In Hoquiam, Wash., a syndicate has been formed which will erect sixty modern homes at once. Bond, Ore., reports unprecedented activity in both residence and business building, as do many other towns of this size in both Oregon and Washington. Plans have matured for the erection of a hundred-room hotel in Port Angeles, Washington and plans for several large buildings, including a hotel and an apartment house, have been announced for Everett, Wash. The Commission of Public Docks, Portland, will shortly call for bids for electric wiring of a nine hundred foot section of the St. John's terminals.

Bells and Buzzers.—An increasing amount of residence building has caused a jump in price of these commodities, and sales have increased heavily. Local stocks are low and immediate replenishment is necessary if demands are to be filled.

Industrial Motors.—The demand shows a noticeable increase, the largest orders coming from out of town for use, principally, in fruit and vegetable canneries, shingle and planing mills and box factories. Authorities believe that this year's business in fractional-size motors will equal if not exceed last year's volume. The majority of jobbers report stocks in fair shape and shipments coming through in sufficient volume to care for the trade. Prices show no recent advance.

Sewing Machines.—The vibrating style of portable sewing machine is now quoted at $62 and the rotary style, full-head motor, at $74. Stocks are sufficient to care for the demand which is showing no noticeable increase.

SAN FRANCISCO

Building permit figures for the month of January for the principal Coast cities amounted to $6,370,000, as against $1,566,000 a year ago. All classes of construction are in good demand.

Tools.—Labor and steel costs have advanced the prices on hand tools considerably. Buffalo grips have advanced from 33⅓ to 50 per cent, and Klein pliers increased from 25 to 40 per cent. Deliveries are still very unsatisfactory, for orders are shipped in such small lots that a continuous shortage results. Heavier line tools, such as pike poles and shovels, are stocked in fairly large quantities. The demand is conservatively figured to have increased 100 per cent over last year's demands, partly owing to new construction and partly to several disastrous windstorms which necessitated considerable reconstruction.

Fixtures.—The demand continues good, although a strike, still unsettled, has caused orders to dam up. Unit fixtures are selling well or poorly according to the type of fixture concerned.

Wire.—Rubber-covered wire is again jumping, now selling in 5,000-ft. assorted lots at a 5 per cent advance over previous prices, making the cost of No. 14 $12.80 per 1,000 f.o.b. Coast points. Circular-mil cable has advanced from 10 to 15 per cent. During the year several jobbing firms increased their rubber-covered-wire service on such varieties as big circular-mil cables and lead-covered sheathing in 600-volt sizes. There has not been a great deal of movement reported yet because the demand for special stuff has been temporarily slow.

Heating Material.—A considerable advance, making standard irons list of $7.25 and toasters for $8.50, has been unfavorably received by the electrical dealers and in their opinion has hastened the time when advancing costs will be counterbalanced by decreasing demand. Up to date the increases have not hurt business but have been overcome by the new merchandising spirit on the part of dealers.

Ironing Machines.—After several years deliveries are steady and good outstanding contracts provide a steady demand. These contracts will be shortly increased from twelve to twenty-five lots, the twelve-lot contract having already fulfilled its purpose.

Ordnance Department Has Electrical Material For Sale

THE Ordnance Department of the United States Army offers for immediate delivery, open for inspection at any time subject to prior sale, the following factory equipment located at the United States Government Warehouse No. 188, Springfield, Mass.:

Four Maris Brothers single-beam bridge cranes, 16-ft. span, 1,000-lb. capacity, 220-volt, direct current.

One 100-kw. Sprague generator, 125-volt, direct current, 500 r.p.m.

Two 25-kw., G. E. generators, 110-volt, direct current, 675 r.p.m.

Twelve Westinghouse motors, from 1 hp. to 50-hp., 440-volt, three-phase, 60-cycle, type C.S., 900 and 1200 r.p.m.

Two Westinghouse motors, 3-hp., 220-volt, three-phase, 60-cycle, type C. S., 900 r.p.m.

Two Lincoln motors, 5-hp., 220-volt, three-phase, 60-cycle, 1200 r.p.m.

Sixteen twelve-circuit, three-wire power panels, 600-volts, slate mounted.

One ten circuit, three-wire power panel, 600-volts, slate mounted.

The Bridgeport District Salvage Board in Bridgeport, Conn., will receive all communications regarding the purchase of the following Mazda lamps, which are at the plant of the Colt's Patent Fire Arms Manufacturing Company, Hartford, Conn.:

100 25-watt lamps, 2,000 40-watt lamps, 700 50-watt lamps, 5,000 60-watt lamps, 144 150-watt lamps, 240 300-watt lamps, 300 500-watt lamps.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

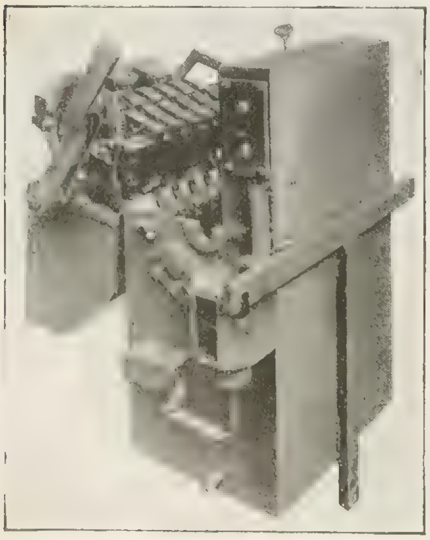
Electrically Lighted Transparency Frame

An indoor electrical advertising fixture consisting of a Circassian walnut frame 5 ft. 3 in. long and 1 ft. 7 in. high, holding five interchangeable transparent glass sides which are illuminated by two 2.5-watt lamps, is being manufactured by the National Retailers' Advertising Corporation, Kansas City, Mo. An adjustable flasher is incorporated in this unit, which is known as the "Gritt electrical fixture." It comes complete with 10 ft. of cord ready to attach to any lamp socket.

Two-Pole, Double-Throw Snap Switch

A double-throw, double-pole indicating snap switch, rated at 20 amp., 250 volts, has been perfected by the General Electric Company, Schenectady, N. Y. The switch is designed to answer the purpose of the double-throw, double-pole knife switch, but combines also the features of being inclosed and indicating.

Starting Compensator with Safety Features

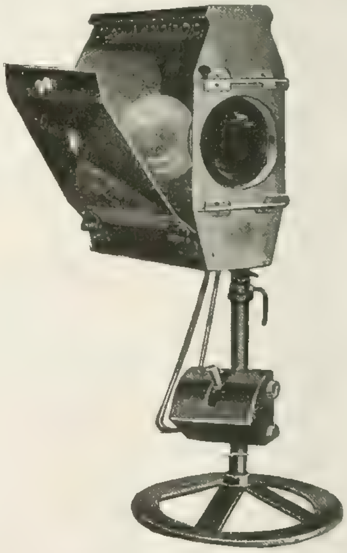


MECHANISM EASILY LIFTED OUT FOR INSPECTION

An automatic low-voltage release and two series inverse-time-limit overload relays are incorporated in the design of the compensators made by the Lincoln Electric Company, Cleveland, Ohio. The overload relays are adjustable to trip at any current and are designed to protect against overload and single-phase operation. The inside mechanism of the compensator, which operates in oil, can be removed by taking out a few screws and can be laid back in the swinging top of the case for inspection and repairs. By changing three connections the starting torque of the motor can be varied. It is stated that a decided jerk must be put on the handle to move it from one position to another, thus preventing arcing of the contacts.

Theater Projector Lamp for Alternating or Direct Current

Two theater projector lamps have been developed by the Brenkert Light Projection Company, Detroit, Mich.



MAY BE OPERATED FROM THE SWITCHBOARD

One of these, the arc type, is of 40-amp. rating for either alternating or direct current and uses a ¾-in. carbon. This type may be operated for either "spot" or "flood" effects. The incandescent type uses a 1000-watt tungsten lamp and is designed for flood illumination.

Cushion Spring Lamp Guard Prevents Lamp Breakage

A cushion spring inside the guard holding the bulb in the center and preventing it from coming in contact with the outer wires of the guard is a feature of a line of steel lamp guards manufactured by the Frank W. Morse Company, 289 Congress Street, Boston. This guard comes in several types for 40-watt, 60-watt and 100-watt lamps. The joints are electric welded and the guards are electroplated in copper or silver.

One-Piece Brass Bracket Makes Assembling Easy

A bracket made of one piece of solid brass is being put on the market by the Peerless Light Company, Chicago, Ill. This bracket is designed to eliminate the assembling of a number of separate pieces.

ONE PIECE OF SOLID BRASS

Electrically Driven Tire Inflator for Garage Use

For bracket mounting in small vulcanizing shops and small garages, for the purpose of direct tire inflation, a motor-driven air compressor has been developed by the Brunner Manufacturing Company, Utica, N. Y. The motor is rated at ¼ hp., and the net weight of the entire outfit is 9 lb. The outfit is not to be used with a tank storage system. For precipitating moisture a small cast-iron chamber is employed. The makers state that the pump will inflate a 35 in. x 4½ in. tire to 90 lb. pressure in four minutes.

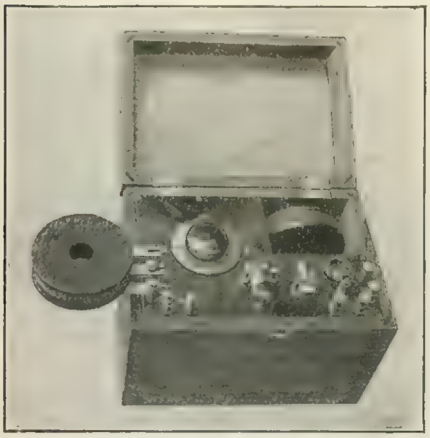
Alternating-Current Wattmeter of Small Size

To correspond to the small direct-current meters which the Roller-Smith Company, New York, N. Y., has had on the market for several years, two alternating-current instruments of the same type and dimensions are now being made. An alternating-current and direct-current wattmeter and an alternating-current voltmeter are the two types which have been developed in this 4-in. size. This line of meters is known as the "Imp" line.

ALTERNATING WATTMETER IS FOUR INCHES IN DIAMETER

Meter for Measuring Long Wave-Lengths

The Clapp-Eastham Company, Cambridge, Mass., has developed a compact portable wavemeter. It is mounted in an oak box, 5¾ in. x 8¼ in. x 6½ in., and weighing, complete, 5 lb. A small compartment in the box holds two inductance windings which may be attached to the meter. When the buzzer is operated the meter emits waves of known length.



MEASURING WAVE LENGTH OF 150 TO 2,000 METERS

Gas Temperature Reduced in Multiple 600-Volt Fuse

Gases formed by the blowing of the fuse and expelled through a metallic washer are reduced to a a low temperature before reaching the atmosphere, it is claimed by the makers of the "Atlas Four-in-One" 600-volt fuse. A system of maintenance providing for the exchange of a new fuse for an old one is operated by the Multiple Electric Products Company, New York City, which manufactures this fuse. The underwriters have approved the fuse in capacities up to 30 amp.

Rocker-Type Washing Machine with Demountable Tub

A rocker-type electric washing machine with a demountable and removable tub is announced by the Wayne Manufacturing Company, St. Louis, Mo. The machine will be known as the "Wayne No. 100." A swinging wringer, oilless bearings, a steel welded framework and japanned panels of sheet steel are other features to which the manufacturer calls attention.

Adjustable Oscillating Fan Mechanism

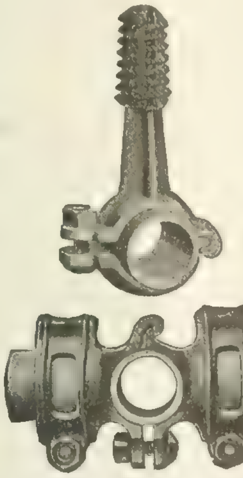
The Dayton Fan & Motor Company, Dayton, Ohio, have announced a new oscillating mechanism for desk fans. Features of this mechanism are compact worm and gear construction, wood thrust bearings and an adjustable crank. This crank is designed to hold the fan stationary or to swing it through several different angles. This new mechanism will be fitted to all "Dayton" oscillator fans of 12 in. and over.

Gasoline-Engine-Driven Generating Set

Four-cylinder, four-cycle gasoline engines of the automobile type, equipped with standard magnetos, carburetors, water pumps, tubular type radiators and fans, furnish the power for the gasoline-engine-driven generating sets manufactured by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Governors regulate the speed to within 4 per cent from no load to full load, it is said, and the compound motors are designed to allow voltage variation of not more than 2 per cent. The sets are made in 5-kw. and 15-kw. sizes for 110 volts or 220 volts. They are designed not only for farmers but for contractors, warehouses, etc.

Interchangeable Threadless Pipe Fittings

A line of pipe-frame structural fittings and devices for supporting high-tension and low-tension wires and cables is being brought out by the Erie Electrical Equipment Company, Inc., Youngstown, Pa. The interchangeability of parts of the fittings is a special feature to which the manufacturers wish to draw attention. These fittings are made of malleable iron.



FITTINGS ARE INTERCHANGEABLE FOR HIGH- AND LOW-TENSION WIRES

Radio Transformer for Experimental Use

An experimental radio-transformer combining a six-turn 8¼-in. coil and fifteen-turn 7-in. coil, mounted so that the latter slides freely inside the former, has been developed by the International Radio Telegraph Company, 326 Broadway, New York City, N. Y.

The total inductances are 8 millihenries and 44 millihenries respectively. The windings may be employed separately as fixed or variable inductances or in series for use on the variometer principle. Full-size calibration curves are furnished for each coil. The transformer weighs 10 lb. and measures, boxed, 12 in. x 12 in. x 15 in.

Small Storage-Battery Charger Requires No Oil or Grease

For charging small storage batteries, particularly used on automobiles, the "Rectigon battery charger" has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The design embraces no moving parts and, the makers claim, requires no oil nor grease. All parts are mounted on a circular cast-iron base and covered with a pressed-steel cover, which is shaped into a handle for easy carrying. The alternating-current leads are provided with a separable attachment plug and the direct-current leads with convenient clips for connecting to the battery. The charger is designed to connect to a 110-volt circuit and for use on batteries of three or six cells rated at 6 volts to 15 volts. It is made in two sizes to give charging currents of 1.5 amp. to 3 amp. and 3 amp. to 6 amp. respectively and weighing 9¼ lb. and 21 lb.

CHARGER IS ATTACHED TO LIGHTING CIRCUIT

Pull-Chain Lamp-Socket Light Controller

The pull-chain shade-holder lamp-socket light controller made by the Anylite Electric Company of Fort Wayne, Ind., has been improved by making use of the "Uno Thread," which has been adopted by many other socket manufacturers.

Notes on Recent Appliances

Universal Fan

An 8-in. fan with a series, universal type of motor has been developed by the Robbins & Myers Company, Springfield, Ohio.

Motor-Driven Hand Sander

The American Floor Surfacing Machine Company, 518 South St. Clair Street, Toledo, Ohio, has developed a motor driven sander for removing shipping marks from boxes and for resurfacing wood surfaces.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE WEBER ELECTRIC COMPANY, Schenectady, N. Y., has just made the announcement of a capital increase from $25,000 to $100,000.

THE HUGHES ELECTRICAL CORPORATION, Syracuse, N. Y., has increased its capital from $25,000 to $100,000, to provide for general business expansion. Notice of the increase has been filed with the Secretary of State.

THE STROMBERG ELECTRIC COMPANY, Chicago, has purchased a site, 628 ft. x 295 ft., from the Consumers' Company and will erect a factory building, 220 ft. x 200 ft., at a cost of approximately $160,000.

A. E. ALLEN

ARTHUR ELLIOT ALLEN has been appointed district manager at New York for the Westinghouse Electric & Manufacturing Company to succeed Edward D. Kilburn, who has been elected vice-president and general manager of the Westinghouse Electric International Company. Mr. Allen is a native of Toronto, Canada, and received his education in England and also in this country. In June, 1902 he entered the employ of the Westinghouse Company at its Newark works, subsequently being placed in charge of the test department, where he remained until 1910. In that year Mr. Allen was loaned to the International Electric Protection Company, for which company he acted as chief engineer. In 1911, having completed that temporary work he returned to the Westinghouse company, being assigned to the supply division of the New York sales office. On Dec. 1, 1915, Mr. Allen was appointed manager of the supply division of the New York office, which position he retained until he joined the Canadian Overseas Forces as a private in October 1917. Later he went overseas as a technical officer in the Royal Flying Corps. After being honorably discharged from the army Mr. Allen returned to the New York office of the Westinghouse company as executive assistant to the manager, from which position he was promoted to manager.

THE H. R. WORTHINGTON COMPANY, Harrison, N. J., manufacturer of pumps, is rushing work on the construction of its three new additions. The structures will be each two-story, 50 ft. x 137 ft., steel and reinforced concrete, and will cost about $100,000.

LORENZO H. PIKE, formerly factory manager of the Hygrade Lamp Company, Salem, Mass., has resigned to join the banking house of H. V. Green Company, Salem. Walter Melvin, formerly of the Franklin lamp factory at Hartford, Conn., has succeeded Mr. Pike.

THE McPHILBEN LIGHTING FIXTURE COMPANY, INC., 264 Fulton Street, Brooklyn, N. Y., is having plans prepared for the construction of a new plant on property, about 56 ft. x 114 ft., recently acquired in Jamaica, L. I.

THE ARNESSEN ELECTRIC COMPANY, INC., 109 Broad Street, New York City, announces that after Jan. 15 its factory, warehouse and main office will be in its new building at 118 Hamilton Avenue, running through to 17-19 Rapelye Street, New York City.

THE DELTA ELECTRIC COMPANY, Marion, Ind., has added more than 24,000 sq. ft. of space to its factory. This company is now turning out about 250,000 dry batteries per month for use in its flashlights, lanterns, bicycle and vehicle lights and spotlights. The company estimates that within a few months the output of No. 6 batteries alone will amount to 250,000 per month.

FAIRBANKS, MORSE & COMPANY, Chicago, one of the oldest electrical corporations in the city, is changing from a closed to an open corporation. The company is issuing 325,000 shares, no par value, against $20,000,000 of assets.

THE WACLARK WIRE COMPANY has sold its plant in Elizabeth, N. J., to the American Copper Products Company, a Delaware company capitalized at $14,000,000. Besides manufacturing various wire products the Waclark company operates a brass mill.

UNIVERSAL BATTERY SERVICE COMPANY, CHICAGO, ILL., has been ordered by the Federal Trade Commission to drop the word Universal from its name, in connection with the manufacture or sale of storage batteries, because of the similiarity of the former name to that of the Universal Battery Company, Chicago, Ill. The claim of confusion among purchasers and misleading of the public was upheld by the Commissioner.

THE ESTATE STOVE COMPANY, Hamilton, Ohio, will speed up production and sales of Estate electric ranges this season. E. I. Williams will continue in charge of sales, but associated with him this year are three men who have served several years with public utilities and who will sell ranges from the standpoint of the central-station man. George E. Dunn, who, since 1914, has been in charge of the retail merchandise sales of the Public Service Company of Northern Illinois, with jurisdiction over that company's twenty-six salesrooms; C. E. Bougher, who has had charge of retail sales in Oak Park, Ill., and H. W. Lippert, from the New York Edison Company, form the new staff.

THE TEN FOOT-CANDLE CLUB FORMED.—The Sunbeam lighting specialists with the Western Electric Company, stationed in the various houses throughout the country, have organized the Ten Foot-Candle Club to co-operate with associations such as the Illuminating Engineering Society, in the campaign to promote the use of higher intensities in the illumination of factories and mills. The club has adopted as its slogan "Devoted to the promotion of adequate illumination properly diffused and without glare." There are no dues and no officers except T. J. Rider, Jr., of the Chicago Sunbeam Office. Mr. Rider founded the club, and signs himself "Lumen." The club has its own stationery, on which the foot-candle meter forming the most conspicuous part of the design and which contains a list of charter members.

THE ELECTRIC HOIST MANUFACTURERS' ASSOCIATION, New York City, announces that at a meeting on Jan. 23 it engaged the services of E. Donald Tolles as executive secretary. The office of the association hereafter will be at 52 Broadway, New York City. C. W. Beaver of the Yale & Towne Manufacturing Company, is the president, and R. H. McCredy, of the Shepard Electric Crane & Hoist Company, is secretary-treasurer. The next meeting of the association is scheduled to be held on Feb. 20, at 9 East Fortieth Street, New York City.

NEW SECRETARY OF NEW YORK ELECTRICAL CREDIT ASSOCIATION.—Franz Neilson resigned as secretary of the New York Electrical Credit Association about the middle of January. Fourteen years and eleven months have slipped by since Burt Ellis, Al. DeVeau, Clarence Sibley, H. R. Swartz, G. E. Pingree and R. B. Coney, then directors, appointed Mr. Neilson to the management of association affairs under their supervision, and in this time the membership has grown from 70 to 155. At the present time a membership drive is under way. The newly elected secretary is E. Donald Tolles, 52 Broadway, New York City, who is by no means a newcomer in the electrical industry and for whom association work is not a new field. After a business career extending over several years, he became associated with Franz Neilson in managing a number of open-price societies and trade associations, among others the association of which he has just been elected secretary. About four years ago, and after seven years' connection with Mr. Neilson and his various associations, Mr. Tolles became secretary of the Atlantic division of the Electrical Supply Jobbers' Association and first assistant to the general secretary, Franklin Overbagh. In this position, he has become known to a large number of both manufacturers and jobbers throughout the United States. During the war he was active in Washington in the interest of the industry, particularly in looking after the interests of the jobbers, and assisted in drafting "Circular No. 23," which provided for the certification of electrical supply jobbers. Mr. Tolles is a graduate of Amherst College and received the degree of Bachelor of Science in 1899. He is an active member of the New York State Bar.

E. DONALD TOLLES

THE WILKES-BARRE WILLYS LIGHT COMPANY has made application for a charter to the Commonwealth of Pennsylvania for a new corporation at Wilkes-Barre, Pa. This company will act as distributors for Willys light plants and accessories in northeastern Pennsylvania and northern New Jersey and in that territory will handle the product locally. The officers of the new corporation are: President, Harold N. Rust; treasurer, George E. Shepherd; vice-president and general manager, Harley C. Wheaton. Mr. Shepherd and Mr. Rust have been in the trade for more than twenty years, being associated in the electrical business in Wilkes-Barre under the name of the Shepherd-Rust Company.

AETNA ELECTRIC APPLIANCE COMPANY ORGANIZED.—The Aetna Electric Appliance Company has been incorporated under the laws of Maine to manufacture and sell industrial and domestic heating appliances. The headquarters of the company are at Boston, and the controlling interests include Walter S. Wyman, general manager Central Maine Power Company and Adironack Electric Power Company, Augusta, Me.; Ralph J. Patterson, resident manager Twin State Gas & Electric Company, Berlin, N. H.; George M. Patterson, Penobscot Bay Electric Company, Belfast, Me.; Dexter H. Spaulding, cmmercial manager Central Maine Powr Company, and A. L. Smith, Jr., Boston. The company is just putting on the market a new electric water heater for tank service.

THE ACME ELECTRIC & MACHINE COMPANY, Cleveland, Ohio, has recently increased its capitalization to $150,000 and is bringing out a line of electrical machinery. C. H. Bunch, chief engineer of the Electric Products Company, Cleveland, Ohio, has resigned that office, and is now connected with the Acme company as secretary and engineer. The new equipment to be manufactured is a complete line of battery-charging equipment and switchboards, together with a small low-voltage generator for farm-lighting trade.

ELECTRICAL SHOWS FOR CENTRAL OHIO.—Plans for the Central Ohio Electrical Show, to be given at Memorial Hall, Columbus, early in April, were outlined at a recent meeting of the joint committee representing the Columbus Electrical Contractors and Dealers' Association and the electrical department of the Ohio State University. One of the features of the exposition will be a display of electrical devices for house lighting.

BARCLAY PARSONS & KLAPP, engineers, 60 Wall Street, New York City, announce the change of the firm name to Parsons, Klapp, Brinckerhoff & Douglas. The personnel remains unchanged, consisting of William Barclay Parsons, Eugene Klapp, Henry M. Brinckerhoff and W. J. Douglas.

EXCEPTIONALLY LARGE MILL MOTOR FOR JAPAN. — The Westinghouse Electric & Manufacturing Company announces that it has received an order to furnish to the Imperial Steel Works of Japan a motor of double-unit reversing slabbing-mill type of 5,800 hp. continuous capacity and 17,600 hp. momentary capacity. Among the accessories combined in this order the company will furnish a motor-generator set, the motor of which will be of 6,250 hp. capacity, three-phase, 25-cycle, and the two generators of which will be of 3,000 kw. capacity each, furnishing direct current at 700 volts to the slabbing-mill motor. A 150,000-lb. cast-steel flywheel is to be used with this set. Other apparatus will consist of exciter set, blower set, air washer, transformer, pumps, etc.

THE AUTOMATIC ELECTRIC WASHER COMPANY, Newton, Iowa, is commencing work on an addition to its factory to cost $135,000, in which it is proposed to produce the new cylinder-type Automatic family washing machine. The addition will represent an increase of 100 per cent in floor space of the Automatic factory.

JOHN E. HUBBELL, counselor-a-law, formerly of Chambers & Hubbell, Philadelphia, has opened offices at 469 Fifth Avenue, New York City, where his practice will be devoted exclusively to patent and trademark matters.

THE ROLLER-SMITH COMPANY, 223 Broadway, New York City, announces the appointment of Walter W. Gaskill, 141 Milk Street, Boston, as its agent for Boston and vicinity and other parts of the New England territory. Mr. Gaskill will supersede the P. I. Perkins Company, which represented the Roller-Smith Company in the said territory prior to the first of this year. Mr. Gaskill was graduated from Harvard and from there went in 1909 to the General Electric Company in its Schnectady works. In January, 1911, he became connected with the Boston office of that company, where he remained until June, 1918, as a specialist in electrical apparatus for pulp and paper mill work. From June, 1918, until April, 1919, he was in Washington with the Bureau of Aircraft Production, his particular work being in connection with the development and production of mobile lighting outfits for the illumination of aviation fields for night flying. Mr. Gaskill will handle, in addition to the Roller-Smith lines, the products of the Ward-Leonard Electric Company, Mount Vernon, N. Y., and the Brown Instrument Company, Philadelphia, Pa.

Supply Jobbers' Notes

CHARLES FELKER, who was manager of country sales for the Central Electric Company, Chicago, has resigned to become sales manager of Sworts Brothers, electrical jobbers, Rockford, Ill.

THE GULF STATES ELECTRIC COMPANY, New Orleans, La., announces its establishment as a new jobbing company. This firm will be open for business on Feb. 1, with George Wygant, formerly manager of the Stone & Webster properties at Baton Rouge, as president and general manager of the company.

Foreign Trade Notes

GREAT BRITAIN MAY PROTECT DOMESTIC ELECTRICAL IGNITION INDUSTRY.—The manufacture of electrical supplies and apparatus in Great Britain received a great impetus during the war, according to a bulletin on the "Economic Position of the United Kingdom, 1912 to 1918," just issued by the Department of Commerce. Although the British output of electrical goods before the war was large, exports considerably exceeding imports, the United Kingdom was dependent on Germany for magnetos and other essential accessories. In 1914 only one firm in England, according to the report, was producing magnetos, and the output of this plant in 1913-1914 was only 1140 magnetos of a simple type. There are now fourteen establishments turning out magnetos at the rate of 130,000 a year. Similarly, in 1914 there were only three firms producing ignition plugs, with an output of only 5000 annually. For the year ending Oct. 31, 1918, the output of mica plugs was 2,148,726. The British seemed determined to hold the independence gained by the electrical accessories industry during the war, and the Committee on Commercial and Industrial Policy reported the proposal of the British Ignition Apparatus Association that imports of magnetos from present enemy countries be absolutely prohibited for five years and after that period a minimum duty of 33 1/3 per cent be levied. Imports from other countries, in the meantime, under the proposal, would pay a duty of 33 1/3 per cent and thereafter 20 per cent.

Almost all of the imports of electrical goods by Great Britain are from European countries and the United States, shipments received from the United States having increased during the war. The exports of British electrical manufacturers are widely distributed. In 1917, however, France and Russia together received more than a third of the entire exports of such commodities.

Foreign Trade Opportunities

A firm in Spain (No. 31297) desires to secure the representation of a manufacturer of telephone and telegraph apparatus and supplies. It guarantees deposit on consignment of models manufactured in the United States. Quotations should be given c. i. f. Spanish ports, if possible, or f.o.b. New York. Correspondence should be in Spanish.

A. Serten has associated himself with the Holland Engineering Company, Amsterdam, Holland, and is in charge of the American department, with special attention to the sale of American electrical and mechanical specialties in Holland. This company desires an agency for electrical and mechanical specialties. Catalogs with prices and discounts are requested.

Several of the more important villages of the Cyclades Islands intend to introduce electric lighting in the near future. Necessary material will for the most part be imported. Full information from municipal authorities at Syra, Greece.

The Eastern Electric & Trading Company, V. G. Motwane, manager, Hornby Road, Fort, P. O. Box 459, Bombay, India, founded in 1909, and at present capitalized at $250,000, with branches in several Indian cities, announces that it has dealt mostly in American products, especially telephones, heating and cooking appliances, primary and storage batteries, lighting and power plants and novelties and wishes further manufacturers' representation.

The Allied Foreign Trade Corporation, 44 Whitehall Street, New York City, announces that it is in communication with a man in Brussels, Belgium, who is interested in buying electrical equipment such as: telephone apparatus, watchmen's clocks, time switches, rheostats, motors, transformers, generators, high-tension and low-tension apparatus, lamps, lighting fixtures, electric heating apparatus, insulated tubes with metallic lining, electric fans and pumps and electric power equipment for driving paper mill, weaving and printing machinery. The corporation requests from manufacturers prices and delivery and would like also to receive two catalogs in English, and if possible in French, on the above equipment.

Trade Publications

PANELS.—Bulletin R-4 on standard unit stock panels has been issued by the Benjamin Electric Manufacturing Company, 247 West Seventeenth Street, New York City.

LIGHTNING ARRESTER.—Bulletin No. 2C just issued by the Electro Service Company, Marietta, Ga., describes in detail the operation of the new Bennett surge arrester. Illustrations of installations that have been made on large systems are shown.

CONDUIT FITTINGS.—The Appleton Electric Company, Chicago, has issued supplementary bulletin No. 8-A, in which are listed the new conduit fittings which have been brought out by the company.

PANELS AND CABINETS.—Meter-control panels and switchboards are described in a recent bulletin by the Frank Adam Electric Company, St. Louis, Mo.

REFLECTORS.—Bulletin No. 75, distributed by the Central Electric Company, Chicago, describes the "Maxolite" R.L.M. standard-dome diffuser.

PUMPS.—Copies of a paper on centrifugal pumps read at the sales convention of the Midwest Engine Company, Indianapolis, Ind., by V. Schleyer, are being distributed by the company.

SAFETY SWITCHES.—Bulletin No. 9 of the Trumbull-Vanderpoel Electric Manufacturing Company, Bantam, Conn., describes a line of safety switches.

DIESEL ENGINE.—Copies of a paper on the Diesel Engine delivered at the sales convention of the Midwest Engine Company, Indianapolis, Ind., by N. McCarty, are being distributed by the company.

WAIT TURBINES.—Copies of a paper on Wait Turbines read at the sales convention of the Midwest Engine Company, Indianapolis, Ind., by H. H. Wait are being distributed by the company.

VALVES.—A 156-page catalog describing Nelson valves and containing a price list is now being distributed by the Nelson Valve Company, Chestnut Hill, Philadelphia, Pa.

THEATER LIGHTING.—"Better Lighting Effects in the Theater" is the title of a new booklet descriptive of the theater-lighting control manufactured by the Major Equipment Company, Chicago.

SAFETY SWITCHES.—Bulletin No. 3 of The Trumbull Electric Manufacturing Company, Plainsville, Conn., lists and describes its line of safety switches.

New Incorporations

THE BIFLECTOR COMPANY of New York, N. Y., has been incorporated by D. F. Kenney, W. F. Campbell and A. L. O'Shea, 38 Park Row, New York City, to manufacture lighting and heating appliances. The company has 1125 shares of capital stock of no par value.

THE BATESBURG (S. C.) RURAL LIGHT & POWER COMPANY has been incorporated by D. E. Etheredge, J. F. Wise and W. D. Holstein. The company is capitalized at $5,000.

THE ROCK SPRINGS (TEX.) LIGHT COMPANY has been incorporated with a capital stock of $8,000 by V. A. Brown, L. R. Smart and E. N. Lovelady.

THE FORDSVILLE (KY.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $4,000 by J. B. Westerfield, Fount Crowe and J. T. Smith.

THE SOUTHWESTERN LIGHT & POWER COMPANY of Tulsa, Okla., has been chartered with a capital stock of $100,000 by Jules Constantin, A. W. McBride and E. M. Gallaher of Tulsa.

THE TUSKEGEE (ALA.) LIGHT & POWER COMPANY has been incorporated by D. E. Laslie and others. The company is capitalized at $30,000 and proposes to operate an electric light and power plant and ice factory.

THE CAROLINA ELECTRIC COMPANY of Rock Hill, S. C., has been incorporated with a capital stock of $10,000 by A. C. Fennell and R. S. Cannon.

THE LARKIN ELECTRIC COMPANY of Salamanca, N. Y., has been incorporated with a capital stock of $10,000 by G. L. Peters, O. O. F. and M. A. Larkin of Salamanca.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

ANDOVER, MASS.—Considerable new electrical and mechanical equipment will be required, it is understood, in connection with the construction of the proposed new laundry plant of the Community Laundry Company, estimated to cost $50,000, to be located in the Shawnee Village district. Construction work on the new plant has been inaugurated.

BOSTON, MASS.—It is reported that the Edison Electric Illuminating Company will build a big steam generating station on the Fore River.

LYNN, MASS.—Plans have been filed by the General Electric Company for the erection of the proposed new additon to its plant on Western Avenue. Contract for the structure, which will be three-story, about 60 ft. x 100 ft., has been awarded to Charles W. Wright, 23 Central Avenue, and it is proposed to inaugurate construction at once.

MEDFORD, MASS.—The City Council has under consideration the installation of "white way" lighting systems in Medford, West Medford, Haines and Tufts Squares, and the Hillside section. It is also contemplating replacing the present street lights with those of double candlepower.

BRISTOL, CONN.—The New Departure Manufacturing Company is planning to build a new power house to be 50 ft. x 120 ft. x 60 ft. It will be equipped with pumps, blowers, refrigerating equipment and three 600-hp. water tube boilers.

DERBY, CONN.—The Derby Gas Company has completed arrangments for the construction of the proposed new two-story brick, concrete and steel addition to the boiler plant at its electric light station, for increased facilities. The structure, contract for which has been awarded to M. A. Durrschmidt, Derby, will be about 40 ft. x 100 ft.

HARTFORD, CONN.—The Eastern Connecticut Power Company is planning to construct a 33,000-volt line, 60 cycles, from Stonington to Pawcatuck. The proposed method of construction has been approved by the Public Utilities Commission.

HARTFORD, CONN. — The Southern New England Telephone Company has begun work on the addition of its local exchange on Pearl Street. The cost of the building, which is to be a six-story and basement structure, 33 ft. x 90 ft., is estimated at $65,000. The contractor is the Ellison Construction Company of Hartford.

Middle Atlantic States

BROOKLYN, N. Y.—A one-story boiler plant is one of the additions planned by the American Safety Razor Corporation of 303 Jay Street. The new plant, which is for general works service, will be located on Lawrence Street.

BROOKLYN, N. Y.—The Cascade Steam Laundry, Inc., 835 Myrtle Avenue, has had plans prepared for the construction of a new four-story brick addition to its plant, for increased operations, estimated to cost $150,000. Considerable electrical and mechanical equipment will be required in connection with the proposed extension.

HORNELL, N. Y.—The Hornell Electric Company is arranging plans for extensions in its system whereby it will be enabled to furnish electric energy for light and power service practically to the entire Cohocton Valley. This will include the towns of Avoca, Wallace, North Cohocton, Cohocton and Atlanta, and plans are being prepared for the immediate construction of a trunk line to extend from Hornell to Wallace, about 30 miles.

JAMESTOWN, N. Y.—The Jamestown Street Railway, Chautaqua Traction Company, Jamestown, Westfield & Northwestern Railway and Chautauqua Lake Navigation Company are planning to purchase a 3,000-kw., 60-cycle, 3,600-r.p.m., 2,200-volt turbine and a 2,500-hp. boiler.

PORTVILLE, N. Y.—The Public Service Commission has granted the Portville & Cattaraugus County Utilities Company permission to construct its proposed new local electric light and power plant, as well as approval of a franchise granted by the municipal authorities.

ROCHESTER, N. Y.—New equipment will be installed and additions will be made to the present stations of the Rochester Gas & Electric Corporation, in accordance with its plans for increased operations.

SCHENECTADY, N. Y.—Bids will be received at the office of the Superintendent of Public Works, at the Capitol, Albany, until Feb. 10, for the construction of the Schenectady-Scotia Bridge abutments and approaches, including track work, trolley wires, feeders, lamps and wiring, etc. Plans may be seen at the above office. Edward S. Walsh is Superintendent of Public Works.

SYRACUSE, N. Y.—Following the arrangements of plans by the Syracuse Lighting Company, 339 South Warren Street, for extensive improvements and additions at its plants and system, estimated to cost a total of $750,000, the Public Service Commission has granted permission to the company to issue notes to the amount of $500,000, to be used to defray a portion of the cost of the proposed 1920 expansion program.

ATLANTIC CITY, N. J.—A new double-circuit system of street lighting will be installed on the Absecon Atlantic City Boulevard. The city has had plans prepared for the proposed work.

GLASSBORO, N. J.—The State Board of Education, Trenton, will build a new one-story power plant in connection with the proposed new local three-story State Normal School, estimated to cost approximately $350,000. Plans for the power plant, which will be about 40 ft. x 75 ft., have been prepared.

NEW BRUNSWICK, N. J.—Large quantities of electrical and mechanical equipment will be required, it is understood, in connection with the construction of the proposed new local plant of the Eastern Potash Corporation, 120 Broadway, New York. The company's plans call for the construction of a total of fourteen units to compose the works, which will include the erection of a steam-operated electric power plant, provided with steam turbines, water-tube boilers and auxiliary apparatus; machine shop, about 100 ft. x 200 ft.; new lime kiln, 200 ft. x 280 ft., 42 ft. in height, which kiln, it is said, will be one of the largest of its kind in the world when completed. The equipment installation will include a complete complement of loading and unloading machinery, hoisting and hauling apparatus, etc.

NEWARK, N. J.—The Industrial Factory Sites Corporation has under consideration the construction of a group of five factory buildings. The proposed group will have a central heating system, but each building will have its own lighting system if the present plans are carried out.

NEWARK, N. J.—The New York Telephone Company is arranging for the construction of additions to its various telephone exchange plants in the local district The work includes extension to its plants at Avan Avenue and Hunterdon Street and at 59 Bloomfield Avenue, estimated to cost $150,000 and $200,000 respectively.

PERTH AMBOY, N. J.—The Raritan Copper Works has plans prepared and inaugurated preliminary work on the construction of two large steel oil-storage tanks to have a capacity of 3,000,000 gal., in connection with its arrangements for the installation of oil-burning equipment in a portion of its plant to replace the present coal operated units. The company has recently completed the construction of a new power plant at its works and will continue the use of coal as fuel in this structure.

SOUTH RIVER, N. J.—The Board of Public Works will build a new one-story brick power plant for municipal service. The structure will be about 55 ft. x 95 ft. and, including equipment installation, is estimated to cost $125,000. Goss, Bryce & Johnson, 55 Liberty Street, New York, are engineers.

CATASAUQUA, PA.—The Lehigh Valley Light & Power Company has had plans prepared for improvements in the municipal street-lighting system, and it is proposed to inaugurate work at once.

EASTON, PA.—The Metropolitan Edison Power Company, of which the Pennsylvania Utilities Company is a subsidiary, has under consideration the construction of a high-tension transmission line to Easton and from there to Dover, N. J.

HARRISBURG, PA—The lighting units in use at the present time in the street-lighting system are to be replaced with units of increased power in accordance with a new city ordinance.

JOHNSTOWN, PA.—The Cambria Steel Company expects to spend about $15,000,000 in expansion work during 1920. Of this amount $2,000,000 will be spent in building two new central power plants. Other improvements include the installation of 4,000 hp. in boilers and superheaters at the Cambria plant, and 8,000 hp. at the Franklin plant.

PHILADELPHIA, PA.—Improvements to the plant of George W. Blabon Company include additions to their central power station which will approximately double its present capacity.

PHILADELPHIA, PA.—Plans have been completed by William F. Read & Sons for an addition to their plant at Jackson and West Twelfth Streets. The addition which is for a boiler plant is to be a one-story building, 23 ft. x 61 ft., and will cost about $7,500.

GEORGETOWN, DEL.—Following the purchase of the plant of John B. Wagamon by L. L. Layton & Sons, plans are being prepared for extensive remodeling and alteration work in the structure for conversion into a cold-storage plant. It is understood that considerable electrical and refrigerating machinery will be utilized.

BALTIMORE, MD.—The Eastern Rolling Mills Company, whose electric generating plant was recently destroyed at a loss reported to be from $35,000 to $50,000, is planning to rebuild the plant.

COLLEGE PARK, MD.—A new central heating plant and conduit system will be installed at the Maryland College of Agriculture. Plans for the work have been prepared by the Board of Managers. It is estimated to cost about $250,000.

CURTIS BAY, MD.—The Sterno Corporation recently incorporated with a capital of $500,000 by interests associated with the United States Industrial Chemical Company, the United States Industrial Alcohol Company and the Curtis Bay Copper & Iron Company, all of Curtis Bay, is having plans prepared for the construction of a new local plant for the manufacture of alcohol-burning devices for automobile service, etc., electric heating and cooking appliances, etc., estimated to cost in excess of $400,000. Considerable electrical and mechanical equipment will be required for the new works. Carl Haner, Jr., connected with the United States Industrial Alcohol Company, is active in the new concern.

WHEELING, W. VA.—It is reported that plans for the purchase of the electric light and gas plant of East Wheeling are under consideration by the Hazel-Atlas Glass Company.

North Central States

DAYTON, OHIO—The Delco-Light Corporation has under consideration plans for the construction of a new power house and other buildings in connection with a central power station. These buildings are part of a building program which, when completed, will greatly increase the size of the Delco plant.

SANDUSKY, OHIO.—The Ajax Rubber Company, 25 West Mount Royal Avenue Baltimore, Md., has acquired a site of about 90 acres in Sandusky for its proposed new plant, to cost about $1,000,000. Arrangements are also being made for a housing project, providing about 400 homes for its employees.

WARREN, OHIO.—Arrangements are being made by the Sunlight Electric Company for the erection of an addition to its plant, 40 ft. x 150 ft.

GEORGETOWN, KY.—Bonds to the amount of $100,000 have been authorized for improvements to the city electric light and power plant and waterworks.

THORNTON, KY.—Contemplated improvements in the local mining properties of the Elkhorn Collieries Company include the installation of considerable electrical equipment.

WHITESBURG, KY.—H. V. Daniel and others propose increasing the capacity of the light and power plant and construction of a new building this year. The improvements will cost $20,000.

DECATUR, IND.—The City Council has selected a site for the new city power plant which will cost approximately $150,000.

DECATUR, IND.—The Indiana Public Service Company has approved the issue of $75,000 electric light and power plant bonds.

EVANSVILLE, IND.—The Evansville Paper Box Manufacturing Company will build a two-story brick and steel plant, containing 300,000 sq.ft.

FORT WAYNE, IND.—The Economy glove factory plant has been destroyed by fire.

GREENCASTLE, IND.—The Putnam Electric Company contemplates the installation of a series street-lighting system, 6.6-amp., alternating current, for Cloverdale. C. W. Otis is manager.

HOBART, IND.—Improvements are contemplated to the municipal electric light plant, including the installation of a new boiler and generator and extensions to local lines. The cost is estimated at about $10,000. R. E. Wheaton is manager.

HUNTINGBURG, IND.—The installation of an additional generating unit in the municipal electric light plant and the erection of a transmission line is under consideration by the City Council. Leo F. Grewe is superintendent.

INDIANAPOLIS, IND. — The Spacke Machine & Tool Company plans new factory building.

LINTON, IND.—The City Council has under consideration plans for moving the city lighting plant and making many needed improvements. Much of the machinery is badly worn and will have to be replaced.

PIERCETON, MD.—The Farmers' Mutual Electric Light & Power Association has been organized to build and equip lines to furnish farmers in the vicinity with light and power. The new company will cover Pierceton, Sidney and Colmer, Ind. T. E. Stone is the electrical engineer.

CHICAGO, ILL.—The L. K. Comstock Company has secured a contract for building a power plant to include sixty 500-hp. boilers, one 300-kw., one 750-kw. and one 1,500-kw., 220-volt generating unit for Sears, Roebuck & Company, Philadelphia. Martin C. Schwab, 30 North Michigan Avenue, is consulting engineer.

DANVILLE, ILL.—The city engineer, Mr. Edwards, is in charge of the new lighting system which is planned for the business district of the city. His estimate calls for a boulevard lighting system with a total of 200 lamps having 12,000 cp. lighting capacity.

HIGHWOOD, ILL.—The Chicago, North Shore & Milwaukee Railroad proposes to purchase during 1920 two 1,000-kw. rotary converters and automatic substation equipment.

PEORIA, ILL.—Bock & Kuhl plan the erection of a twelve-story bulding.

XENIA, ILL.—The Xenia Electric Light Company contemplates the installation of a 25-hp. oil engine and a 20-kva. generator. N. T. Pierce is manager.

FAIRWATER, WIS.—The Fairwater Electric Company contemplates the erection of electric transmission lines into the farming districts. J. W. Laper is secretary and manager.

LAKE MILLS, WIS.—The municipal electric light and water department is contemplating the erection of transmission lines into the farming districts. B. C. Engsberg is superintendent.

MILWAUKEE, WIS.—The bureau of illumination of the municipal street lighting system contemplates the installation of 750,000 ft. of underground cable. William W. Rumsey is general superintendent.

SAUK CITY, WIS.—The Sauk City Power Company is contemplating the construction of a transformer station and power line in Dunn Township. The general manager of the company is in charge of the work.

WAUSAU, WIS.—In order to increase its generating capacity to practically double what it is at the present time, the Wisconsin Valley Electric Company has under consideration plans for the construction of a dam at the foot of Bulls Falls in the Wisconsin River. The project will be undertaken in the spring and will eliminate the falls.

MINNEAPOLIS, MINN.——The City Council has voted bonds amounting to $35,000 for the purpose of building a new power, heating and lighting plant at the workhouse.

DAVENPORT, IOWA.—The Associated Masonic bodies plan the erection of a million-dollar temple.

ASH GROVE, MO.—The Ash Grove Light & Power Company is planning to rebuild its electric plant, which was burned at a loss of $30,000.

EMINENCE, MO.—Contemplated improvements at the present time include the installation of an electrical copper smelter. The work is being done by J. E. Bennett of Springfield, Mo., at an estimated cost of $250,000.

ST. LOUIS, MO.—The American Bakers' Machinery Company has planned to construct a plant that will have 60,000 sq.ft. of floor space. The architect is E. C. Jansen, Chemical Building.

SCHUYLER, NEB. — Bonds to the amount of $55,000 have been voted for rebuilding the electric light plant.

ROSSVILLE, KAN.—The Rossville Electric Light & Ice Company contemplates the installation of a new 60-kw. generator and also extending its electrical service to Delia and Willard. A. H. Daw is manager.

Southern States

MURFREESBORO, N. C.—The Chowan Railway & Power Company wants prices on electrical equipment in connection with the electrical generating station which it is planning to build for a railway from Orlando, N. C., to Franklin, Va.

WINSTON-SALEM, N. C.—The P. H. Hanes Knitting Company, which recently increased its capital from $2,000,000 to $12,000,000, is planning an addition of reinforced concrete to its plant. The new building is to be a six-story and basement, 210 ft. x 83 ft., and will be put up by the Southern Ferro-Concrete Company. The machinery to be installed includes knitting, dyeing, drying and napping machinery.

GREENVILLE, S. C.—A new plant comprising two buildings and estimated to cost $50,000 is to be erected by the Greenville Iron Works. Machinery is to be purchased for the machine shop, which will cover 7,000 sq.ft. of floor space, and for the foundry, covering 8,500 sq.ft. of floor space. The new plant is to be of sheet-iron and steel construction and will have a daily output of 18 tons. W. Lindsay Wilson is the manager.

SENOIA, GA.—The Senoia electric light plant has been purchased by A. H. Jones, who intends to improve the plant so that the lighting system of Senoia will be proportionate to its size.

CHATTAHOOCHEE, FLA.—The contract has been awarded for the new power plant of the Florida State Hospital Home of Nurses. The plant, which is to be of brick and concrete construction, 60 ft. x 120 ft., will cost about $100,000. The engineer is C. S. Hammatt of Jacksonville.

CHATTANOOGA, TENN.—A structural-steel, fireproof building, 100 ft. x 200 ft., will be erected by the newly incorporated Lookout Boiler & Manufacturing Company. Machinery will be installed for the manufacture of plate and sheet-metal work, tanks, towers and boilers.

BIRMINGHAM, ALA.—The Alabama Power Company reports that there is no foundation in fact for the rumors that it is about to build additional hydro-electric plants.

BELZONI, MISS.—The town is to vote on the issue of $275,000 in bonds, the proceeds to be used in improvements to the light and water plants and for paving the streets.

LITTLE ROCK, ARK.—It is reported that plans are under way for additions and improvements to the plant of the Southwestern Bell Telephone Company. These changes, which are made necessary by increased operations, will cost approximately $200,000.

OZARK, ARK.—The Rainbow Manufacturing Company is planning for an addition to its plant which will be 168 ft. x 80 ft. and will cost about $12,000. Machinery to be installed at an estimated cost of $30,000 will be electrically driven with a daily capacity of 1,200 lb. of wrapping twine, rope, etc. W. M. Hunter is the architect and engineer.

WYNNE, ARK.—Bids will be received for the new city water and light plant by the commissioners, S. W. Ogan, R. T. Simmons and W. W. Shaver. Plans for the project have been drawn up by the engineers in charge.

BOYCE, LA.—Bonds to the amount of $30,000 have been voted for improvements to the town electric light and waterworks plant.

NEW ORLEANS, LA.—The New Orleans Railway & Light Company expects during the coming year to purchase a 15,000-kw. turbine with condenser auxiliaries, a 30,000-gal. fuel-oil storage tank with pumps, piping, etc., and a 1,500-kw., 125-250-volt rotary.

KAPLAN, LA.—The city is contemplating a bond issue amounting to $48,000 to cover the cost of improvements to the municipal electric light and waterworks system. Eugene Eleazar is the Mayor.

KENEDY, TEX.—The Kenedy Light & Power Company is planning to rebuild its power plant, which was recently destroyed by fire.

Pacific and Mountain States

ENUMCLAW, WASH.—The Enumclaw Light & Water Company is negotiating for the sale of the company's plant to the city of Enumclaw for a price fixed at $50,000. The price covers the city water system and electric plant.

MUKILTEO, WASH.—The Mukilteo and Seaview Improvements Clubs are considering plans for improvements to the lighting and power service in the city.

SEATTLE, WASH.—In his report to the Mayor, Superintendent of Lighting J. D. Ross asks for $1,750,000 for completion of Cedar Falls power plant to a capacity of 18,000 kw. He estimates the cost of Cedar Falls plant at $3,500,946.66. The sealing of the new dam has cost to date $381,814.07. Completion of penstock and installation of new generator will add $600,000 to the cost of the plant.

TACOMA, WASH.—The Blue Bird Electric Shop recently received contract for electrical fixtures in the new $300,000 apartment house to be built in Seattle by Mrs. Mae E. Young. The contract was awarded on a competitive design basis.

CALEXICO, CAL.—Plans have been completed by the Holton Power Company for the construction of a local substation of reinforced concrete. The work will be begun at once.

HERMOSA BEACH, CAL.—A new electric street-lighting system is being considered by the local authorities.

LOS ANGELES, CAL.—The Southern California Edison Company has under consideration plans for the construction of a substation at New Port Beach, and a power line to San Juan Capistrano. The estimated cost will be $50,000.

MODESTO, CAL.—Application for permission to divert 20,000 cu.ft. a second of water from the Tuolumne River for power and irrigation purposes has been made to the California State Water Commission by the Modesto irrigation district. The project includes the construction of dams, power houses and distributing system at a cost of $16,000,000.

PASADENA, CAL. — The Wagnerlite Company expects to build new factories at Pasadena, Cal., and Davenport, Ia., this year and will be in the market for all kinds of factory equipment, motors and electrical machinery.

SANTA BARBARA, CAL.—The city is contemplating the erection of a power house to take care of the city's electrical needs. Bonds necessary for the proposed project will be voted on in the near future

KELLOGG, IDAHO.—The Bunker Hill & Sullivan Mining & Concentrating Company is planning to build a new hydro-electric plant to supply power for its mill, mine and smelter. The building will be a three-story brick structure.

LEWISTON, IDAHO.—This place has been included in the plan of the Pacific Power & Light Company for extensive improvements. The company will this year spend more than $2,000,000 in improvements and betterments to its plants in the

Northwest, and several thousand dollars will be expended here.

HOLBROOK, ARIZ.—Bonds will be issued to supply the necessary funds for the installation of a new municipal electric light and power plant. Plans and specifications are being prepared for the work. A. M. Nicholson is the engineer in charge.

BINGHAM, MONT.—The city has voted bonds to the amount of $50,000 for a light and water plant. It is proposed to operate the new plant with an oil engine.

CHEYENNNE, WYO.—In order to take care of increased business, the Cheyenne Light, Fuel and Power Company is installing a 1,000-kw. turbo-generator in its power house. This installation necessitates further an increase in condenser and cooling pond capacity.

Canada

VANCOUVER, B. C.—J. C. Reston, electrical contractor, Nova Scotia Building, has received contract for supplying and installing three complete sets of electric equipment for three steel steamers under construction by the Provincial Government in Vancouver. The equipment includes engine room telegraph sets, electric lighting and call-bell systems.

WINNIPEG, MAN.—A transmission line which when completed will be 60 miles long, with a capacity of 20,000 kw., is under construction from Winnipeg to Portage la Prairie. At present one circuit is being installed with an estimated carrying capacity of 5,000 kw. at 66,000 volts. The plans call for a second circuit as soon as the power demand warrants it and substations at Winnipeg and Porta la Prairie. The cost is estimated as $4,600 per mile.

MONTREAL, QUE.—An automobile tire-fabric plant to cost about $1,000,000 is to be constructed near Montreal by F. L. Jenckes of the Jenckes Spinning Company, Pawtucket, R. I. Several of Mr. Jenckes' associates are interested in the enterprise, which will give employment to approximately 1,000 hands.

Record of Electrical Patents

Notes on United States Patents

(Issued Jan. 27, 1920)

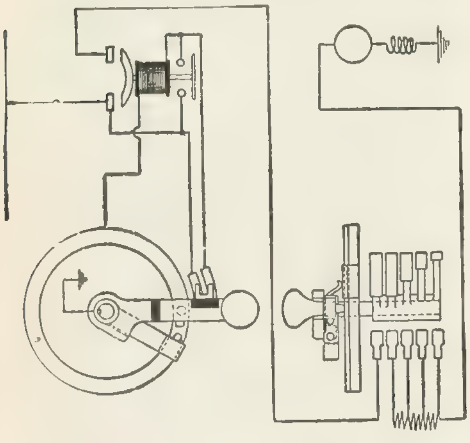
14,797 (reissue). Wheel Brake; Chester B. Mills, East McKeesport, Pa., and John P. Nikonow, New York, N. Y. App. filed July 22, 1918. Motor connected through gearing and levers for rolling and blooming mills.

1,328,804. Attachment for Electric Controllers; Arvid R. Anderson, Columbus, Ohio. App. filed Jan. 20, 1917. Protects apparatus during no-voltage periods.

1,328,873. Dynamo-Electric Starting, Lighting and Ignition Mechanism for Automobiles; John A. Heany, Jersey City, N. J. App. filed Nov. 3, 1917. Utilizes both motor-dynamo and motor.

1,328,892. Starter Applicable to Magnetos; Henry Parkin, Philadelphia, Pa. App. filed Jan. 2, 1919. Locks starter.

1,328,925. Rolled Condenser for Sparking Apparatus; Franz Kratz, Stuttgart, Germany. App. filed Aug. 20, 1919. Frame held together by pressure exerted during winding.



1,328,804—Attachment for Electric Controllers

1,328,933. Radio Receiving Apparatus; Roy E. Thompson, New York, N. Y. App. filed Aug. 21, 1917. Coupling difficulties eliminated.

1,328,966. Electromagnetic Brake for Motor Road Vehicles; George Pollard, London, England. App. filed Oct. 14, 1918. Reduce air gap.

1,328,981. Electrolytic Apparatus; Edward O. Benjamin, Newark, N. J. App. filed June 24, 1918. Surface area of plates increased by forming elevations or depressions.

1,328,986. Selecting System; Amos F. Dixon, Newark, N. J. App. filed Aug. 1, 1917. Printing telegraphy.

1,328,993. Switch Box; Don H. Hayden, Cleveland, Ohio. App. filed Dec. 18, 1918. Units fastened together at edges.

1,328,996. Transmitter; William G. Houskeeper, Philadelphia, Pa. App. filed March 25, 1918. Selenium as resistance varying material.

1,329,001. Telephone System; Eric R. Lundius, Brooklyn, N. Y. App. filed Jan. 4, 1918. Signals station after termination of conversation.

1,329,004. Telephone-Exchange System; Harry W. MacDougall, East Orange, N. J. App. filed June 4, 1917. Automatic ringing systems for link circuits.

1,329,027. Coil for Dynamo-Electric Machines; Simon Sparrow, St. Louis, Mo. App. filed May 29, 1916. Permits length of armature to be reduced.

1,329,029. Telephone Apparatus; John S. Timmons, New York, N. Y. App. filed April 13, 1918. Talking circuit on aeroplane.

1,329,031. Transmitter Support; Fred D. Waldron, Brooklyn, N. Y. App. filed Feb. 25, 1918. Held in position.

1,329,043. Indicating Device for Vehicles; Charles P. Diemer, Sapulpa, Okla. App. filed April 9, 1917. Battery-operated.

1,329,083. Electromechanical Chronometer Driving Mechanism; Cornelis D. J. Jamin, Rotterdam, Netherlands. App. filed Sept. 18, 1917. Rocker operated by electromagnetic and mechanical force.

1,329,125. Manufacture of Electric Accumulators; Henry Leitner, London, and William Exley, Pontefract, England. App. filed April 15, 1919. Lead sulphuric-acid bi-polar type.

1,329,132. Electric Arc Lamp; Frederick W. Miller, Los Angeles, Cal. App. filed March 8, 1919. Three carbons form single arc.

1,329,135. Method of Electric Welding; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed Jan. 15, 1919. Transmission-gear housing welded in one operation.

1,329,136. Method of Electrical Welding; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed May 21, 1919. Welds pieces to exact dimensions.

1,329,144. Method of Connecting Plates by Electrical Riveting; Albert B. Rypinski, Brooklyn, N. Y. App. filed Aug. 26, 1919. Metal plate riveted to non-metal plate.

1,329,152. Starting Mechanism for Internal-Combustion Engines; Horace R. Van Vleck, Montclair, N. J. App. filed Dec. 12, 1917. For large high-speed engines.

1,329,167. Rheostat; Robert W. Ebeling, Oakland, Cal. App. filed Sept. 18, 1917. For sign lighting.

1,329,168. Multiple-Circuit-Resistance Control; Robert W. Ebeling, Oakland, Cal. App. filed Sept. 18, 1917. Dims or brightens lights to produce blended colors.

1,329,180. Storage-Battery Separator; Walter E. Holland and James M. Skinner, Philadelphia, Pa. App. filed May 17, 1919. Utilizes 40 per cent porosity perforated separators.

1,329,181. Storage Battery and Method of Preparing Same; Walter E. Holland, Philadelphia, and Lawrence J. Pearson, Wyncote, Pa. App. filed Sept. 5, 1919. Storage for indefinite time without deterioration.

1,329,193. Distributing System; Paul MacGahan, Pittsburgh, Pa. App. filed Dec. 10, 1914. Section of line disabled without interruption to any substation in ring formation.

1,329,204. Electrical Water Heater; Ralph J. Patterson, Berlin, N. H. App. filed Aug. 20, 1919. Within boiler or in pipe line.

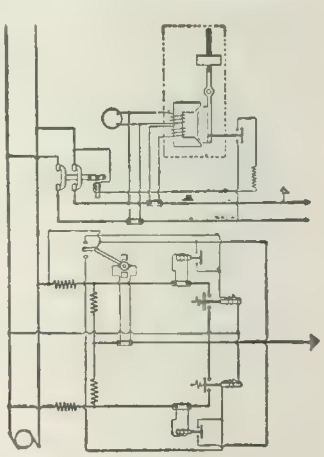
1,329,216. Motion-Picture Apparatus; Norman T. Whitaker, New York, N. Y. App. filed April 17, 1917. Indicates amount of film projected.

1,329,242. Coil-Supporting Device for Dynamo-Electric Machines; Rudolf E. Hellmund, Swissvale, Pa. App. filed July 11, 1916. Braces coils projecting beyond ends of core members.

1,329,243. System of Control; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Sept. 9, 1915. Phase-advancing means for regulating operation of polyphase induction motors.

1,329,247. Dynamo-Electric Machine; Jan A. Kuyser, Sale, England. App. filed Oct. 27, 1915. Ventilates magnetizable core members.

1,329,255. Automatic Protective Gear for Electrical Systems; Mostyn Rosebourne, Manchester, and Frederick A. Couse, Urmston, England. App. filed Nov. 3, 1916. When subjected to heavy grounds.



1,329,255—Automatic Protective Gear for Electric Systems

1,329,267. Commutator Cylinder; John S. Dean, Wilkinsburg, Pa. App. filed Jan. 5, 1917. Attached fan blades for ventilation.

1,329,276. Apparatus for Adding to the Output of a Main Power Station the Output of One or More Distant Sources; Severn D. Sprong, Brooklyn, N. Y. Automatically interconnecting hydro-electric generating stations.

1,329,277. Commutator and Process of Producing the Same; Charles A. Van Dusen, Toledo, Ohio. App. filed Feb. 12, 1919. Utilizes one-piece holder and bakelite insulation.

1,329,283. Thermionic Amplifier; Harold De F. Arnold, Maplewood, N. J. App. filed July 30, 1918. Audion type.

1,329,287. Automatic Party-Line Telephone System; Wilson L. Campbell, Chicago, Ill. App. filed July 31, 1906. Party-line subscriber calls automatically.

1,329,315. Electrolytic Apparatus; Victor M. Weaver, Harrisburg, Pa. App. filed Aug. 22, 1914. Sealed construction provided.

1,329,330. Electric Fitting; George B. Thomas, Bridgeport, Conn. App. filed April 30, 1919. Lamp located with relation to focal center of reflector.

1,329,233. Arc-Welding System; Otto H. Eschholz, Wilkinsburg, Pa. App. filed May 7, 1919. Railway voltage used with safety in producing short arc.

Electrical World

The consolidation of Electrical World, Electrical Engineer *and* American Electrician

Volume 75 New York, Saturday, February 21, 1920 *Number* 8

Well Put

THAT was a happily expressed idea to which utterance was given at the recent Conference Club meetings—that co-operation in the industry had in the past been hampered by suspicion and fear—suspicion of the other fellow, who must be "getting something out of it," and fear of getting into jail under the operation of rigorous anti-combination laws. There are signs of a coming era of good feeling when both the suspicion and the fear will vanish.

How Radio Can Help

THE extension of interconnection programs into realized operating schemes puts a strain upon intercompany telephone facilities which deserves careful investigation. The policy of establishing direct connection by radio telephone between adjacent dispatching centers which are co-operating regularly should, we believe, supersede the plan of relaying messages between important plants involved in the interchange. Time is required to accomplish this, but the value of interconnected service justifies thorough and modern arrangements.

Relieving Short Stocks

LET the importance of more efficient distribution of electrical goods not be lost sight of in the laudable pursuit of increased production. The times are ripe for thoroughgoing analyses of distribution costs and requirements in many branches of commerce and industry. Too much guesswork has impaired the accuracy of many utterances upon this subject in the past. By relieving short stocks as much good, if not more, can be accomplished as by increasing per capita outputs in the factory. Scientific analysis of the volume, character and localization of demands will help mightily in this direction.

Utility Profits and Development

A CALIFORNIA banker, in testifying before the commission of that State, expressed the opinion that it was more to the interest of the people to see that hydro-electric power was properly developed than to bicker over fractional differences in the number of cents to be paid for a kilowatt-hour of energy. In support of this opinion he instanced the great San Joaquin Valley, now only one-fifth developed and dependent absolutely upon hydro-electric power for the development of the other four-fifths. The power cannot be furnished without capital, and capital, other things being equal, goes where the highest price can be had. Are not those who would hold the electric companies down to a profit so meager as to put their securities in the class of shopworn goods among the persons—as persistently with us as are the poor and respectable only for their numbers and their ancient lineage—whom the old saying calls penny-wise and pound-foolish?

Franklin K. Lane

THE approaching retirement of Secretary of the Interior Lane from the Cabinet will leave that body the poorer by the loss of a far-seeing, clear-thinking and conservative mind of the engineering type. His administration of his office enhanced still further its importance, already great when he entered upon it seven years ago. By his faculty of clear and comprehensive statement, by pen and by word of mouth, in his official reports and on the public platform, he did much to increase among the American people a true realization of the tremendous national wealth that is theirs for the development. He leaves the government at a time when the demand for food, for fuel, for manufactures of all kinds, and for power to aid in their production, is greater than ever in our history. The Department of the Interior, which is vitally connected with throwing open under proper safeguards the storehouses of the nation, may come to rank in time of peace as one of the three or four greatest divisions of the government. It will be fortunate if it shall always have at its head a man of Mr. Lane's caliber. Were there no other reason for approving him, electrical engineers and executives would find warrant for high praise in his consistent stand for and vigorous advocacy of a water-power bill and his broad-minded insistence that this act should be fair alike to the investor and the public.

The Jobber a Stabilizer of Merchandising

THE necessity of the electrical retailer in the chain of electrical merchandising has been broadly acknowledged within the last few years. The central station cannot get along without the contractor-dealer; rather than compete with him, it has advanced to the stage where it is ready to assist him in his business, helping him to improve his methods and increase his sales. Of recent months there has been some feeling on the part of the electrical jobber that his position should be similarly justified. The Electrical Supply Jobbers' Association has rather widely advertised its attitude in the matter, and the position of the wholesale distributer has been discussed on many occasions. The position of the power company was well stated in the discussions which were brought out at a recent convention of the Northwest Electric Light and Power Association in Seattle. There a question was asked as to how large stocks should be carried by central stations still in the merchandising business, and it was very frankly stated that the power company should depend upon the jobber to maintain large stocks and should reduce its own stocks to a minimum compatible with efficient service to the public.

There is no question of the importance of the wholesale distributer in the stabilizing of merchandising conditions. His ability to study the local market and to handle demands in large orders is of inestimable value to the manufacturer. The convenience to the retailer, who thus has a large stock to draw on without the necessity of maintaining a considerable surplus in his own business, as well as the interest and assistance of the highly paid organization maintained by the jobber, is too great to need further comment.

Electrical Smelting Furnaces

WE ARE publishing in abstract an important paper on electrical iron smelting recently read before the Swedish Iron Institute by F. Holmgren. Sweden is a peculiarly favorable ground for the introduction of electric smelting because it is rich in high-grade iron ore and in cheap water power. Coal is high, and therefore there is every incentive to smelt the ore electrically if this process is practicable, as has proved to be the case. Mr. Holmgren's paper deals with tests made at several of these primary smelting furnaces in which the results had been not altogether satisfactory with a view to finding out the sources of loss and planning improvement. Some extremely important factors obtruded themselves immediately the investigations was started. At the very beginning it was found that with the heavy currents employed the location of the instruments at the transformers was a bad one and that it was necessary really to get information about the electrical conditions in the furnace itself before the case could be properly analyzed. In one furnace investigated the energy losses in the leads between the transformers and electrodes were nearly 20 per cent of the entire capacity of the furnace.

It was soon found that the important electro-magnetic forces due to the huge three-phase currents in the furnace itself must be seriously reckoned with. The unbalancing possible in the furnace and the eddy currents developed in the adjacent iron structures both proved to be large disturbing factors in the operation of the furnace. It proved, moreover, that there was no proper common neutral point which could be relied upon, so that the action in the furnace was unbalanced. In the original arrangement tried each phase was connected to two opposite electrodes, and the unsatisfactory conditions found led to the connection of each phase to two adjacent electrodes, with the result of considerably reducing the losses in the conductors and an improvement of the power factor from 0.7 to an average of 0.91. A second furnace investigated led to similar conclusions and to a similar change in the connections. In this case that there were extraordinary differences in magnitude and direction between the currents at the transformer terminals and at the electrodes was at once apparent, and on determining the distribution losses in various parts of the conductors it turned out that half of the total loss of a little more than 600 kw. between the transformer and the furnace was due to work done on surrounding iron structures, and that more than 500 kw. was transformed between one set of conductors and another. It was estimated that rearrangement of the leads corresponding to that in the first furnace studied would cut the loss in two.

Considerable trouble in the operation of furnaces was also traced to the unbalanced electromagnetic conditions inside the furnace. Anything, in fact, which produces uneven energy supply through the electrodes gives uneven distribution of heat and unsatisfactory operation. Aggravated by improper mixing of the charge, the conditions may be much worse. The whole investigation shows not only the extremely irregular conditions that may be produced in the secondary circuit to and in the furnace but also the very considerable loss chargeable to this cause. The nearer one can come to investigating the actual working conditions inside the furnace, the more information may be obtained as to methods of improvement. It is interesting to note that the experience gained through the smelting practices in Sweden shows that frequency in itself is not a very important matter, good results being obtainable with any of the standard frequencies which are in use from 25 cycles up.

The whole situation disclosed by Mr. Holmgren's investigation is extremely instructive as showing the very unusual conditions which arise in dealing with unstable balancing of very large secondary currents in proximity to magnetic masses. To see big cables writhing under their mutual stresses or perhaps bars torn from their supports gives a new point of view, and one which the article under notice shows to be needed in the study of these big smelting furnaces.

Power Shortage on the Pacific Coast

RELIEF from the serious power shortage in California has in some measure been gained by transfers of power from one system to another by means of interconnections, but the ultimate accomplishment in this direction has about been reached. Steam plants are being forced to the utmost, with considerable waste of fuel as a result. Crude petroleum, which is the main fuel used in the steam-power plants of California, is steadily rising in cost. The conditions seem likely to have an important influence upon the electrical development of that State. It is apparent that in order to make provision for a series of very dry years there must be allowance for an increased "margin" between power-plant development and power-plant use. More hydro-electric plants will undoubtedly be constructed over a wide area, so as to take advantage of favorable precipitation conditions wherever they exist throughout the State.

Probably, too, considerably larger provision will be made for storage reservoirs; for, though in many quarters it is felt that storage of waters from year to year solely for power purposes is hardly feasible, nevertheless great reservoirs are to be created in the West to store water for combined power and irrigation uses, and these will tend to revive confidence in the ability of the power systems to tide over a future period of prolonged drought. The construction of additional auxiliary steam plants will be necessary to make the "working margin" of electric power in that State at all times certain.

Despite the rainless period and its attendant warnings to the industry, it must not be assumed that alarmist sentiments prevail in the councils of Pacific Coast power companies. They are going forward with their plans for immense development in the near future, knowing that the ever-increasing demand for electrical energy for industrial and agricultural purposes will insure the stability of investments in hydro-electric power plants. Yet the prevalent drought serves as a reminder that adequate reserves to provide for emergency are equally necessary in the power industry as they are elsewhere.

High Tension Air-Break Switches

ELECTRICAL engineers on the Coast, which has been for years the skirmishing line of electrical progress, have developed the air-break switch for transmission lines to a point far beyond its earlier expectations. When one is working at from 60,000 to 150,000 volts the oil switch proposition, excellent as it is in its results, becomes a serious item of expense. Like many other elements of the switching equipment, it has grown from a piece of apparatus to an architectural magnitude, and particularly on rather lightly loaded lines the cost gets burdensome. Our readers will therefore be interested in an account of the air switches used by the Southern Sierras Power Company, at present operating the longest straightaway transmission line in the world, stretching for more than 400 miles (650 km.) from the source of power at Mono Lake to the Mexican border. There are cases of longer transmission under certain circumstances between stations on extensive networks, and through interconnections of power systems which do not fundamentally depend on extreme long-distance work. But the claim of the system here considered to be the longest transmission line at present in regular operation we believe to be substantiated.

Six months ago the main line, which had been working at 60,000 volts, was raised to 90,000 on the way to the limit of 140,000, which will be used later. At each of the main control points along the line air-break switches have been installed on the main circuit, built for 140,000 volts working pressure. At the remote points there is always about 350 miles (550 km.) of line to be dealt with, so that the conditions are extreme. For this formidable task switches were constructed having a vertical break which appears to give the most favorable condition for clearing the arc. The spacing between phases is no less than 14 ft. (4.3 m.) and the end horns flare somewhat across the line away from the center horn, giving an increased spacing and factor of safety at opening. They are of single-break construction, each mounted on a steel tower. In all nine such units have been installed. In spite of the extreme length of the switch blades they are easily operated, thanks to their lightness. Each blade is built up of a pair of tapering pressed-steel channels which are inter-braced and connected with copper ribbon conductors. Attachment of the incoming aluminum cables is made at the hinge ends of the flexible cables by a suitable lug. The horns are of galvanized steel tube, also tapered. The operation of these switches as time goes on will be watched with a good deal of interest, as they are quite the largest yet constructed, but there seems to be no reason why they should not operate successfully. The main difficulty to be feared is the slower break than with oil switches involving some risk of resonance phenomena. The general success of air-break switches before has led to confidence in undertaking their use under what will be, when the full voltage is reached, extreme conditions.

Piece Work on Motor Repairs

IN ANOTHER issue of the ELECTRICAL WORLD an account was given of some of the experience gained in one of the big Pennsylvania steel mills in making necessary motor repairs, particularly to armatures and commutators. This mill, as the last word suggests, has direct-current equipment, and it was found that the motor repairs made by day labor seemed to be unnecessarily expensive. It was therefore decided to introduce piece work in the repair shops, and consequently a piece work schedule was applied to all the various items of repairing armatures and commutators. The workmen at first objected, but on trial it was found that they were actually making high wages—for the armature winders about $1 an hour, on piece work based on approximately one-third of the daylight work-time schedule. This is a large showing for savings, without pressing the workmen in the matter of wages. It would be interesting to know the total amount of repairs, which would throw considerable light on the ultimate desirability of direct-current motors in this kind of work. The general principle, however, of piece work on repair tasks which have often to be repeated seems to be a good one and one worthy to be followed wherever the requirements justify it.

Trying Daylight Saving on a Partial Scale

THE French government has recently adopted a program of daylight saving for two years, the date of setting the clocks ahead being fixed as March 15. This is considerably earlier than any date contemplated here, but of course France as a whole lies fully 5 deg. further north than the northern United States, which perhaps accounts for the difference. For our own country in general the date heretofore set is more appropriate. Just what the spasmodic efforts made here in various cities to continue daylight saving will amount to remains to be seen, but where they are to be supported by local authorities it will be wise to settle on the same conventional date of change. We recently published a study of the effect of daylight saving on residence lighting, worked out from Boston data, which was very instructive. It showed an actual reduction in lighting bills amounting to only a little more than 3 per cent. This is considerably less than the estimates that were made when the first enthusiasm was high; it is so small in fact as to be quite lost in the shuffle of a central station's business.

So far as the lighting industry is concerned there is no particular reason for or against daylight saving except possibly in a very few localities. The matter is really wholly one of the convenience of the working public, and here it is virtually reduced to a question of city versus country. Unquestionably the average city dweller is a gainer while the farming communities stand to lose owing to the entirely different situation respecting hours and conditions of business. At present we seem to be in for a "double standard" of sunlight, and it will be extremely instructive to see how it works out after a year's experience. The thing most seriously affected is railway working, particularly with reference to suburban schedules, and here will come the real test of the double system as a matter of all-around convenience.

John A. Britton

A foremost builder of the West as engineering executive of the most extensive hydro-electric distribution system in the world

LONG before the hydro-electric plant on the San Antonio Creek, the first hydraulic station to be installed in California, was placed in operation, and sixteen years before the famous single-phase transmission line at Telluride was completed in 1890, John A. Britton became identified with central-station operation on the Pacific Coast. His forty-six years of active service have been part and parcel of the wonderful story of how water powers have been harnessed and high-tension lines built and interlaced in the Land of the Golden Sunset. It is a story built on courage, foresight and ability to estimate accurately the future possibilities of electric service. Mr. Britton became an employee of the Oakland (Cal.) Gas Light Company in 1874, steadily advancing to the position of president. Since 1907, as vice-president and general manager of the Pacific Gas & Electric Company, in which the earlier companies were merged, he has had charge of all construction work and been responsible for the operating and financial policies of the company. It is not only as an executive-engineer, however, that Mr. Britton has won distinction. His work on the public policy committee of the N. E. L. A. is well known; he has been for many years a member of the board of regents of the University of California and was a prominent director of the Panama-Pacific International Exposition. The California electrical co-operative campaign and its beneficial results have largely been made possible through Mr. Britton's foresight. Naturally he has been among the foremost and best equipped advocates of water-power development, and the fulfilling of his reasoned prophecy of what it would mean to his section emphasizes, when it is viewed in the light of his actual accomplishments, his right to the place he now holds as the foremost of the builders of the West.

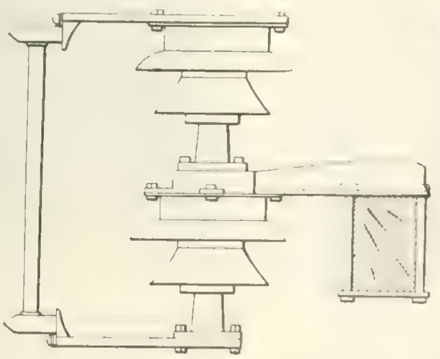
Switching on the World's Longest Line

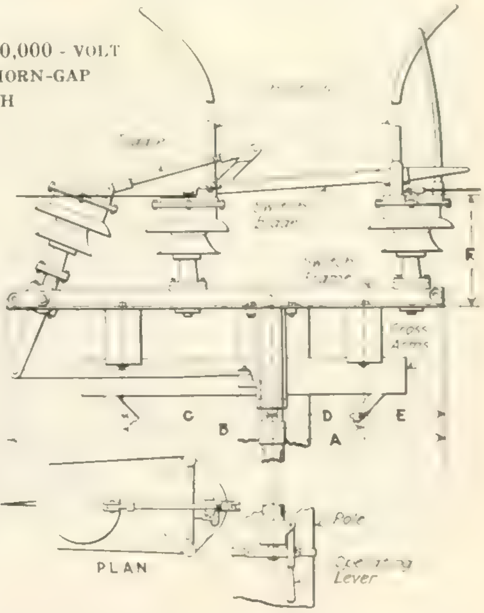
Method Employed by the Southern Sierras Power Company to Provide for 140,000-Volt Air-Break Switches on Each End of Its 348-Mile Transmission System

BISHOP CREEK STATION WHERE 140,000-VOLT SWITCHES ARE INSTALLED

In 1912, the Southern Sierras Power Company completed what was at that time the longest direct transmission system in the world, transmitting power from Bishop to San Bernardino, California, the length of transmission line being 238 miles (380 km.). The original voltage for operation was 60,000. The system was designed with the view to later raising the voltage to 140,000. Since that time the system has been extended from San Bernardino to the Mexican border, making an additional length of transmission of 110 miles (200 km.). In addition to this the main line was connected with what was the plant of the Pacific Power Company at that time, giving an additional length of 70 miles (112 km.). Thus the present distance of transmission from Bishop to the Mexican border is 348 miles (557 km.), the distance from Mono Lake to the Mexican border being 418 miles (669 km.), which is still the longest transmission in existence.

In July of this year the main transmission line, which has been operating at 60,000 volts, was raised to 90,000 volts, with the intention of later raising to 140,000 volts. As the sectionalizing switches along the line had been built for 60,000 volts, it was necessary, therefore, to replace them with switches designed for a higher voltage and rated at a higher capacity.



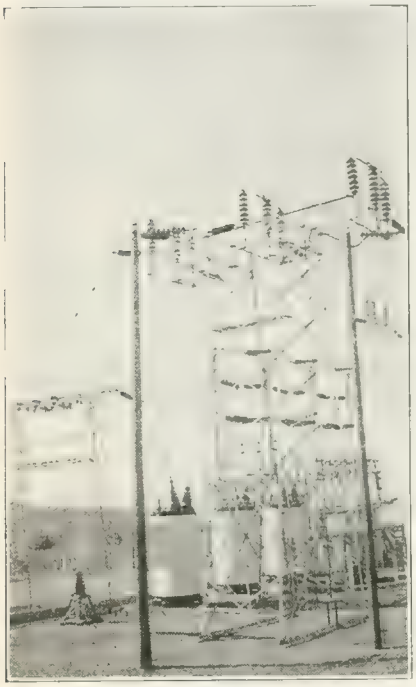


DETAILS OF 140,000-VOLT AIR-BREAK HORN-GAP SWITCH

At each end of the original transmission, namely, at the Bishop control station and San Bernardino, air-break switches were installed in the main line, two switches being employed at each location.

Switching at 140,000 volts is not such an ordinary practice that it is viewed without misgivings yet, nor is interrupting a 348-mile (557-km.) circuit the simplest problem in the world. Still the Southern Sierras Power Company has tackled this problem in connection with the main transmission line from Bishop Creek station to the Mexican border, putting in outdoor air-break switches at the generating station and at San Bernardino. While the present operating pressure is only 90,000 volts the lines and switching equipment are being modified to withstand 140,000 volts, with the intention of raising to that pressure later.

In determining upon the most suitable switches for this work, the experience gained in several years of operation brought forth certain fundamental points of design, which were by all means desirable in a horn-break switch. The spacing between phases, which originally was considered safe, was found to be inadequate, and as a result, the spacing has been materially increased. The reason for this was that with the closer spacing the arcs would blow across between phases and short the system. With the increased spacing this result is avoided. Increased spacing means, of course, an increased size of structure on which the switches are mounted. There are practical limitations to the increase of spacing, both in the cost of the supporting structure and in the available room, without changing the position of the lines.



HIGH-TENSION SWITCH TOWER

There are on the market different types of horn-break switches, which may be classified in general in two ways:

1. Those which break with a horizontal motion, the blade rotating about a vertical axis.
2. The switches which break in a vertical plane, the arc being drawn upward by the action of the blade.

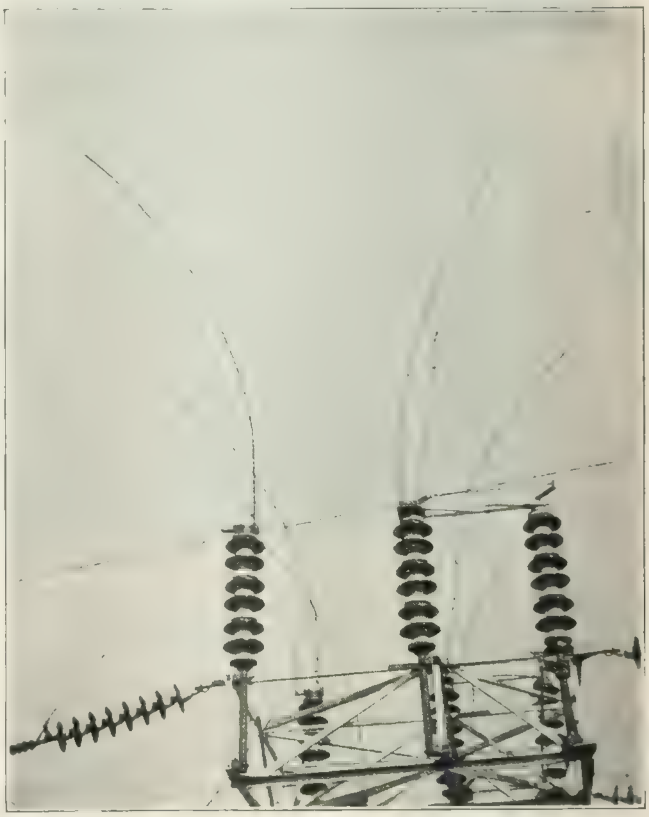
The switches which operate by rotation will of necessity call for relatively large spacing between phases, since the horizontal motion of the blade will draw the arc over in the direction of the adjacent phases. This is evidently a very undesirable result, not only on this account, but also because the arc starts at a point near the top of the insulators, where the wind is very liable to blow it either onto the insulators, with danger of cracking, or down to the framework. With a vertical break, on the other hand, the spacing between phases may be minimized. The arc is drawn upward by the contact on the end of the blade, and is, therefore, first established at a point a considerable distance above the top of the insulators, where it cannot touch the insulators or short on the framework.

The switches which have been adopted by the Southern Sierras Power Company for the intermediate stations on their transmission line are the largest air-break switches which have ever been built. The spacing between phases is 14 ft. (4.3 m.). The end horns in addition to flaring in the usual manner, flare across the line away from the center horn, thus providing an increased spacing where the arc grows longer, and giving an increased factor of safety. Eight of these switches are installed at the stations on the main transmission line and one switch at Plant No. 3, near Bishop. The switches are single vertical break, and each switch is mounted on a steel tower. The illustrations show the general nature of the construction. Each pole of the switch is supported on a single insulator, built up with six 14-in. (3.5-cm.) Ohio Brass disks. These insulators are of the sectional type, the various sections being interchangeable, so that in event of damage to any insulator it is necessary to replace only the damaged unit. As this work is accurately done in the factory, it is a very easy matter to make replacement should any be required.

Great care is used in the assembly of the insulators, the tops of insulators being coated with paraffine and gaskets being used throughout between pin and insulator and also between the cap and insulator. The latter are subsequently removed after the cement has hardened, in order to prevent any possible effect of endwise temperature strains cracking the shell of the insulator. The insulator pins and caps are made of malleable galvanized iron, accurately faced and drilled.

The sections of the insulator are bolted together by six ½-in. (1.3 cm.) bolts. An important feature in the design used is that the flanges are so located that they preserve the proper arcing distance to ground. In some types of constructon this point is not carefully covered, in fact in some cases fully 40 per cent of the air gap to ground is sacrificed in the improper location of the flanges.

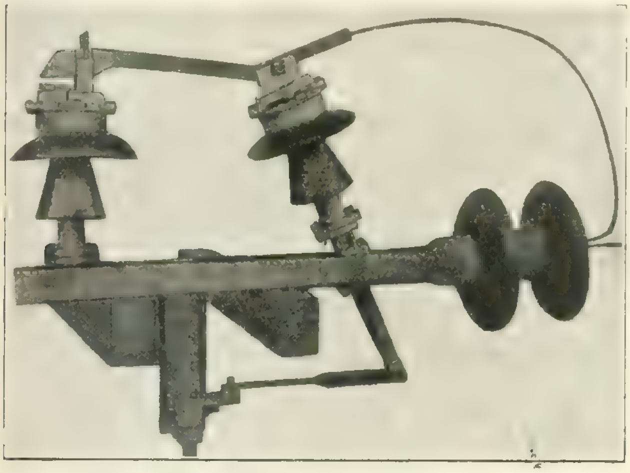
Owing to the necessary length of the insulators and the horns mounted thereon, it is essential that the whole structure, as well as the insulators themselves, be thoroughly rigid. This point is carefully covered in the design; at the same time the advisable factor of safety is in no case exceeded.



CLOSE-UP VIEW OF HIGH-TENSION SWITCH

One important advantage of the separable type unit is not only its interchangeability, but also the allowance for changes in plant should any be necessary in the future. For instance, if it is desired to increase the insulation, additional sections of insulator may be added, or if it is desired to build up new apparatus, the same insulators may be used therefor. Another important feature of the separable type of unit is that all operating parts of the switch may be mounted independent of the insulators or the parts which mount thereon.

In spite of the weight of the operating insulators, the mechanism is so arranged that the operation of the switches is exceptionally easy. The mechanism provides a double toggle action when the blade is entering or leaving the clip, and a single toggle action at the other end of the stroke. The main operating shaft turns through 180 deg. for the stroke. This connects at the upper end through a connecting rod, with a crank on the center insulator pin. The other insulator pins are operated through a longitudinal connecting rod. The hinge insulator pin carries an extended bearing, in which the upper end of the operating insulator rotates, thus making the main operating strain self-contained. On the upper end of the shaft extension of the operating insulators is mounted a crank, which operates the blades through a connecting link, this crank being nearly on dead center when the blade is in the clip. This, of course, greatly cuts down the torsional strains on the operating insulators, as well as the power to operate the switch. All connecting rods and links are adjustable in length, being provided with bronze ends.


HIGH-TENSION SWITCH CLOSED

The construction of the blades is interesting and novel. Owing to the length of the blades it is essential to cut down, as far as possible, the weight of the operating parts, to minimize the strains of operation and to prevent undue jar on the insulators. The blades are exceedingly light, and at the same time are strong and rigid. They are constructed with two special pressed steel channels, tapering in section in both directions toward the clip end. These channels are suitably braced at intermediate points, and two strips of ribbon copper are used as conductors. Current is taken at the hinge end through flexible cable into suitable lug, onto which the incoming aluminum cables are, in turn, clamped.

The clips are universal in action, each jaw consisting of a rigid face of cast brass mounted on a brass pin supported in turn on the spring, which is made of galvanized steel. When the switch is open the jaws come together, thus precluding the entrance of dirt. The usual type of clip employed leaves a small opening between the jaws when the blade is in open position, inviting a deposit of dirt on the contact surfaces with consequent heating and destruction of the clip, or in cold climates will allow the formation of ice between the clip faces, thus rendering the switch inoperative without suitable shelter hoods. With the jaws of the clip in contact when the blade is open this difficulty is entirely overcome. The accurate alignment is always available, whatever the position of the blades in the clips, owing to the universal joint. Flexible ribbon conducts the current from the clips to the base bar.

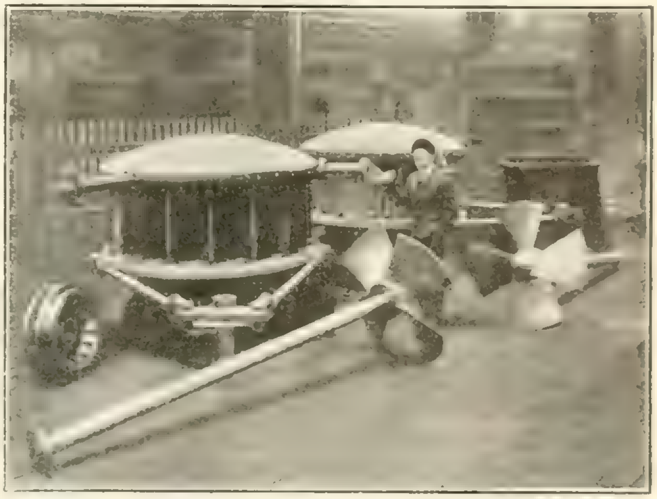
The horns are constructed of galvanized tubular steel, tapering in section from the lower end, thus providing a light and rigid construction without undue strain on the insulators. The magnetic material of the horns is expected to assist in extinguishing the arc.

The blades are equipped with follower contacts, with a flexible spring, which makes contact with a wiper finger against an auxiliary horn mounted on the clip cap.

A New Type of Hydraulic Turbine Runner

A NEW type of hydraulic turbine runner with the blades radially constructed for straight axial flow has been described by Forrest Nagler of the Allis-Chalmers Company. On account of its greater speed and lower cost, he predicts great usefulness for it in the field of low-head developments. The radial construction seen in the illustration is said to offer the absolute minimum of wetted surface and of bending moment on the roof of the blade.

The primary advantages are pointed out by the writer as follows: (a) Lower generator cost due to an increased speed of 50 per cent and over above previous practice. This saving varies from 15 to 35 per cent of the generator cost, depending on its size and speed. (b) Lower turbine cost due to simpler runner. This averages around 10 per cent, the runner being about one-third the weight of the corresponding mixed-flow type and much easier to build either solid or with separate blades. (c) Smaller generator diameter, which in turn means a smaller power house. (d) Higher generator efficiency, due to better design possible with the higher speed. This is seldom less than 2 per cent gain and may conservatively be stated to vary from 1½ to 3 per cent. (e) Greater turbine flexibility, which permits the plant to give more power under flood conditions when the head is greatly reduced. More complete information may be obtained by reference to the *Journal A. S. M. E.*, December, 1919.


HYDRAULIC RUNNER FOR STRAIGHT AXIAL FLOW

Analysis of Incandescent Lighting Costs for a Year

Unit Operating Costs and Fixed Charges for All Sizes of Vacuum and Gas-Filled Lamps for Economy Comparison

IN DETERMINING the total operating cost of any system of lighting three items must be considered:

First—Fixed charges, which include interest on the investment, depreciation of permanent parts and other expenses which are independent of the number of hours of use. Sometimes this item forms the greater part of the total operating expense, yet it is only too often omitted from cost tables.

Second—Maintenance charges, which include renewal of parts, repairs, cleaning, labor, and all costs, except the cost of energy, which depend upon the hours of burning.

ANALYSIS OF OPERATING COSTS—110-VOLT TO 125-VOLT INCANDESCENT LAMP UNITS*

Lamp and Reflector Data Upon Which Costs are Calculated	Vacuum Tungsten				Gas-Filled								
Size of Lamp, Rated Watts	25	40	50	60	75	100	150	200	300	400	500	750	1000
Cost of lamp, list*	$0.350	$0.350	$0.350	$0.400	$0.700	$1.100	$1.650	$2.200	$3.250	$4.300	$4.700	$6.500	$7.500
Cost of lamp, standard package discount	.315	.315	.315	.360	.630	.990	1.485	1.980	2.925	3.870	4.230	5.850	6.750
Average cost of reflector with socket, standard package discount	1.700	1.700	1.700	1.700	2.200	2.300	2.300	3.200	3.800	3.800	3.800	4.900	4.900
Cost of unit, standard package discount	2.015	2.015	2.015	2 060	2.830	3.290	3.785	5.180	6.725	7.670	8.030	10.750	11.650
Operating Costs													
Annual fixed charges:													
Interest on total investment, 6 per cent	$0.121	$0.121	$0.121	$0.124	$0.170	$0.197	$0.227	$0 311	$0.404	$0.460	$0.482	$0.645	$0.699
Depreciation on reflector, 12½ per cent	.213	.213	.213	.213	.275	.288	.288	.400	.475	.475	.475	.613	.613
Labor, monthly cleaning	.540	.540	.540	.540	.540	.540	.540	.810	.810	1.080	1.080	1.080	1.080
Total	$0.874	$0.874	$0.874	$0.877	$0.985	$1.025	$1.055	$1.521	$1.689	$2.015	$2.037	$2.338	$2.392
Maintenance, cost per 1,000 hours:													
Lamp renewals, standard package discount	$0.315	$0.315	$0.315	$0.360	$0.630	$0.990	$1 485	$1.980	$2.925	$3.870	$4.230	$5.850	$6.750
Lamp renewals, $150 contract discount	291	.291	.291	.332	.581	.913	1.370	1.826	2.698	3.569	3.901	5.395	6.225
Lamp renewals, $1,200 contract discount	2.56	256	.256	.292	.511	.803	1 205	1.606	2.373	3.139	3.431	4.745	5.475
Energy cost per 1,000 hours at 1 cent per kw.-hr.	$0.250	$0.400	$0.500	$0.600	$0.750	$1.000	$1.500	$2.000	$3.000	$4.000	$5.000	$7.500	$10.000

* The prices on lamps and reflectors upon which calculations of this table are based are subject to change without notice; they are used here solely for convenience in engineering calculations.

† Discounts range from 10 per cent. to 40 per cent, depending upon the quantity of lamps ordered.

Third—The cost of energy, which depends upon the hours of burning and the rate for electrical energy.

The life of a lighting system depends not only upon the wearing out of parts but also upon obsolescence. There are few installations in this country which have been in use for a period of seven or eight years which are not already obsolete. Although the lamps may be in good operating condition, economy demands that they be replaced by more efficient illuminants. The rate of depreciation on all permanent parts is equal to at least 12½ per cent. A table which would show the total operating expense of vacuum lamps for all sizes, with every discount from the list prices, for all possible periods of burning per year, and under all costs of power, would be so large that it would be impracticable to use it. From the table shown herewith, however, the operating expense of units under any set of conditions may be found with little calculation.

The total investment includes the cost of lamps, reflectors, holders and sockets. The investment in permanent parts is the total investment minus the price of lamps. No depreciation is charged against the lamps inasmuch as they are regularly renewed. The labor item under fixed charges provides for the cleaning of all units once each month. For the smaller units with steel reflectors the cost of cleaning is taken as $0.045 per unit for each cleaning. Data obtained from installations where accurate cost records are kept show that this figure is conservative for labor at $0.45 per hour. The cost of cleaning other reflectors is taken in proportion to the amount of labor required. Some illuminants require attendance at regular intervals. The cleaning is done at the same time and is, therefore, included under the maintenance charge. For units which require no regular attendance the cleaning expense becomes a separate charge. It will be noted that the fixed charges form only a small part of the total operating cost for an incandescent lighting system. The folly of using reflectors of poor quality which impair the efficiency of the units is evident.

The maintenance charge is given for a 1000-hour period of burning. To find the annual charge in any case it is necessary to multiply by the ratio of the total hours of burning to 1,000 hours. Where lamps are purchased at other than the prices given the proper correction should be applied. In an incandescent lamp system the renewal of lamps is practically the only maintenance expense.

The energy cost is given for a 1,000-hour period with energy at $0.01 per kilowatt-hour. The energy cost per year is found by multiplying by the cost per kilowatt-hour in cents and by the time of burning in thousands of hours.

An example will illustrate the use of the table. It is required to find the total operating expense per unit per year for lighting an erecting room in showing the procedure in illumination calculations. This room was lighted with 1,000-watt gas-filled lamps. The lamps are burned a total of 4,000 hours and are purchased at the discount obtained on a twelve-hundred-dollar contract. The cost of energy is $0.02 per kilowatt-hour.

From the table we obtain the following:

(1) Fixed charges	$2.39
(2) Maintenance, 4,000 × $5.475	21.90
(3) Energy, 4.000 × 2 × 10.00	80.00
Total	$104.29

The table was taken from Bulletin 20A by Ward Harrison and H. H. Magdsick, National Lamp Works, Cleveland, Ohio.

Problems in Electric Furnace Smelting—II*

Furnace Losses Are Greatly Decreased by Rearranging Transformer Leads—Irregularities in Operation Between Electrodes of Shaft Furnace Are Discussed and Remedies Pointed Out

By F. H. HOLMGREN

RADICAL reduction in losses and improvement in power factor of polyphase electric smelting furnaces of the shaft type were brought about by carrying transformer terminals to adjacent electrodes instead of to opposite electrodes. The tests were fully described in the ELECTRICAL WORLD for Jan. 24. The measurements give a clear picture of the electrical conditions up to the electrodes and show the best method in which to arrange the leads. Inside the furnace the resistance can be divided into a "working resistance" in which the principal energy is developed and a "conductor resistance" between the electrodes. It has been shown how the currents pass through this conductor resistance, but it has not as yet been possible to determine the relative magnitude of the two resistances, which undoubtedly has an intimate relation to the operation and the furnace temperature.

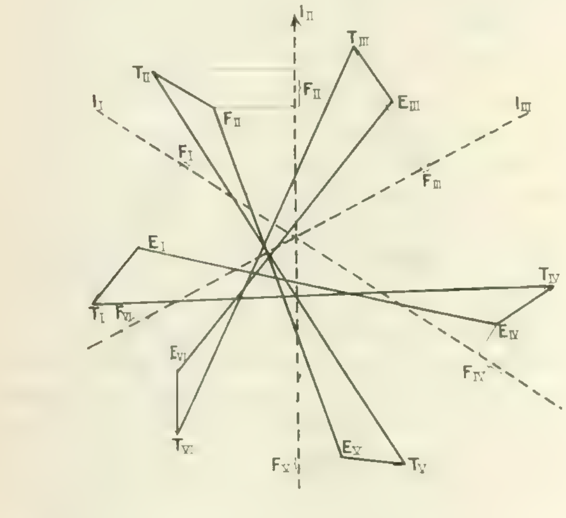


FIG. 8—DIAGRAM OF TEST OF FURNACE NO. 2 AT DOMNARFVET

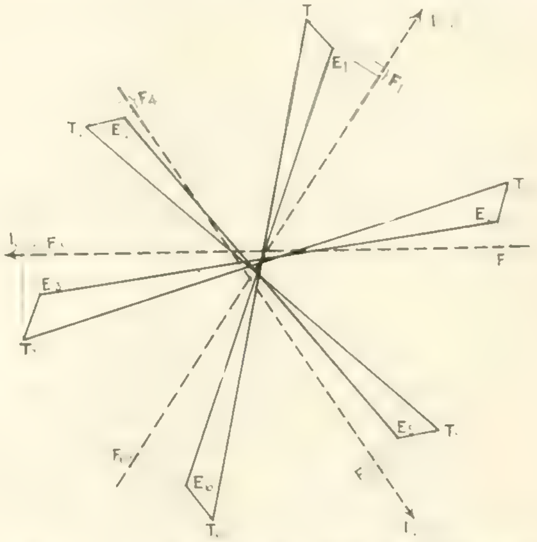


FIG. 9—VOLTAGE DIAGRAM FOR FURNACE WITH CORRECT ARRANGEMENT OF LEADS

It can safely be assumed that unequal heat supply also was the cause of the irregular operation which was noticed both in furnace No. 4 at Domnarfvet and in the Soderfors furnace before the connections were changed, while the performance of furnace No. 2 at Domnarfvet was decidedly better from the beginning. As seen from Fig. 8, the leads did not here cause the same disturbing effect on the instrument readings. Regardless of how the furnace leads are arranged, the instruments must always be connected as close to the electrodes as the heat radiation from the furnace will permit. With a perfect arrangement of the leads, this is of course not so important, as confirmed by Fig. 9, which represents a voltage diagram of the Soderfors furnace after the leads had been changed. This diagram should therefore be compared with diagrams Figs. 1 and 3, but above all with Fig. 6.

From the preceding there is good reason to believe that there exists a certain reciprocal action between the electrical and metallurgical phenomena inside the furnace which it is of utmost importance to understand.

Earlier investigators have already dealt with the equilibrium of electric furnace operation in that with a surplus of coal the operation will readily become "hot," meaning that the furnace temperature would be above normal, while with a surplus of ore it will become "cold," meaning that the furnace temperature would be below normal. The former condition is characterized by a tendency of the current to rise, that is, the resistance in the furnace drops and the temperature rises with reduced operation. Referring to the previously mentioned division of the resistance inside the furnace, we find in the first place that the "working resistance" drops, which undoubtedly depends on the reduced operation.

It may be possible that this takes place because in the active arc zone the reduced iron drops down into the bath below the electrodes and the carbon monoxide escapes by the easiest way along the electrodes up to the stack, whereby the section nearest these will be exposed to an unusually severe heat.

The gas blast will cool the mass and the arch between the electrodes, whereby at least the upper part of the mass between the electrodes will have a relatively low temperature and a correspondingly higher resistance.

If now there is a reduction in the operation on account of a surplus of carbon, then the real smelting zone, which therefore practically contains iron drops and rising carbon monoxide, will be thinner and thinner and the working resistance will drop. The surrounding zone, which practically consists of conducting carbon, will be forced more and more toward the electrode, until it finally sticks to it and the "working resistance" ceases more or less to exist. The resistance between the electrode and the mass is thus exceedingly small and the current rises considerably. As the reaction $FeO + C = Fe + CO$ is strongly endothermic, and as any cold charge is prevented from descending into the bath, the reduced operation will always mean an increased heat supply to the mass surrounding the electrode, which also in turn lowers the resistance in the mass between the electrodes. If there is in the charge when it enters the hearth a certain surplus of carbon in proportion to the available oxygen for formation of CO, then there is, of course, no possibility for this to oxidize, as, contrary to the case with ordinary blast furnaces, the mass is not passed through by any gas with an oxygen surplus. An accumulation of carbon will then take place which will more and more prevent the charge from descending, and a reduced operation will result. Such carbon accumulations are especially apt to take place when coke is used on account of its compact nature and its tendency to graphitize.

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*Abstracted and translated from the transactions of the Swedish Iron Institute by E. A. Lof.

The "cold" operation, on the other hand, is characterized by the fact that with a rich, easy reducible ore there will be a too large arc zone around the electrode with accompanying high "working resistance." On account of the increased operating condition, the surrounding mass will not be sufficiently supplied with heat, but will solidify. The arcs between the electrode and the mass will finally go out and the operation will stop.

Unbalanced Operation Between Electrodes

As has been pointed out above, the heat supply has often proved to be very irregular at the different electrodes. On the other hand, it seems to be true that the arc zone, which is desirable for a successful and regular operation of the furnace, has a certain relation to the operating conditions of the electrode in question. As soon as the charge around the electrode reaches an unsuitable composition (surplus of coal or ore) it has been found that the operating conditions become bad, owing either to electrical heat supply with accompanying disturbance of the electrical phenomena (during "hot" operation) or because the electrical phenomena have been disturbed with an accompanying checking of the electrical heat supply (during "cold" operation). In the former case an increased ore supply is resorted to and in the latter a reduced supply.

That the heat in electric furnaces is very unevenly distributed cannot be disputed, and that an uneven energy supply through the electrodes will still further increase this condition is self-evident. The result of this has also often showed itself during tappings in that the iron then often shows a changing temperature. It even sometimes happens that at tappings iron and slag will be poured in alternating successions.

It shows therefore that there has been an irregular metallurgical condition at the different electrodes, depending partly on the uneven energy supply and partly on a different composition of the charge at the different electrodes. At one electrode the furnace may thus show typically "hot" operation with a low effect, while the operation at the other electrodes may be entirely normal. The uneven successive tapping of iron and slag can naturally also be due to the fact that under each electrode there has been formed an individual iron bath with accompanying slag cover, which confirms the unequal heat distribution within the furnace.

Electrodes Should Be Controlled Individually

It seems therefore as if the crucible of an electric furnace can be considered as consisting of a number of furnaces equal to the number of electrodes. When the operation of an electrode tends to get "hot" it should therefore be possible to prevent this by cutting off the current from this electrode for such a length of time that the surplus of carbon may be removed in some manner. As an increased ore supply through the stack affects all the electrodes, it would seem that in order to obtain a steady operation of the furnace the electrodes should be controlled individually. With "hot" operation ore should therefore be supplied through special holes in the dome to the respective electrodes if such holes will not unduly weaken the furnace construction.

The uneven distribution of coal and ore in the charge, which is liable to cause a "hot" operation, should therefore be avoided by a careful mixing before the charging. If ore and coal are supplied to the furnace in the ordinary way in the form of alternate layers, it is possible that the profile of the stack may influence the charge at the electrodes. If we follow the layers down through the stack, we find that the sinking will be more rapid in the center of the stack on account of the friction against the walls (Fig. 10) It is therefore possible that the occasional surplus of coal is due to the fact that a layer of coal, or a part thereof, during its progress through the bosh will take up a position parallel to the electrodes and finally surround the same in the form of a mantle and thus prevent the operation with a resulting overheating.

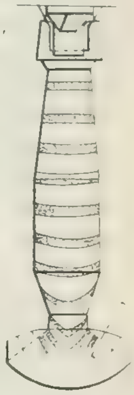

FIG. 10—PROGRESS OF CHARGE THROUGH FURNACE

Another kind of "hot" run is also possible, namely when the electrode is unable to burn itself free and form an arc, regardless of the fact that the charge does not contain any local or general surplus of carbon. This may depend on the special nature of the electric furnace process, in that the furnace can only be supplied with a sufficient quantity of electrical energy required by the process on the supposition that this is produced in arcs. By simply conducting the circuit through the charge it is not possible to produce the required energy and heat for the furnace, on account of the limited low value of the resistances. Why a reaction corresponding to this energy does not take place in the mass so heated, and thus cause reduced operation, is difficult to explain. Instead we obtain a surplus of heat in the furnace. It may possibly be caused by the fact that the smelting process ceases and that therefore the reduced material is not removed as rapidly as necessary.

Causes of Operation With "Frozen" Electrodes

This corresponds to what was found with the Helfenstein furnace. A low electrode voltage could not be used on account of the inside resistance of the furnace. The operating capacity was very small and the operation very "hot," the heat rising further and further in the bosh and stack. As soon as a higher voltage could occasionally be noticed at any of the electrodes an increased capacity was also observed. The electrode had then very likely burned itself free, while the Helfenstein furnace thus "normally" ran with frozen electrodes. The reason for this might have been that the contact surface between the electrode and the mass, due to the furnace construction, was too great, so that the energy required for burning the electrode free was greater than could be produced with the arrangements of the leads, etc.

"Hot" operation due to the same cause was also noticed in the Soderfors furnace before its reconstruction. The great distance to the bottom of the furnace made it often necessary, especially with hangings, to push the electrode far down in order to get any current to pass. When then the charge fell the reaction surface became too great and the electrode was unable to burn itself free. On account of the great free length of the electrodes within the crucible and their slope with respect to the "falling-down" angle of the mass, they were often broken. The remaining stump was then quickly pushed down to prevent burning of the roof, and contact with the broken-off part was established, with the result that the reaction surface became still greater and a burning-free was impossible. Since the height of the crucible has been considerably reduced, any "hot" runs from this cause have not been observed.

REDUCING LOSSES BY REBUILDING THE CRUCIBLE

As a result of the rebuilding of the crucible it may be noted that with a suitable electrode surface in the mass the current became relatively low, which, of course, was of greatest importance as far as the secondary transformer windings and the low-tension leads were concerned. It was furthermore possible to keep the voltage high without unduly overheating and damage to the furnace lining. The low current had an especially favorable effect on the losses in the conductors, as these were reduced to only about 180 kw. from 282.5. The inside resistance of the furnace was increased from 1,250 microhns per electrode to not less than 2,700 microhns, and it is, of course, desirable to keep this resistance as high as possible. The upper limitation is the risk of "cold" operation with a rich charge and irregular operation on the whole, this being due to the tendency of the arcs to go out and also to the silica reduction.

From the above it is apparent that it is very important to use electrical measuring instruments for obtaining a knowledge of the metallurgical progress inside the furnace. The operation is closely related to the load for the same charge, and it is necessary to gain a knowledge of the resistance which is obtained in the furnace for different compositions of the charge in order to determine on the best operating method therefor. With a charge rich in ore, and thus with low resistance, for example, it is not permissible to wait with the lowering of the electrode until the same voltage is reached as is reached with a poorer charge and a relatively high resistance.

CONSIDERATIONS IN PLANNING NEW ELECTRIC FURNACES

Frequency.—Some of the furnaces with the original arrangement of the connections—that is, with the transformers connected to opposite electrodes—operate with 25-cycle power and a good power factor. There are also several furnaces with the new arrangement of connecting the transformer to adjacent electrodes in operation on 50-cycle power, with good power-factor results and low losses in the conductors. If the leads, therefore, are correctly arranged, it may be stated that electric furnaces can be satisfactorily operated with any of the standard frequencies now in use.

Electrodes.—There are two ways in which the capacity and thus the production of a furnace may be increased. One is by increasing the electrode diameter with the number of electrodes remaining the same, and the other is by increasing the number of electrodes, keeping the diameter the same. Both these arrangements necessitate an increase of the current supply. An increase of the voltage is, however, not permissible on account of the irregular operations which would result therefrom and the effect which the voltage has on the furnace process in reducing the silica. Of the two first named arrangements, an increase in the size of the electrode will surely result in an increased operation on account of the larger smelting zone which is thus obtained; but the difficulties with the current supply will also grow in that the "useful" area of the electrodes, due to the skin effect, will not increase in the same proportion to the actual area. Besides this, there will be increased difficulties in connection with the leads for carrying the large currents. It seems therefore as if more can be gained by the second alternative; that is, by increasing the number of the electrodes. At present there are furnaces in operation with four, six and eight electrodes, and from the electrical point of view there is no reason why the number cannot be increased to nine. The "neutral" column of the charge is, however, likely to be larger and larger, and it may be questioned whether it would not be advisable from an operating standpoint to raise the bottom of the crucible in the center when the diameter has reached a certain dimension, provided that this would not cause an increased pressure of the charge against the electrodes.

Electrode Terminals.—This is generally one of the weak points in electric furnace installations, and every effort should be made to improve the same. A good contact is essential, as about 30 to 40 per cent of the losses from the transformers to the electrodes are to be found here. Arrangements should also be made to facilitate a quick change of electrodes and an easy raising or lowering.

Leads.—As has already been explained, the tests and investigations have shown conclusively that the leads must be arranged in a manner which will reduce the resultant electromagnetic fields to a minimum. Conductors which carry the same current but in opposite direction should be placed together as closely as possible. This led to the suggestion of connecting adjacent electrodes to the same transformer phase, whereby a much better power factor is obtained and also shorter connections and lower losses therein. The form of the conductors is also of great importance with alternating currents when large currents have to be handled, on account of the influence which the electromagnetic field around the conductor has on the current distribution within the conductor, reducing the useful area. It has also been proved that with uncompensated conductors very little is gained regarding the current distribution therein, whether these consist of multiple or solid bars. Better radiation is, of course, obtained, and therefore a lower direct-current resistance; but the current within the conductors will nevertheless be distributed as if the conductor had been solid. Where the conductor run is uncompensated—that is, where it is impossible to interleave + and — bars—it is advisable to arrange the conductor in the form of a pipe [O], two half pipes [( )] or even as four bars arranged to form a square [□]. At 50 cycles it will be possible in this manner to bring down the losses to less than one-half of that with parallel bars. In other words, only one-half the amount of copper need be used in these portions of the leads.

As far as the compensated part of the leads is concerned, much has been done to reduce the surrounding electromagnetic fields by interleaving the + and — bars. For the same area the resistance will also be lower if the thickness of the two outside bars is only made one-half of the inside ones. Where the individual bars are of different lengths the longest ones should be placed outside so as to obtain as low a field as possible around the same. Each bar should preferably be connected to an individual transformer winding, and in such a case the forward and the return conductors should be bunched and interleaved. They should also be arranged so that the voltage drop in the conductors to the individual transformer windings will be as nearly alike as possible, in order to assure an equal distribution of the load among the different windings. When pipes are used for the leads the amount of copper can be reduced by water cooling. The losses will, however, be higher. Such water-cooled pipe conductors are often used in the leads nearest the electrodes where the heat from the furnace is excessive.

Electrical Arrangement.—From what has been said in the above it is evident that the shorter the leads the better will the operation be from the electrical point of view. This was fully demonstrated in furnace No. 2 at Domnarfvet, where the transformers were placed immediately adjacent to the furnace and where the operation was the best from the beginning. From the general operating standpoint, however, this arrangement has many disadvantages, in that it takes away much of the space nearest the furnace which is essential for the operation otherwise. Besides this, the transformers are directly exposed to the heat from the furnace. This arrangement has therefore not been followed in the later installations, where the transformers have been placed in a common room separated from the rest of the installation. This transformer room has in different installations been installed at different elevations with respect to the control platform, but the leads have generally been carried along the ceiling above this platform and from there down to the electrodes. It would seem advisable, however, to install the transformers at such a height that their terminals would be at the same elevation as the electrode terminals. In other words, the leads should, if possible, be installed in a single horizontal plane.

Furnace Operation from the Electrical Point of View.—In the preceding paragraphs it has often been pointed out that in the electric furnace process the metallurgical and electrical phenomena have an intimate relation to one another, and from this it follows that the operation must be conducted with this in view.

The problem is to produce the greatest quantity which the limitations of the installation will permit, and this with due consideration of the quality of the product. When such a furnace can produce up to 10,000 tons of pig iron per year, and possibly more, the importance of keeping the operation uniform and as near maximum as possible is obvious. All interruptions, etc., should be localized to include as small a part of the installation as possible.

On account of the connection to the transformers, there has so far always been a mutual electrical relation between two electrodes. But, inasmuch as the operation has been found to be somewhat independent at the different electrodes, the question arises whether it would not be advisable to make an arrangement whereby each electrode could really be independent of the other. This could most easily be done by means of a bottom electrode connected to the transformer neutral. Whether this would meet with any practical difficulties, however, must first be investigated. Another advantage of this would be that in case of repairs or when changing electrodes only one electrode need be disconnected. With a surplus of coal at one electrode the current could temporarily be shut off from this electrode to prevent "hot" operation. A closer and more frequent regulation of the electrodes would then also be possible, thus permitting the highest voltage to be maintained more uniformly.

The electrical instruments serve as a good guide to the operator, provided that they are connected so that the leads to the furnace have no disturbing influence. Individual measurements at the different electrodes are preferable, and, for this reason, the instruments should be connected either to the bottom electrode, if there is such a one, or otherwise to some suitable conducting point in the bottom of the furnace. Besides a voltmeter which it should be possible to connect between the neutral and the respective electrodes, there should always be a wattmeter for each pair of electrodes, the potential coil of which can be interchanged to different electrodes. By thus carefully following the electrical progress at each electrode, especially as regards the size of the "working resistance," it would at least be possible to discover in time when there is a tendency for "hot" or "cold" operation and thus to take the necessary precautions against it. A knowledge of the load on each individual electrode should also give an indication of the limitations as far as the furnace lining is concerned, and it would be highly desirable to have pyrometers installed in the roof near the electrodes if this could be done from a practical point of view. It would then be easy to determine when the electrode should be lowered.

CONCLUSION

1. The low-voltage leads are of utmost importance as far as the losses and power factor are concerned, and their arrangement should be carefully planned in new installations.
2. The electrical measuring instruments should be arranged so that they will really indicate the electrical conditions at the electrodes.
3. There is an intimate connection between the electrical and metallurgical phenomena at the different electrodes, and an individual control of the electrodes is desirable. It seems that the electrical measurements should be a good guide in determining the metallurgical progress, and for this reason we should endeavor to obtain a deeper knowledge of the relation between the electrical measurements and the metallurgical phenomena. An intimate collaboration between the metallurgist and the electrical engineer is essential in this study, as it is in the study of the physical character of the arc zone.

Checking Differential Relay Installations

Method of Avoiding Incorrect Connections, a Current Transformer with Improper Ratio, or Relay with Wrong Number of Turns, Etc., That May Cause Tripping Flux in Relay Under Normal Conditions

By RAYMOND BAILEY
Philadelphia Electric Company

MUCH time and thought is usually devoted to the selection of the relays by large power generating and transmitting systems for the purpose of automatically disconnecting defective equipment, but the most careful selection is without avail unless tests are made to insure that the relays will function as desired. A very small error in the installation may cause the relays to disconnect the part of the system to which they are connected in time of trouble on some other part of the system, thereby defeating the very purpose for which the relays are installed.

A method for checking double-winding* differential relay installations, extensively used for the protection of power transformer banks, is outlined in the following paragraphs. Figs. 1 and 2 show the connections of this type of relay applied to three-phase/three-phase and three-phase/two-phase transformations respectively.

An incorrect connection, a current transformer of improper ratio, or a relay with the wrong number of turns, etc., may produce a resultant flux in the relay core when the transformer bank is carrying normal load current. Even though this resultant flux is not great enough to operate the relay under normal load conditions, it may cause the relay to function in case of a short circuit somewhere on the system supplied by the transformer bank, which would, of course, be very undesirable.

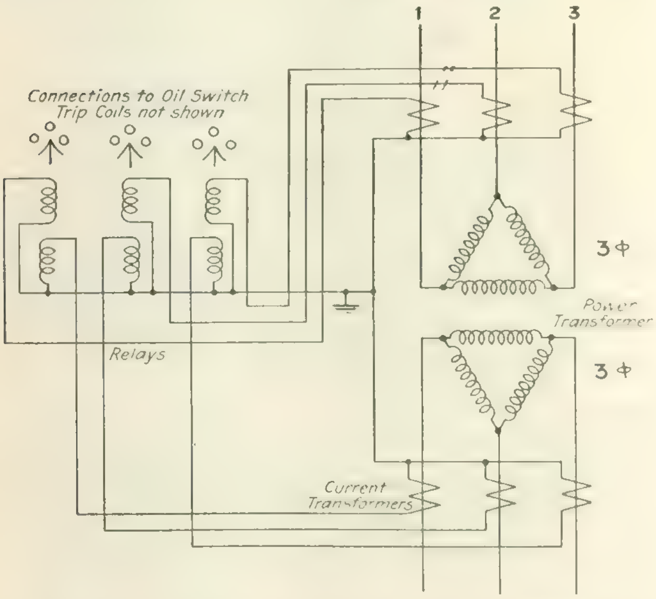

FIG. 1—CONNECTIONS OF DOUBLE-WINDING DIFFERENTIAL RELAYS TO A DELTA-DELTA POWER TRANSFORMER BANK

The test outlined in this article requires the use of a special test core, which is substituted for the relay core during the test, and a low-reading voltmeter. The test core is in reality the secondary of a transformer, the primary of which consists of the two relay coils differentially connected, and is used to determine the magnitude of the resultant flux. It is not intended to include in this article the design data for the test core in view of the fact that it would apply only to the type of relay for which it was built. Fig. 3 will, however, give the reader a general idea of the construction of the core, which has about seven hundred turns of No. 31 magnet wire on it.

The best results will be obtained from tests with this core if it is kept in mind when designing the core and making the tests that all resultant flux should link with the turns on it.

Before checking any relay installation a number of readings should be taken in the laboratory with the core and a relay for comparative purposes.

The current in either relay winding which will cause the relay to operate should first be determined. The relay core should be removed (this can usually be done by removing the thumb nuts on the lower end of the calibration tube) and the test core inserted in its place. Volts generated in the test-core winding by different currents (in one winding of the relay) up to and including the operating current should be read. The voltmeter used for this work should read as low as 0.5 volt and should require a very small current as the test core has a limited capacity.

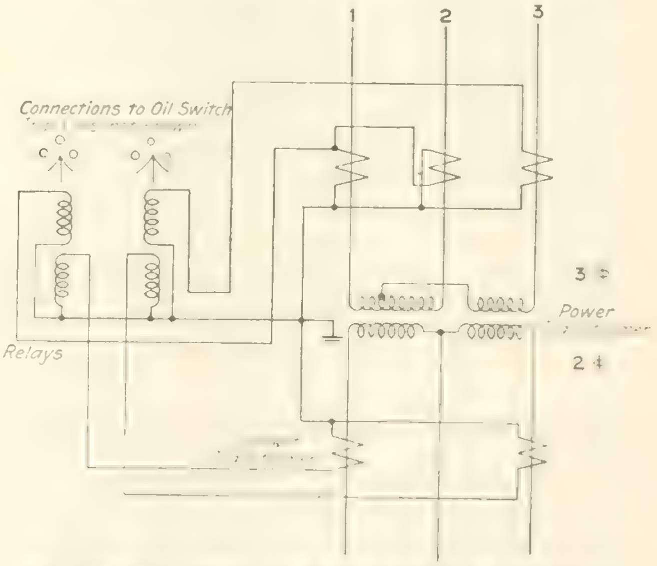

FIG. 2—CONNECTIONS OF DOUBLE-WINDING DIFFERENTIAL RELAYS TO A T-CONNECTED POWER TRANSFORMER BANK

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*The ratios of turns of the relays and the current transformers are so arranged that the normal load current in the power transformer bank will produce no resultant flux in the relay cores. The failure of a power transformer winding will change the ratio between the currents in the secondary circuits of the current transformers on both sides of the transformer bank, causing the relay to function and disconnect the bank.

A relay installation is checked by reading the volts generated in the test-core winding when it is substituted for the different relay cores while the power transformer bank is carrying at least half rated load. These readings should be compared with the laboratory readings to determine whether or not an excessive resultant flux exists. When making this comparison the number of turns of the laboratory relay and the current in it must be compared with the turns and current in the relay under test.

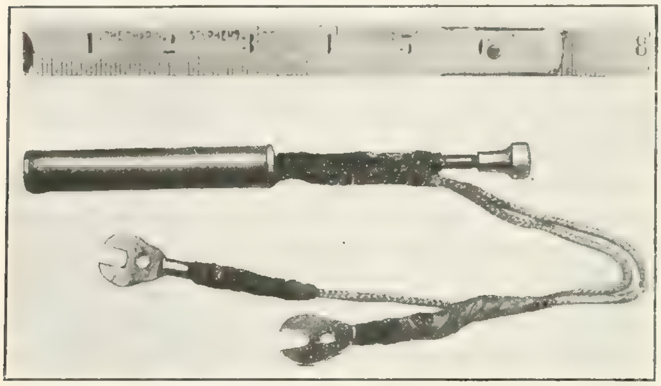


FIG. 3—TEST CORE USED FOR CHECKING DOUBLE-WINDING DIFFERENTIAL RELAY INSTALLATIONS

A zero voltage reading is hardly to be expected owing to the fact that there are a number of conditions which will produce a small resultant flux in the relay. Should a zero reading be obtained, a momentary deflection of the voltmeter pointer should be obtained by short-circuiting a relay coil to prove that the coils are carrying current.

If a comparatively large voltage reading is obtained, the entire relay installation should be gone over until the trouble is located. Whether or not the voltage readings represent a resultant flux large enough to cause trouble may be determined by comparison with the laboratory data, at the same time considering the magnitude of the current existing if the transformer bank were feeding a short circuit.

The test outlined above has, since its adoption by the Philadelphia Electric Company, been used to locate errors in relay installations which would have without a doubt caused them to function incorrectly.

Checking High-Range Meggers With Low Resistances

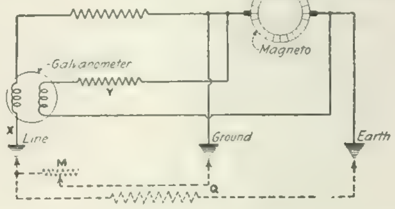
By Means of Shunting Resistances All Points of the Scale May Be Checked with Relatively Low And Inexpensive Resistance Units

By Richard E. Brown
Electrical Engineering Department, University of Pennsylvania

In order to check meggers which have ranges anywhere from 10 to 2,000 megohms, it would appear that a large number of standard resistances of unusually high values were required. Standard resistances in the order of 2,000 megohms are unusual and if made of wire would require several thousand miles of the smallest size. The method outlined in this article makes it possible to imitate the effects of these unusually high resistances by using standards of relatively low resistance.

The main parts of a megger are a high-voltage magneto and a differential galvanometer. The parts are arranged and connected as shown in the diagram. The terminals marked *line*, *guard* and *earth* are used in making connections for taking measurements and also in checking the instrument.

The method for checking the various points on the scale is as follows: The resistance of the circuit X of the galvanometer is determined by a Wheatstone bridge. To make this measurement the bridge is connected across the terminals marked *line* and *guard*. A standard resistance Q having a fairly large value, is connected across the terminals marked *line* and *earth* and a variable resistance, M, is connected across the terminals marked *line* and *ground*. Inspection of the diagram will show that circuit M is in parallel with circuit X. A definite fraction of the current flowing through Q is, therefore, shunted around the galvanometer. It is evident that by varying M the deflection of the instrument can be made anything desired. If the resistance Q is kept constant and M made equal to X, one-half of the current through Q flows through the galvanometer, and the indication of the instrument should be $2Q$. If M is made equal to one-nineteenth of X, the instrument indication should be $20Q$. By making M smaller and smaller it is possible to produce the equivalent effect of very high resistances and to check the high points on the scale as readily as the lower ones.



METHOD OF CONNECTING MEGGER FOR TEST

A little reflection will show that the method is correct. Suppose the point on the scale corresponding to $20Q$ ohms were checked directly by connecting a standard of $20Q$ ohms between the terminals marked *line* and *earth*. The expression for the currents through the galvanometer circuits would be

$$I_x = V/(x + 20Q),$$

and

$$I_y = V/Y.$$

If this point were checked by the method suggested, the galvanometer currents would be

$$I_x' = I_y' \quad I_m' = \frac{V'}{(x \cdot 20 + Q)} = 19\, I_x',$$

$$I_x' = V'\ (X + 20Q),$$

and

$$I_y' = V'/Y.$$

V and V' represent the terminal voltages of the magneto. These voltages, on account of different armature drops, are unequal and the currents I_x' and I_y' are less than the currents I_x and I_y respectively. Inspection of the formulas will show, however, that

$$I_x'/I_y' = I_x/I_y;$$

that is, the relative values of the currents are equal. The indication of a megger depends on the relative strengths of the currents in circuits x and y and is consequently the same for the direct method and the method suggested.

Tendencies in Rate Regulation

Disposition Is Seen to Concede on the Part of the Public That Revenues Must Be Adjusted as Fixed Costs and Operating Expenses Vary to Maintain a Fair Return on Capital

By L. R. NASH
Stone & Webster, Boston

THE regulation of public utility rates, like many other human activities, has been affected profoundly by the world war. Operating costs and fixed charges increased so rapidly that the commissions for the most part realized that long-drawn-out investigations were out of the question, if, in fact, they were needed at all in connection with the expansion of facilities and service so essential to victory. The public also was disposed to accept rate readjustments in the lighting and power field forced upon the companies by rising expenses, and it is noteworthy that so few expressions of hostility to coal clauses, war surcharges, new rate bases and the like came to the front. In the electric railway field the psychological aspect of a daily contact with increased rates has delayed popular accommodation to higher fares, but a gradual acceptance of their necessity is evident throughout the country.

It would be an error to assume that rate increases responsive to cost levels beyond the control of the utilities were ever welcomed by the consuming public, but the readiness with which such increases have been received in numerous cases the country over shows that some conception of what the utilities are struggling to overcome has lodged in the understanding of the man in the street.

It is as important for the investor to obtain a fair wage for the use of his capital as it is for the laboring man to receive an adequate reward for his services. The fall in the purchasing power of money means that to-day the investor must have nearly twice as many dollars capital wage as in the pre-war period, corresponding to increased remuneration for labor and to increased cost of materials and supplies. The larger net return due the investor can, I believe, be obtained more easily by increasing the valuation or rate base than by augmenting the percentage upon investment yielded by public utility operations. A significant acknowledgment of the necessity of recognizing that the rate base must be figured upon a new price foundation appears in a recent decision of the United States Supreme Court in Lincoln (Neb.) Gas & Electric Light Company vs. City of Lincoln et al. (250 U. S. 256).

Here the court notices judicially "that, primarily owing to the war, costs of labor and supplies have advanced greatly since the ordinance [relative to gas rates] was adopted, and largely since the case was last heard in the court below, and that annual returns upon capital and enterprise the world over have materially increased, so that what would have been a proper return for capital in gas plants and other public utilities a few years ago furnishes no safe criterion for the present or the future."

To-day it is easier to obtain recognition of 8 per cent as a minimum reasonable return than of 6 per cent in former times. In the Lincoln case above cited the court declined to declare a 6 per cent return prima facie evidence of non-confiscatory rates, pointing out that 8 per cent was the lowest rate generally sought and obtained upon capital invested in banking, merchandising and other business in the vicinity. Of course, there is room for a much wider appreciation of the need of a larger yield upon capital than in the past, and decisions of the foregoing tenor are both encouraging and helpful.

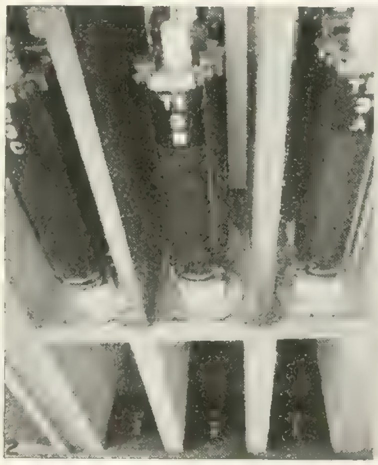
A tendency can be seen now toward giving greater consideration to intangibles in establishing the rate base. The commissions are not inclined to set value upon franchises apart from actual legitimate money outlays incurred in connection with their granting, such as legal expenses, cost of special elections, clerical work and the like; but development costs, expressed as deficits below a fair return upon the rate base in the early years of operation, are being recognized more appreciatively by the commissions. The study of depreciation is being continued, and better methods of handling the retirement of plant through the setting aside of a proper reserve out of earnings are in evidence. There is need of compiling accurate engineering data upon the life of equipment which at least will serve as a guide in the practical treatment of this subject. The war service of many plants has brought the subject of equipment life to the front and a wider public realization of the influence of depreciation as a factor in service maintenance is bound to come in time.

By and large, there can be seen a disposition to concede that revenues must be adjusted, as fixed costs and operating expenses vary, to maintain a fair capital wage. The policy of permitting utilities to initiate and establish new schedules of rates, subject to future revision if the regulatory body so determines, if more widely applied, will help to reduce the burdens carried by the utilities and release funds for service improvement.

One of the best things that could happen to the utility industry has transpired in this growing recognition, even if slow to function, on the part of the public and the commissions that in a time of changing values, rigid rate bases and fixed returns must give way to a flexible readjustment which will insure the public at a reasonable price the service which it demands and will need in future and insure the employee and the investor alike a fair wage for their co-operative contribution to the wants of the consumer.

THE *Edison spirit, which has been one of the most valuable adjuncts of the company in its wonderful growth, is based on the good old Golden Rule of doing unto others as you would have them do unto you and thereby being kindly, courteous and helpful to the other people connected with the company.*—W. L. PERCEY, of *the Southern California Edison Company.*

Features of the New Substation at Flushing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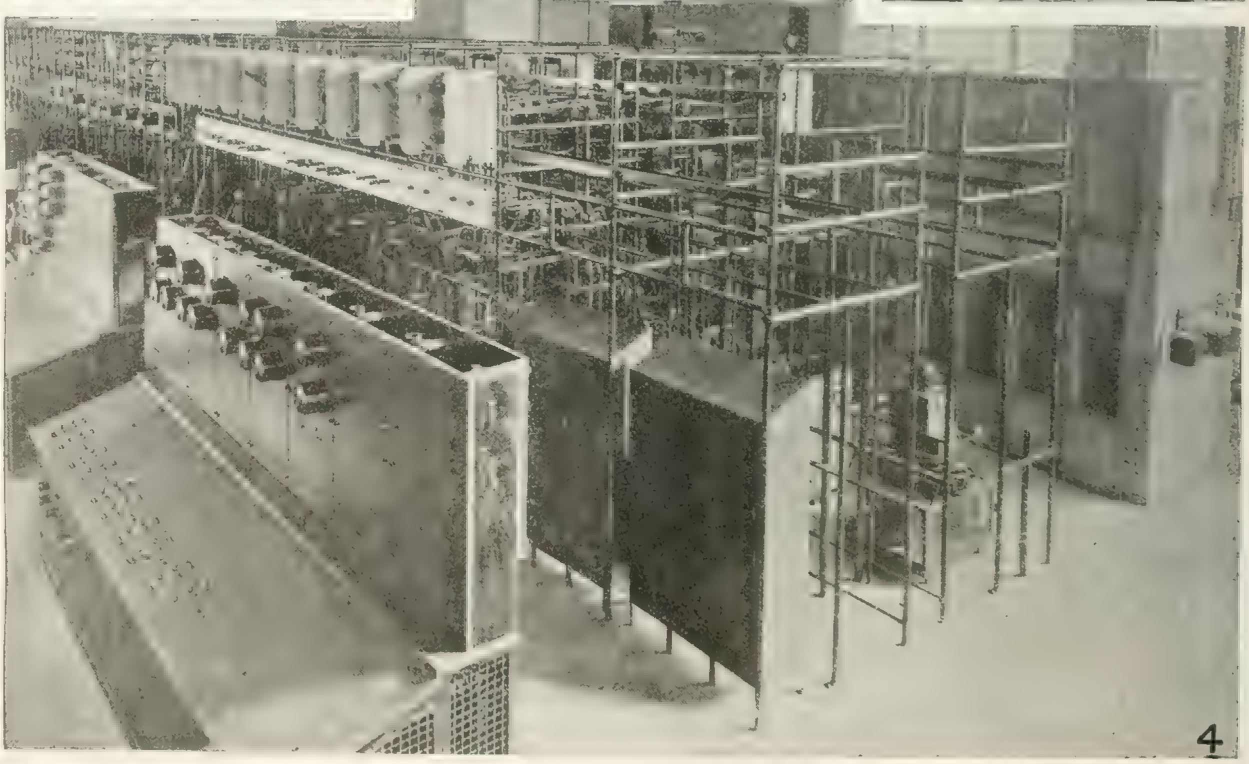
TYPICAL VIEWS OF FLUSHING SUBSTATION

No. 1—Large doors (below) to transformer compartments.

Nos. 2 and 3—Oil switch and disconnecting switch compartments showing lettering scheme.

No. 4—General view of switchboards and bus structure.

3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Features of New Substation at Flushing

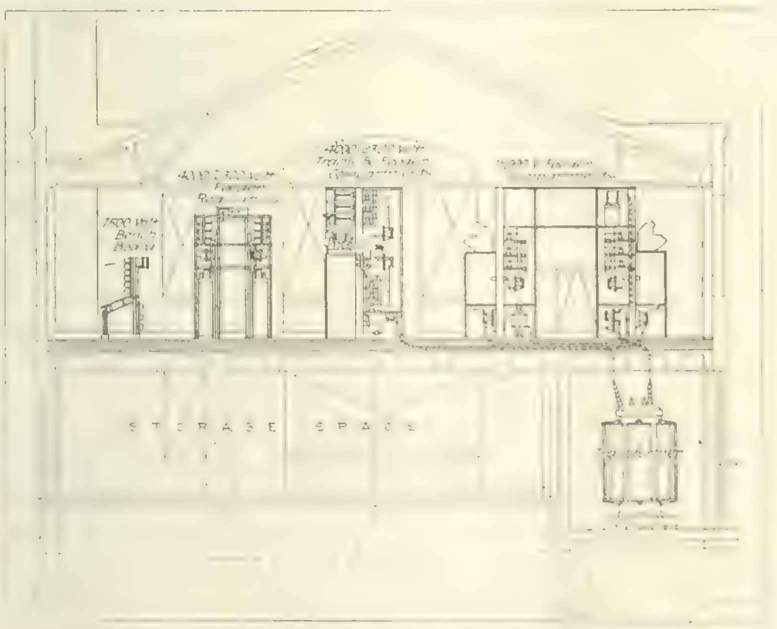
Serves a Scattered Load with Three-Phase, Four-Wire System and Street Lighting—Main Transformers Have Two Separate Secondary Windings or Buses at Different Voltages

By W. C. BLACKWOOD

Electrical Engineer New York & Queens Electric Light & Power Company

THE load in the territory supplied by the Flushing substation of the New York & Queens Electric Light & Power Company increased to such an extent in the last few years that the capacity of the station building and site was overtaxed and it was necessary to provide a new station which has just been placed in service. This substation building was designed to serve as headquarters for underground and overhead construction groups in the vicinity, and every facility has been provided for handling the necessary material as well as the substation equipment. Features of bus and building construction as well as the flexibility of electrical connection schemes are here described in some detail.

The increase in load was due not only to war business, but to a steady and rapid growth of industrial load, particularly in the College Point section. The old substation was erected in 1900 and served an area of approximately 45 sq. miles (115 sq.km.), including the towns of Flushing, College Point, Whitestone, Bayside, Douglaston, Little Neck, Corona and Elmhurst—all in the city of New York. The new substation is built on a piece of property 225 ft. x 325 ft. (68 m. x 99 m.) opposite the old station and extending through from Lawrence St. to Collins Pl. The building is a two-story combination storeroom and substation 94 ft. x 122 ft. (29 m. x 37 m.) There is a difference in elevation of 19 ft. (5.8 m.) between Lawrence St. and Collins Pl. and for this reason the substation was placed on the second floor and the storeroom, which requires less daylight, on the first floor. There is also a garage building on the same property and the remaining space is used as a storage yard.



SECTIONAL ELEVATION SHOWING TRANSFORMER COMPARTMENTS, FLOOR CONSTRUCTION AND OPERATING ROOM

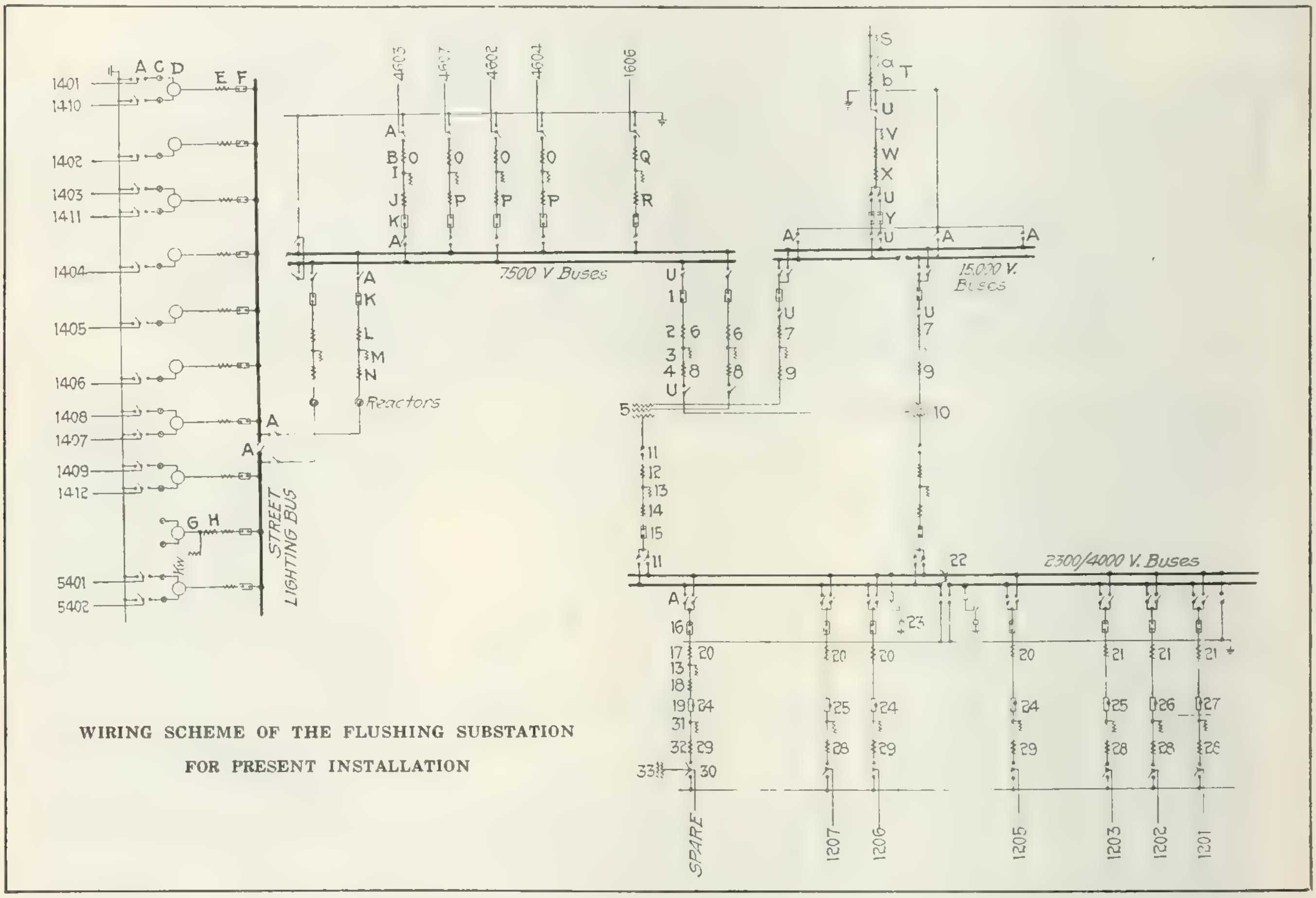
STOREROOM SUPPLIES CONSTRUCTION CREWS

The storeroom is used for materials employed in overhead and underground construction in the district supplied by the substation. At one side of the building there is a covered shipping room in which the line trucks are loaded, and the storeroom floor is at the level of the truck platforms. Circuits are provided for charging electric trucks while loading and unloading. A portion of the storeroom is partitioned off for the storekeeper's office and steel bins are provided for the storage of small material. A 6-ton platform scale has been erected near the edge of the shipping platform, and a traveling hoist is arranged to serve the entire storeroom. In one corner there is a room for the accumulation of scrap wire and other material. On the same floor there is a room 20 ft. x 23 ft. (6 m. x 7 m.) which is used by the line gangs for miscellaneous work on rainy days and has in it lockers for the men's clothes.

The substation is designed for an ultimate capacity of 25,000 kva. with the possibility of extending the building for a considerable increase over that capacity. The present installed transformer capacity is 10,000 kva. The station is supplied at 15,000 volts by underground cables direct from the 201st St generating station of the United Electric Light & Power Co. and is tied to the generating station and the other substations of the company by 7,500-volt, three-phase lines.

A one-line diagram on page 434 of the connections in the station. The ultimate 15,000-volt main bus is divided into four sections with one incoming and one outgoing line and one transformer connected to each section. The auxiliary bus is in one section. The 7,500-volt bus is arranged as a continuation of the 15,000-volt bus and is so designed that it may be changed over to 15,000-volt service at some future time when the use of 7,500 volts for transmission may be abandoned. The transformers are designed for three voltages, 15,000, 7,500 and 4,000, three-phase, with three electrically separate windings. The capacity of each transformer is 5,000 kva., which may be taken from any of the three windings. This design was selected for the first two units because of its flexibility and its economy, as a single three-winding unit acts as a spare for two ratios of transformation. Space is provided in the station for four incoming 15,000-volt lines, four outgoing 15,000-volt lines four transformers (two 5,000-kva. and two 7,500-kva.), six 7,500-volt lines, ten 2,300/4,000-volt distribution feeders and twenty-eight series street-lighting circuits. The initial installation consists of one 15,000-volt line, two 5,000-kva. transformers, five 7,500-volt lines, seven 2,300/4,000-volt feeders and fourteen street-lighting circuits.

can be removed for the installation or removal of a transformer. There is an oil tank in a pit under the driveway which is connected by piping to all of the transformers, a pump in one of the transformer rooms being used to raise the oil from the tank into the transformers. Provision is also made in the piping for the connection of a portable oil-drying and filtering outfit. The switchboard, bus structures, feeder regulators and constant-current street-lighting transformers are on the second



WIRING SCHEME OF THE FLUSHING SUBSTATION FOR PRESENT INSTALLATION

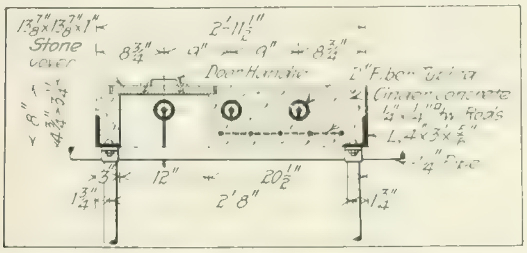
KEY TO WIRING DIAGRAM

A—300A, 15,000-volt disc switch.
B—Cur. tr. for I.W., W.H.M., R.V.A.I., Am.
C—Circuit plugs.
D—Constant cur. trans.
E—K-28, 10A for O.L. relays.
F—K-5, 200A, 7,500-volt O.C.B.
G—BQ-4 pot. trans.
H—D-20, 10A cur. tr.
I—2P, 200W pot tr. for I.W., W.H.M., R.V.A.T., Am.
J—Cur. tr. for O.L. & R.E. rel.
K—H-3, 300A, 15,000-volt O.C.B.
L—3K-48, 100A cur. tr. for Am. O.L. & R.E. Rel.
M—2P, 200W pot. tr. for I.W., W.H.M., R.V.A.I., Vm.
N—2K-48, 100A cur. tr. for I.W., W.H.M., R.V.A.I.
O—2K-48, 200A.
P—3K-48, 200A.
Q—2K-28, 60A, 15,000-volt.
R—2K-48, 60A, 1-K-28, 60A.
S—3-P, 200W pot. tr. for ground relay.
T—United Electric Company (a) 2 pot. tr. for W.H.M., printometer; (b) 2 cur. tr. for W.H.M., printometer.
U—60A, 15,000-volt disc switch
V—2P, 200W pot. tr. for W.H.M., Vm., Wm.
W—2K-48, 300A cur. tr. for W.H.M., I.W., R.V.A.I.
X—3K-48, 300A cur. tr. for R.E. rel., Am.
Y—H-3, 500A, 15,000-volt O.C.B.
1—H-3, 500A, O.C.B.
2—Cur. tr. for diff. rel.
3—2-P, 200W, pot. tr. for W.H.M.
4—Cur. tr. for W.H.M., Am.
5—5,000-kva. transformer No. 4.
6—3K-48, 600A.
7—3K-48, 300A.
8—2K-48, 600A.
9—2K-48, 300A.
10—5,000-kva. transformer No. 3.
11—800A, 15,000-volt disc switch.
12—3W-2, 600A cur. tr. for I.W., W.H.M., R.V.A.I., Am.
13—2-200W pot. tr. for I.W., W.H.M., Vm., R.V.A.I.
14—3K-50, 2,000A cur. tr. for diff. rel.
15—K-52, 300A, 15,000-volt O.C.B.
16—K-52, 800A, 7,500-volt O.C.B.
17—3W-2 cur. tr. for O.L. rel., Am.
18—3W-2, 300A cur. tr. for I.W., R.V.A.I., W.H.M.
19—I.R.S. regulators.
20—300A.
21—150A.
22—2,000A, 15,000-volt disc switch
23—Lightning arresters.
24—F4, 200A, 46-kw.
25—F7, 100A, 23-kw.
26—F4, 90A, 20-kw.
27—F4, 100A, 23-kw.
28—100A.
29—200A.
30—300A, 2,500-volt disc switch.
31—2-P, 200W pot. tr. for I.W., W.H.M., Vm., R.V.A.I.
32—W-2, cur. tr. for L.D.C.
33—Station light and power.

The general arrangement of apparatus is shown in the section through the building on page 443 and the photographs on page 432. The transformers are installed in individual rooms on the first floor with doors opening onto a driveway. The doors are fitted with louvers for ventilation, and the entire door and frame floor. Offices for the district superintendent and his assistants and a locker room, toilets and shower bath for the station operators are also on this floor.

All lines enter and leave the substation underground, and there are conduit systems with large manholes on both sides of the station. The 15,000-volt and 7,500-volt cables enter pothead compartments in the transformer rooms. Metering and ground relay protection transformers are also installed in these compartments. From the compartments single-conductor cables are run to the bus structure in fiber conduits built in the floor. All conduits in the floor are placed in a space 12 in. (30 cm.) deep between the reinforced-concrete floor slabs and the finished concrete floor. The conduits were laid on top of the floor slab in four levels to allow for crossing of the various runs. The vacant spaces were then filled in with hollow-tile blocks and concrete was poured into the smaller and irregular spaces between blocks. The 2-in. (5-cm.) finished floor was then laid on top of the blocks.

In order to group all of the switch controls, relays and instruments on as short a board as possible, the bench type of board was selected. Ammeters, voltmeters, reactive component indicators, wattmeters, etc., are placed on the front of the upper section, switch controls and voltmeter receptacles on the bench, calibrating terminals for the instruments on the lower front section and relays on the lower rear section. A special section for watt-hour meters was arranged in the rear of the upper section. Instruments in all General Electric horizontal edgewise, and switch controls are of the pull-button type. Westinghouse induction relays are used. For uniformity the street-lighting switchboard was also made a benchboard. On it are the controls for the oil switches on the primary of the constant-current transformers and the circuit ammeters. The plug switches on the secondary of the constant-current transformers are installed on small panels at the transformer structure. No short-circuit plugs are provided, as it has been found that they are not necessary on circuits feeding incandescent lamps only.



SECTION OF FEEDER REGULATOR BUS IN CONDUIT

The bus structures are of light-buff pressed brick with horizontal shelves of Alberene stone. The phase barriers for 15,000-volt oil switches are also of Alberene stone. The structures are approximately 14 ft. (4.3 m.) high, but they are so designed that all disconnecting switches may be easily reached from the floor. Wire-glass panels are used in doors over compartments in which there are disconnecting switches or oil switches. In the other doors the panels are of asbestos wood. The switches on the 15,000-volt and 7,500-volt buses are General Electric type H-3, and on the 2,300-4.000-volt bus type K-52 switches are used. Single-pole switches are used on the three-phase grounded neutral feeders to localize trouble to one phase in the event of a short circuit or ground on that phase. All lettering and marking is placed inside of the compartments to prevent mistakes due to the interchanging of doors. The marks are so placed that they may be read through the wire-glass doors.

Each distribution feeder is equipped with three single-phase induction regulators, and a transfer bus is provided to allow the transfer of any feeder to a spare set of regulators or the tying together of feeders in case of regulator or oil-switch trouble. The transfer bus is run in fiber conduit incased in concrete on the top of an iron pipe structure.

In designing the lighting system for the operating room attention was given to providing good illumination in the switch compartments and to the prevention of reflection from the glass over the instrument dials. A totally indirect system was adopted with X-ray reflectors on the top of the bus structures and the benchboard. This arrangement provides lighting from totally concealed sources as not even the fixtures are visible. The lighting of the switch compartments is accomplished by using two intensities in this system. One intensity is sufficient for general illumination, and the higher intensity (obtained by switching on additional lamps) is used when illumination is needed in the compartments for disconnecting-switch operations or inspection of apparatus.

A fifty-nine cell, 40-amp.-hr. storage battery is installed for switch operation and emergency lighting. This battery is charged by a 5-kw. motor-generator set which runs continuously. The emergency lights are automatically switched onto the battery if the alternating-current source fails. A stationary vacuum cleaner has been installed with outlets at various points in the building, and rubber insulating nozzles are used for cleaning the apparatus.

The station was designed by the company's engineering division, and all apparatus was installed by the construction division.

Energy Consumption of Electrical Pumps in Copper Mines

As PUMPING in the Michigan copper mines is a problem of high heads rather than of handling great volumes of water, the reciprocating pump has been found the most economical and only this class of equipment has been installed in recent years. However, both centrifugal and plunger pumps are in use. The work is done by pumps ranging in capacity from 200 gal. (756 l.) per minute to 2,100 gal. (7,950 l.) per minute, relaying the water from one storage reservoir to another and finally to the surface. Considering energy consumption, it is evident from the accompanying table that the reciprocating pumps are more economical for the work.

ENERGY CONSUMED PER 1000 GAL. PER 1000 FT. OF HEAD

Shaft	Type of Pumps	Total Vertical Head	Shaft Angle in Deg	No. of Pumps	Capacity of Pumps Gal.-Min.	Thousands of Gal. to Surface	Kw.-Hr	Kw.-Hr. per 1000 Gal. per 1000-Ft. Head
A	Recip	2,090	38	3	400	11,105	112,000	4.8
B	Cent.	2,885	38	4	1,000	13,970	290,000	7.2
C	Recip.	2,230	70	2	400	84,334	835,740	4.6
D	Cent.	2,215	70	3	200	5,700	102,230	9.1
E	Recip	2,200	70	3	200	16,693	355,700	5.[illegible]
	Cent.	1,400	70	2	200	18,614		

Shafts A and C in the table may be compared, one being a three-lift and the other a two-lift installation for about the same head, with pumps of the same rating. The two-lift installations show a slight saving in power. Shafts B and D are equipped with centrifugal pumps, the higher-rated pumps showing somewhat better economy. The relation between the reciprocating and centrifugal units shows a consumption of from 55 per cent to 75 per cent greater for the latter. As these figures are for actual operating conditions with all losses such as leakage from reservoirs included, the conclusion should not be reached that one type of pump is better than the other. Shaft E shows a combination, as both lines were operated from the same kilowatt-hour meter. Figures shown are for a period of one year.

Readers' Views and Comments

Generator Voltage Regulation

To the Editor of the ELECTRICAL WORLD:

SIR: The writer was much interested in the suggestion made by W. A. Darter of Brenham, Tex., on page 1011 of the Nov. 29 and Dec. 6, 1919, issues of the ELECTRICAL WORLD regarding misadjustment of alternator rheostats. But I think another suggestion should be added to apply when there is no automatic voltage regulator used and especially where the exciter and alternator have a common source of power so that the same speed variations affect both. In such installations it is generally the case that the engine is of smaller capacity, compared with the load fluctuations, than in the bigger and better-equipped plants, and therefore engine speed regulation is not so good, making better voltage regulation with regard to speed advisable even at the cost of some of the economy.

In several instances where voltage regulation was giving trouble the writer has found the exciter voltage very low, so low as to be well on the "steep side" of the "knee" of the exciter speed-voltage regulation curve, and the condition was bettered if not entirely corrected by using a 100-volt or 105-volt pilot lamp across the exciter brushes and instructing operators to keep it nearly up to normal candlepower by adjusting the exciter voltage with its rheostat and making further adjustments by use of an alternator rheostat.

This is another case where economy must be balanced against service. EMERSON A. ARMSTRONG.

Lincoln Motor Company, Detroit, Mich.

No Complaints of Ashes from Powdered Fuel

To the Editor of the ELECTRICAL WORLD:

SIR: Referring to the article in your issue of Jan. 17, 1920, on "Oil and Powdered Fuel for Central Stations," by C. H. Delany, the writer wishes to point out that the statement made by Mr. Delany in the latter part of his article that the ash which passes out through the chimneys with the stack gases is objectionable in the case of city plants is not borne out by facts in cases where pulverized coal is being used and has been used for considerable time in cities, particularly where the stacks are 150 ft. (45 m.) high or over.

The following extracts from letters which the writer has received from places where pulverized coal is being used under boilers speak for themselves on this question.

From a large public utility corporation (Oct. 2, 1919):

> We have been burning 150 tons of coal per day for the last two years in a plant in the center of the city, one block from the City Hall and surrounded on all sides by the highest buildings in the city. We have received no complaints and can find around about here no evidence that would indicate that our ash descends anywhere in the vicinity. My own belief is that it is so finely divided as to make it extremely doubtful that it descends at all until such time as it takes up moisture. The ash itself, being free from all combustible, of course, is grayish-white and does not soil or blacken anything it touches.

From the Puget Sound Traction, Light & Power Company, Seattle:

> There have been no complaints from any one in connection with this plant, which is in the heart of the city. The stacks are high and the ash undoubtedly floats away, and it is impossible even to see any amount of ash passing from the stacks.

From the New Richmond Hotel, Seattle:

> As these parties have a high stack, there have been no complaints, even though they make a practice of blowing the tubes and combustion chamber, allowing all the ash, except what slags, to go out of the stack.

From the Broadway High School, Seattle:

> They also blow a great deal of the ash out of the stack, but there is considerable of it collected in a long tunnel between the stack and the boilers, which they clean out about once a year.

From the L. C. Smith Building, Seattle, Wash.:

> This building is forty-one stories high, and there have been no outside complaints from parties in that vicinity.

FULLER ENGINEERING COMPANY.
Frederick A. Scheffler, Manager Power Deparment.
Allentown, Pa.

Ground Wire on Transmission Lines

To the Editor of the ELECTRICAL WORLD:

SIR: The subject of a protective ground wire for transmission lines interests us greatly, and I should like to have our position made clear to the readers of the ELECTRICAL WORLD. We oppose its use vigorously, contending that better results will be obtained by putting an equivalent amount of money into additional insulation. Our reasons are based upon many years of observation, and many operating engineers hold the same opinion.

On the other hand, the arguments advanced for and against the ground wire are difficult to evaluate, chiefly because of the uncertainty regarding the protection which it affords. The simple mathematical theory is satisfactory, but, as I recall, does not take account of whether the circuit is grounded star or insulated delta. Electrostatically, the conductors of the former are at earth potential. On systems of the same physical dimensions what are the charges that can accumulate through atmospheric induction, grounded and insulated, with and without ground wire protection? Where the conductor arrangement is in vertical planes there is definite evidence that the top conductors shield the ones below and that voltage disturbances are more frequent on the top wires. How would this be affected by transposition?

If a miniature line, perhaps a hundred feet long, were constructed beneath an insulated metal plate or screen and high frequency, of the order of 300,000 cycles, were applied between the plate and ground, the charging currents could probably be measured by milliammeters, which are readily available and of good accuracy. From calculated capacitances the potentials could be determined.

The method described has occurred to me as of possible value for demonstration and for checking calculated relations. W. A. HILLEBRAND.

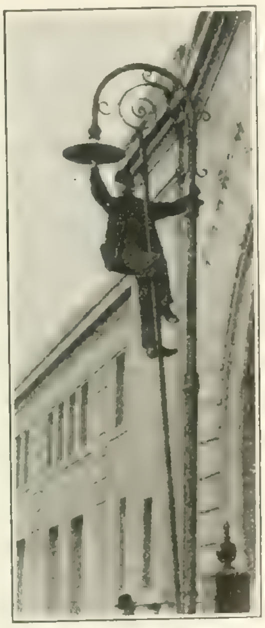
Ohio Brass Company, San Francisco, Cal.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

One-Pole Ladder Facilitates Street-Lamp Inspection

TO AVOID the use of the conventional double-pole ladder for inspecting reflectors and replacing the incandescent bulbs on the fixtures lighting the water front of San Francisco, an inspector employed by the Harbor Board devised the ladder shown in the illustration. Formerly it was necessary for the inspector to carry a large ladder from the nearest dock, if one was available. Sometimes none was, and in any event the work of carrying the ladder was heavy.



The special ladder weighs only a few pounds and is carried by the inspector from pole to pole. At the top of the ladder there is a hook which fastens to the scroll work near the top of the fixtures. The bottom of the ladder is strapped to the fixture at a point about 3 ft. (0.9 m.) from the ground to hold it steady while the inspector is climbing and to protect it from being struck by a passing motor truck, which might throw the inspector from his position. C. W. GEIGER.

San Francisco.

Moisture Is Cause of Generator Breakdown

SOME time ago a generator in a power plant failed, the cause apparently being the failure of the insulation from deterioration. The generator was drawing its cooling air from outside, and the end shields formed part of the air ducts to and from the winding. The outside temperature previous to the breakdown was very low, and the temperature of the duct through which the air entered was virtually the same. The engine-room temperature was 30 deg. F. above the temperature outside, and the amount of steam leakage was not excessive. However, a large amount of moisture was deposited on the inlet shield owing to the engine room being cooled by it below its 100 per cent humidity temperature. This moisture went through the shield joints, the faces of which were very porous, and fell on the windings, ultimately breaking down the insulation.

The end shields of the turbo-generators are made in halves so that there is a circumferential joint to the shell of the machine and an axial joint at the top where the two halves butt. The circumferential joint was made with a spigot, and there were blow holes in the castings so that the joints were not watertight. These blow holes were filled up with a soft jointing compound, and the faces were afterward filed flush. When the end shield had been fitted the joint edges were sealed with a very small quantity of the same material. This proved to be perfectly watertight, and after months of service there is no crack in the outside seal.

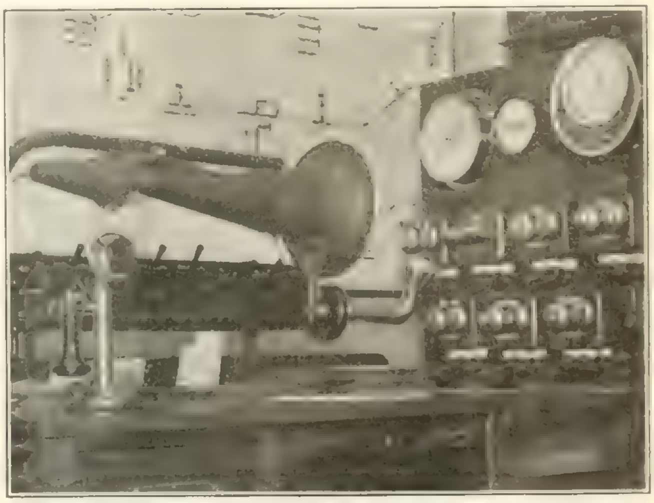
It was not considered advisable to use a soft jointing compound between the faces, as there would have been danger of a portion being squeezed out and dropping on the windings. MARK MEREDITH.

Liverpool, England.

High-Power Telephone for System Dispatching

PRIVATE telephone systems maintained by power companies for the operation of their system and the transaction of company business are very often subject to inductive interference from their own power lines. In some cases these private telephone lines are carried along directly beneath the high-voltage lines and on the same poles. Usually the lines are transposed, and "bleeder" transformers are used to drain them of transient disturbances and to maintain a balanced potential at all times. These measures are very effective, but they never entirely clear a line.

Up to several years ago the power companies had to be content with the ordinary telephone apparatus on the market. This apparatus, while designed for a different class of work, generally less severe, gives fairly good service on comparatively quiet lines. However, when the lines are very noisy and important business is to be carried on, such as load dispatching and switching, it is important that the transmission should be very clear.



MEGAPHONE RECEIVER AMPLIFIES SOUND

In October, 1918, the San Joaquin Light & Power Corporation installed in their dispatchers' office a high-power telephone. There are no new principles involved in this instrument, but it is a telephone set on a big scale, designed to transmit a greater volume of power and to amplify greatly the received energy. With this set it is practicable to talk over very noisy lines and over greater distances on comparatively clear lines than was ever possible with the ordinary telephone instrument. The energy for this set is supplied by an automobile-type storage battery, which is charged occasionally by a small Tungar rectifier. The whole installation has proved a successful solution of a rather annoying problem.

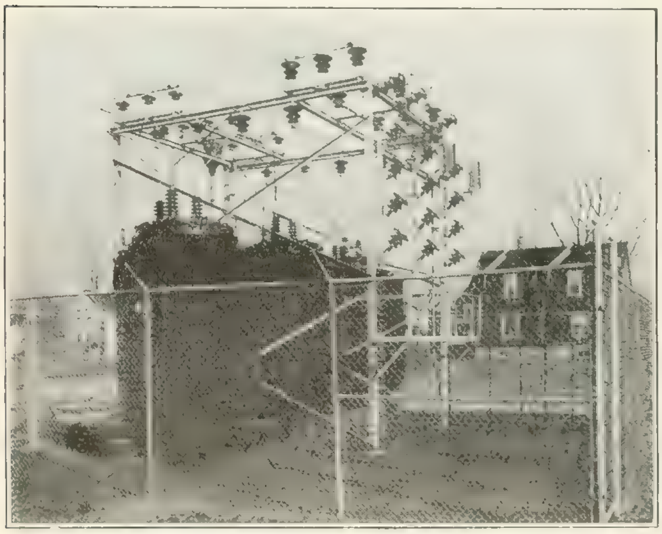
Another feature of the set worthy of note is the reduction of the "raps in the ear" which it is possible for the user to get. The standard telephone receiver, when held tightly to the ear, as is necessary when listening over a line exposed to inductive interference, causes the user to receive a painful and often dangerous injury to the eardrum at the time of an occurrence such as a short circuit on the power system. This set, by the introduction of an air cushion in the funnel, prevents any such danger.

R. C. Denny,
Operating Department.
San Joaquin Light & Power Corporation,
Fresno, Cal.

Outdoor Substation Built at Low First Cost

Low first cost and compact arrangement are the features of the substation shown in the accompanying illustration. This equipment comprises a 12,000/33,000 volt step-up station and its cost was only $4 per kva. The primary side of the station is connected to a 12,000-volt underground feeder, and the secondary feeds a 33,000-volt urban line.

With its arresters the station occupies a ground space of 27 ft. x 32 ft. (8 m. x 10 m.) inclosed by a wire fence.



OUTDOOR SUBSTATION FOR URBAN SERVICE

The tower, assembled from steel-galvanized sections, carries the following equipment: One three-pole remote-controlled air-break switch on the incoming 12,000-volt bus, one switch of similar design on the 33,000-volt outgoing bus, three single-pole combination choke coils, disconnecting switches and fuse mountings, one oxide-film lightning arrester, three 1,633-kva. single-phase transformers and a few busbar supports for holding the copper-tube buses.

There is no automatic overload protection on the substation, as the supply end of the underground 12,000-volt feeder is equipped with an automatic oil switch. The three-pole switches are operated from ground level by means of handles which can be locked in either open or closed position, and the choke coils are connected in the outgoing leads on supporting bases which also carry the disconnecting switch with limit fuses in the lightning-arrester circuit. These "disconnects" can be opened and the arresters disconnected without interfering with the load service.

The transformers and arresters were furnished by the General Electric Company, the remainder of the material by the Delta-Star Electric Company.

Synchronous Effect of Two Parallel Transmission Lines*

An INTERESTING phenomenon has been observed in the case of a tie-in between the lines of the Southern Sierras Company, which operate at 60 cycles, and those of the Southern California Edison Company, which operate at 50 cycles.

Circuit No. 1 of the tower line of the Southern Sierras Power Company was in use at the time for transmission at 90,000 volts between the generating plants on Bishop Creek and the San Bernardino substation. This circuit was also tied in with the Southern California Edison system through a 6,250-kva. frequency changer set at the Edison Company's Colton substation.

Circuit No. 2 of the tower line was to be used temporarily as an emergency connection between a 10,000-kva. generating plant at the northern end of the line and a 55,000-volt transmission line leaving the San Bernardino substation, the reason for this connection being that one of the three-phase, 88,000/55,000-volt, 4,000-kva. transformers at the San Bernardino station was out of service and there was insufficient transformer capacity remaining to carry the 55,000-volt load at the station.

Circuit No. 2 was energized by the hydro-generating plant and was to be synchronized at the San Bernardino substation with circuit No. 1 through the three-phase transformers mentioned. As the frequency of the incoming plant approached that of the 60-cycle system it was observed that the pointer of the synchroscope showed a tendency to slow down when passing the 180-deg. out-of-phase position and swung rapidly past the point denoting phase coincidence. When the frequencies of the two systems became equal the instrument came to a stop with the pointer 180 deg. away from "in-phase" position. No significance was attached to this by the operator at the time, but when the condition prevailed for several minutes an investigation was made on the assumption that something had gone wrong with the instrument or instrument wiring. After checking these and finding that they were all right on other synchronizing transformers, it was noticed that the frequency of the incoming circuit remained fixed as though tied in with the remainder of the system.

Communication with the incoming hydro-electric plant followed, and it was learned that the operator there was puzzled as to why the line had not been synchronized during the long period in which his plant had held a steady speed at normal frequency, for he had not seen the other switchboard indications that would show that his plant was synchronized in the usual way with the other line. During this interval the system frequency had varied half a cycle either side of 60, and the frequency of the incoming plant made a corresponding change.

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*Presented by R. H. Halpenny at a meeting to consider operating difficulties at the Pacific Coast convention of the A. I. E. E.

By this time the San Bernardino operator came to the conclusion that the phenomena was due to the mutual action of the two tower-line circuits, and he instructed the hydro-plant operator to increase or decrease the water on the waterwheel until his plant broke away from the system frequency, after which he was to return to the former condition as nearly as possible. This had the desired effect in that the hydro-plant soon dropped out of step with the system, not without a marked inductive effect, however, for a series of voltage swings from 5 per cent below to 5 per cent above normal was observed as the frequencies became different. Needless to say, the operator when synchronizing was careful to "make a shot" with a rapidly swinging synchroscope pointer when the plant again approached the frequency of the system.

This same action was since noticed on other occasions when it has been necessary to synchronize under similar conditions, in one instance with a different plant on the incoming circuit.

Entrance of Moisture to Cable Prevented by Means of Tap

As MANY cable failures are due to the entrance of moisture into the insulation, care must always be taken when tapping cables to make splices waterproof. The Kansas City Light & Power Company has developed a method shown in the accompanying illustration, that entirely overcomes the problem. This connection between underground and overhead circuits consists of three single-conductor, 300,000-circ.mil, 600-volt rubber-and-lead-covered cables in a 3.5-in. (88 mm.) iron conduit. In the manhole these cables splice into one three-conductor, 500,000 circ.mil. paper-and-lead-covered cable; on the pole they terminate in a three-pole weatherproof cut-out and junction box. The lead cap at the top of the conduit furnishes support for the cables and also serves to keep water out of the pipe. Each conductor, where it leaves the top of the conduit, is wrapped with alternate layers of white linen and P. & B. paint, and the crotch is filled with solder to seal the conduit against the entrance moisture.

LEAD CAP PREVENTS ENTRANCE OF MOISTURE AND SUPPORTS CABLE

Above the cut-out is an older method of cable construction with a three-conductor cable. This method, however, does not prevent the entrance of moisture into the cable, especially when the "Y" is inverted. The engineers have found it practically impossible to keep moisture out of the "Y" branch when the crotch is exposed to the rain. D. D. CLARKE.

Kansas City (Mo.) Light & Power Company.

Data and Results of Steam Power Plant Test

IN ORDER to determine the economy in terms of kilowatt-hours per pound of oil of a unit recently installed in the Lake Union plant of Seattle, a complete boiler test was made by J. D. Ross, superintendent of lighting. The unit tested is the second one installed in the plant, and it consists of four 823-hp. Stirling boilers supplying an Allis-Chalmers steam-turbo unit of 12,500 kw. capacity. Data on and results from this test are given herewith. It is seen that 0.775 kw.-hr. was obtained for every pound of oil fired. In addition, the thermal efficiency of the plant was found to be 14.64 per cent and the combined efficiency of boilers and furnaces to be 82.76 per cent.

REPORTS OF TEST OF STEAM PLANT

DESCRIPTION OF APPARATUS

Four 873-hp. Stirling safety water-tube boilers.
Four Foster superheaters.
Thirty-two Cochrane water heaters of 200,000 per hour rated capacity each.
One 12,500-kw. Allis-Chalmers-Parsons turbo-generator unit.
Peabody-Hammel oil furnace: Water heating surface, 8,226 sq.ft.; superheating surface, 755 sq.ft.
One 12,500-kw. Allis-Chalmers-Parsons turbo-generator unit.
Auxiliaries driven by induction motors or impulse steam turbines, or by both.
Exciter driven by steam turbine and fuel-oil pumps driven by reciprocal steam engines.
Type of condenser, Wheeler rectangular jet.
Capacity of condenser:

		Vacuum		B.-Hp.
Gal per Minute	Lb. Steam	In.	Deg	Water
11,000	150,000	28 5	60	290
11,000	200,000	27 5	60	290
11,000	100,000	28 85	60	290
11,000	50,000	29 0	60	290

Duration of test, eleven hours, with turbine running continuously.

AVERAGE PRESSURE AND TEMPERATURE

Steam-pipe pressure near throttle by gage, lb	183 7
Steam pressure, turbine inlet after throttle, lb	171 2
Vacuum in condenser, inches of mercury	28 74
Temperature at throttle (includes superheat), deg. F.	506.0
Temperature feed water entering boilers, deg F	183 6
Temperature of escaping gas leaving boilers, deg. F.	481.8

HOURLY QUANTITIES OF COAL, WATER AND STEAM, AND RATES

Oil as fired per hour, lb	9,881.7
Equivalent evaporation per hour from and at 212 deg., lb	152,149
Calorific value of fuel: Proximate analysis as follows:	
Gravity, 15.4 deg. Baumé at 60 deg. F.	0.963
Water, per cent	2.9
Silt	None
Sulphur, per cent	100
B.t.u. (gross)	18 045
Correction of B.t.u., value for sulphur, B.t.u.	41.1
Average kw. output, gross	87,350
Auxiliary load, total kw.-hr	3,086
(a) Auxiliary load, kw.-hr. per hour	280 5
(b) Auxiliary load, total kw.-hr	2,869
(c) Exciter, kw.-hr	217
Net kw.-hr. per hour	7,660 5

ECONOMY RESULTS

Kw.-hr. per lb. of oil as fired	0.7752
Kw.-hr. per bbl. of oil as fired	261 53
B.t.u. per barrel of oil as fired, 337.3 × 18,045 =	6,086.575
Kw.-hr. per bbl. of oil corrected to standard barrel of 6,216,000 B.t.u.	267.07
Heat units in oil consumed per kw.-hr	23 315
Water evaporated per lb. of oil as fired, lb	13 33
Water evaporated per lb. of oil as fired, from and at 212 deg. F., lb	15.39

EFFICIENCY RESULTS

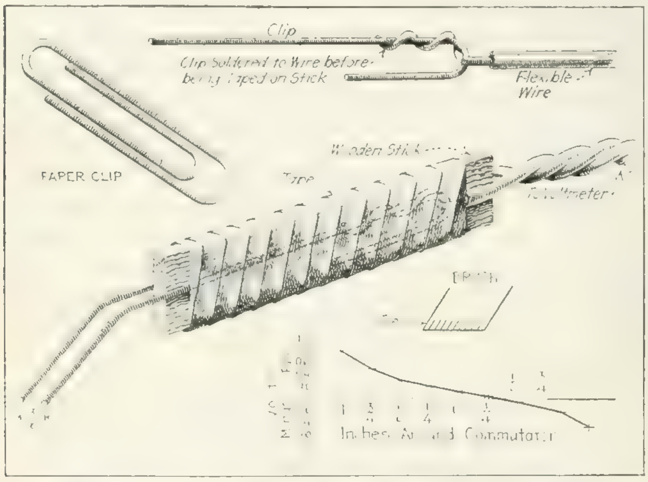
Thermal efficiency of plant, 3,415 ÷ 23 315 =	14 64	per cent
Combined efficiency of boilers and furnaces, based on oil as fired,	82 76	per cent

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

How to Determine Interpole Strength Curve

IN DETERMINING the correct strength and shape of interpole for direct-current machines the voltage curve should be obtained because the needed adjustments can be easily ascertained from this curve. This can be done by means of two metallic points insulated from each other and a low reading voltmeter, preferably from 3 volts to 5 volts full scale. The contact points which are made of springy steel wire (ordinary paper clips can be used) are bent in the form shown in the illustration and soldered to the voltmeter leads. They are taped together on a flat stick so that the points will be about $\frac{3}{16}$ in. (5 mm.) apart.



DEVICE FOR DETERMINING VOLTAGE CURVE OF INTERPOLE AND CURVE AS DETERMINED BY TESTS

By holding these points lightly but firmly on the commutator while the machine is running under load and noting the voltmeter readings for a point ahead of, under and behind the brush it is an easy matter to plot the voltage curve. In plotting this curve inches are used for the horizontal distances and tenths of a volt for the vertical distances.

Group-Motor Drive Found Advantageous for Light Work

AFTER a thorough study of possible operating conditions, the superintendent of motive power in a New England specialty factory recently found that group driving was the most economical as to both initial and operating cost. The experience of the establishment showed, for example, that for every 5 hp. in individual drives the same work could be satisfactorily accomplished by 3 hp. in group installation. As the machinery in this plant was not of the heavy type, the problem was whether it would be better to install a 3-hp. motor to drive a group of punches from a common line shaft or to equip each unit separately with a 1-hp. motor. Although the punches were all equipped with flywheels, the power-factor fell to 60 per cent or thereabout with individual driving, compared with 80 to 85 per cent in the group system. Low power factor was penalized by the electrical supply company in this case, and the energy consumption, though somewhat less with individual drive, did not offset the advantages of lower first cost, better power-factor and decreased wiring and control expense associated with the system.

Power Requirements of Machines in Bindery

Schedule Shows Ratings of Motors Installed for Driving Machines as Compared With Requirements Obtained From a Power Survey

IN CONSIDERING removal of its plant of 118 individual direct-current motor-driven machines to a locality where only alternating-current is obtainable, the J. F. Tapley Company, book manufacturers, New York City, made an extensive power survey of its equipment. Although the investigation was initated primarily to secure the necessary data for obtaining quotations for the new motors, the study developed the fact that several of the machines were not correctly motored. One instance of this incorrect motoring was the driving of two Smyth case-making machines of the same size by 1 hp. and ½ hp. motors respectively (see item 57 in the accompanying table). The tests showed that a ½ hp. motor is capable of driving this type and size of machine.

Another case brought to light was the Seybold smashing machine which, although being driven by a 5-hp. motor, required only 2 hp. for normal operation. The larger motor was installed because of the high power necessary for starting the machine. It has a large flywheel which requires a large starting torque. When alternating current motors are installed, one can probably be selected which will have a high-starting torque and still be rated only slightly above the running requirements. Such a motor would be desirable because of the low power factor which would be entailed if the machine were overmotored.

In the present plant an effort has been made to standardize, as much as possible, on the sizes and makes of motors installed. In this way if the motor of one machine breaks down, it can be quickly replaced by one on a machine not in operation. Of course this procedure cannot be carried out to any extent when alternating-current motors are installed on account of the power factor.

Later it is the intention of the company to record the data shown on cards so that the information can be used and changed more easily. The chart, however, has served its purpose for comparison of machines and serves as a permanent record of requirements of the various machines. R. E. PETERS, Works Engineer.

New York, N. Y.

DETAIL MACHINE AND MOTOR SCHEDULE OF J. F. TAPLEY CO.

Ref. No.	Machine	Motor Equipment								Motor Control Apparatus			Drive	Driving Equipment				Max. Mach. Pulley Dia. Allowable	Machine Motive Data			New Motor H.P. Recomm.
		H.P.	Volts	Marked Speed R.P.M.	Actual Speed R.P.M. Max.	Actual Speed R.P.M. Min.	Winding	Type or Form	Manufacturer	H.P.	Style	Manuf.		Motor Pulley Face	Motor Pulley Dia.	Machine Pulley Face	Machine Pulley Dia.		Machine Drive Shaft-speed Max	Machine Drive Shaft-speed Min	H.P. Req. Equip Loaded	
1	Dexter cutter (50 in.)	3	230	1150	1160		C.	L. Frame 3, Form A	Stanley, G I	3	S R.	C H.	B	4	4¾	4	20	35	320		3	3
4	Dexter cutter (44 in.)	3	230	1150	1145		Sh.	L. Frame 3, Form A 2	Stanley, G. I.	3	S R.*	C. H.	B	4	5	4	20	34	300		2	2
6	Duplex trimmer—Seybold	3	220	1050	1100		C.	Universal	Jenney	3	S R	C. H	B.	4	5¼	4	26	34	490		3	3
8	Corner cutter—Seybold	1	230	1450	1500		Sh.	G 302	Diehl	1	S R	C H	B	3	3¼	2	24	24	45		½	½
9	Corner cutter—Seybold	¾	220	900	850		Sh.	D	Watson	1	S R	C H	B	3	5	2	24	24	40		½	½
10	Corner cutter—Hickok	¼	230	490	440		Sh.	G 302, E.S.J. 3022 L.	Diehl	¼	S R.	C. H	B.	3	3½	1¼	16	16	100		¼	¼
11	Dexter D 16, point feed folder	1	230	550	580	450	Sh.	L. Frame 2, Form A 199	Stanley, G. I	½	R R	C. H.	B.	2½	2	3	8½	8½	180	130	½	½
12	Dexter single fold, 24 in.	½	230	1400	1450	900	Sh.	C.A. Class 2	General Elec	½	R R	C. H.	B.	3	3	4	11½	11½	375	270	½	½
13	Dexter D 16, point feed folder	1	230	550			Sh.	Frame 2, A 199	Stanley, G. I	1	C S R.	C. H.	B	3½	4¼	4	11½	11½	290	210	½	½
14	Dexter drop roll folder, D 16	2	230	1150	1300	930	Sh.	L. Frame 2, A 20	Stanley, G. I	2	S S S R	C H	B	3½	3¼	3¼	16	24	280	200	2	2
17	Dexter suction feed single fold	1	230	1275	1400	1050	Sh.	C 2, A 74	General Elec	1	R R	G E.	B	3¼	4	2¾	10	16	600	460	1	1
18	Chamber D 16-D 32, 4-fold folder	2	230	1150	1440	800	C.	Frame 2, A 26	Stanley, G. I	2	S S S R	C H	B	3½	3	4	10	16	470	270	2	2
19	Chamber quadruple, 16-page folder	2	234	1100	1180		C.		Fidelity	2	S R.	C H.	B	3½	4	3¼	10	22	510		2	2
21	Chamber drop roll jobber	2	230	1150	1100	700	C.	2, A 26	Stanley, G. I	2	R R *	C H	B	3½	3¼	3¾	9½	9½	400	260	2	2
23	Chamber drop roll jobber	2	230	1150	1100		C.	2, A 26	Stanley, G. I	2	S S S R	A S C	B	3½	3¼	3¾	10	10	320		2	2
24	Chamber D 16, point feed folder	1	230	550	550		Sh.	L. Form 2, A 199	Stanley, G. I	2	S R *	C. H.	B	3½	3½	3½	8	8	280		½	½
25	Belmont 3-fold point feed folder	½	230	600	770		Sh.	I. L. 8	Hawthorne, W. E.	2	S R.*	C H.	B	2½	2¾	3⅜	10	10	200		½	½
26	Brown single folder	¼	230	1725	1900	700	Sh	G 300	Diehl	⅛	F R	C H	B	1½	1½	2¼	14	14	270	120	¼	¼
27	Anderson single folder	1	230	1335	1440	410	Sh.	Frame 1, A 2	Stanley, G. I	½	C S R	C H.	B	3½	4	3½	22	22	290	180	½	½
28	Booth power folder	¼	230	600	800		Sh.		Fidelity	¼	S R	C H.	B	Grove	3½	Grove	9¼	9¼	400		¼	¼
29	Seybold smashing machine	5	230	1150	1200		C.	Form A, Frame 5	Stanley, G. I	5	S R *	C H.	B	5	3¼	5	30	30	150		5	5
31	Seybold book compressor	2	230	1150	1140		Sh.	Form A 20, L. Frame 2	Stanley, G. I	2	S R *	C H.	B	1½	2½	3¼	36	36	250		2	2
32	Thompson "Laureat" press	1½	230	850	1300	650	C.	Form D, Lundell R T.	Sprague, E	1	T L S S R R	E C & M C H	B	4½	5	3½	23	23	275	150	1½	2
36	Sheridan Embossing press	2	230	1150	1360	1200	C.	Form A 26, L. Frame 2	Stanley, G. I	2	C S R	C H.	B	3½	3½	4	18	18	300	280	2	2
41	Rubbing-off machine	1	230	1275	1275		Sh.	Form A 74, Type C Q I	Western, E	1	T L S. S	C. H	B	3½	1¼	3½	8	14	410		1	1
42	"Buffalo" rubbing-off blower	2	230	1150	1180		Sh.	Form A, L. Frame 2	Stanley, G. I	2	S R *	C. H.	B	3¾	6½	3	4	8	2600-4	1965	2	2
43	American gold laying machine	¼	230	1900	1900		Sh.	Size B, Type C M	Crocker-Wheeler				B	1¼	2	1¼	7	8	580		¼	¼
49	Crawley power, rounding and backing machine	2	230	1160			Sh.	Form A 20, L. Frame 2	Stanley, G. I.	2	R R *	C H.	G	2	2½	2¼	37½	37½	76	73	2	2
53	Gulberg & Smith gathering machine	3	260	1150	1200	920	Sh	L. Frame 3, Form A 2	Stanley, G. I	3	R R.	C H	B	4	5	4½	18	18	330	130	3	3
54	Marresford automatic tipping machine	½	235	800	850		Sh	G 302	Diehl	½	S R.	C H	B	5	2½	2¼	10	Spec	240		½	½
56	Seybold rotary board cutter (42 in.)	1	230	515	570		C	L. Frame 2, Form A 26	Stanley, G. I	2	S R *	C H	B	3½	3½	4	24	36	82		1	1
57	Smyth case-making machine	¼	230	600	670	500	Sh	R T. 1 Lundell, Form D	Sprague, E	½	C. S R *	C H	B	2	3¼	1½	10	Spec	250	100	½	½
60	Cover bender	¼	230	600	780		Sh	P	Fidelity	¼	S R	C H	B	2½	2¼	2¼	10	10	140		¼	¼
61	Latham Monitor multiplex punching machine	¼	230	600	640		Sh	Form E S & F. 3012 A, Type G 301	Diehl	¼	S R	C H	B	3¼	2¾	3¼	15	15	145		¼	¼
62	Frohm Simplex stripping and reinforcing machine	½	230	1200	1500	1250	Sh		Fidelity	½	F R T I S S	E C & M E C & M	B	2	6	1½	5½	5½	32	28		½
63	Smyth casing-in machine	1	230	1000	1290	1040	Sh		Fidelity	1	F R T L S S	E C & M E C & M	B	3	2½	1½	10	Spec	350	300	1	1
64	"Isaacs" glue machine (16 in.)	¼	230	700	900		Sh.	GS 299	Diehl				B	Grove	1½	Grove	6	6	250		¼	¼
68	"American" wringer machine (16 in.)	¼	235	600	660		Sh	G 301	Diehl	¼	T. L S S	C H	B	2½	2¾	2½	11	11	140		¼	¼
72	Smyth cloth cutting machine	¼	230	850	960		Sh	G 401	Diehl		Snap		B	3½	3	1⅞	13	Spec	240		¼	1
73	Sawyer leather measuring machine	¼	220	600	800		Sh	P E	Fidelity	¾	S R	C H	B	2½	1½	2¼	15		90		¼	¼
74	Fortuna skiving machine	¼	230	1725	1900		Sh	G 300	Diehl		Snap		B	2¾	2¾	1¾	31	Spec	2600	2400	¼	¼
75	Smyth sewing machine	¼	115	700	800	750	Sh	299	Diehl		F R	C H	B	2	2½	1⅞	7	Spec	250	80	¼	⅛
91	Smyth sewing machine	¼	240	600	690	650	Sh	G 301	Diehl		F R	C H	B	2¼	1½	1⅞	10	Spec	150	120	¼	¼
96	Smyth sewing machine	¼	220	700	980	850	Sh	G 299	Diehl		F R	C H	B	1¼	1¼	1⅞	12	Spec	160	125	¼	⅛
97	Singer sewing machine	¼	220	1800	2000	1000	C	551	Diehl		T C	C H	B	Grove	1½	Grove	3	Spec	900	550	¼	¼
103	Singer sewing machine	¼	230	1450	1500		C	G 300	Diehl	¼	S R	C H	B	2¼	3	3¼	14	Spec	340		¼	¼
105	Latham monitor wire stitcher	¼	230	600	680			G 302	Diehl	¼	S R	C. H	B	2¾	2½	2½	13½	Spec	160		¼	¼
106	Gould-Eberhardt shaper	2	230	500 1500	720	540	Sh	R R 2, B 2	General El	2	C S R	C H	B	3½	4½	3¼	10	22	330	260	2	2
107	Foote-Burt universally adjustable drill	¼	230	1200	1200		Sh.	P.	Fidelity	¼	S R	C H	B	2¼	2¾	3¼	6	11	610		¼	¼
108	Putnam engine lathe	2	230	500 1500	1580	500	Sh	C R 2, Form B 11	General El	A 5	R 75 Controller	G E	G		2¼	1¼	10	Spec	112	32	2	2
109	Emery wheel	¼	230	1500	1580			Form R T 25, Type Lundell	Sprague	¾	S R	C H	B	1½	2¼	1⅞	2¼	6	1900		½	½
110	Bridgeport heavy auto. knife grinder	3	230	1100	1100		Sh	C Q 3, Form A 20	General El	3	S R *	C H	B	4¼	7	7	23¼	23¼	340		3	3
111	Gang sawing-out machine	2	220	1150	1100		Sh	Frame 2, Form A 2	Stanley, G. I	2	S R *	C H.	B	3	5½	3¼	4	10	1500		1	2
112	Minnich power baling machine	3	230	800	900		Sh		Fidelity	3	S R *	C H	G	2½	3¾	2	24¼	24¼			3	3
1[illegible]	Fortuna skiving machine	¼	110	1700	1750		C	Form L B	Ft. Wayne				B	1¼	2¼	1⅞	3½	Spec	2600	2400	¼	¼

KEY TO ABBREVIATIONS AND SYMBOLS USED IN ABOVE SCHEDULE

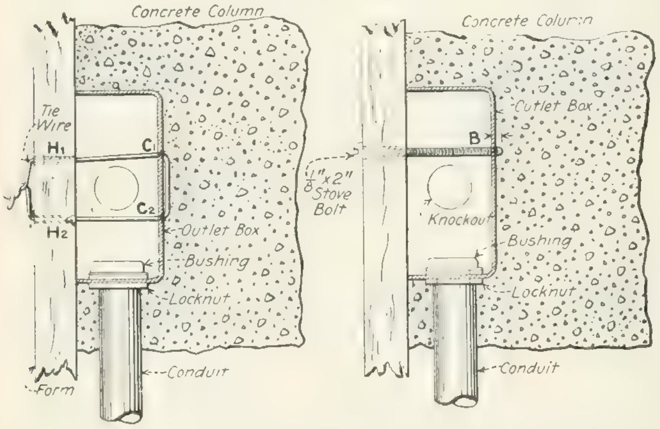
C H = Cutler Hammer Mfg. Co. G E. = General Electric Co. A S C = Automatic Switch Co. E C & M = Electric Controller & Mfg. Co. N E C C = National Electric Controller Co. Sh. = Shunt
C = Compound B = Belt Drive G = Gear Drive * = Magnetic Overload Release. Frict. = Friction Drive. Spec = Special T C = Treadle Controller S R = Starting Rheostat
C S R = Compound Starting Rheostat R R = Regulating Rheostat F R = Field Regulator. T L S S = Time Limit Self Starter S S S R = Self Starting Speed Regulator

NOTE.—Manufacturers' serial numbers and Tapley numbers are also tabulated in the original table.

Side Outlets Fastened in Concrete Forms With Wire or Screw

DIFFERENT wiremen use different methods for attaching side-outlet boxes (for baseboard receptacles, switches, fan outlets, bracket outlets and the like) to the wooden forms before the concrete is poured. Two methods which are used frequently are shown. One involves the use of a piece of iron wire for fastening the steel box to the form. Old bailing wire will serve the purpose, but wire of smaller diameter will answer as satisfactorily. Two holes, H_1 and H_2, are bored through the form board, at the position where the box is to be attached. Then the box is tied securely in place by twisting the ends of the wire which extend through the holes. After the form has been removed, these wires can be severed with a pair of nippers at the points C_1 and C_2.

The second method shown makes use of a machine screw sufficiently long to extend through the form board and into one of the tapped holes in the back of the box. The latter arrangement is better, more accurate and more economical where machine screws are at hand. Where they are not the tie wire will suffice.



FIGS. 1 AND 2—WIRE AND MACHINE-SCREW METHODS OF HOLDING OUTLET BOXES IN PLACE

After the concrete has set and the forms have been taken down, the machine screws can be removed easily with a screw driver. They should never extend very far from the back of the box into the concrete. That is, the distance B in Fig. 2 should not be more than $\frac{1}{16}$ in. or $\frac{1}{8}$ in. (1.6 mm. or 3.2 mm.). LYMAN L. AFTON.

Kansas City, Mo.

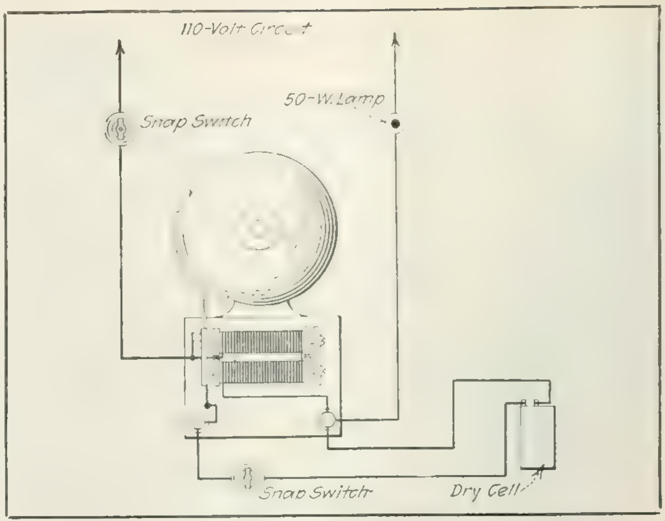
Ordinary Bell Indicates Condition of Circuit

WHEN used as an alarm to indicate that a source of energy supply has failed, the scheme illustrated has proved very dependable, simple and inexpensive. An ordinary iron-box bell is used, the coils being connected permanently in series with a 50-watt, 110-volt lamp to a 110-volt circuit. One dry cell is connected across the banding posts of the bell.

Under ordinary operating conditions, the current through the lamp is sufficient to keep the armature pulled against the pole pieces. When the armature is in this position, no current flows from the cell as the contacts are held open. If the main circuit is de-energized, the bell armature springs back against the contact breaker, thus closing the cell circuit and causing the bell to ring in the usual way. The hum produced on alternating-current circuits can be eliminated by mounting the bell on rubber or cork. C. C. MOLER,

Northern Virginia Power Co., Superintendent.

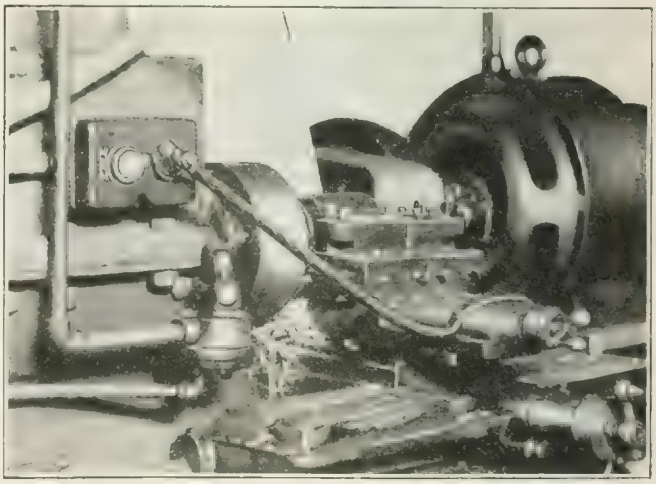
Winchester, Va.



IF THE LIGHTING CIRCUIT IS DE-ENERGIZED, THE BELL WILL RING

Motor-Driven Lathe Stopped Automatically

BY THE use of the home-made automatic stop shown in the accompanying illustration one man is enabled to operate two Chard lathes in a New England shop. The lathe is driven by a 5.5-hp., 230-volt Westinghouse direct-current motor with push-button control. The tool is fed into the work on a cross-feed axis, and when the limit of safe travel is reached the driving motor is instantly stopped. This is accomplished by means of a push-button contact made by a $\frac{9}{16}$-in. (14 mm.) iron rod attached to the base of the tool carriage. This rod, 18 in. (45 cm.) long, is provided with an adjustable set screw at the left-hand end which enables the operator to secure a close range of adjustment in automatic stopping. The rod is forged into a flat strip to facilitate attachment to the tool carriage base.



WHEN TOOL REACHES END OF TRAVEL THE MOTOR IS AUTOMATICALLY STOPPED

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Plan to Interest Customer Stockholders in Company Affairs

THE Union Electric Light & Power Company of St. Louis has added a new section to its house organ, the *Wire and Pipe*, which is headed "Stockholders' Section." This publication, beginning with the January number, will be mailed to all stockholders for the purpose of informing them of the company's activities and financial condition and of acquainting them with the organization which carries on the company's work. From time to time communications of special interest to holders of stock will appear.

The January issue announces the sale of an additional million dollars of 7 per cent preferred stock ($2,000,000 is already outstanding), the sale of which was authorized by the Public Service Commission in January, 1918, but was not carried out owing to the Liberty loan campaigns of the government. The stock is now offered for the purpose originally authorized—namely, to pay for extensions to its lines, property and plant—at $100 per share for cash and $102 on the ten-payment plan.

Cost of Serving Small Customers with Lighting

THE cost of serving a small lighting customer is higher than many central stations operating in moderate-sized communities appreciate, and the following figures from a paper by Bowen Tufts, of C. D. Parker & Company, Boston, Mass., presented before the New England Section of the National Electric Light Association, are of considerable interest. Both companies mentioned are operated by the Parker interests, company A serving two small towns with a total population of 8,000, the connected lighting load being about 74 per cent of the total connected load. Company B serves five towns with a population of 18,000, the connected lighting load being 26 per cent of the total connected load.

COST PER YEAR PER CUSTOMER

	Company	
	A	B
Reading and care of meters	$1.60	$1.64
Repairs to meters	.02	.03
Repairs to street lines and wires	1.49	1.11
Main high-tension lines (repairs)		.37
Pole line rental	.28	.38
Clerk hire	.63	.85
Printing and stationery	.36	.43
Insurance	.47	.47
General office expense	.62	.71
Taxes on equipment for lighting customers	1.28	1.42
Tools and miscellaneous expense	.17	.15
Management charges	.17	.85
Rent of office	.10	.06
Legal expense	.16	.19
Stamp tax	.03	.02
Electricity purchased for lighting customers	7.56	4.55
	$14.94	$13.23
Depreciation at 5 per cent, prorated	4.22	6.82
Interest at 6 per cent on prorated investment and quick assets	6.85	9.85
Total	$26.10	$29.90

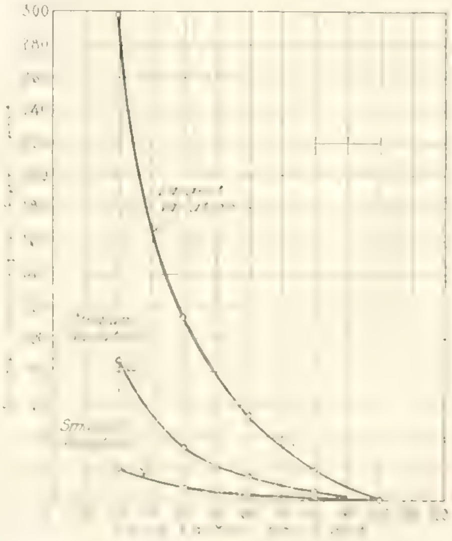
Mr. Tufts said that he believed that the minimum charge allowed in Massachusetts should be increased from $9 to $18 per year in view of the increased costs of material and labor, with future adjustments to meet changes occurring. If this could be done, it would immediately mean that electricity could be sold at a lower rate and thereby greatly increase its use, with a resulting tendency toward lower unit costs. The actual investment per customer is often from two to three times as large in thinly settled territories as in the cities. The average revenue per customer in the two cases cited was $1.80 and about $4 per month.

Energy Costs to Large Consumers of Power

A Study of the Rates Charged by Light and Power Companies to Customers Using Large Amounts of Electrical Energy

BY H. C. THUERK

THE present time appears to the writer to be an opportune one in which to consider the possibility of standardizing central-station rates, and it was with this ultimate consideration in view that some interesting information was collected from the rate schedules of several of the large electric light and power companies of America. A study was made of the various applications of load factor and power factor in the energy contracts of these companies, and data were compiled which present in concise form the prevailing practice of handling these factors in rate schedules. Such data should be considered in any problem of standardizing central-station rates.



CURVES SHOWING RATE INCREASES OF COMPANIES HAVING LARGEST AND SMALLEST VARIATIONS AND MEDIAN RATE

Fifty-two companies were solicited for information on the subject outlined above, and replies were received from forty-four of them. The data contained in the communications from these companies form the basis for the observations and results given in what follows.

The annual load factors of the companies' plants show a variation from 32.5 per cent to 92.2 per cent, with a median value of about 52 per cent. The monthly load factors show a variation from 40 per cent to 92.8 per cent, with a median value of about 61 per cent. The power factors of the companies also vary considerably, depending somewhat on the time of day at which they are measured. The variation is from about 70 per cent to 100 per cent, with 90 per cent as a fair average value.

There seems to be little uniformity among the companies regarding the method or basis of determining the maximum demand of a consumer. The time interval over which the demand is taken varies from the instantaneous demand to a sixty-minute demand interval. In some cases a certain percentage of the connected load is taken as the maximum demand. The fifteen-minute demand is most generally used, with the thirty-minute demand next in importance from the standpoint of general usage.

Of thirty-seven companies which take load factor into consideration in their wholesale power rate schedules, twenty-five have the Hopkinson or demand and energy charge rate incorporated in them. This indicates that the prevailing method of handling the load-factor problem is by the use of the two-charge rate. Two of the companies use the three-charge or Doherty rate, while seven use the additive rate, which depends upon the number of hours' use of the maximum demand, together with a minimum-bill qualification. This rate differs little from the two-charge rate as regards complexity, but is much less equitable to the central-station company. The substitution of the latter rate for the less satisfactory minimum-bill schedule would result in a standardization of the rates which are most equitable to both consumer and operating company.

COST OF ENERGY TO CUSTOMER

Summary of the cost of energy per kilowatt-hour at different load factors for a specific load having a maximum demand of 1,000 kw.; also increase in rate for lower load factor using 100 per cent as basic price for energy

No. of Company	Cost per Kilowatt-Hour in Dollars					Rate Increase in Percentage			
	Load Factor					Load Factor			
	100	80	60	40	20	80	60	40	20
1	0.0171	0.0178	0.0190	0.0213	0.0284	4.1	11.1	24.6	866.1
2	0.0104	0.0108	0.0116	0.0132	0.0179	3.8	11.5	26.9	72.1
3	0.0245	0.0291	0.0368	0.0522	0.0976	18.8	50.2	113.0	298.0
4	0.0100	0.0107	0.0117	0.0139	0.0202	7.0	17.0	39.0	102.0
5	0.00638	0.00672	0.0073	0.00845	0.0119	5.3	14.4	32.4	86.5
6	0.0089	0.0095	0.0104	0.0123	0.0179	6.7	16.8	38.2	101.0
7	0.0125	0.0132	0.0142	0.0164	0.0227	5.6	13.6	31.2	81.5
8	0.0122	0.0140	0.0171	0.0230	0.0395	14.8	40.2	88.5	224.0
9	0.0118	0.0128	0.0144	0.0176	0.0272	8.5	22.0	49.2	130.7
10	0.0073	0.00865	0.0109	0.0132	0.0211	18.5	49.3	80.8	189.0
11	0.00725	0.00782	0.00875	0.0104	0.0148	7.9	20.7	43.5	104.0
12	0.0070	0.0075	0.0083	0.00997	0.0149	7.1	18.6	42.5	113.0
13	0.00703	0.0077	0.00888	0.0109	0.0169	9.5	26.3	55.0	141.8
14	0.0148	0.0156	0.0169	0.0197	0.0268	5.4	14.2	33.1	81.1
15	0.0100	0.0100	0.0100	0.0108	0.0188	0.0	0.0	8.0	88.0
16	0.0094	0.0098	0.0106	0.0122	0.0168	4.3	12.8	29.8	78.8
17	0.0056	0.00593	0.00650	0.00761	0.01096	5.9	16.1	35.9	95.7
18	0.00682	0.00685	0.00688	0.00694	0.00905	0.4	0.9	1.8	32.7
19	0.015	0.015	0.015	0.015	0.015	0.0	0.0	0.0	0.0
20	0.0081	0.00845	0.0090	0.0102	0.0137	4.3	11.1	25.9	69.2
21	0.0100	0.0100	0.0100	0.0108	0.0188	0.0	0.0	8.0	88.0
22	0.0084	0.0085	0.0087	0.0090	0.0100	1.2	3.6	7.1	19.1
23	0.0130	0.0138	0.0150	0.0175	0.0249	6.2	15.4	34.6	91.5
24	0.00709	0.00735	0.0078	0.0087	0.0111	3.7	11.1	22.7	42.3
25	0.0147	0.0149	0.0152	0.0158	0.0176	1.4	3.4	7.5	19.7
26	0.00709	0.00735	0.0078	0.0087	0.0111	3.7	11.1	22.7	42.3
27	0.00957	0.00995	0.0106	0.0119	0.0154	4.0	10.8	24.4	61.0
28	0.00509	0.0056	0.00648	0.00814	0.0127	10.0	27.3	59.9	149.2
29	0.00608	0.00635	0.00679	0.00768	0.0103	4.4	11.7	26.3	69.5
30	0.0058	0.0066	0.0080	0.0107	0.0190	13.8	37.9	84.5	228.0
31	0.0069	0.00725	0.0079	0.0091	0.0128	5.1	14.5	31.9	85.5
32	0.0098	0.0102	0.0109	0.0123	0.0165	4.1	11.2	25.5	68.4
33	0.0109	0.0116	0.0128	0.0151	0.0222	6.4	17.4	38.5	103.8
Median	0.00865	0.00908	0.0105	0.01205	0.01595	5.5	14.5	32.8	86.0

Only one company bases its maximum demand on kva. rather than kw. This appears to be theoretically the proper basis for determining the maximum demand of a consumer, since the output of a central station and its distribution system depends not on the kw. of the load it is supplying, but upon the kva. The difficulty of determining the kva. demand of a consumer has probably been responsible for the apparent unpopularity of this method.

In order to get some idea of the cost to the consumer of energy supplied by these companies, the accompanying table was prepared. This table gives a summary of the cost of energy per kilowatt-hour for each company at load factors varying from 20 per cent to 100 per cent for a specific load having a maximum demand of 1,000 kw. The median values of the cost of energy in cents per kilowatt-hour have been worked out from this table and are placed at the bottom of it. These values give a fair idea of the average price of energy as charged by the central-station companies of this country and Canada.

Using the cost per kilowatt-hour at 100 per cent load factor as the basic price for energy, the increase of the rate over this basic price for the lower load factors has been determined and placed in this table.

In order to obtain a rate increase curve which would represent most typically the practice of the operating companies, the medians of the values of rate increases were found and are given in the table. This median rate increase curve and the rate increase curves of the two companies having the greatest and least variations due to lowering of load factor have been plotted on the same set of co-ordinates and show vividly the variation in the present practice of handling load factor in energy contracts.

The companies are compared on the basis of the rate increase values rather than on the actual cost of the energy because of the fact that the latter is governed almost entirely by local conditions. Items such as the price of coal, labor and supplies, distance of central stations to consumers and the nature of the lighting and power loads of the companies make a comparison on any other basis unjustifiable.

From the table and the curves it is apparent that for the particular load conditions assumed there is a very very wide variation in the rate increases of the companies. This variation is dependent to a great extent upon the ratio of the fixed charges to the operating expenses of any one company. The larger this ratio, the smaller will be the rate increase for the lower load factors, since in this case the demand charge forms a larger part and the energy charge a smaller part of the total cost of the energy than when the ratio is small.

Dependability of Electric Meters

AT A RECENT gathering of the California State Association of Electrical Contractors and Dealers in Sacramento some interesting statistics as to the dependability of electrical service meters were presented by Charles G. Johnson, State Superintendent of Weights and Measures for California. Of 80,703 meters inspected in London in 1917, said Mr. Johnson, 78,739 were found correct. Out of 86,025 inspected in Edinburgh, only 770 were found in error. Out of 29,154 inspected in Canada in 1908, 58 were in error. In that same year, in New York, out of the total of 103,236 meters inspected, there were 2,045 fast and 1,675 slow. In Massachusetts in 1908 it was found that 99.8 per cent of the 58,678 meters inspected were correct.

"Evidence such as this," commented Mr. Johnson, "could be multiplied indefinitely to prove that the vast majority of meters in use today were correct when they were put into service, and while in the case of meters concerning which complaint has been made the proportion of fast ones is naturally greater than is the case with other meters, the average error of such meters, if taken over a considerable period of time, will rarely exceed 5.5 per cent. The burden of evidence seems to prove conclusively that the public service company loses vastly more by its slow meters than it gains by those that are fast."

Profit Making Not Always Profiteering

Central Stations as Well as Manufacturers Are Entitled to a Profit When Their Product Is Made and Marketed Economically

By "KASSANDRA"

PUBLIC utilities have suffered in the past from the indiscriminate use of the words "trust" and "corporation" in an invidious sense, and, as pointed out in a recent publication, it behooves us not to make others suffer from the same kind of error. "Profiteering," for instance, is a horrid word; but let us inquire as to how profits arise and as to what makes profiteering. Profit, of course, is the difference between cost and sale price. Cost, however, is used with many meanings. "Cost" sometimes means the bare cost of the raw material, at other times the cost of the raw material plus labor. In still other cases interest on borrowed money is included in cost but not any return on the rest of the investment. However, it is clear that for our purposes cost should include all these items, provided that the return on the investment is a reasonable one. An unreasonable return may be obtained in either of two ways—first, by getting the cost down; second, by putting the price up.

Is profiteering by getting the cost down in any way reprehensible? Is it wrong to make profits by reducing costs? If a manufacturer or distributer sells the goods at the lowest price for which any one else will sell goods of the same quality, is any percentage of profit immoral or wrong in any way? Should not such a manufacturer or distributer be allowed and encouraged to make 100 per cent or more on his investment, so long as he sells the goods at prices as low as those of his competitor? Why should he not be entitled to the whole saving that he has made? No matter what he does with it at first, the public in the end gets some advantage from his savings.

If, on the other hand, a man who sells at the lowest price is punished in any way or discouraged by an excess-profit tax or a supertax, he suffers and in the end the public also suffers. It is clear that the making of profits by reducing costs is not wrong, but how about profits made by raising the price? *i.e.*, suppose the manufacturer doesn't make any savings but just raises prices. Now, whether this is profiteering or not would seem to depend on whether people are obliged to buy of him rather than of his competitor. If they don't buy, then he makes no profit. If, however, people do buy, why is it they buy of him rather than of any one else? Is it not the case that this manufacturer supplies a quality of service which is worth more to the purchaser than they can get elsewhere? It may be said that all the manufacturers might get together and all charge $11 for shoes which cost only $10, but this points to the conclusion that there is never any profiteering (that iniquitous profiteering) on the part of independent manufacturers but that profiteering exists only as the result of a trade combination or monopoly. However, most businesses are open to all. Suppose the hundred or thousand or ten thousand shoe manufacturers should all get together and start to profiteer. Why can't the trunk makers and harness makers start in to make shoes? They can in a short time make shoes at as low cost as the others because they have or can get fairly easily the necessary leather and labor and plant. If, however, they refuse to do it, who is the iniquitous profiteer? On the one hand, we have the shoe manufacturer who will sell the public shoes for $11. On the other hand, we have the rest of the leather people who could make shoes for $10 but who refuse to make them at any price—or perhaps the trunk maker says, "All right, I'll make a thousand pairs of shoes if you will pay me $15 a pair."

Some people have made profits during the war, but are we not glad that they did the work? If the profiteers had foreseen a penalty for profiteering, would they not have said: "We had better sit tight and do the way the rest of the people do; then we won't be committing the crime of profiteering." And how would we have won the war?

We were mighty glad to get people to work. Is not the man who worked and made a profit deserving of more credit than the man who didn't work? Of course, the man who worked and gave his service and perhaps his life for the country without any reward at all is the man who deserves the most credit, but he deserves his credit for the work he did and not for the profit he refused to take.

Let us put these in the following order: First, the soldier who gave his life or the citizen who gave his property without return; next, the men who did the work cheaper than any other would do it at the time and made the maximum of profit by economy and skill in manufacture; next, the less skillful manufacturer who did the work and covered the costs and a return on the investment but made no profit. The men last named did less for the country than the men who made profits which now add to the total wealth of the country. Finally, lowest of all, are the men who sat tight and did nothing but tried to discourage profits and economies by threatening that they would "get" the profiteers.

Investigation always shows that the so-called profiteers (outside of a few illegal monopolies) have made their money by economies in manufacturing distribution and that at the time they sold their goods they were selling them at or below the price at which any one would then sell goods of equal quality. If a central station can keep its prices down to what the normal central-station operator can do, and can then make savings in addition by care and skill, is it for the public advantage that it should be accused of profiteering, or should it be encouraged by being allowed to pay high dividends and to attract more money to the business?

Digest of Electrical Literature

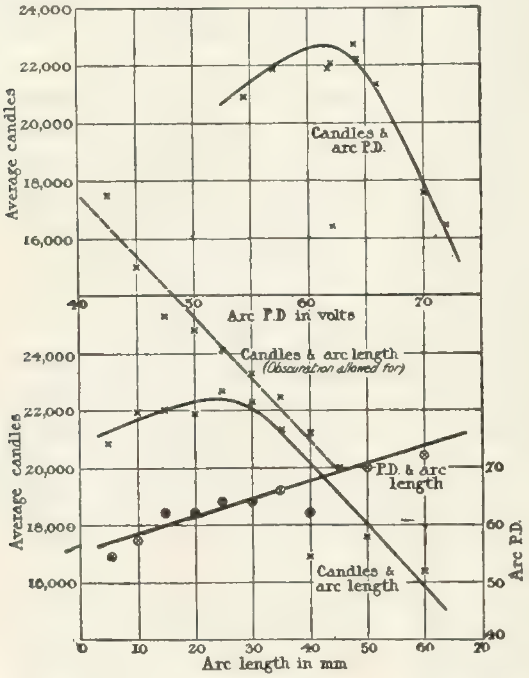
Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Recent Progress in Armature Design.—**Wolff**—This article forms a review of a great number of recent patents relating to details of armature winding. Descriptions are given of various arrangements for cutting down eddy-current losses in heavy conductors by splitting the copper in several parallel bars, which are insulated from each other and systematically transposed.—*Helios*, March 30, April 6 and 13, 1919.

Lamps and Lighting

Carbon Arcs for Searchlights.—**C. G. Patterson, J. W. T. Walsh, A. K. Taylor** and **W. Barnett**.—The object of the investigations as stated by the authors was (a) to develop the best method of testing carbons in order to prove their value for searchlights, (b) to compare the relative qualities of existing carbons other than flame carbons for producing high-intensity searchlight beams, (c) to determine what improvements can be made either in the carbons themselves or in the methods of burning them. As shown in the illustration, the potential difference and the arc lengths increase or diminish together, but a large change in these quantities did not affect the average candlepower. In order to obtain under working conditions a given amount of light from a given positive carbon, it is necessary to pass through it a given current, the voltage across the arc and the arc length required to avoid hissing being immaterial. A positive carbon taking 200 amp. at 70 volts—i.e., 14 kw.—will emit the same light as one taking 200 amp. at 100 volts, or 20 kw. From the point of view of light emission from the positive crater, the extra 6 kw. is wasted. In order to insure, however, that all but a very small proportion of the light directed toward the mirror from the positive carbon misses the negative, it is necessary for the arc length to exceed a certain minimum figure and to obtain carbons which will take the maximum current through the positive crater at this minimum arc length, thus securing all the light possible with the minimum amount of dissipation of heat at the arm.—London *Electrician*, Dec. 5, 1919.



VARIATION OF CANDLEPOWER WITH VOLTAGE AND ARC LENGTHS

Report of the Committee on Progress, Illuminating Engineering Society.—This is a very complete report on the progress made in illumination during the past year. The report can best be described by briefly enumerating the subjects taken up as follows: Gas, electric incandescent lamps, arc lamps, lamps for projection purposes, influence of the war, street lighting, other exterior illumination, interior illumination, fixtures, photometry, physics, legislation, physiology, illuminating engineering and books. The report was prepared by the committee under the chairmanship of Francis E. Cady.—*Transactions I. E. S.*, Nov. 20, 1919.

Renewed Lamps.—A process which is said to be due to F. Harrison for the renewal of burned-out metal-filament lamps is described in considerable detail. This process is now in commercial use in a London factory.—London *Electrician*, Dec. 26, 1919.

Home Lighting—How to Make It Comfortable and Effective.—**A. L. Powell** and **R. E. Harrington**.—Attention is called to the considerations which enter into the design of an illuminating system for the home. The light must be comfortable and without glare. The fixtures should be artistic and harmonize with the surroundings. Color effects may also be readily obtained at a reasonable cost. Each room in the home is then taken up and suggestions made for its adequate and proper illumination.—*Transactions I. E. S.*, Nov. 10, 1919.

Generation, Transmission and Distribution

Selecting a Switchboard for a Plant of Moderate Size.—**G. E. Wendle**.—It is shown how a 30,000-kw. central station came to select a truck type of switchboard, and an analysis of the local conditions and description of the equipment are given.—*Electrical Review*, Dec. 20, 1919.

Hydro-Electric Power Collection.—**Charles P. Steinmetz**.—The author discusses a future power development in which very simple generators are located at many small hydraulic power sources. These pump power to central stations, where it is controlled and fed into power line. This paper amplifies former articles on the subject by Dr. Steinmetz.—*General Electric Review*, November, 1919.

Induction Generator Plants.—**C. M. Ripley**.—In some instances, and under specially favorable circumstances, the induction-generator plant with little or no attendance may be justified. The author presents a brief description of such of these as have been in operation for a sufficient time to demonstrate their practicability. If the prices of coal and labor continue to rise, it is possible that the small induction-generator plant may soon be economically more feasible than it is at the present time. The table gives data concerning the number of plants in practical operation that were too small to be profitably developed as synchronous generating plants.

Name of Plant	Kilowatt-Hours Per Year	Head-Feet
Pacific Power & Light Company, drop plant (1,400 k.w.)	6,000,000	50
San Joaquin Light & Power Corporation, Crane Valley Plant (1,000 kva.)	3,500,000	80-120
San Joaquin Light & Power Corporation, Reservoir 1-A plant (425 kva.)	3,000,000	39
Greenfield Electric Light & Power Company, Green River plant (100 hp.)	250,000	8½ - 11½
Taylor Wharton Iron & Steel Company	150,000	14
Total	12,900,000	

—*General Electric Review*, November, 1919.

Preventing Versus Correcting Poor Power Factor.—H. Goodwin, Jr.—The author advocates considering every detail in connection with poor power factor as worthy of attention. By carefully testing motors and keeping the records it is possible to prevent over-motoring, which is the chief cause of low power factor.—*General Electric Review*, November, 1919.

Peat for Electric Generating Plants.—E. Philippi.—The great importance of peat for the future coal-saving program of Germany is emphasized. The author estimates that the peat reserves in Germany represent an energy of 1,790,000,000,000 kw.-hr., or a supply of 2,050,000 kw. uninterruptedly for 100 years if utilized in large steam plants.—*Elektrotechnische Zeitschrift*, Aug. 28, 1919.

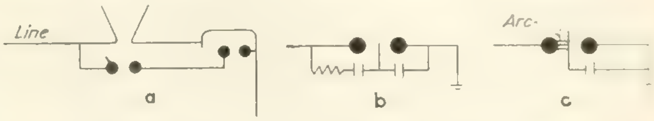
Limitations of High-Voltage Transmission—T. A. Worcester.—In dealing briefly with the developments of higher voltages for transmission purposes the author shows this growth by means of the accompanying table.

INCREASE IN TRANSMISSION VOLTAGES

Year	Maximum Voltage	Year	Maximum Voltage
1894	11,400	1907	104,000
1896	22,000	1909	140,000
1900	54,000	1912	150,000
1901	80,000		

He says that at the present time there are about fifty companies operating at 70,000 volts or above and that their systems aggregate some 14,000 miles (22,500 km.) of single-circuit line on which over 2,000,000 suspension insulator disks are used and to which over 2,000,000 kw. in generating capacity is connected. One of the chief difficulties to be dealt with in the use of extra high voltage is the supply of the required charging kva. from one generator when the line is run at light load. The charging kva. of a 200-mile (320-km.) 60-cycle line operating the 220,000 volts at the generating end would be approximately 50,000 kva. Making use of the standard type of any suspension disks, it will be necessary to use twelve or fourteen units for the 220,000-volt lines. In this case it is necessary to reduce the voltage stress over the insulated disk next to the line. Various schemes of grading have been suggested, and the prospects are good that some practical arrangement of this sort will be worked out in a short time. Regarding the expense of insulating the lines for the extra-high-voltage transmission, this is not difficult from the point of view of the expense, since the extra high voltage is only economical when large amounts of power are involved. To illustrate, a 250-mile (400-km.), 110,000-volt line for 10,000 kw. cost $2,500,000, whereas a line of the same length operating at 220,000 volts with 100,000 kw. capacity would cost $7,500,000, an increase in output of ten to one with an increase in cost of three to one. In one case the line investment is $250 per kilowatt and in the other $75 per kilowatt.—*General Electric Review*, November, 1919.

Lightning.—F. W. Peek, Jr.—This is the second article on the subject by the author and takes up the effect of lightning voltages on arrester gaps, insulators and bushings on transmission lines. The author calls attention to the necessity of producing lightning arresters of very high speed if steep wave-front impulses are to be removed before damage is done to apparatus. A number of interesting gap combinations are shown. Two sphere gaps used in *a*, one of which is covered and the other exposed to the weather. These gaps are balanced to break down simultaneously, and the spark of the outside one is transferred into the horn when it rises and breaks. In *b* is shown a selective scheme whereby the voltage distribution depends upon the frequency. For steep wave fronts the resistance has the effect of opening the circuit on that side. The gap on that side breaks down, as at *c*. The spark-over voltage thus changes with the steepness of wave front.—*General Electric Review*, November, 1919.



Equipment of Spanish Hydro-Electric Power Systems.—A description of the hydro-electric plants and transmission system of the Sociedad Hidroelectricà Espanola, which is the second largest development in Spain, its production in 1917 amounting to 143,000,000 kw.-hr.—*Southwestern Electrician*, December, 1919.

What the Adoption of Higher Steam Pressures Will Mean.—F. R. Parsons.—The writer considers the effect of higher steam pressures on standard boiler design, on the materials used and on reciprocating engines. He states that in connection with reciprocating engines the use of increased superheat corresponding to pressures of 500 lb. (35 kg. per sq.cm.) or so would make more difficulty than the higher pressure.—London *Electrician*, Jan. 2, 1920.

Traction

Electric Locomotives for Industrial Purposes.—Kenneth Andrew and Walter Fixter.—A general description of the advantages and adaptability of the storage-battery trolley and combination storage-battery and trolley types of locomotives.—*Journal Engineers' Club of Philadelphia*, January, 1920.

Installations, Systems and Appliances

Modern Electric Furnace Practice as Related to Foundries in Particular.—W. E. Moore.—It is said that since 1913 the number of electric furnaces employed in the steel industry in the United States and Canada has risen from 19 to 335, practically all of which are of the arc type. After giving particulars regarding the operation of acid and basic furnaces, the author enumerates the superior properties which have created the present demand for electric steel. He points out the advantages of the electric furnace over the open-hearth furnaces in steel melting and states the features of the various classes of arc furnaces which have made that type so commonly employed in the field. The crucible and converter processes are briefly described, and it is shown how the acid type of furnace is the best for foundry work. Comparative operating costs of producing liquid steel by the converter and electric furnace processes are then given, which bring out the marked economy of the latter. The paper concludes with notes on the employment of the electric furnace in malleable-iron foundries and on the selection of the most suitable type of furnace for a given installation.—*Paper presented at the meeting of the American Society of Mechanical Engineers*, Dec. 5, 1919.

Electric Propulsion of Merchant Ships.—W. R. EMMET.—The author states that improvements in electrical designs have been developed which have led him to the belief that electric drive is justified in all large ships and that it will very soon develop a wide application. With the operating experience now available as a result of the electric drive on warships, the writer points out in detail the advantages of electric drives in the matter of efficiency, economy, reliability, etc.—*Paper presented at meeting of the Society of Architects and Marine Engineers*, Nov. 14, 1919.

Electricity in Tin Mining.—D. M. W. HUTCHISON and W. J. WAYTE.—This paper is based on experience by the authors in tin mining in the Federated Malay States. It contains extensive tables showing the power required for various operations and the cost of electrical energy to perform this work.—London *Electrician*, Dec. 26, 1919.

Electrophysics and Magnetism

Criteria for the Testing of Magnetic Materials.—The writer divides the necessary tests into two parts, (a) the tests on materials and (b) the tests on products. He then applies tests which are directly related to his requirements. In a material test the material only is involved, but in the product test there are involved conditions due to the design and the manufacture as well as those due to the material.—London *Electrician*, Jan. 2, 1920.

Magnetic and Mechanical Testing of Iron.—It is pointed out that many mechanical defects in iron used for various purposes can best be detected by the magnetic properties.—London *Engineering*, Nov. 28, 1919.

Units, Measurements and Instruments

Testing Transformers by the Alternating-Current Potentiometer.—DOUGLAS C. GALL.—In testing instrument transformers it is pointed out that it is difficult to measure alternating voltages to 0.001 volt with a voltmeter. With the alternating-current potentiometer the writer states that only three readings are necessary for the determination of phase displacement and ratio of transformation. The three readings of voltage are self-checking, inasmuch as they form three sides of a triangle which should close.—London *Electrician*, Nov. 28, 1919.

Telegraphy, Telephony and Signals

Telephonic Transmission of Superimposed Circuits.—KAZUKIGO OGANA.—In this article is contained a mathematical discussion of the possibility of increasing traffic facilities by superimposing on two existing telephone lines a standard circuit. In one case under discussion repeating coils are used at both ends of the line where the phantom circuit is attached. The other system under consideration makes use of retardation coils to the middle points of which are connected the phantom lines. —*Research Bulletin Number Seventy-eight, Department of Communications*, Tokio, Japan.

The Fessenden "Pelorus" (Wireless Compass).—REGINALD A. FESSENDEN.—The present article gives a brief description of the various types of the Fessenden "pelorus," indicating the causes of the erroneous readings which have been obtained and describing the methods which must be used to obtain accurate results. —London *Electrician*, Dec. 19, 1919.

Vacuum-Tube Amplifiers. — W. SCHOTTKY. — The author claims to have been one of the first Germans to take up the study of vacuum-tube amplifiers from an engineering standpoint, and in this paper he gives an outline of the results of his studies. In the first part of the article the functions of the input transformer are discussed, and analytical expressions are derived which define the conditions of optimum amplification when adapting a given tube to a certain amplifier problem. The second part deals with the predetermination of the tube constants from certain constructional data of the tube. The problem is reduced to a unit-dimensional one by introducing the so-called "effective potential in the grid plane" as a single variable. Expressed in terms of the plate potential and the potential values on the control elements, this "effective potential" is a linear function whose coefficients depend only upon the design of the tube and the electrodes. It is shown that the optimal amplification of a cylindrical tube with one grid is proportional to the square root of the plate battery voltage and to the square root of the length of filament and grid, and inversely proportional to the square root of the distance from filament to grid. The theory is checked by measurements on a Siemens-Halske tube of given design.—*Archiv für Elektrotechnik*, May 5, 1919.

Miscellaneous

The German Aluminum Industry.—Upon incentive from the German Department of War Materials a number of big aluminum works were erected during the war, the electric energy being supplied over a system of 100-kv. transmission lines connecting the large steam plants in the lignite districts with the respective works. In a recent book by Tröger the future of this war industry is discussed. The German production is estimated at 40,000 tons a year as compared with 73,000 in the United States and Canada and 80,000 in other European states. Tröger finds that the cost of production will be 0.51 mark per kilogram higher in Germany than in other countries and that the price ratio of aluminum to copper will be 1.60. The latter figure shows that aluminum will be unable to compete with copper for conductors since the weight ratio of corresponding conductors is as 1:1.5. It is therefore proposed to equalize, by artificial means under control of the government, the price of German-produced aluminum with that of the imported ware, and also to keep the price ratio of aluminum and copper equal to 1.50.—*Elektrotechnische Zeitschrift*, Sept. 11, 1919.

The Human Body as a Conductor of Electricity.—M. GILDEMEISTER. — Extensive investigations, including resistance measurements with direct and alternating current, have led the author to the conclusion that the high direct-current resistance and the leading phase angle observed in alternating-current measurements are due to the electrolytic polarization of the skin. *Elektrotechnische Zeitschrift*, Sept. 18, 1919.

Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Methods of Electrolysis Survey and Experiment

A STUDY is being made of improvements possible in the methods of carrying out the surveys leading up to work in mitigation of electrolytic corrosion, and particular attention is being given to the methods of measuring the current flowing in pipes and the leakage of current from pipes, to replace the old method of measuring differences in voltage between the metal structures concerned. A number of instruments have been built, and, having given satisfactory results in laboratory tests, they will shortly be tried out under field conditions. Because of the contradictory character of the evidence as to the conditions under which corrosion of lead cable sheaths occurs, it has been necessary to carry on a great deal of laboratory work, as, for example, to determine the variation of corrosion with varying current densities in earth, sand and water. In agreement with previous results, it has been found that the corrosion per unit of current is greater when the actual current density is small. Experiments have been carried on to simulate the condition which occurs when parts of a piping system are alternately positive and negative so that at times the current flows into and at other times out of the metal. The relative amount of corrosion has been found to decrease very rapidly when the portion of time during which the specimens are positive is decreased, and it appears probable that in such cases some of the metal is actually re-deposited on the specimen when the current is reversed, although it has not yet been possible to prove this conclusively.

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

ALUMINUM ALLOYS, MECHANICAL PROPERTIES AND RESISTANCE TO CORROSION OF.

Light aluminum alloys of several compositions belonging to each of the three ternary series, aluminum-magnesium-copper, aluminum-magnesium-manganese and aluminum-magnesium-nickel, were rolled out into sheet and tested in tension as cold-rolled, after annealing, and after heat treatment, consisting of quenching from about 500 deg. C. and aging at ordinary temperature. The alloys of the aluminum-magnesium-copper series were superior in all conditions to those of the other series, in respect to tensile properties. The tensile properties of the aluminum-magnesium-copper series may be much improved by appropriate heat treatment. The alloys of the aluminum-magnesium-nickel series are also improved by heat treatment, but not in the same degree as the former series. The alloys of the aluminum-magnesium-manganese series are not improved by heat treatment. Samples of representative compositions of each series were exposed to corrosion in the salt spray test, and the appearance of the samples observed after one and after two months' exposure to the action of the salt spray. The alloys of the aluminum-magnesium-manganese series [illegible] corrosion in general better than those of the other series, and this agrees with other experience in the corrosion of such alloys. The heat-treated specimens of the aluminum-magnesium-copper series were, however, but little inferior to those of the manganese series in their resistance to corrosion. The annealed and the cold-rolled samples of that series were the least resistant to corrosion of any of the alloys tested. Hard-rolled commercial aluminum corroded much more than any of the alloys. Annealed aluminum was more resistant to corrosion than the hard-rolled aluminum but did not compare favorably with most of the alloys.—*P. D. Merica, R. G. Waltenberg and A. N. Finn, Bureau of Standards, Washington, D. C.*

CABLES, DIELECTRIC LOSSES IN.

There has been considerable discussion during the past two years on the subject of dielectric losses in underground cables. Very little real progress appears to have been made, although several large cable users are planning to incorporate in their cable specifications a clause relating to dielectric losses. The committee has been advised that cable manufacturers have been working on this prbolem with a view to standardizing equipment and methods of measurements, and it is recommended that succeeding committees give this matter their attention.—*A. I. E. E. Committee on Transmission and Distribution.*

FURNACE, ELECTRIC, FOR THERMAL ANALYSIS.

Rosenhain in 1915 published a description of a furnace for the thermal analysis of metals, operating on a new principle. Instead of varying the temperature of the furnace containing the specimen under investigation, he heated the furnace so as to produce a uniform temperature gradient along its length and moved the specimen through the furnace. Some improvements have been made in the design of this furnace, and a simple method of mounting has been devised which gives highly satisfactory results using specimens of less than 2 grams weight.—*H. Scott and J. R. Freeman, Jr., Bureau of Standards, Washington, D. C.*

GLASS, THERMAL EXPANSIVITY OF.

At the request of the War Industries Board the thermal expansivity of some optical glass was determined for use in naval searchlight mirrors. The decision as to whether or not the glass was suitable rested exclusively upon its thermal expansivity. With the stretched wire dilatometer constructed for the purpose expansions were measured up to 300 deg.—*A. W. Gray, Milford, Del.*

INSULATING MATERIALS, LAMINATED PHENOL TYPE.

In order to determine how an electric apparatus will behave in service, it is important to know how the insulating materials upon which the conducting parts are mounted will be affected by the electrical conditions involved. The permanence, strength and numerous other mechanical and electrical properties, such as the effects of moisture, the amount of power loss in the material, etc., are all factors of importance in determining the suitability of insulating material for a given service. Extensive investigations have been made during the war, and the results of the work have been such as to point the way to improvements in methods of manufacture and quality of products. A publication now in preparation by the bureau is entitled "Properties of Insulating Materials of the Laminated Phenol Type." In this work the bureau has had the cordial coöperation of the manufacturers of this class of materials and the navy and Signal Corps.—*Bureau of Standards, Washington, D. C.*

PHOTOMETRY, PHOTOELECTRIC, BY THE NULL METHOD.

In connection with the color standardization work of the National Bureau of Standards, it is desired to have available a number of independent methods of making spectrophotometric determinations, especially in the visible part of the spectrum; for it is generally admitted that the fundamental basis of color specification is spectrophotometry. To supplement the other methods at present in use at the bureau, and especially to overcome the well-known uncertainty of measurements by these other methods in the blue and violet, a method has been developed for accurate and convenient photoelectric spectrophotometry, suitable for routine determinations. The null method is used, and two photoelectric cells and the proper batteries are connected in a sort of Wheatstone bridge arrangement, with the electrometer as the indicator. Radiant energy from a 600-watt gas-filled incandescent moving-picture lamp, after dispersion through a Hilger constant deviation spectrometer, is incident upon one of the photoelectric cells. Radiant energy from a 14-watt gas-filled lamp is incident on the other photoelectric cell. The photoelectric currents generated in the two cells by the radiant energy from the two lamps tend to nullify each other so far as charging the electrometer is concerned, and by proper adjustments the two currents may be made exactly equal.—*K. S. Gibson, Bureau of Standards, Washington, D. C.*

[This is in line with the modern endeavor to do away with dependence upon the human eye in photometry.—EDITOR.]

RUBBER, DIRECT DETERMINATION OF INDIA RUBBER BY NITROSITE METHOD.

The method of determination of india rubber described by Wesson was applicable only to compounds containing new rubber, and even for these was not always satisfactory. By suitably varying the procedure it has been found possible to extend the usefulness of the method to compounds containing reclaimed rubber and substitutes, as well as lamp-black and bituminous substances. The method is based upon the formation of rubber nitrosite, which is purified and burned in a combustion furnace, and the carbon dioxide formed is calculated to rubber.—*John B. Tuttle and Louis Yurow, Bureau of Standards, Washington, D. C.*

SOUND, A STANDARD OF.

A simple appartus has been constructed and tested which bids fair to furnish a standard of sound of any desired pitch and particularly free from overtones. The apparatus consists essentially of a trap made of pure glass, similar to a trap used with a mercury-vapor pump. The air may be heated with a Bunsen burner. By supplying heat electrically at a constant rate the pitch may be kept constant [illegible] time.—*Charles* [illegible]

STEEL, ELECTROLYTIC RESISTANCE METHOD FOR DETERMINING CARBON IN.

Method and apparatus have been devised for rapidly and accurately determining carbon in steel by absorbing in a solution of barium hydroxide the carbon dioxide resulting from direct combustion of the metal in oxygen and deducing the carbon content from the change in electrical resistance of the barium hydroxide solution.—*J. R. Cain and L. C. Maxwell, Bureau of Standards, Washington, D. C.*

STEEL—LOCATION OF FLAWS IN RIFLE BARRELS BY MAGNETIC ANALYSIS.

This investigation was undertaken for the purpose of determining whether an application of magnetic analysis was practicable for the detection of flaws in rifle-barrel steel. By means of apparatus especially constructed for the purpose a large number of bars were explored for magnetic uniformity along their length. In spite of the fact that these bars were taken from material which had previously been rejected as the result of drilling tests, not one was found which contained a pipe. The results obtained, however, demonstrated that the method is amply sensitive to detect and locate flaws. Further study is necessary to determine to what degree the sensitivity of the apparatus should be reduced in order not to cause the rejection of material which is satisfactory for all practical purposes and also to determine the type and magnitude of the effect which will be produced by a pipe. For this reason the work is being continued by the Winchester Repeating Arms Company, which coöperated in the investigation and at whose plant the apparatus has been installed.—*R. L. Sanford and W. B. Kouwenhoven, Bureau of Standards, Washington, D. C.*

SUBMARINE RADIO.

Experiments were made by the bureau in co-operation with the Navy Department to determine the possibility of communication under water. Using a coil aerial instead of an antenna it was found entirely feasible to communicate with the submarine and all parts of the equipment entirely submerged. The coil used was a single turn of wire attached on the outside of the submarine. The coil has a number of advantages over the antenna for submarine uses. The wave length of an antenna circuit changes while the submarine is submerged, and the antenna does not function at all when completely submerged. The coil circuit, however, does not change in wave length during or after submergence. The depth of submergence possible increases with wave length. Using this simple device, signals transmitted from the other side of the Atlantic were easily received when the submarine was submerged. Transmission experiments were not carried very far, but it was established that the coil could also be used for transmission over a distance of 15 km. It thus becomes possible for a ship and a submerged submarine to exchange recognition signals, which is a most important advance in the functioning of submarines. The coil aërial is a satisfactory direction finder when submerged, just the same as when used in air.—*Radio Laboratory, U. S. Bureau of Standards.*

TIN, CONSERVATION OF, IN BEARING METALS, BRONZES, AND SOLDERS.

An investigation has been made regarding the possibilities of conservation of tin in bearing metals, bronzes and solders—much of the data having been obtained from questionnaires sent to representative manufacturers and users of the abovenamed alloys. Tables have been compiled showing the chemical composition and physical properties of many of the suggested alloys and also for service tests of genuine babbitt and a high-lead bearing metal. Tentative recommendations for standard grades of bearing metal are also included. Proper solders for various industrial uses can be recommended, and a new solder has been developed consisting of a preponderance of lead with small amounts of tin and cadmium.—*G. K. Burgess and R. W. Woodward, Bureau of Standards, Washington, D. C.*

VARNISHES, INSULATING, ELECTRICAL CHARACTERISTICS OF.

An investigation is in progress with the object in view of determining the electrical characteristics of high-temperature varnishes and shellacs now on the market, especially their dielectric strength and losses. An attempt will be made to produce a super-varnish that will retain its physical properties and electrical strength for temperatures up to 600 deg. At the same time the effect of heat on dielectric losses will be investigated.—*H. Logan, New York City.*

WELDING, ARC, AUTOMATIC MACHINES.

The skill of the operator or the human element is still the most vital factor in producing uniform high-grade joints. We have to depend upon the operator in maintaining the constant length of arc and upon his judgment in determining the most desirable current adjustment with the variable conditions of the work on hand. Automatic self-feeding welding machines have been recently designed and are being experimented with. Much usful research and development can be done along these lines.

WOOD AS INSULATOR.

We have abstracted moisture from wood by the dry-kiln process, which is rather slow but not particuarly expensive, and which, although reasonably effective, will not take out the last particle of moisture. A more effective process is to heat the wood in a steam-jacketed vacuum tank from which the moisture as it evaporates is continually pumped out and condensed. This method will probably take out more moisture than any other, but is quite slow and expensive on account of the expensive apparatus required, the cost of attendance and the other operating items in connection with operating a steam plant for heating and a vacuum pump. Apparently the reason for the slowness of this process is that when the sticks of wood are in the vacuum tank there is only a very slow transfer of the heat from the steam jacket through the vacuum to the wood. The insulating compound is ordinarily injected into the wood by placing the pieces to be treated in a tank to which the melted insulation is admitted and sucking the air out of the pores of the wood by means of a vacuum pump until no more air can be pumped out. The vacuum is then released and pressure put on the tank, which forces the insulating compound into the wood. The difficulty in carrying on this process consists in determining how much pressure should be applied and for how long a time in order to impregnate wood of various kinds to various depths.—*H. H. Cochrane, Butte, Mont.*

Suggestions for Research

CABLES, TEMPERATURE MEASUREMENT IN.

The A. I. E. E. Standardization Rules prescribe a certain upper temperature limit for cables, but there seems to be no practical method available at present for actually measuring the core temperature of a high-tension cable in operation. A research into the possibilities of direct or indirect determination of this temperature will be of great value to the industry. This point was brought out at the last A. I. E. E. convention.—*Editorial Suggestion.*

FURNACE, ELECTRIC, POWER-LIMITING DEVICE.

Some steel plants purchase electric energy for furnace operation from power transmission or distributing companies on a maximum-demand basis. Sometimes a peak load comes simultaneously on several furnaces, thus unnecessarily increasing the monthly bill. A device is desired which not only would warn of the approach of the desired maximum demand but would automatically cut down the load on one or more furnaces at will, not allowing the total load to exceed the agreed value. Reactance coils connected into the main circuit in sections by means of automatic contactor switches are not recommended because the power factor is low as it is, and the tendency is to penalize the customer for it.—*Editorial Suggestion.*

INSTRUMENTS FOR AEROPLANES.

Two instruments which it would be very desirable to have on an aeroplane would be one giving the speed of the plane relative to the ground (not relative to the air) and one showing the altitude of the plane above the ground. Pilots flying at night with a barograph know only their altitude above sea level, and as they may not know the character of the ground over which they are flying, when they fly at low elevations (1,000 ft. to 2,000 ft. [300 m. to 600 m.] above sea level), they are not at all certain that they are at a safe altitude.—*E. H. Sherbondy, Bureau of Aircraft Production, Washington, D. C.*

INSULATORS, HIGH TENSION.

Progress in the design of high-tension insulators must provide for (1) reduction of porosity to the lowest possible limit, (2) joints designed to avoid cracking from expansion and contraction, and (3) ample mechanical strength.—*A. I. E. E. Committee on Transmission and Distribution.*

LIGHTNING ARRESTERS AT HIGH ALTITUDES.

The question of flashover ratings at high altitudes is steadily becoming of greater importance. In the past lightning-arrester spark gaps in the Colorado district and other similar high places have required settings far beyond those indicated by the change in air density, temperature, etc. It is possible that other factors such as waves of short length in the sunlight, ionization by mineral deposits, etc., have an effect. College students, instructors and engineers in the West who have the opportunity of working at high altitudes, say along transmission lines, could do some valuable work in testing flashovers, calibrating sphere gaps, etc., under varying conditions of altitude, humidity, sunlight, etc.—*L. W. Chubb, Pittsburgh, Pa.*

MOTOR, INDUCTION TYPE, REACTIVE STARTER FOR.

A three-phase choke oil with a *solid* iron core is permanently connected to the slip rings of the rotor. The motor is started and reversed by applying the full voltage to the stator. At high values of slip the choke coil acts as a starting resistance, owing to heavy eddy currents. At full speed the effect of the choke coil is small. The motor may be quickly reversed at full speed, the choke coil acting as a brake. It is used in some heavy-duty drives in England, for example, in steel mills, but is very ittle known in this country. With a decided tendency towards alternating-current drives in steel mills, this simple method of control deserves serious attention.—*Editorial Suggestion.*

RADIO TRANSMISSION.

A number of research problems in radio transmission and reception that await solution will be found at the end of an article on the subject by Dr. J. H. Dellinger of the Bureau of Standards, *A. I. E. E. Proceedings.* October 1919, page 1147. Theoretical as well as experimental problems are mentioned, and the subjects include wire antennas, coil aerials and condenser aerials.

SWITCHES, DISCONNECTINC.

A case has been reported of a severe short circuit in a large hydro-electric plant, when the locking latches on some disconnecting switches were sheared off and even the supporting insulators were torn asunder by the magnetic forces and by the resulting arc and explosion. This suggests the possibility of holding the blade in place by a tension spring instead of a latch. The spring will yield, allowing the switch blade to come out, and then it will pull it in again, leaving it to the oil switch to open the circuit. Some experiments in this direction are desired.—*Editorial Suggestion.*

TRANSMISSION LINE, ARTIFICIAL, WITH ADJUSTABLE CONSTANTS.

The present type of artificial transmission line, with its fixed inductance coils and condensers, does not permit of a ready adjustment of reactance and capacity per unit strength. On large transmission systems, where new branches are being projected and new interconnections considered, it would be of great convenience to possess an artificial transmission line with easily adjustable constants. Such a device could be set up and loaded in the laboratory to correspond to a new line, and its performance directly obtained without comparatively tedious computations involving complex quantities and hyperbolic functions.—*Editorial Suggestion.*

TRANSMITTER, TELEPHONE, RELATION BETWEEN PRESSURE AND RESISTANCE.

Prof. G. D. Shepardson in his book on "Telephone Apparatus," page 101, states that published data seem to be wanting upon the relation between pressure and resistance for modern transmitters of the carbon-cell type. Here is a fruitful field for investigation with the view to a rational transmitter design.

THERMO-COUPLE, TUNGSTEN-MOLYBDENUM.

Referring to the suggestion on this subject published in the Research Section in Vol. 74, page 370, Aug. 16, 1919, I wish to call attention to the tungsten-molybdenum couple. I reported upon it briefly at the eighth international congress of applied chemistry (*Proceedings*, Vol. 26, page 505), 1912, and a further investigation would no doubt lead to some practical design of this couple.—*Colin G. Fink, New York City.*

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

Radio Stations Taken Over by Government to be Returned to Owners

BY AN executive order of the President, all radio stations and systems taken over by the federal government and now held by it under authority of executive orders of April 3 and April 30, 1917, will be returned to their owners at midnight of Feb. 29.

All restrictions that were placed on radio stations not necessary to the government for naval communications will be removed at the same time, after which the control and operation of all such radio stations will be subject to the provisions of the act to regulate radio communication approved Aug. 13, 1912.

Rocky Mountain Geographic Section of N. E. L. A. Proposed

THE New Mexico Electrical Association will withdraw from the Pacific Coast Section of the National Electric Light Association and join with the state associations of Colorado and Wyoming to form the Rocky Mountain geographic section of the national body. Action to that effect was taken at the sixth annual convention of the association, held at Albuquerque, N. M., on Monday, Tuesday and Wednesday of this week. President Ballard of the National Electric Light Association, together with William H. Onken, Jr., editor of the ELECTRICAL WORLD, attended the convention for the purpose of explaining the geographic section plan and how state associations are tied in with it and with the national headquarters at New York. As in the case of Colorado and a number of other states having effective state organizations, no change is contemplated in the activities of the state organizations, which will function as heretofore. Delegates will be appointed to meet with delegates from other state organizations in conference, and this conference committee will form the geographic section.

A very good program was provided for the meeting, and the subjects were diversified to cover the needs of the smaller utilities. Much interest was manifested in national association matters and in the visit of President Ballard. The program was as follows: Presidential address by D. W. Morgan of Las Cruces; "The Coal Situation," by D. E. Bent of Tucumcari; "Fire Loss by Electricity," by L. A. Barley of the Rocky Mountain Fire Underwriters' Association, Denver; "The Legislative Situation," by Albert Simms, legal adviser of the association; "The Outlook for Electrical Merchandising," by J. J. Cooper of the Mountain Electric Company of Denver; "The California Electrical Co-operative Campaign," by K. E. Van Kuren of the Westinghouse Electric & Manufacturing Company, Los Angeles; "The National Electric Light Association," by President Ballard; "The Electrical Outlook," by W. H. Onken, Jr., editor of the ELECTRICAL WORLD, New York; "Developments in the Industry," by B. C. J. Wheatlake of the General Electric Company of Denver; "Public Relations of Public Utilities," by J. F. Greenawalt of the Mountain States Telephone & Telegraph Company of Denver; "Battery-Charging Load," by Prof. R. W. Goddard of the New Mexico College of Agriculture and Mechanic Arts; "Lighting," by R. M. Merrill of the National Lamp Works of Cleveland, Ohio; "The Lamp Industry," by E. A. Dacis of the Los Angeles office of the Westinghouse Lamp Company; "Distributing Transformers," by D. C. Lamaree of the Westinghouse company's Los Angeles office.

E. A. Roberts of Carlsbad was elected president of the New Mexico association for the ensuing term.

Northwest Developments Await Passage of Water-Power Bill

CONSIDERABLE hydro-electric work is reported to be projected in the Northwest which will be delayed until the final passage of the pending water-power bill.

E. P. Hopson of Portland, Ore., has filed two applications with the state engineer for permits to appropriate water for commercial light and power purposes—one calling for the development of 18,000 theoretical horsepower at a cost of $1,300,000 in Crook County and the other for the development of 43,000 theoretical horsepower at a cost of $1,500,000 in the same county. It is reported that work will begin on these projects immediately after the enactment of the federal legislation now pending which will permit the utilization of water power from sources in public lands.

According to an unofficial report, the Northwest Electric Company of Portland has under consideration the erection of a five-million-dollar power plant in the North Fork of Lewis River, work to begin this summer.

Interconnection Proving Its Worth

HYDRO-ELECTRIC companies in New England are handicapped at this time by low water, due in large measure to the freezing of small tributary streams in their upper watersheds, but every possible effort is being made to conserve the joint resources of the water-power and steam companies. Interconnection is playing a helpful part here, notably between the New England Power, Boston Edison, Eastern Massachusetts Electric, Narragansett Electric Lighting, Turners Falls Power & Electric, Connecticut Power and Hartford Electric Light companies and the steam and hydro-electric installations of the Connecticut Light & Power Company. The normal rating of the new Stevenson hydro-electric station of the Connecticut Light & Power Company is 18,000 kw., but this was reduced by low water last week to about 5,000 kw. or 6,000 kw. With the Housatonic River responding to warmer weather, this plant will carry at least 75 per cent of the important industrial load of the company in the Waterbury-Bristol district. For a time last week the Worcester Electric Light Company was obliged to cut its supply of energy to the New England Power Company, but this was resumed Monday.

News in Brief

Summary

of Important Happenings in the Industry During the Week

There has been relatively little movement of electrical material in the East this past week. Freight embargoes, delayed traffic and a general slackening in actual electrical construction work because of the cold have kept business on a lower level than has been occupied for some time. Delayed deliveries are keeping raw materials from the mills and causing finished products to pile up in warehouses. In most cases demand is limited only by supply. Especially do shortages exist in all the conduits, wiring porcelain, porcelain for switch bases and cut-outs, lamp and heater cords, flexible armored conductor, metal molding, labor-saving devices and hollow ware. The demand is high on all these articles and also for sewing machines, tape, line material, heavy cooking devices, lamps, refrigerators and industrial trucks, although the supply of the latter is in fair shape. Price advances have been applied to loom, Torrington vacuum cleaners, Edison storage batteries, Westinghouse turbines, metal molding and cotton insulating materials.

Collections are falling off a bit because of tight money and poor mail service and are being watched closely by jobbers. Building plans for spring construction are progressing at a good rate all over the country.

The Hydro-Electric Power Commission of Ontario is endeavoring to purchase energy to supply the needs of its power customers. It is reported to be 40,000 hp. short of its contract requirements. An increased power rate is likely to follow any purchase of electricity by the commission.

President Ballard of the N. E. L. A. was welcomed warmly at Atlanta by members of the Southeastern Section.

The Electrical Credit Association of Chicago has decided to change its name and will probably become the Central Division of the National Electrical Credit Association.

That farm-lighting plants offer a big field for electrical jobbers was brought out in the course of a meeting of the Central Section of the Electrical Supply Jobbers' Association at Chicago. W. R. Herstein of Memphis was elected chairman for the ensuing year.

All the radio stations and systems taken over by the federal government in the war will be returned to their owners at midnight of Feb. 29 and the pre-war provisions governing such plants will thereafter be in force.

The stockholders of the Hartford (Conn.) Electric Light Company have voted to purchase the Connecticut Power Company, thus facilitating both expansion and economy.

As the result of vigorous action by public officials, public utility executives and business men the outlook for an adequate coal supply in the New England States is more encouraging.

The interconnections now existing among New England electric companies have proved of great value in meeting the conditions of inadequate power supply caused by frozen streams.

Considerable hydro-electric development in the Northwest, including two or three large projects in Oregon, awaits the passage of the water-power bill now in its last Congressional stages.

The Society for Electrical Development announces renewed activity among its members following the period of curtailment imposed upon them by the war policy of retrenchment in expenditures.

At a hearing before the President's Coal Commission the public service utilities protested against the coal operators being permitted to pass on to them the increase in price occasioned by the 14 per cent raise in miners' wages, as well as against recent confiscations by the Railroad Administration of fuel consigned to them. Representatives of the National Electric Light Association declared their adhesion to the policy of summer storage of coal in still greater measure if this can be made feasible.

At the sixth annual convention of the New Mexico Electrical Association, held in Albuquerque this week, it was determined that the association would withdraw from the Electric Light Association and join with the state associations of Colorado and Wyoming to form the Rocky Mountain geographic section of the national body. E. A. Roberts of Carlsbad was elected president of the association.

Important meetings scheduled for early dates are: Commercial Section, Indiana Electric Light Association, Fort Wayne, Ind., March 4; Southwestern Electrical and Gas Association, Galveston, Tex., May 13, 14 and 15; Ohio Electric Light Association, Cedar Point, Ohio, July 13 to July 16; Oklahoma Utilities Association, March 9, 10 and 11.

President Calvert Townley of the A. I. E. E. in his address at the midwinter convention of that body, held in New York this week, urged strongly that engineering bodies should make their influence felt in public affairs. He dwelt on the accomplishments of the Engineering Council and discussed a plan already in process of organization for obtaining representation of the engineering bodies in civic and other public movements.

Herbert C. Hoover in his inaugural address as president of the American Institute of Mining and Metallurgical Engineers discussed at length the economical situation of the nation.

The fifth annual meeting of the Associated Manufacturers of Electrical Supplies will be held in New York City on March 18. Section meetings will be held previously.

In an endeavor to interest factories in greater light intensity as a vital factor in increased production, the Illuminating Engineering Society is to assist and sponsor a committee of ten.

The Consumers' Power Company of Michigan is planning a new steam station with a probable rating of 40,000 kw. for operation on its interconnected system of hydraulic and steam plants.

Waterwheels of Allis-Chalmers build, resembling ship propellers in appearance and designed to give high speeds at low heads, have been installed in the Plainwell (Mich.) station of the Consumers' Power Company, where 164 r.p.m. at 12-ft. head is obtained from them.

A conference of the engineers of the California State Railroad Commission was held in San Francisco on Feb. 17 to consider means of meeting the drought situation, which is the worst in the history of the state. Northern California will have a power shortage of 25 per cent this summer if the dry spell continues, according to Power Administrator Butler. Conditions in the agricultural sections of the Sacramento Valley are serious.

Manufacturers to Meet in Week of March 15

THE fifth annual meeting of the Associated Manufacturers of Electrical Supplies will be held at the Waldorf-Astoria, New York City, on March 18, for the election of governors, presentation of reports and other business. In the evening the fifth annual banquet will be held.

Following is a schedule of the section meetings to be held during the week of the annual meeting, commencing March 15, at the offices of the association, and at the rooms of the Old Colony Club, Manhattan Hotel:

Monday, March 15.—At the association rooms: Industrial Lighting Section, 10 a.m.; Signaling Apparatus Section, 2 p.m.

Tuesday, March 16.—At the Old Colony Club: Outlet Box Section, 10 a.m.; Line Material Section, 2 p.m. At the association rooms: Snap-Switch Section, 10 a.m.; Molded or Formed Insulation, 10 a.m.; Lamp-Receptacle and Socket Section, 2 p.m.; Air-Circuit-Breaker Section, 2 p.m.; Attachment-Plug Section, 4 p.m.

Wednesday, March 17.—At the Old Colony Club: Fan-Motor Section, 10 a.m.; Rigid-Conduit Section, 10 a.m.; Non-Metallic-Conduit Section, 2 p.m.; Armored-Conductor Section, 4 p.m. At the association rooms: Panelboard and Switchboard Section, 10 a.m.; Fuse Section, 10 a.m.; Knife-Switch Section, 2 p.m.; Electrical Porcelain Section, 2 p.m.

Utilities in Sympathy with Coal Storage Plan

PROTESTS against permitting coal operators to pass to consumers the 14 per cent wage increase awarded the miners were registered before the President's coal commission on Feb. 17 by representatives of several public utility associations. The confiscation and diversion of public utility coal by the Railroad Administration also came in for severe condemnation. Some of the public utility witnesses told the commission that they regarded it essential to continue in force the government restrictions on coal until normal conditions have been restored.

George W. Elliott, of the National Committee on Gas and Electric Service, was the first witness. He called attention to the fact that public utilities use 50,000,000 tons of coal annually. With 98 per cent of this coal bought on contracts, the public utilities have been hard hit by the action of the coal operators in passing on the 14 per cent increase to them, he said.

M. H. Aylesworth, general manager of the National Electric Light Association, among other things urged that steps be taken to make it profitable for public utilities companies to buy coal at summer prices for storage. He told of the additional expense occasioned by the rehandling made necessary by the storage of coal. At this point in his testimony Chairman Robinson asked whether, in view of the general public's dependence on public utilities and of the fact that many thousands of mine workers are seriously affected by the seasonal character of the purchases of coal, it were not the duty of public utilities companies to store coal even if the cost to them should be greater. Mr. Aylesworth replied that it is his personal conviction that it is their duty.

Charles Edgar of Boston, representing the National Electric Light Association, said that the Boston Edison Company has a storage capacity for 100,000 tons of coal but is unable to utilize all of this owing to the fact that deliveries of coal cannot be had in summer months. It has been the practice of the Boston company to store three months' supply of coal during the summer, he testified, while the practice of the New York Edison Company is to enter the winter with a two-months' supply. Inability to get coal last summer found the New York company at Christmas time with a margin of only 20,000 tons of coal. He declared that public utilities companies generally are in entire sympathy with the storage plan.

Townley Urges Engineers to Participate in Public Affairs

Midwinter Convention of the A. I. E. E. Is Largely Attended—President Discusses Nature and Purpose of National Engineering Body

A LARGE attendance of members, many from other sections of the country, marked the midwinter convention of the American Institute of Electrical Engineers, which was held on Wednesday, Thursday and Friday of this week at the Engineering Societies Building, New York City. Technical sessions were held on all three days. These will be reported in next week's issue of the ELECTRICAL WORLD. Visits of inspection to the plants of the New York Edison Company, the Brooklyn Edison Company, the United Electric Light & Power Company, the American Telephone & Telegraph Company and other utilities, and to the Electrical Testing Laboratories, were made by many of the delegates. On Thursday evening the customary dinner-dance was held at the Hotel Astor.

President Townley opened Wednesday night's meeting with an address regarding the organized participation in national affairs by engineers. He stated that it had been decided to operate through the agency of representatives of the engineering societies rather than by the formation of one national society of engineers. He urged particularly that this body of engineers should confine itself to activities in which the engineer's advice is of particular value, as distinguished from political and other general problems. It was said that several of the national engineering societies have already approved of the plan, and conferees have been appointed to consider the organization of this engineering body. President Townley attributed a large share of this accomplishment to the A. I. E. E. development committee.

"It would be premature," said Mr. Townley, "not to say hazardous, to say now that if and when delegates from a large number of societies come together they will organize, and their sponsors will support a federation such as has been proposed by the joint conference committee, but at least the national societies will have done their duty, and if the plan should carry it will place in the hands of a democratic body of engineers chosen from engineering organizations of every kind all over the United States a large measure of authority and responsibility to speak for the engineering profession and to take united action on matters of common concern. It is because of the far-reaching character of this prospective step that I have chosen to speak to you about it tonight. I regard it as one of the most important of the organization matters which are today before the engineers of the country."

In discussing the probable activities of such a national engineering body Mr. Townley pointed to some of the things which have already been done by the Engineering Council. The Council was organized during the war and its first activity was to help the government to find engineers suitable for the many different tasks for which they were sorely needed. They helped to pass upon the merits of an enormous number of devices, processes, methods and inventions, all of them new and untried. Since the armistice the Council has co-ordinated and expanded the employment bureau maintained over a period of years by some of the national societies. It is also conducting an exhaustive examination into the classification and compensation of engineers in government service. In co-operation with the United States Chamber of Commerce the Council has given material aid toward the passing of the water-power legislation in both the House and Senate.

In undertaking such important work the speaker pointed out the necessity of putting strong men into office in the national engineering body, men on whose judgment engineers can rely and who may be counted upon to have the courage of their convictions both to act when necessary and to refuse to act in the times, much more numerous, when matters beyond the purview of their organization are proposed. There must be remembered also the necessity for authority to act without reference to the supporting bodies for approval.

NEW ORGANIZATION TO CONSIST OF DELEGATES FROM EXISTING BODIES

"One of the fundamental features," the speaker said, "of the plan prepared by your development committee, and which also appears in that adopted by the joint conferees, is that the new national organization shall be composed of delegates from existing engineering bodies. It will not be a new society composed of individual members. Such a plan was given exhaustive consideration by the conferees and in the end decisively rejected." He pointed out the futility of attempting to organize and maintain a large society of all engineers and said that, in spite of all the efforts put into organization of engineering societies since the beginning, more than half the engineers of the country belong to no engineering organization at all, and that there has been an undoubted tendency to split off and subdivide rather than to unite.

"The primary objection to the plan adopted," said Mr. Townley, "is that the work of the new organization is to be quite different from that in which most of the old organizations have been engaged. Instead of dealing in the main directly with technical or inter-organization matters, it will deal more largely with public affairs, and as the existing societies are not organized for this purpose and in fact have not only not done it but have in some instances shown opposition to the idea, they should not be relied upon to back it now, but on the contrary an entirely new body should be created, one that is not hampered or shackled in any way. The answer to this argument is that, while the existing societies were not organized for the kind of work now contemplated, several local affiliations of them have been functioning around many of the sorts of work proposed for a number of years and doing it very well, and that the Engineering Council has already proved its efficiency and only needed a larger appropriation and the more representative membership to be afforded by the new plan to occupy a much wider field."

The requests for financing the work of the conference have been modest, Mr. Townley asserted, and later on, if the organization is formed and has a chance to demonstrate its value, the engineers of the nation will have ample information on which to alter the dues if they see fit.

"The only other comment which I feel should be made," said Mr. Townley, "is a word of caution, and is born of my experience while serving the Institute on Engineering Council. That body has been beset on all sides to advocate or to oppose legislation, and while it has not hesitated to do so when the questions involved were of a nature where the advice of engineers would be of particular value, it has steadfastly declined to become involved otherwise. Bearing this fact in mind, my word of caution is against any policy which will cheapen the engineer. Our collective advice is valuable on subjects with which we are qualified by experience and training to deal, and so long as we confine ourselves to such subjects and present a united front our influence can and will be considerable. But the minute we digress and begin to deal with matters outside the purview of engineering and subjects closely allied thereto we sacrifice our preferred position and have no more claim to be heard than any body of educated citizens of similar numbers. We also would then almost certainly make the very serious mistake of misrepresenting our membership, because, while engineers can be safely counted upon to agree on fundamental facts, they are of all shades of political belief and have as many different views as any one else regarding other questions. My word of caution therefore is really a plea to you to give this side of the subject your due thought and to make your views known at all proper times and places."

Water Power Advocate Leaves Cabinet

FRANKLIN K. LANE

Secretary of the Interior Lane, whose resignation from the Cabinet will take effect March 1, has earned the warm approval of all interested in electrical development by his vigorous and persistent advocacy of a water-power bill fair alike to the public and the investor. To him is due much credit for the bill now in the last Congressional stage.

Big Companies Resume Membership in Society for Electrical Development

RENEWED activities in development work by the Society for Electrical Development are under way after the period of curtailment imposed upon members by the war policy of retrenchment in expenditures. Many of the larger utilities and commercial organizations in the industry have resumed their membership in the society. The consequent increase in available funds will enable the society to function in a fuller way than has been possible now for many months.

In a statement to the ELECTRICAL WORLD James M. Wakeman, general manager of the society, says: "During the war the Society for Electrical Development was obliged to restrict its activities, although it continued throughout to do all its curtailed budget permitted and 'carried on' sufficiently to justify the subscriptions of those members who supported it. During the past three months so many of the big companies have resumed their membership—the General Electric Company, Commonwealth Edison Company, Edison Electric Illuminating Company of Boston, Consolidated Gas, Electric Light & Power Company of Baltimore, Middle West Utilities Company, etc.—that the funds available for the society's work are more than 50 per cent greater than at the time of the November meeting of the board of directors."

The society was established in the year before the war, and since then, in addition to its various other endeavors, has successfully conducted three national electric weeks. Henry L. Doherty was president of the society from the beginning until last November, when he was succeeded by W. W. Freeman, president of the Union Gas & Electric Company, Cincinnati.

South Enthusiastic Over Plans of the N. E. L. A.

AT A LUNCHEON given by the Georgia Railway & Power Company to R. H. Ballard, president of the National Electric Light Association, the interests of the geographic sections received considerable impetus. The luncheon was attended by most of the leading men in the electrical field in the Southeastern Section of the N. E. L. A. Mr. Ballard outlined in a lucid manner his plans for a much broader field of association work than heretofore, a radical departure from precedent being evidenced in his expressed desire to interest the manufacturing and jobbing fraternities as well as the central stations in the value to them of the national association.

He particularly stressed the importance of the geographic sections proceeding upon well defined co-operative plans so as to weld all progressive men in the electric field into one constructive organization. Mr. Ballard's ideas were received with enthusiasm by those present at the luncheon.

In addition to the constructive work discussed by Mr. Ballard, both he and William H. Onken, Jr., editor of the ELECTRICAL WORLD, by whom he was accompanied, touched upon the broader phases of the industry and outlined the tentative program for the coming convention at Pasadena.

DINNER GIVEN BY ELECTRICAL MEN OF NEW ORLEANS TO R. H. BALLARD, PRESIDENT OF N. E. L. A.

Messrs. Ballard and Onken left Atlanta for New Orleans, the second stop in their journey to the Pacific Coast. Here they were the guests at a trade dinner attended by ninety-two representatives of the central-station, electrical jobbing, contractor-dealer and electrical manufacturing interests of the city.

H. L. Doherty & Company Optimistic

In a brief preliminary report of the operations of the Cities Service Company in 1919, Henry L. Doherty & Company strike a note of optimism. Under the company's system each manager is required to prepare a forecast of what the coming year will mean to his property. These forecasts, which have just been summarized, point very clearly to a record year in every department, and the company declares its absolute confidence that the earnings of public utilities accruing to the Cities Service Company for 1920 will be the greatest in the history of the organization. In other words, it feels that the utility division is now making progress on a basis indicating that the handicaps occasioned by the war have been met effectively and that renewed progress in this department of activity can be anticipated.

Coal Supply for New England Utilities More Encouraging

NEW ENGLAND central stations entered the week with no small anxiety as to their coal supply, following repeated commandeering of coal in transit by the railroads. Some of the larger companies have been obliged to pull down their coal stocks to levels representing from two to three weeks' operation at this season, and strenuous efforts are being made by state governors, Fuel Administrator James J. Storrow and leading utility and business interests to obtain something like a normal flow of coal into the district. In response to these representations, the Railroad Administration by the first of the week had begun to resume the delivery of coal to public utility consignees to an encouraging extent; so that while the situation at this writing is extremely critical in many cities in the interior and none too certain at the tidewater stations, there is reason to believe that, if no further general diversion occurs and if the utmost energy is devoted to transporting coal into New England, general shut-downs of central stations will be avoided.

ESTIMATED DAY'S RUN OF COAL ON HAND IN FOURTEEN LARGE NEW ENGLAND CENTRAL STATIONS AS OF FEB. 16, 1920.

Company or City Served	Day's Supply	Company or City Served	Day's Supply
Bridgeport, Conn.	21	Portsmouth, N. H.	17
Boston, Mass.	11	Providence, R. I.	21
Brockton, Mass.	17	Salem, Mass.	31
Cambridge, Mass.	60	Springfield, Mass.	7
Hartford, Conn.	11	Waterbury, Conn.	7
Lowell, Mass.	17	Worcester, Mass.	10
Manchester, N.	11		
New Bedford, Mass.	21	Average	21

The table shows the approximate amount of coal on hand on Monday last, in terms of days' run, in fourteen of the larger central stations in New England.

Purchase of Connecticut Power Company by Hartford Company

STOCKHOLDERS of the Hartford (Conn.) Electric Light Company voted at the annual meeting on Feb. 10 to purchase the Connecticut Power Company, as was anticipated in a recent issue of the ELECTRICAL WORLD. The stockholders of the latter company have not as yet passed upon the transaction, but it is expected that it will be consummated without difficulty. The acquisition of the Connecticut Power Company will enable the Hartford company to expand its service advantageously, devoting more energy to wholesale distribution.

The Connecticut Power Company possesses a franchise to do business anywhere in the state and already supplies a developed business which will earn more than $300,000 per year above the interest charges on its bonds. This company has a paying business in New London, Middletown, Bristol, Thomaston and elsewhere, but except for water power has no generating stations. The water-power plant is at Falls Village, has a capacity of about 10,000 hp. and cost about $1,000,000. It is connected with central Connecticut by a 66,000-volt transmission line tied into the Hartford system, and this line will be extended southeasterly across the state to interconnect these systems with that of the Eastern Connecticut Power Company in the New London district, and thence with the lines of the New England Power Company. Electrical continuity will then be realized from Salem and Boston, Mass., and Providence, R. I., to Falls Village and Derby, Conn.

In a statement to a representative of the ELECTRICAL WORLD, the management of the Hartford company points out that its policy will be to sell power to various local distributing companies, but not to own or control the policies of such companies. It is believed that no relief can be looked for in the price of fuel, and economies in its use require the employment of larger generating units than are at present in service at Hartford. In the last five years the size of steam turbines at Hartford has increased from 4,000 kw. to 10,000 kw. rating, with the result that the company's fuel cost per kilowatt-hour has increased only 42 per cent despite the doubling of the price of coal.

The business in Hartford alone is not sufficient to warrant a station of the size needed for efficient operation, and it becomes necessary for the Hartford company to sell its surplus energy to other cities, this being permitted by the Connecticut Power Company's franchise. The Hartford company has a generating capacity of 37,500 kw. at present, serves 35,500 customers and consumes 73,000 tons of coal annually, its station rate being 2.01 pounds per kilowatt-hour. Plans for a new steam station, to be equipped with 20,000-kw. generating units, are being prepared for the Hartford company by Stone & Webster, Boston.

Farm-Lighting Plants Big Field for Electrical Jobbers

WITHDRAWAL of the jobber from retail merchandising received considerable attention at the Feb. 9 meeting of the Central Section of the Electrical Supply Jobbers' Association held in Chicago. Paul Tafel, of the Tafel Electric Company, Louisville, Ky., led the discussion, in which it was brought out that local conditions were the determining factor. In Chicago, for instance, it was shown that the development of the jobbers' local business had helped in building up a retail trade due to the limited number of retail stores in such a large field.

Petty warehouse thievery was due partly to the lenience of the jobbers in the prosecution of offenders. It was thought that a firm stand in this matter would be beneficial to the jobbers' organization, V. G. Eastman stated in a discussion of this subject. B. B. Downs of St. Paul pointed out some of the methods to use in building up a farmhouse lighting outfit business and gave typical costs per lighting unit in building up such a business. His figures showed the enormous field for this class of jobbers' trade, and he made the statement that with all of the manufacturers of lighting outfits pushing the sales to the maximum there would still be business for all.

Picking the right man for the organization was the subject covered by Martin J. Wolf, St. Louis, who built up a hypothetical jobbers' organization showing the characteristics of the men required to fill the different positions successfully. Price reductions do not stimulate business as a whole, said R. P. Oblinger, and price cuttings should not be resorted to unless for the sake of moving obsolete lines, in which case it would be better to make arrangements with old customers who might benefit by this price reduction.

Plans for the trip of the Central Section to San Francisco in June were discussed. About seventy members have already signified their intention of making the trip. W. R. Herstein of Memphis was elected chairman for the ensuing year.

Ontario Hydro-Electric May Have to Increase Power Rates

ARRANGEMENTS are under way by the Hydro-Electric Power Commission of Ontario, Canada, to obtain power from other sources in order to meet the demands on the system until the Queenston-Chippewa development has been completed. Consumers on the Hydro system are being asked to state their 1920 requirements because the additional power will be limited.

Up to the present the Hydro-Electric Commission, so far as could be learned, has advanced rates for power in Ontario only by cutting the 20 per cent prompt payment discount to 10 per cent. The commission states, however, to its power customers that the additional power required, which must be purchased, will cost the commission more and that the increased cost will have to be passed on.

At the present time the commission is generating and purchasing about 265,000 hp., which is reported to be 40,000 hp. short of its contract requirements. At times, however, during this winter the generating plants, because of troubles from ice and bad operating conditions, have been affected to a still greater extent. On Jan. 31 the shortage, reports state, was increased by more than 100,000 hp. Supply interruptions to customers as a result of these conditions have naturally become more frequent.

Farm-Line Standardization Proposed

A PRELIMINARY report covering the standardization of farm lines was drawn up at a recent meeting of the farm-line committee, Iowa section, N. E. L. A. This report will be subject to revision at a June meeting.

A detailed study was made of the standard minimum requirement specifications for farm-line construction. These specifications call for rural service lines of good sound material constructed in a workmanlike manner. Poles, cross-arms and hardware are to conform to a standard practice. Insulators are to be of a good grade of brown porcelain such as are regularly used by the operating companies of the state. Poles are to be set in the ground the proper depth, according to their length. Lightning arresters are to be graded shunt, multi-gap or low equivalent type. Horn-gap arresters shall not be used owing to the belief of the committee that they set up dangerous surges when arcing over on one side of the line.

The committee recommends that each farm line be dealt with as a wholesale consumer when possible and that 25 kva. be the smallest substation tapped in on 33,000, 16,500, 13,200 and 11,000-volt lines. All farm lines outside of incorporated towns should be and remain the property of the farmers, to be operated and maintained by them. In this connection sample articles of incorporation, notice of incorporation and method of petitioning the Board of Railroad Commissioners for a franchise to erect and operate transmission lines are included in the report.

It was the general opinion that a service charge plus a small rate per kilowatt-hour for all energy is the ideal rate. Definite figures were postponed until more data should be available showing the losses and power factor of farm lines. A general scheme is given of proposed rates which seem to meet the general conditions. The report includes a standard form of contract with the suggestion that all farm-line contracts be made for long periods, say twenty years, with a readjustment clause at the end of one, two or three years.

Large Steel Mill Has 118,000 Hp. in Connected Load

Twenty-three of the 2,169 Motors Have a Horsepower of 37,000—Alternating Motors Represent 27 per Cent of Number and 55 of Horsepower

THE degree of electrification which has been obtained at the Maryland plant of the Bethlehem Steel Company was indicated the evening of Feb. 7 by R. B. Gerhardt, superintendent of the electrical department, in a paper presented before the Philadelphia Section of the Association of Iron and Steel Electrical Engineers. He said that there are 2,169 motors on the electrical system, representing a total connected load of 117,850 hp. From the time that the ore and coal arrives by steamer or by cars to the time when the finished product is loaded onto cars, electricity plays a most important part. Not only is electrical energy used for transporting and handling the material, but it is fully utilized to insure safety and in many cases automatic operation. The accompanying table indicates the extent to which electricity is being used in different departments.

Plant	Number of Motors	Connected Horsepower	Kw.-Hr. Per Ton Material [illegible]
Ore handling	60	3,618	1.2
Coal handling ..	56	4,101	—
Coke oven — total	174	8,035	1.3
Blast furnace (includes blowing engine house, ladle house, pig-casting plant, skull-cracker plant, sintering plant)	96	10,887	6.2
Bessemer and open hearth No. 1	96	4,711	—
Open hearth, No. 2	141	7,947	4.6
Bloom and rail mills	136	5,190	
Bloom, billet and bar mills	181	18,474	20.8
Sheared plate mill (36 in. by 110 in)...	122	8,653	44.0
Universal plate mill (60 in.)	126	10,128	—
Sheet and tin-plate mill...	96	6,070	—

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* There are also six lorry cars and seven cranes in this department.

† Excludes casting plant and sintering plant (sintering plant averages 15.5 kw.-hr. per ton of sinter.)

Energy for this load is supplied from two sources, about 17,000 kw. being available from Baltimore and the remainder from 5,000-kva. gas-engine-driven generators, of which there are five though only three of them are now in operation. This gas-engine plant is designed to have an ultimate rating of 100,000 kva. The mill is fed by means of a distribution system which consists of a 6,600-volt double-bus circling the mill and connected with four switching stations that serve the principal substations. An interesting feature of the distribution circuits is that they are made of 1,000,000-circ.mil. double-braid weatherproof cable instead of bare wire on account of the gaseous condition of the atmosphere which would corrode copper.

It was brought out in the discussion of the paper that the load factor was approximately 60 per cent. This is calculated from power-demand readings required by the contract with the central station and the installed generator rating at the mill. About 580 of the motors are operated on alternating current having a connected load of 64,000 hp., 23 high-voltage mill-type motors representing a connected load of 37,000 hp.

The Human Side of Engineering

Opportunities and Responsibilities of the Profession—Pure and Applied Science Must Work Hand in Hand—Make the World Safe for Science

THAT the engineer, as his paramount duty in a changing century, must dedicate himself to the great problems of humanity and safeguard civilization by controlling science for beneficent purposes was the declaration of President Ira N. Hollis of the Worcester (Mass.) Polytechnic Institute in an address before the Associated Engineers at Nashville, Tenn., on Jan. 19. The engineer's place must become increasingly important, and if the world is to grow better, he must strive to exert his influence in the direction of righteousness, working for the good of mankind rather than for the ambitions of nations, the speaker said. Engineering as it is coming to be understood invariably has within it the element of construction and the employment of energy in some form, but in addition the human side of industry must be considered. In modern times this has become an immensely important part of the profession, and engineers can never reach a position of commanding influence as citizens without taking it into consideration.

Pure and applied science can never be separated if the whole truth is known with regard to any problem, Dr. Hollis continued. Engineers have only recently awakened to the importance of research and of a complete study of every problem set before them. Scarcely a problem has been exhaustively investigated. Research is still in its babyhood, while application is older than history. Many investigations undertaken by engineers suffer from the lack of adequate training in physics. As a rule, engineering schools offer too little physics, generally on the ground that engineering is commercial and that the profession has no time to deal with the minute quantities and small measurements of the laboratory.

"The sooner we get away from the differences and jealousies now existing among our national specialty societies and their local societies of engineers, big and little, and form one United States Engineering Society with a building of its own in Washington," Dr. Hollis said in conclusion, "the sooner we shall come to the same commanding influence over public affairs as our compatriots in business have already attained. There is plenty of room for the professional societies as they are now constituted, but there is an absolute need for something either planned through the national societies already existing or developed out of the local societies rapidly coming into existence. There is no reason why the effort of the Engineering Council should not be the beginning and nucleus of a larger idea."

Delegates to Pick Oranges at Pasadena N. E. L. A. Convention

IT HAS been arranged as one of the features of entertainment and education for the delegates who attend the convention of the National Electric Light Association at Pasadena next May that they shall have opportunity to go into fine orange groves that lie close by in the San Gabriel Valley and pick the golden fruit from its tree. Tours of the "empire of the orange" are being arranged for delegates, and those familiar with the industry will take pleasure in pointing out the practical side of electric application.

In southern California practically all of the orange groves are under electric irrigation. Lands that were once semi-arid sheep pastures have been brought under intensive cultivation by the electric motor, which, year by year, is reclaiming the desert.

N. E. L. A. DELEGATES WILL PICK ORANGES HERE NEXT MAY

From a load-factor standpoint, irrigation of the orange groves will be intensely interesting to electrical men, but electric pumping is only one feature of the orange industry. The orange packing house is today operated entirely by electricity. First the fruit is washed by electrically driven washers. Then the brand label is placed on it by another electric device. It next finds its way into the electric sorter, in which the oranges are graded for the market. Even the boxes are made and nailed up by electric machinery, and in some of the largest packing houses there are many electric labor and time-saving devices.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Pueblo Saves $10,000 a Year by Electrical Pumping.—Pueblo, Col., uses electrically driven pumps in the waterworks of the city, the first large unit, with a daily capacity of 3,000,000 gal., having been installed in 1918. The trustees estimate an annual saving of $10,000 with complete electrical equipment.

World Trade Club Advocates Metric System.—The World Trade Club of San Francisco is circulating "Metric Literature Clues," an index to books and articles on the standardization of weights and measures, with the object of promoting the adoption of the metric system in the United States and Great Britain.

Electricity in the Army.—As a result of a survey now being made by the General Staff of the United States Army it has virtually been decided that electrical cookers and other electrical equipment shall be used at army posts to the exclusion of other appliances where the cost of electricity is 3 cents a kilowatt-hour or less.

Surcharge to Stay Pending Decision.—Pending the Railroad Commission's final decision in the matter of the application of the San Joaquin Light & Power Corporation for an increase in rates, the surcharge of 15 per cent which the company has been collecting will remain in effect. The commission has issued an order to this effect.

Fire Losses from Electricity.—Figures prepared by the National Board of Fire Underwriters show that damage from fires of electrical origin in 1918 was $894,785 more than in 1917 and $4,220,874 more than in 1916, the increased loss being due to the wider use of electrical energy. Losses from this cause in New York State reached $2,746,956, and in Pennsylvania they were $2,351,088.

Engineering Council's Campaign for Funds.—At a conference of the governing bodies of the member societies of the Engineering Council held in New York recently it was recommended that each of the four founder societies should contribute for 1920, $5,000 toward the work of the council instead of $3,000 as hitherto, and that the American Society for Testing Materials should contribute $1,000 instead of $600. In addition to this, every member of the constituent societies except junior and student members will be asked for a contribution of $2. It was declared that without increased financial support the public welfare work of engineers will be seriously discredited.

Extension of Time for Selling Stock.—The Western States Gas & Electric Company has received permission from the California State Railroad Commission to extend the time in which to sell the $178,000 preferred stock authorized by the commission last year. The time is now fixed as Dec. 31, 1920.

The Electric Brass-Melting Furnace.—The steady growth in favor of electric furnaces for use in brass foundries is evidenced by the announcement that the Ohio Brass Company has signed contracts for the installation of these furnaces in its Mansfield (Ohio) foundry. The first unit will be a General Electric furnace with a capacity of a ton of molten metal an hour and a maximum demand of 400 kw. This furnace will replace oil-fired equipment.

New Interconnected Line in Indiana.—The high-tension line recently built by the Interstate Public Service Company between Seymour and Williams, Ind., to furnish power for a large territory in southern central Indiana has been placed in service. It will be energized by the generating station at Williams and will be connected at Seymour with the transmission line between Indianapolis and Seymour, which has been in service for a number of months.

Enlarging the Rate-Fixing Powers of Public Service Commission.—By the provisions of a proposed amendment to the state constitution now before the Virginia Legislature power would be given to the Corporation Commission of that state to increase the rates charged by public utilities even in cases where maximum and minimum rates have been fixed by franchises granted by cities and towns. Amendments to the constitution have to be approved by two successive legislatures and then be submitted to popular vote.

Ringing Ships' Alarm Bells by Wireless.—According to the American Chamber of Commerce in London, a wireless "calling" device has been perfected by which ships in distress can ring alarm bells on other ships within wireless range even though the operators on these ships are off duty. The invention comprises a special automatic transmitter key on the sending ship and a corresponding selective receiver relay on the other boats. By its use a powerful bell starts ringing on the ships called a few seconds after the key at the calling station is pressed.

Electric Supply in the United Kingdom.—In the inaugural address of Sir Charles A. Parsons, president of the British Association for the Advancement of Science, the rapidly increasing use of electricity was alluded to at length. At the end of last year, the speaker asserted, the central electric stations in Great Britain and Ireland contained plant aggregating 2,750,000 kw., 79 per cent of which was driven by steam turbines. The part played by the number, location and size of generating stations, by the power factor and by the extent of networks in bringing about cheap electricity were dwelt upon.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Pennsylvania State Association of Electrical Contractors and Dealers.—The annual meeting of this association has been postponed and will be held on or about March 10 in Erie.

Pennsylvania Electric Association, Central Section. — The Pennsylvania Hotel, Harrisburg, will be the meeting place of the Central Section of the Pennsylvania Electric Association on Wednesday, Feb. 25.

New York State Association of Electrical Contractors and Dealers.—At a meeting of the executive committee of this association at Syracuse M. H. Johnson of Utica was elected chairman, James F. Burns of Schenectady treasurer and J. P. Ryan of New York secretary.

New York Electrical Society.—This society will meet Feb. 26 in the Engineering Societies Building. Robert F. Gowen will read a paper on "Some Long-Distance Radio-Telephone Tests," and Charles A. Eaton will talk on "The Electrical Side of the Great Industrial Unrest."

A. I. and S. E. E., Birmingham Section.—The Birmingham (Ala.) Section of the Association of Iron and Steel Electrical Engineers will hold a meeting on March 13 to be devoted to "general ideas and discussions." Every active member is invited to prepare a paper on a subject pertaining to the application of electricity in the iron and steel industry.

Chicago Electrical Contractors Elect Officers.—The Electrical Contractors' Association of Chicago has elected officers for the ensuing year as follows: President, J. Norman Pierce; treasurer, J. O. Kelso; assistant treasurer, O. F. Burnett; secretary, J. W. Collins; assistant secretary, A. H. McGrew; executive committee: J. Norman Pierce (chairman), W. A. Jackson, L. H. Lamont, L. D. Gray, F. S. Leasure, A. Wagner and Tom Meade.

Annual Banquet of Engineers at Boston March 30.—All branches of the engineering profession will be represented at the eleventh annual banquet of engineers at the City Club, Boston, on the evening of March 30. The speakers will include the presidents of the national engineering societies: Paul D. Cravath, of New York, who will discuss "Economic Relations of the Peace Treaty," and Dean Roscoe Pound of the Harvard Law School. Irving E. Moultrop, chairman of the Boston Section of the A. I. E. E., will preside. Prof. Dugald C. Jackson is chairman of the general committee.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Assumption of Risk.—In action for damages because of fatal accident to employee, assumption of risk is no defense under the labor law where the preliminary notice is adequate, according to the Court of Appeals of New York. (125 N. E. 541; 227 N. Y. 345.)

Eminent Domain.—The erection of a wall in the bed of a river by the state on lands owned by it is not, the Supreme Court of the State of New York holds, an appropriation or use of the property of a company on the other side of the river, although the wall has narrowed the channel and at certain seasons so checks the flow of the river as to set back water in the company's tailrace and on its waterwheels. (179 N. Y. S. 294.)

Rights of Appropriator of Water of Stream.—When appropriation of water of a stream is made, the rights of the appropriator, it is held by the Supreme Court of Montana, are limited to the natural condition of the stream at the time and are not enlarged by subsequent improvements made by another which increase the supply flowing in the stream, and if such other person himself increases the available supply, he has a prior right to use it to the extent of the increase, but the increase must constitute a new or independent source of supply. (185 P. 1112.)

Fatal Accident to Employee Not Arising from His Employment.—Where an employee, while going from a telephone to the room where he was employed, stopped to talk with a fellow workman on matters unconnected with the employment and leaned on an iron table, taking hold of an electric lamp to enable him to look into a tank, from a motive of curiosity, his consequent death from electric shock was not, in the judgment of the Supreme Judicial Court of Massachusetts, an accident arising out of or in the course of his employment, entitling his dependents to compensation. (125 N. E. 565.)

Rehearings Before Public Utilities Commission.—Under Section 67 of the public utilities act, a rehearing before the Public Utilities Commission of Illinois can be asked at any time within the thirty days allowed for appeal, according to a decision of the Supreme Court of that state. Where the commission grants an unrestricted rehearing the whole case comes up for consideration as though no judgment had ever been entered, in which event the thirty-day limitation for appeal begins to run when the final order is entered after the rehearing and not at the date of the original order. (125 N. E. 495.)

Jurisdiction of Public Service Commissions Over Wholesale Rates Upheld.—The United States Supreme Court has handed down a decision in the case of the Napa Valley Electric Company vs. the California Railroad upholding the power of the commission over the wholesale rates of public utility companies. This decision establishes a precedent for commissions in all the states, the case having been recognized as a test of their authority in this matter. The suit arose when, on the application of the California Light & Telephone Company, the commission fixed the rate for the wholesale energy supplied to the telephone company by the Napa Valley company and the latter company denied the commission's jurisdiction. The decision confirms that of the state court.

Master's Negligence and Servant's Assumed Risk.—The Supreme Court of North Carolina has laid down the following principles in cases involving injury to an employee: The duty of a master to provide reasonably safe appliances and a safe place in which to work is absolute and cannot be delegated to another without incurring risk for the neglect of such other; it is the master's duty when he discovers a danger of which the servant is ignorant to warn him of it; a servant assumes the risks arising from the master's negligence if he knows of the defect from which they arise and appreciates the dangers; if negligence of master concurs with that of the servant in causing an injury, the master is liable; in action for injuries testimony regarding subsequent repairs was admissible in corroboration of evidence that defect existed. (101 S. E. 498, 518.)

Powers of Public Service Commission. —The Supreme Court of Nevada, in maintaining the constitutionality of the Public Service Commission law of that state, has declared (1) that though the commission cannot dispense with the essential rules of evidence which conduce to a fair and impartial hearing on the question of rates, it has liberal discretion in passing upon the competency of evidence; (2) that, the law providing that all rates fixed by the commission shall be deemed in full force and effect until final determination, the district court had no right to grant an injunction *pendente lite* restraining their enforcement; (3) that the courts cannot interfere with the commission or review its determinations further than to keep it within the law and protect the constitutional rights of the utilities; (4) that the section of the law providing that rates fixed by the commission shall remain in force until final determination by the courts having jurisdiction does not require that rates remain in force until final determination in the Supreme Court but only pending final determination by district courts; (5) that the district courts' jurisdiction is confined to passing upon the reasonableness of the charge, the court having no right to itself establish a rate. (185 P. 801.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

"Readiness-to-Serve" Charge.—"It is a popular error," the Pennsylvania Public Service Commission declared in a case against a gas company, "to say that a 'readiness-to-serve' charge requires consumers to pay for that which they do not receive. This is a wholly fallacious conception. Such charges are based upon the fact that the plant must be kept in a condition to render immediate service to each of its patrons whether he draws upon it or not. It costs the company money to be ready at all times to render such services. The real question which confronts the public and the commission is not with respect to the legality of such charges, but whether there be reasonableness in amount under the testimony."

Rural Telephone Service.—Among decisions handed down by the Missouri Public Service Commission affecting telephone service in small communities and rural districts in that state are these: An estimated value of $74 a station for 183 subscribers is excessive, but $50 a station is reasonable; an income of 11.8 per cent for return and depreciation on property valued at $10,650 is approved; the fact that subscribers have enjoyed free service with a nearby town does not necessarily justify its continuance; charging the same rate for party-line residence service as for direct-line service is discriminatory; a monthly charge of 50 cents for class A rural service, the subscriber owning and maintaining the line and equipment, is reasonable; increased rates for service permitting a net income of $23.42 on property of not less than $1,000 in value approved.

Proper Basis for Capitalization.—In a petition for consent to the transfer of the franchise, works and system of an electric plant in Madison County to the Solsville Electric Light & Power Company, the Public Service Commission of the State of New York, Second District, authorized a total capitalization of $30,000 notwithstanding that the price paid for the plant was only $20,000, it being shown that the present value of the plant, based upon the capital actually expended, less depreciation, was approximately the former sum. The commission held that as between a public utility and the public capitalization should be allowed to the extent of the investment less depreciation. As between the buyer and the seller of such utility the market price naturally measures the value. Where a question may be raised between buyer and seller because these valuations differ the court and not the Public Service Commission has jurisdiction.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

William Porter, formerly assistant engineer in the motive-power department of the Interborough Rapid Transit Company in New York City, has resigned to join the sales organization of the Electric Service Supplies Company at Philadelphia, Pa.

William S. Turner, consulting civil and electrical engineer of Portland, Ore., has recently returned from an extended trip throughout the East. His work in that section included valuation reports on various Pacific Coast properties, an effort to interest New York capital in developing a large hydroelectric power proposition in which he is interested, and a study of the electric railroad situation, especially as regards rates, franchises and motor-bus competition.

Major Harry H. Kluegel, formerly chief electrical engineer of the Mount Whitney Electric Company, who was engaged in camp construction in the West during the war, is now connected with the Walter Reed Hospital, Washington, D. C.

R. H. Bacon, who has been assistant electrical engineer for the Copper Range Company of Painesdale, Mich., since 1916, has joined the editorial staff of the ELECTRICAL WORLD. Prior to his connection with the Copper Range Company Mr. Bacon had been employed by the Eastern Michigan Power Company, by Woodmansee & Davidson, Chicago, by the L. K. Comstock Company of New York City and by other operating concerns.

H. L. H. Smith, an electrical engineer connected with the New England Power Company at Worcester, Mass., and previously on the staff of the Brooklyn Rapid Transit Company, is making a survey of one of the electric lighting systems in the West Indies, where electrical conditions and development are coming more and more under American direction.

Harold G. Paine, formerly principal assistant to N. J. Neall, Boston, has joined the engineering staff of Jackson & Moreland, Boston, following two years in government work. Mr. Paine was graduated from the University of Minnesota in 1906, electrical engineering course, and from 1906 to 1908 was employed in the engineering department of the Minneapolis General Electric Company. During this period he was in charge of field work in lightning protection on the Taylors Falls-Minneapolis transmission line and had other varied experience. For the next four years he was employed in the offices of D. C. & W. B. Jackson, Boston and Chicago. In 1913 he became associated with Mr. Neal and during this connection was occupied in designing, appraisal and other field work, including new plant electrical layouts for the Rumford Falls (Me.) Power Company and the Goodyear Rubber Company. Following the entry of the United States into the war, Mr. Paine was directly engaged in the design and supervision of electrical installations at Camp Devens, Mass., and the Camp Grant extension, later having in hand similar work at Camp Las Casas, Porto Rico. In the past year Mr. Paine has been on special work for the United States Shipping Board.

K. W. Adkins, engineer of the Missouri Inspection Bureau, Kansas City, Mo., was elected president of the Western Association of Electrical Inspectors at the recent annual meeting of the association in St. Louis. Mr. Adkins, who was born in Clay County, Mo., thirty-six years ago, attended the public schools and William Jewell College at Liberty, Mo. For five years after leaving college he was engaged in electric construction and operating work, but for the last fourteen years he has been engaged in fire prevention and fire protection engineering in his native state. He is also a member of the electrical committee of the National Fire Protection Association, the National Association of Electrical Inspectors, and the Underwriters' Uniformity Association, in all of which he has maintained an active interest.

K. W. ADKINS

C. M. Jansky, Jr., has recently been appointed an instructor in electrical engineering at the University of Minnesota, to specialize in radio and transient phenomena. Mr. Jansky is a graduate of the University of Wisconsin. He has had teaching experience in the army training schools and in the University of Wisconsin, following several months of research work on military intelligence problems at the Western Electric laboratories in New York City. He collaborated with his father, C. M. Jansky, in writing a textbook on radiotelegraphy. At the University of Minnesota his work will include courses with the Signal Corps unit and with other advanced students.

Thomas R. McAuley, manager of construction and operation of the Calgary (Alta.) Municipal Railway, has accepted the position of general manager of the New Brunswick Power Company, St. John, N. B.

Robert E. Barrett has been elected treasurer of the Holyoke (Mass.) Water Power Company, succeeding Albert A. Sickman, assistant treasurer and hydraulic engineer. Mr. Sickman had been serving as acting treasurer since the sudden death several months ago of Wallace E. Sawin, who had held the position of treasurer of the company for many years. Mr. Barrett has been connected with the Turners Falls Power & Electric Company for about a year, having charge of the erection of the power station of the company at Chicopee.

Obituary

John H. Manahan, formerly an engineer with Sargent & Lundy, Chicago, specializing in large power-plant construction, and a graduate of the Massachusetts Institute of Technology, Boston, in 1896, died recently at Boston. Mr. Manahan was active in electrical work for some years and also was employed by the American Stoker Company for a time. Of late he had devoted much attention to the invention and development of internal-combustion engines.

Walter J. Warder, Jr., chief engineer of Roth Brothers & Company, Chicago, died on Jan. 20, at his residence in that city. Mr. Warder was born Aug. 14, 1879, in Chicago. He was employed by the Western Electric Company for about four years, where he had experience in the testing and design of motors and generators. He then was employed by Roth Brothers & Company for about five years, during which time he designed a complete line of direct-current motors and generators. These machines are still being manufactured by the company. He left Roth Brothers & Company to broaden his experience and for a time was with the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa., the Adams & Westlake Company at Chicago and the Crocker-Wheeler Company at Ampere, N. J. He then left the electrical business to engage with the Tampa Steam Ways Company at Tampa, Fla., in shipbuilding, being interested also in the automobile business there. About three years ago he returned to the electrical business with Roth Brothers & Company as chief engineer in electrical and mechanical design. During the past few years he had been particularly interested in the development of a line of plating generators.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Jobbers' Costs Slightly Reduced on Increased Volume of Business

STATISTICS compiled by the central division of the Electrical Supply Jobbers' Association show that, even with the expansion of the volume of business during 1919 over 1918, the cost of doing business fell off only very slightly. Of the seventeen jobbers reporting, thirteen show a slight decrease in the per centage cost of doing business of from one-quarter of one per cent to 4 per cent, while four of those reporting actually show an increase. Inefficient warehouse help, increased cost of labor, rentals, increased cost of insurance and various other items are said to be the accountable factors, offsetting the increase of business volume as high as 150 per cent. The extreme variations in the cost of doing business are accounted for by the difference in specialization. One jobber, for instance, may handle supplies requiring more warehouse space and more help to handle heavy supplies than another whose volume of business of a different class is fully as great but may be done at a smaller percentage of cost. The following table shows the per centage of increase of volume of business, of the seventeen jobbers who reported together with a comparison of the per centage of operating costs for the years 1918 and 1919:

Member No.	Percentage of Increase 1909 Over 1918 Volume	Percentage of Operating Expense 1919	Percentage of Operating Expense 1918
1	50	18 3	19
2	150	16	17 7
3*	106	13 4	17 4
4*	55 5	15 6	16 2
5*	5	17 3	17 7
6	68 8	14 4	16 8
7	7 4	24 6	18 7
8	42	16 7	20 2
9*	35	15	18
10	48 6	13 5	11 2
11	60	19	20
12	38 8	14 25	12 6
13	28 2	18 7	19 9
14	20 8	19.21	18 62
15	63 2	15	15 84
16†	50	13 75	16
17	59	17 75	18

Salaries of executives, bonuses and commissions are included in all cases, except those marked *, which exclude bonuses and commissions, and that marked which excludes bonus

No Profit in Distribution of Heating Devices, Jobbers Declare

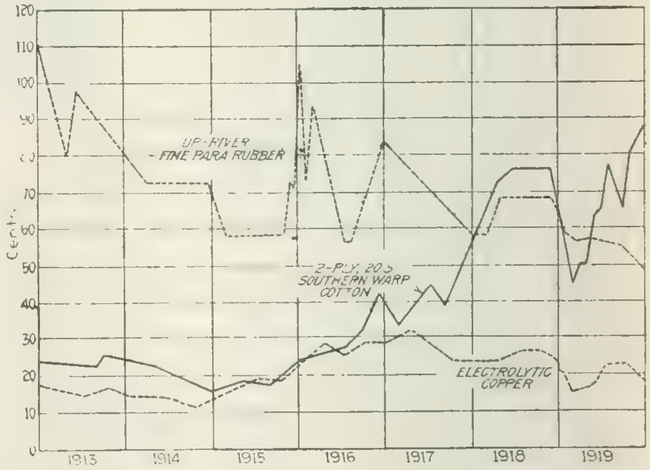
THERE is considerable discussion among the trade as to whether or not the distribution of electrical heating devices is a profitable business for supply jobbers. Under the present method of distribution there are several prominent Eastern jobbers who say it is not profitable. What is more, at least two manufacturers declare the production of this material is not profitable, and retailers say they cannot make expenses on their sales. The one exception to this pessimistic view is the so-called jobber who sells at retail. Here, it is said, the differential between jobber's cost and retailer's cost is sufficient to carry over a profit on the handling of the heating devices where in the case of either the jobber or the retailer the profit is declared to be insufficient to overcome the cost of handling the goods and leave a net balance.

One reason for this situation is the small units in which heating appliances are distributed. A prominent Eastern jobber has stated that during last June his average order was under $10, and that for 1919 his orders averaged $24. A factor instrumental in raising this figure to $24 was the unit packing method inaugurated last spring by one manufacturer. Too many small orders are being booked today by distributers. From one source comes the announcement that 80 per cent of orders are under $10 and that 88 per cent are for less than six devices.

In order to place the sale of these devices on a more satisfactory basis, one method which has been suggested is to segregate absolutely the jobber and the retailer. The jobber performs a very necessary service for the manufacturer in wholesaling his stock and distributing his goods, and for this service he should be paid a sufficient amount to leave a fair net balance over his costs. The retailer likewise renders a definite service and as such should be paid a sum sufficient to attract him to handle the goods. One jobber has suggested that the distribution of heating devices be placed on a basis similar to that of the distribution of lamps, and he believes that they will be purchased by the public in a few years in the same way the public buys lamps today. The trade already feels that the retail price is all that the consumer is willing to pay.

Fixed Bases Have Little Meaning in Code Wire Quotations

THE widely varying prices of the different materials entering into the make-up of insulated copper wire are making it more and more difficult to judge the price of any size of code wire from a given base price for that kind of wire. As a matter of fact, insulated-wire bases mean little in themselves today. Rubber-covered wire is now quoted on bases varying from 23 to 30 cents, the average being just under 28 cents. This means little to a wire customer who may be interested in sizes other than No. 14, as manufacturers say No. 14 is the size on which rubber-covered wire is based. Discounts, changing as labor and material costs change, allow for the difference in price of the various sizes of code wire.



TREND OF PRICES ON UP-RIVER FINE PARA RUBBER, TWO-PLY, 20S, SOUTHERN WARP COTTON AND ELECTROLYTIC COPPER

At one time the cost of code wire was largely dependent upon the cost of bare copper wire. Labor, rubber, cotton, compounds, etc., were changing little in value. Consequently a single base could be used advantageously. Since the end of 1915 rubber has been decreasing in value, cotton warp has been increasing and copper has been fluctuating, but within rather small limits. During 1919 up-river fine Para rubber went from a high of 64 cents a pound to a low of 48 cents and is still decreasing, present quotation being 45 cents. In the same period two-ply, 20S Southern warp cotton, starting at 66 cents, went to a low value of 44 cents, then rose to 87 cents, and is still rising. The present quotation is 95 to 98 cents a pound. Electrolytic copper in 1919 varied between the limits of 14.50 cents and 23.50 to 24 cents a pound and is now approximately 19 cents. Bare copper wire closely follows fluctuations in the raw copper costs. Consequently in the last year the cost of cotton has been playing a very important part, as well as the steadily increasing cost of labor. Cotton plays a larger part in small sizes of code wire than in large sizes, while copper is of more importance in the larger sizes. Labor plays a more important part in the smaller sizes.

At least two manufacturers of code wire are basing their quotations on net prices derived from the cost of each size of wire. This method appears to point out a way of arriving more closely at wire prices when the costs of materials other than copper are changing so widely in an article in the various sizes of which these materials enter to such disproportionate amounts.

The attached curves have been made up from curves received from the *Textile World Journal* and from the *India Rubber World,* and give the trend of prices of up-river fine Para rubber and of two-ply, 20S Southern warp cotton, in connection with electrolytic copper. The 20S size of two-ply warp is widely used, along with sizes up to 30S, in rubber-covered wire insulations and has been taken because it is representative. The different sizes of cotton, however, vary in price as demand and supply change.

Five Largest European Lamp Companies Form Two New Combinations

SOME interesting competition in the export lamp market may be expected shortly. For five years United States and Holland have had the world's markets for incandescent lamps largely to themselves. Germany, once a powerful factor in this line, is making arrangements for a "come-back," by a consolidation of her lamp-production. At the same time, the most powerful lamp interests in England and Holland have pooled operations.

The Osvam Works, Ltd., is the name of a new electric lamp manufacturing company, capitalized at 30,000,000 marks, which has just been organized in Germany, taking over the lamp factories of the German General Electric works, The Siemens-Halske and The Auer incandescent lamp works. This report has just been received by cable and shows the outcome of the amalgamation of these companies which was proposed last fall and was reported on page 1041 of the Nov. 29 and Dec. 6, 1919, issue of the ELECTRICAL WORLD.

At the same time comes the report of the amalgamation of the British and Dutch incandescent lamp companies, the Edison Swan Electric Company, Ltd., and the Philips Incandescent Lamp Works. G. L. F. Philips and A. F. Philips will join the British company's board of directors, it is stated.

Advances in Yarns Cause Rise in Cotton Electrical Goods

COTTON electrical materials have again advanced in price. Flexible non-metallic conduit prices are about 10 per cent higher than they were a week ago. Price at time of shipment is rather generally ruling. Prices on tapes and webbings, which had been withdrawn, were greatly increased in varying amounts last week. Varnished-cambric tapes and cloth advanced about 10 per cent. Friction tape has been advancing more or less sporadically, with the common grades of splicing tape quoted around 45 and 50 cents a pound.

The spot-cotton market slumped early in February, but started to recover at the end of last week and at this writing is at 38.45 cents. The yarn and fabric market has been rising for several months. Inability to secure sufficient labor in the process work of making the semi-finished products in the face of the heavy demand is given as the cause for the continued increases in price of these materials.

Loom manufacturers are booked up for many months ahead, and their policy of price at time of shipment shows the uncertainty of the cotton-yarn market for the coming months. Orders for varnished cotton insulating tapes and cloths are extremely heavy, but they are for rather short delivery. The buying seems to be much of the hand-to-mouth variety rather than for long shipments, showing an expectation on the part of the users of a drop in the market. There is a light shortage of the finer yarns for use in making the thinner grades of varnished cloth, namely, those of 5-mil and 6-mil thickness.

Lamp Agents Say They Are Unable to Make Six Turnovers a Year

PROTESTS have been coming in from lamp agents against the tungsten lamp manufacturers whose new contracts require a turnover of lamp stocks six times a year. The B agents feel that they cannot make six turnovers a year, especially under present conditions of lamp production and of transportation, when it is difficult to get prompt shipments. Some orders of two and three months' standing have not yet been received, among which are some for bowl-frosted and round lamps.

Under conditions holding today, the B agents feel that a turnover four times a year is a very fair rate, and several prominent Eastern B agents have given that as the maximum obtaining. Even three would not be considered excessively low, it seems. In order to keep the detailed accounts, B agents must of necessity spend considerable time and money, and they feel that the end is not justifying the means. Jobbers state that if the lamp manufacturers are willing to pay for this detailed accounting system, some attempt could be made to approach more nearly the rate of six turnovers.

The important feature of the new rider is the statement of the manufacturers that it is not a cut-and-dried contract, but that they are of an open mind on the subject and ready to entertain any suggestions on the part of the B agents in an endeavor to better it. Not all of these agents have signed the rider, but some have attached their signatures with a feeling that it is not all that it should be.

High Plane of Used Apparatus Market Attracting Many Sales

THERE is little doubt that the used electrical machinery market has come through the war and the first year of reconstruction in such a condition as to place it on a much higher plane than it previously occupied. It is necessary that a business become better as it lives, if it is to live at all. During the war there was sufficient attraction in this market to draw many new members into it; this had a tendency to localization of the market. These ranks were later depleted, however, and dealers are not now all of the opinion that the market has remained localized. In fact, some of them state that they are doing a broadly distributed business.

There is, of course, some direct selling of apparatus, but for the most part the dealer handles the transactions. The condition of the market today is such that all machinery must be in first-class condition. The dealers feel that in order to keep the business on a high plane the apparatus must be thoroughly tested and renovated, embracing a distinct service. One-year guarantees are almost general on second-hand motors. From this follows the necessity of shunning the promiscuous equipment because much of it the dealer of today would not care to guarantee. Only material which is readily salable at a reasonable profit is being handled.

The class of trade which the used apparatus dealer is now reaching, is, in the opinion of a representative dealer, one which before the war was unwilling to consider the possibilities of this market. From another source comes the statement that an enormous demand now exists from industrial concerns whose ordinary requirements were crippled during the war because of the inability to get machinery. There has always been a demand from some utilities and industrials for turbo units in excess of 2,000 kw., but the supply of units of this size is very limited and is said to be short of the demand. Deliveries of large units from manufacturers is now so long that little difficulty is being experienced in placing used equipment of high-grade manufacture whenever it can be found.

Units of about 500 kw. and under are in good demand for mines and industrials. Buyers are asking for high-efficiency prime movers, and machines are not easily sold which have been discarded because of high steam or fuel consumption. Many small boilers are changing hands, but the supply of larger sizes has not been equal to the demand. Dealers say that motor sales are increasing, and that no exception is made for large sizes. Capacities up to 250 hp., especially for alternating current, are moving in very satisfactory volume. The opinion is that there is much business on paper which will be placed as soon as present economic conditions are straightened out. The usual dealer's supply of fractional motors is far below present demand.

Metal Market Situation

Copper is moving at an extremely slow rate for domestic purchasers. Recent buying has taken care of virtually all of the first quarter and a part of the second. Purchases for the first period were in large quantities, and it is expected that consumption for the second period will be as large as, if not larger than, that of the first.

Producers evidently believe in the present market, for they are still holding to their price of 19 to 19.12½ cents a pound for February and March delivery. The outside market cannot even scare up any appreciable sales at a half cent under the producers' price. The latter's quotations for second-quarter delivery are 19.25 cents, while the outside market is quoted at 18.75 to 19 cents a pound.

There have been a few sales for export within the past week, and this has had a stabilizing effect upon the market. The advance in sterling permitted the making of these sales on a little more favorable basis for the buyer. This is the one metal that Europe cannot produce; it is essential to her industries and there is no substitute for it. She can, however, continue on a minimum quantity while the exchange situation is so unfavorable to her purchases abroad, but even rather small benefits through rising exchange are likely to open the way for greatly increased buying of the red metal.

Zinc reacted to a firmer market because of the advance in exchange last week. The domestic market is quiet, and inquiries are for prompt and nearby shipment, long shipments being considered in a less favorable attitude.

There is little spot lead available, although there is some in transit which is being bought whenever offered.

Aluminum has dropped one-half cent and is now quoted at from 31 to 32 cents a pound.

Scrap coppers and brasses are a fraction lower, while heavy lead is three-eighths of a cent higher under a somewhat heavier demand. The scrap market in general, however, is very quiet.

NEW YORK METAL MARKET PRICES

	Feb. 9	Feb. 16
Copper	£ s d	£ s d
London, standard spot	121 15 0	118 5 0
	Cents per Pound	Cents per Pound
Prime Lake	19.00	19.00
Electrolytic	18.50 to 18.62½	18.50
Casting	18.00	18.00
Wire bars	22.25	22.25
Lead, trust price	8.75	8.75
Antimony	11.50	11.62½
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Spelter, spot	9.00 to 9.10	9.05 to 9.15
Tin	58.00	59.75
Aluminum, 98 to 99 per cent	31.50 to 32.50	31.00 to 32.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	17.00 to 17.50	16.50 to 17.00
Brass, heavy	10.00 to 10.50	9.50 to 10.00
Brass, light	9.00 to 9.50	8.75 to 9.00
Lead, heavy	6.87½ to 7.12½	7.25 to 7.37½
Zinc, old scrap	5.00 to 5.12½	5.00 to 5.12½

THE WEEK
IN TRADE

CONTINUED cold weather and depth of snow are keeping down the high rate of electrical business encountered in January. Temporary stoppage of actual construction relieves to some extent local delivery situations which at best are now very poor. Railway embargoes in the East are keeping raw materials from manufacturers and piling up finished products in their warehouses. The South is immune from bad weather conditions but is short of material. The San Francisco territory faces a very acute water shortage for irrigation purposes, which is already having some little effect on electrical sales. Building plans are maturing well in all sections. Collections are being closely watched.

Shortages are felt in general in wiring materials, except wire, and socket devices. All classes of cords are short. Porcelain and slate parts for switch and cut-out bases are locally hard to get. Absence of spot lead and long-time shipments are lengthening shipments of power and other lead-covered cables, demand for which is heavy.

There is a good demand for lamps, socket appliances, wiring materials of all kinds, tape and motors, and local demands call for sewing machines, line materials, heavy-duty cooking devices, refrigerators and industrial trucks. Price advances were reflected in loom, metal molding, turbines, Edison storage batteries and one make of vacuum cleaner.

NEW YORK

Transportation facilities in New York City have been almost completely tied up since the storm. Embargoes are still holding up freight and arrivals of electrical material in the city have been light. Consequently stacks of steel products in particular are low. The influenza is on the wane, and sales and clerical forces are in a little better shape. Building has not recovered, however, and cannot do so until material can be moved and the weather moderates. Building plans, on the other hand, are going ahead in a good way, and hardly a day passes without the announcement of several new structures, each one in seven figures. Home developments are also working out.

Price advances have been announced on turbines, alkali storage batteries, loom, cotton insulation and metal molding. Jobbers are tightening up a bit on collections.

Flexible Armored Conductor.—Price advances of two weeks ago are buying jobbers' quotations up to $95 and $96 for 1,000 ft. of No. 14 double strips.

Rigid Conduit.—Some jobbers with small stocks are quoting $76 for 1,000 ft. of ½-in. black pipe. Others, depending on manufacturers' stocks, are quoting $108. Supply is very limited.

Non-Metallic Flexible Conduit.—A price advance of 10 per cent was effective last week. Bookings are very heavy and supply is light.

Metal Molding.—A 10 per cent advance went into effect a week ago. There is little available and the demand is heavy. Fittings were similarly affected.

Power Cable.—The utilities are ordering heavily for spring work. Lead is short and deliveries are around three months.

Lamp Cord.—The market is getting tighter and prices are $22 to $23 per 1,000 ft. for No. 18 twisted cord. The shortage is general.

Heater Cord.—The heavy winter has held up mining of asbestos, and the shortage of this material is reflected in the small quantities of heater cord available. Demand is heavy. Better supply is expected in the spring.

Silk Cord.—Shortage of silk thread is leading to a substitution of artificial silk for cords. The former silk cord has virtually disappeared from the market.

Heaters.—Sales have been good, and some jobbers with almost no stocks have decided to call it a season and not order any more.

Varnished-Silk Insulation.—A small quantity of silk is available to cope with a heavy demand for tape and cloth. Prices are stable.

Turbines.—Prices on the entire range of Westinghouse turbines have been advanced. Quotations in before Feb. 6 will be protected until March 1.

Storage Batteries.—Prices on all types of Edison batteries will advance approximately 10 per cent on March 1, but quotations in prior to March 6 will be protected.

Wire.—Stocks in general are ample, although jobbers are short on a size here and there. Mill deliveries are good. Prices are steady at about $12.50 for 1,000 ft. of No. 14

BOSTON

Orders are holding up well. Jobbers' stocks are depleted in appliances and some kinds of wiring material. Deliveries are confirmed chiefly to local express and parcel post shipments from distributers' warehouses, the flow of incoming freight having been sharply curtailed by adverse weather and railroad embargoes. Collections are rather poor for the time being. Prices hold firm in the main, with stiffer quotations in loom and a representative make of vacuum cleaner. Building operations under contract to Feb. 12 in New England total $22,030,000, compared with $6,483,000 in the same period of 1919 and $10,559,000 in 1918. A 66,000-volt transmission line will shortly be built in Connecticut to connect the Connecticut Power-Hartford Electric Light systems with the New London-Norwich district. A five million dollar hotel is planned for Providence, R. I., and banking and insurance structures for Boston, totaling $7,000,000, are on the latest lists of new work. Business in interior New England has been greatly handicapped by stormy weather, and central stations out of reach of tidewater coal are running close to the edge of a famine. Retail electrical sales are feeling the effect of bad weather.

Wire.—Prices are steady, rubber-covered being quoted around 30 cents base, weatherproof at 29 to 30 cents, and bare at 24 cents. Water shipments are coming through fairly well. The demand is easier for the moment.

Dry Cells.—Some overstocks of ignition batteries are reported, despite a fair demand. No. 6 cells bring $32.90 per 100 in barrel lots, with $33.90 for igniters.

Flexible Armored Conductor.—Prices are stiff, $95 per 1,000 ft. being quoted on No. 14 single-strip in coil to 1,000 ft. lots. Small quantities bring $100. Here and there fair stocks are reported, but nothing like a fat surplus can be located.

Non-metallic Flexible Conduit.—Prices are up, the $\frac{7}{32}$-in. size bringing $37 per 1,000 ft. in coil to 1,000-ft. lots, and the ¼-in. size $40. Jobbers are oversold on this material for months ahead.

Tubes.—A severe shortage exists, some bins being empty. Nominal quotations run around $9 per 1,000 for standard packages.

Nail-it Knobs.—These bring $28 per 1,000 in barrel lots, but the scarcity of nails is holding up shipments.

Sockets.—Pulls, 65 cents; keys, 29 cents, and keyless, 27 cents, were quoted Monday. Shipments from the factories are improving materially, and if the railroad embargoes end soon, customer's requirements will be met comfortably for the time. Manufacturers report increasing business from all parts of the country, and labor conditions are somewhat better.

Lamps.—The usual January slump in orders did not materialize, and manufacturers are obliged to ship orders on the installment plan again. Deliveries are hampered by snow.

Vacuum Cleaners.—Business is very brisk. A price advance from $49.75 to $55 at retail, following a factory increase, went into effect on Torrington cleaners Feb. 15.

Refrigerating Equipment.—An active demand is noted. "Automatic" equipment has advanced in price 5 to 10 per cent. Piping is hard to get, but motor requirements have been well anticipated.

Appliances.—Stocks of hollow ware are running low, and shipments are considerably disturbed by railroad conditions. Portable lamps are moving well at reduced rates.

Molded Insulation.—An enormous demand is being encountered. Factory stocks are negligible, and prices are firm.

CHICAGO

The volume of business being done by Middle West jobbers seems to be limited only by their inability to keep up stocks. Practically all stocks are spotty, one jobber having a fairly good line of certain goods while another will be practically cleaned out in the same line. Shortages are greatest in iron conduit, outlet and switch boxes, and metallic armored conductor. The sewing-machine business continues in large volume with the cabinet type coming along stronger. The opening up of the spring business in weatherproof wire is expected shortly and stocks are being acquired in anticipation of this business. Inquiries are already being received for line materials for construction work that will begin as soon as weather conditions are more favorable. House wiring is proceeding in certain localities at an unusual rate. In some mining sections such as northern Michigan hundreds of houses are being wired by the mining companies in order to better living conditions, with a view to holding labor. The selling of heating appliances on the partial-payment plan is increasing after the holidays. Jobbers state that one of the peculiar trade conditions has been that the greater part of the holiday business was on a cash basis. Building permits issued in Chicago for the week ended Feb. 14 amounted to $3,300,000, with $2,000,000 of this in an apartment hotel. Kansas City is to have a consolidated interurban station to cost $1,750,000.

Wire.—Stocks of both rubber-covered and weatherproof are in fairly good shape. No. 14 rubber-covered is quoted at $12.50 per 1,000 ft. in 5,000 ft. lots and $11.25 to $11.75 per 1,000 ft. in 10,000-ft. lots.

Sockets.—New prices on sockets after last week's increase are as follows: ⅛-in. key sockets, $28.05 per 100 in standard packages of 500, $33 per 100 for one-fifth standard package and $37.95 per 100 for less than one-fifth package; keyless sockets at $25.50 per 100 for standard package, $30 per 100 for one-fifth package and $34.50 per 100 for less than one-fifth package; pull sockets at $51 per 100 for standard package of 250, $60 per 100 for one-fifth standard package, and $69 per 100 for less than one-fifth package.

Snap Switches.—Stocks are fair with new prices as follows: 5-amp. single-pole non-indicating switch is quoted at $23.80 per 100 in standard packages of 250, one-fifth package at $28 per 100, and less than one-fifth standard package at $32.20. Three-way switches are quoted at $40.80 per 100 in standard packages of 100, $48 per 100 in one-fifth package lots, and $55.20 per 100 for less than one-fifth package.

Rosettes.—There is a considerable demand for concealed type rosettes for cheap house-wiring work. Stocks are somewhat spotty. Concealed rosettes are quoted at $12.75 per 100 in standard-package quantities of 250 and up to $17.25 per 100 for less than one-fifth standard package.

Lamp Cord.—No. 18 cotton-covered is stocked very poorly in some cases and is hard to obtain from manufacturers. It is quoted at $26 per 1,000 ft. in 500-ft. lots and at $24.25 per 1,000 ft. in lots of over 1,000 ft.

Conduit.—Stocks are very short with prices as a rule on basis of delivery. Where quotations can be made from stock, ½-in. enameled is quoted as low as $73.10 for 1,000 ft., ¾-in. enameled at $96.60 for 1,000 ft. and 1-in. enameled on the same basis at $142.80.

Fiber Conduit.—Stocks are fairly good in fiber conduit. The socket joint 3-in. is quoted at $14 per 100 ft. and $13 on orders of $500 list.

Non-metallic Flexible Conduit.—A price advance of about 10 per cent was announced on Feb. 13. Stocks are very spotty.

Dry Batteries.—Stocks of dry cells are in fairly good shape. The regular No. 6 cell is quoted at 45 cents for less than 12, 38 cents on 12 to 50, 36¼ cents on 50 to 125, 33¼ cents on quantities over 125. The igniter cell runs above 1 cent higher and the telephone cell 3 cents higher.

Switch Boxes.—Stocks of sectional switch boxes are very low in some cases. Manufacturers are working mostly on the fast-moving boxes, and as a result certain types are hard to obtain.

Sewing Machine.—The sewing-machine business continues in excellent volume. An increasing number of cabinet-type machines are being sold as compared with the portable type. The Free Westinghouse is listed at $63 for the portable vibrating shuttle type and $100-$106 for the rotary shuttle cabinet type, depending on the cabinet finish. The Wilson is quoted at $72 for the portable type.

ATLANTA

Business activities continue to move at an unprecedented rate, and the prospects are that only the shortage of material will slow down operations. Building permits continue to increase, a large number of apartment houses and commercial buildings being under construction and projected. High prices on all materials have not served in any way to dampen these operations. Authorities announce that the value of the agricultural products of the South amounts to 44 per cent of the entire country's products and equals approximately ten billion dollars. This assures the continued supply of funds for the financing of all classes of building and expansion throughout the section. Difficulty is reported in obtaining materials, particularly lumber and those commodities dependent upon steel for their manufacture.

Jobbers report a growing popularity of all types of labor-saving devices, particularly washing machines, dishwashers, vacuum cleaners and the like.

Flexible Armored Conductors.—A price advance of approximately 4 per cent has been announced. An acute shortage exists because of poor shipments, which are now quoted at 90 days.

Wire.—Stocks throughout the section continue spotty, most firms quoting a shortage on the popular sizes of both rubber-covered and weatherproof, although there is a fair amount of the larger sizes available. Shipments are fair but are so quickly absorbed as to prevent the accumulation of stocks in Nos. 6, 8 and 10. Prices are steady, with rubber-covered at 28 cents base and weatherproof at 29 cents base.

Heating Devices.—Unusually strong demands continue, and contractors are placing orders for the 1920 holiday trade. The present supply does not equal the demand and little hope of improvement is held out because of slow shipments.

Friction Tape.—Despite the exceptionally high prices, an extraordinarily large demand is reported by the trade. Owing to good shipments, no difficulty is yet being experienced in supplying the demand. Prices are quoted, weatherproof, lots less than 5 lbs., 73 cents; 50 lb. to 25 lb., 62 cents; 25 lb. to 100 lb., 56 cents.

Automatic Refrigerating Units.—Manufacturing jobbers report an increasing demand for household refrigerating units. Sales are on the increase. Active sales campaigns are being outlined for the spring months.

Line Material.—All articles entering into line construction are moving briskly, owing to belated expansion by distributing systems throughout the section. One jobber reports the sale of approximately 1,000 poles in Florida alone within the past thirty days. The supply of line material is holding up well and shipments are fair.

Fans. — Jobbers are placing heavy orders for spring stocks, one of the most prominent having doubled the quantity of his order for 1919. Large sales are anticipated despite an expected increase in prices.

Washing Machines.—A tremendous demand continues in the face of the recent price advance, one jobber alone reporting the sales of 500 machines in the past thirty days. Shipments are slow, especially of the swing-wringer type.

SEATTLE—PORTLAND

Business activity in Seattle and the Puget Sound district as a whole shows very little improvement over the past two weeks. The movement to shipyards and industrials at present in negligible. However, a certain sales volume is maintained by the movement of domestic appliances and house-wiring devices, the latter showing a gradual increase. Jobbers' stocks as a whole are in good condition because of the light demand, although the shelves cannot be said to be overstocked. Building activity is general throughout the Northwest. Home building forms a large part of new construction. However, public and civic improvement is also quite widespread. The building material market is being swayed by the building activity, and prices, it is felt, will remain firm. So far as the Northwest is concerned, the outlook for the farmer is good.

In Portland, manufacturers' representatives state, prospective business is looking very good, and actual sales for the past week have been materially better than a year ago. The main difficulty is not a matter of obtaining business but rather of obtaining material from the East. Jobbers report that business has not been so good in the past week, but that prospects which will materialize in the near future are very satisfactory, and they feel that general business conditions will improve soon. Credits have to be watched very carefully at the present time, because a number of small contractors, former shipyard electricians, are starting in business. This condition, however, will be eliminated as soon as industrial conditions improve. Contractors report wiring for residences, commercial garages and industrial plants very active. Good labor is scarce.

SAN FRANCISCO

Only about one-quarter of the normal amount of rain has fallen and the draught situation is extremely serious. Strikes of telephone linemen and operators were rather unsuccessful. Several telephone offices have officially announced that no extensions will be made during 1920. It is reported that the government will soon commandeer water from some of the power lakes for irrigation purposes.

Ironing Machines.—The ironing machine business, which has been principally in the hands of department stores and special kitchen-furnishing stores, is rapidly passing over to a channel of distribution through electrical dealers, and several jobbers who have not hitherto pushed the line are placing carload orders.

Farm Plants.—It is unfortunate that just when farm plants began to be shipped from various Eastern factories dealers find that the water shortage interferes with their sales.

Household Devices. — Sales of washing machines and vacuum cleaners in the country districts have slowed down, although they are moving better than ever in the cities. It is found, however, that customers are more inclined to shop about and try several machines before deciding. Various strikes have hurt the business, for they have tied up regular time payments.

Ranges.—February has been a particularly active month for prospects of heavy-duty cooking material, such as ranges of 20 kw. and larger, big bake ovens and miscellaneous hotel cooking equipment. This demand is largely due to the checking and overhauling of equipment for the coming resort season and to advertising.

Schedule Material.—Domestic sockets, switches and the like have jumped 7½ per cent with comparatively few anticipating orders reported. Jobbers are asked to anticipate their year's requirements, however, so that the factories can be advised accordingly. Industrial inclosed switches, such as are demanded by state laws, have jumped 10 per cent. The biggest item ordered now is the double-throw switch for range and water heating. The jobbers are laying in good stock in expectation of the successful maturing of range campaigns.

Reflectors.—Window reflectors of several styles advanced about 10 per cent. Stocks are comparatively poor, being rather spotty. A good demand exists.

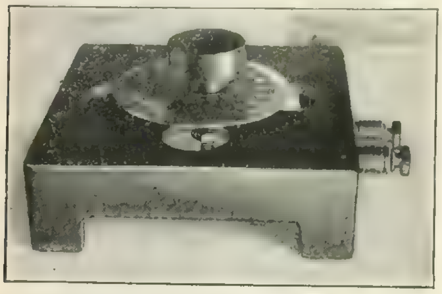
Weatherproof Wire.—The present price on base sizes in coil lots is 33 cents per lb. f.o.b. Pacific Coast points.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Rheostat for Wireless

A radio rheostat 4 in. square, to be used either on a table or screwed to the back of a panel, is being manufactured by the Clapp-Eastham Company, Cambridge, Mass. This rheostat is designed for providing a convenient variable resistance for wireless and other work. The rotary handle moves from zero to maximum resistance through an angle of 120 deg. The rheostat may be either set on a table or screwed to the back of a switchboard panel with only the control handle and scale in front of the board. The complete instrument weighs 1½ lb. It is supplied in sizes ranging from 12.5 ohms maximum resistance with 3 amp. maximum to 1,000 ohms with 0.3 amp. maximum.



FOR USE ON TABLE OR MOUNTED ON PANEL

Cable Connector for Quick Work

For making quick connections to heavy-duty portable machines small motors, transformers, etc., where connections are made and broken frequently, the General Electric Company, Schenectady, N. Y., has developed a new cable connector. It is made to fit several standard sizes of wires and rated at 30 and 60 amp. and 250 volts. This connector consists of two molded compound halves with male and female hollow brass nipples for screwing the two halves together. The wires are soldered into sleeves with a solid end surface contact which slip through the threaded nipples, making connection when the two halves are screwed together.

Muffle-Type Heat-Treating Furnace

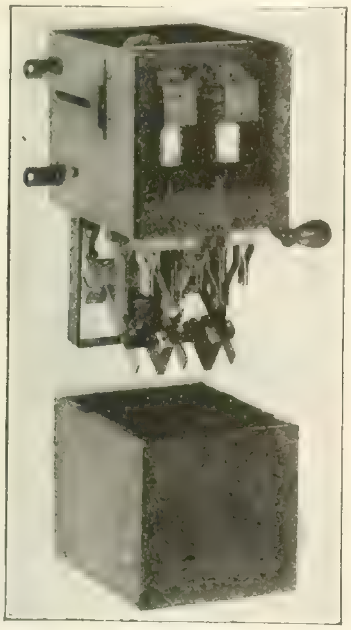
An electric furnace of the muffle type, which is designed by the General Electric Company to meet the demand for a durable, economical, compact and convenient furnace for temperatures up to 850 deg. C. for baking vitreous enamel, hardening and tempering tools, dies, etc., has been developed.

The heating element, which is mounted on the outside of the muffle and covered with compound, is in two parts, giving two degrees of heat. The muffle is mounted in a strong steel casing, and the walls, door, etc., are insulated.

The control panel, which is on top of the furnace, is equipped with a main-line switch, a double-throw switch for high or low heat and a red pilot lamp which acts as a warning to the operator when the furnace is on high heat. There are rheostat connections at the side for use when lower temperatures are desired.

Oil Switch for Star-Delta Control

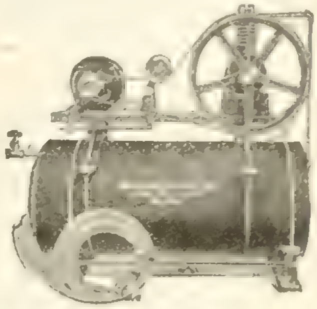
An oil switch for star-delta motor control has been placed on the market by the Electrical Machinery Sales Company of Chicago, which is a development of the Carman & Fryer knife switch. Trip coils give protection against overloading the motor, and a no-voltage release throws the switch to the off position in case of service interruptions. A cover, which is not shown, fits over the top portion, inclosing all parts. It is claimed that the length of the contact jaws tends to prolong the life of the current-carrying parts, as the make and break points are clear of the current-carrying surfaces. In throwing the switch to the starting position the handle is thrown up and must be lowered slightly, releasing a catch, before it can be thrown higher up into the running position. The switch cannot be left in the starting position because of the provision of a spring which tends to throw it out.



OIL TANK LOWERED

Small and Noiseless Air Compressor

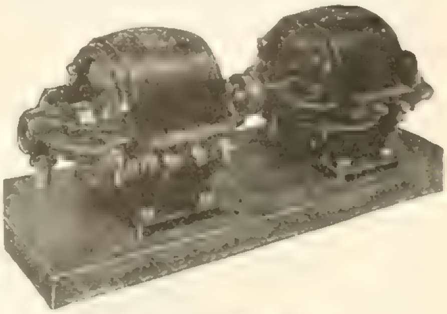
For use where the noise incident to gear drive would be objectionable, the belt-driven air compressor manufactured by the Brunner Manufacturing Company, Utica, N. Y., has been designed. The power plant consists of an air compressor with a capacity of 2½ cu.ft. of air per minute, belt-driven by a ½-hp. motor. A spring device is provided to maintain correct belt tension. The power plant is mounted on a cast-iron sub-base which is supported by the tank, and the entire outfit is 3 ft. long, 1½ ft. wide and about 3 ft. high. The air tank has a capacity of 32 gal. and is guaranteed for 150 lb. working pressure. The motor is furnished for either 110, 220 or 32 volts direct current and 110 or 220 volts, 60 cycles or 25 cycles, alternating current.



SMALL AND QUIET IN OPERATION

500-Volt Radio Motor-Generator

A 500-volt, 100-watt generator driven by a 110-volt motor makes up the set developed for radio purposes by the International Radio Telegraph Company, 326 Broadway, New York City. The generator is designed for use with 500-volt vacuum tubes and for other purposes requiring not over 0.3 amp. It is designed to carry 100 per cent overload for short periods. It has a forty-eight-bar commutator so as to produce a minimum "ripple" and gives quiet operation. Voltage variations are said to be slight since the generator is flat compound-wound. The set is supplied with either a direct-current or an alternating-current motor.



GIVES 500 VOLTS FOR RADIO WORK

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE GENERAL ELECTRIC COMPANY, Pittsfield, Mass., is arranging for the immediate erection of a new brick addition to its plant in the Morningside district. The structure will be about 100 ft. x 400 ft. and will be used as an extension to the enameling department.

THE AETNA ELECTRIC APPLIANCE COMPANY, Boston, is placing on the market a new electric water heater to be known under the trade name of "Hotvent." This heater was designed by Ralph J. Patterson, who has recently been appointed commercial manager of the Twin-State Gas & Electric Company, Boston, Mass.

THE STROMBERG ELECTRIC COMPANY has secured permit to build a five-hundred-thousand-dollar factory in Chicago, Ill.

THE ELECTRICAL REFRACTORIES COMPANY is the name under which the Novelty Clay Forming Company has operated since Jan. 1. The new company, reincorporated in Ohio, has purchased resently a large modern factory at East Palestine, Ohio, which will enable its capacity to be tripled. No change has been made in the organization or management.

SMALL POWER PLANTS FOR SALE BY GOVERNMENT.—Among the electrical equipment still on hand and that is being offered for sale by the Director of Sales are 400 new generator sets of a special design that were made for research work in the trenches and that are said to be readily adaptable for use by small towns and for small light and power plants. These sets are being offered for sale at a considerable reduction from their original cost.

THE IDEAL ELECTRIC & MANUFACTURING COMPANY, Mansfield, Ohio, has opened new headquarters in Philadelphia for negotiating and engineering purposes. The offices are in the Baxter Building, and D. M. Hilliard is in charge.

H. W. POWER has resigned as secretary of the White Lily Manufacturing Company, Davenport, Iowa, to become secretary-treasurer and general manager of the H. F. Brammer Manufacturing Company, Davenport, maker of "Grand Electric," "O. K. Electric" and "O. K. Bench Electric" washing machines. Mr. Power has been connected with the White Lily company for seventeen years.

THE ELASTICAP COMPANY, Hoboken, N. J., incorporated with a capital of $125,000, manufactures mechanical and electrical goods and devices, and particularly a patented rubber splice insulator known as "Elasticap," a device to replace the rubber elastic tape now used for end-splices in fixtures and outlet boxes. Elasticaps have been accepted after test by the Underwriters' Laboratories, Inc., as of Jan. 6, 1920.

THE ELECTRICAL ENGINEERS' EQUIPMENT COMPANY has opened a district sales office at 2611 Union Central Building, Cincinnati, Ohio. This office will be in charge of R. M. Heim, who for a number of years has been connected with the Chicago office of the Electrical Engineers' Equipment Company.

RALPH B. COLEMAN has been appointed sales manager of the Omaha Electrical Works, 1214 Harney Street, Omaha, Neb. This company handles motors, generators, engines, boilers, elevators, etc., and also does repair work. Mr. Coleman was formerly connected with the Electric Machinery Company of Minneapolis, and with the Moloney Electric Company as manager of its Chicago office.

THE DOMESTIC ELECTRIC CORPORATION, Atlanta, Ga., has been incorporated with a capital stock of $1,000,000, and will exclusively distribute the Delco Light products. F. K. Runyan, who will be president and general manager, for four years has had charge of distribution of the Delco Light products in Georgia and has been conducting the business as a direct branch of the Domestic Electric Company. The other officers of the company are A. M. Bergstone, vice-president, and Frank Jeter, secretary and treasurer.

THE PHELPS FARM LIGHT & POWER COMPANY has established Southeastern headquarters in Atlanta, Ga. Several salesmen will travel from the Atlanta office, and expert service men will be kept in this field by the company. The organization will cover the states of Georgia, Florida and Alabama. The Phelps company is one of the largest manufacturers in the Middle West of complete light and power systems for homes, stores, institutions and other users of light and power. The main factories are at Rock Island, Ill.

MACHINERY CENTER OPENED.—The Allied Machinery Company of America has recently opened at Center and Walker Streets, New York City, an exhibition of construction and industrial machinery of several kinds.

RAYMOND MARSH, who for the last four years has been secretary of the American Washing Machine Manufacturers' Association, Chicago, has resigned to become general sales and advertising manager and assistant to the president of the Syracuse (N. Y.) Washington Machine Corporation. Prior to his connection with the electrical industry Mr. Marsh was for four years assistant secretary of the Davenport (Iowa) Commercial Club and other business organizations in Davenport. During his connection with the Washing Machine Association the industry has grown from one which did $7,000,000 worth of business in 1912 to one which did $15,000,000 worth of business in 1919.

RAYMOND MARSH

EASTERN FACTORY AND BRANCH FOR FRENCH FLASHLIGHTS AND DRY CELLS.—The growing demand in the East for French Ray-O-Lite flashers, Ray-O-Lite batteries and French dry cells, products of the French Battery & Carbon Company, Madison, Wis., has necessitated the establishment of a factory at Newark, N. J., and branch office at 71-73 Murray Street, New York City. All Eastern business of the French Battery & Carbon Company was taken care of by the New York branch on Jan. 1, 1920.

ERNEST V. PANNELL is now stationed in New York City as special sales engineer for the British Aluminium Company, Ltd. He was graduated from the Northampton Engineering College in London, England, in 1908, and after a few years' construction and testing experience joined the staff of the British Aluminium Company in 1911. He has since been associated with the various factories and rolling mills of the company and also with the commercial side, having for the last four years been manager of the Canadian head office in Toronto. Mr. Pannell is a member of the American Institute of Electrical Engineers.

THE APEX APPLIANCE COMPANY is adding $200,000 reconstruction to its Chicago factory.

THE STANDARD ELECTRIC & ELEVATOR COMPANY, INC., Baltimore, Md., has just opened a Philadelphia office at 1105 Finance Building, with C. G. Schafer as district manager. Mr. Schafer for the the past ten years has been sales and application engineer of the Westinghouse Electric & Manufacturing Company and has had a broad experience in the sale of equipment in the marine and industrial trade of the Philadelphia district.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., announces that, arrangements having expired under which the St. Paul Electric Company, St. Paul, Minn., has maintained stocks of Emerson and Northwind fans and Emerson motors at that point, the Northern Electric Company of Minneapolis will have available larger stocks of this apparatus than in past years. A carload of Emerson and Northwind fans is to be added to the Minneapolis stock of the Northern Electric Company for the season of 1920. Furthermore, a like arrangement with McCarthy Brothers & Ford, Buffalo, N. Y., having expired, a stock of Emerson and Northwind fans will be maintained at Buffalo during the season of 1920 by the Johnson-Wahle Electric Company, 222 Pearl Street.

STANDARD STEEL BEARINGS, INC., 347 Madison Avenue, New York City, which is owned and operated by the Marlin-Rockwell Corporation, has been organized to consolidate the plants of the Marlin-Rockler Bearing Company, Philadelphia, Pa., Braeburn Steel Company, Pittsburgh, Pa., Rockwell Drake Bearings Division, Plainville, Conn., Willow Street and Hawden Divisions, New Haven, Conn., and the Norwich Division, Norwich, Conn. The new organization was determined solely by considerations of efficiency, in view of the program of expansion necessitated by the growth of demand for the products named, according to a statement from the company. No change is implied either as to policy or executive and operating personnel.

THE ELECTRO SERVICE COMPANY, which some time ago acquired all the patent rights covering the Bennett surge arrester invented by C. E. Bennett, electrical engineer of the Georgia Railway & Power Company, is now manufacturing these arresters in several designs in a new plant established at Marietta, Ga. This type of arrester, which relieves surges due to lightning, switching disturbances, arcing grounds and the like, is being made for voltages from 2,300 to 110,000. It is now understood that two other types will soon be ready, one for 140,000 volts and the other for 1,500 volts direct-current railway service. G. N. Lemmon is general manager of the company in charge of production. The following sales representatives have been appointed: Maxwell Engineering & Manufacturing Company, 61 Broadway, New York City; Mill Power Supply Company, Charlotte, N. C., and E. A. Thornwell, 1026 Atlanta Trust Company Building, Atlanta, Ga. A new bulletin, known as No. 2C, which has just been issued, describes in detail the operation of the arrester and shows some of the actual installations of the device that have been made.

OIL BURNER EQUIPMENT PLANT STARTED AT STAMFORD, CONN.—The Petroleum Heat & Power Company, a reorganization of the Fess Rotary Oil Burner Company, Boston, Mass., has begun the erection of a factory on Stamford Harbor, Stamford, Conn., for the manufacture of oil burners and equipment for changing over steam plants from a coal-burning to an oil-burning basis. The company is capitalized at $2,000,000 and is backed by Boston and New York interests. The first factory building to be 200 ft. long by 160 ft. wide. Ultimately it is anticipated that about 4,000 persons will be employed. The officers are: President, Col. F. Lorthrop Ames, Boston; vice-presidents, Robert Adamson, New York, and W. G. McTarnahan, Boston; treasurer, F. Murray Forbes, Boston. Others reported to be financially interested, include W. Cameron Forbes, Boston, former Governor-General of the Philippine Islands; George E. Cabot and Henry G. Lapham of Boston; W. C. Durant, president General Motors Corporation; Andrew Adie, Boston; Bradley W. Palmer and F. H. Prince, Boston; Louis G. L. Kaufman, New York, Henry R. Hoyt and Gen. Coleman du Pont, New York. The company informed a representative of the ELECTRICAL WORLD recently that special attention will be paid to equipment for the conversion of central stations from a coal-burning to an oil-burning basis.

Supply Jobbers' Notes

THE MOHAWK ELECTRICAL SUPPLY COMPANY, Syracuse, N. Y., announces the following changes in connection with the expansion of the sales department, made necessary by a greatly increased business and plans for the future. H. M. Sliter, for the past seven years manager of the Elmira district office of the General Electric Company, has been made sales manager, and J. J. McGuire of the sales department of the company has been made assistant sales manager.

C. C. McKIRAHAN has been appointed sales manager of the Central Electric Company, Chicago. After being graduated from Kansas State University Mr. McKirahan was in the electrical department of the Santa Fe Railroad until he joined the forces of the Central Electric Company seven years ago. He traveled in Kansas for this company until two years ago, when he was made manager of the engineering department, which position he held until his present appointment.

CHARLES SELZER has resigned as sales manager of the Central Electric Company, Chicago, to become sales manager for the B. R. Electric Company, Kansas City, Mo. Mr. Selzer was manager of the Chicago office of the Adams-Bagnall Company until he became connected with the Central Electric Company five years ago.

THOMAS N. MEHAN, who has been connected with the Electrical Appliance Company, Chicago, for eight years, has become a member of the sales organization of Paul W. Koch & Company, Chicago, and will handle local distribution of the "Jiffy" products and electrical specialties, which are being marketed by that company.

L. E. LE VEE, formerly sales manager of the Clemens Electrical Corporation, Buffalo, N. Y., is now the manager of the appliance department of the Robertson-Cataract Electric Company, Buffalo, N. Y. Mr. Le Vee was recently elected president of the Electric Club of Buffalo.

THE ELECTRICAL POWER & APPLIANCE COMPANY, Yakima, Wash., has been formed by Al Schroeder, C. H. Kirby, A. L. Fullbright et al. to represent the Western Electric Company. The concern will maintain a farm-lighting plant depot, and its territory includes the southwestern section of the state, with dealers in all towns to handle the Western Electric lines.

NEW SUPPLY DIVISION MANAGER FOR WESTINGHOUSE SEATTLE OFFICE.—On Jan. 1, 1920, the appointment of J. G. Miles as supply division manager of the Westinghouse Electric & Manufacturing Company's Seattle office became effective. Mr. Miles succeeeds C. V. Aspinwall, now the company's representative at Spokane, Wash. Mr. Miles has seen long service in the supply department of the company, serving for several years as the head of the insulation section at East Pittsburgh, Pa. His grasp of the details of supply work has been responsible for the upbuilding of a considerable portion of supply sales and also for the exploitation of many new products, some of the better known of which are the bakelite and bakelite micarta products, particularly as applied to insulation and gears.

Foreign Trade Notes

MINIMUM PRICES ON ELECTRIC LAMPS ESTABLISHED BY ITALY.—By a recent decree the Italian government has established minimum prices at which lamps can be sold. This supplements the decree as noted in these columns on Dec. 20, 1919, by which the so-called 25 per cent tax was created. The new prices are:

	Lire
Carbon-filament lamps each, ...	1.60
Metallic-filament lamps of whatever type:	
Up to 60 cp. each................	3.00
From 65 to 250 cp. each..........	6.00
From 250 to 900 cp. each.........	16.00
Of 1,000 cp. and greater, each.....	24.00

The value of the lira on Feb. 13 was 17.72 to the dollar.

FREE IMPORTATION INTO POLAND OF SOME ELECTRICAL GOODS.—The most recent regulations permit entry into Poland without special license of electrical articles for installation (except chandeliers, lamps and shades), incandescent lamp bulbs and hand flashlights, cables and insulated wire.

NEW ZEALAND'S INCREASING TRADE IN ELECTRICAL IMPORTS FROM JAPAN.—During the years 1915, 1916, 1917 and 1918 New Zealand imported from Japan electrical machinery in the following respective amounts: $12,784, $63,575, $73,688 and $188,980.

ITALIAN INVESTMENTS IN ELECTRICAL INDUSTRIES INCREASE.—During the year 1917 investments in Italian industries embracing electrical operation and supplies amounted to 191,000,000 lire, while during 1918 the investment almost doubled to just under 359,000,000 lire. This investment was surpassed by only one other industry, that of the manufacture of metals. The difficulties of obtaining supplies from abroad account for this progress in the electrical industries. Recently organized companies in Bologna will manufacture hydro-electric and traction supplies and storage batteries.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

The electrical commissioners in a city in Australia (No. 30,856) desire to receive quotations and full information for the purchase of boiler-house machinery, including boilers, economizers, etc., coal and ash handling machinery, turbo-generators, condensing plants, electrical storage batteries, traveling cranes, electrical instruments, switch gear, switches and all accessories, synchronous condensers and water turbines for direct coupling to generators. Description of machinery and equipment required may be had on application to the bureau or its district offices.

A firm in England (No. 31,394) having a branch office in the United States desires to be placed in touch with manufacturers of electrical labor-saving appliances, with a view to their sale in England. It is particularly interested in washing machines, vacuum cleaners, dish-washing machines, electrical clothes dryers, motor-driven sewing machines, and electrical water heating apparatus. Articles of the highest class, and in large quantities are wanted.

A company in Honduras (No. 31,396) desires to purchase machinery for an ice plant, capable of producing 3,500 lb. of ice per day. Quotations wanted on electric machinery, f. o. b. New York, or preferably San Francisco. Payment, one-third cash with order, balance by drafts of equal amounts, 90 days, 120 days, and six months from date of shipment. Correspondence may be in English. Complete information should be furnished with first communication.

A firm specializing in American electrical manufactures in England (No. 31,496) desires to secure an agency or purchase electrical machinery and control gear, motors and generators, alternating and direct current; will purchase if agency is unobtainable.

An electrical engineer in Argentina (No. 31,662) desires to purchase electrical machinery, motors, generators, etc., for medium-power electric plants (100 hp. to 200 hp.), and requests immediately catalogs giving detailed specifications.

A firm of manufacturers in Spain (No. 31,689) desires to secure the sole agency on commission for the sale of electrical machinery and supplies and electric flatirons.

A commercial agent in the West Indies (No. 31,690) desires to purchase a small ice-making plant of a maximum capacity of 3 tons, preferably combined with electric lighting plant sufficient for 250 16-cp. lamps.

An American exporting house (No. 31,503), which has established branches in all the principal cities of the Levant and maintains showrooms, warehouses and service stations, desires to represent American firms for the sale of electrical apparatus.

An agency is desired by a firm in Switzerland (No. 31,516) for the sale of stationary motors driven by electricity, horizontal, 20 hp. to 120 hp., and compressors, cranes and rigs.

An importer in Belgium (No. 31,519) desires to secure an exclusive agency for the sale of electrical and electro-mechanical products of all sorts.

An agency is desired by a man in Italy (No. 31,709) for the sale of electric lamps, electrical supplies and novelties.

New Incorporations

THE TRENTON LIGHT & POWER COMPANY of Fox Lake, Wis., has been incorporated by C. J. Schoenfeld and others. The company is capitalized at $15,000 and proposes to generate and distribute electricity for lamps and motors.

THE GILBERT (IOWA) ELECTRIC COMPANY has been incorporated with a capital stock of $15,000 to supply electricity for lamps and motors in Gilbert. John Hill is president of the company.

THE UNION POWER COMPANY of Mullens, W. Va., has been chartered with a capital stock of $25,000 by Harrison B. Smith, Duke W. Hill and David C. Howard, all of Charleston, W. Va.

THE BLANCHARD (OKLA.) MILL & POWER COMPANY has been chartered with a capital stock of $25,000 by Thomas C. Dyer, H. C. Freeney and A. O. Maddox, all of Blanchard.

THE GILBERT (S. C.) ELECTRIC LIGHT & POWER COMPANY has been incorporated with a capital stock of $3,000 to install an electric plant in Gilbert. K. B. Price is engineer and manager.

THE CENTRAL POWER COMPANY of Geneva, Ala., has been incorporated with a capital stock of $150,000 to develop a water-power project.

THE LAUREL HILL ELECTRIC COMPANY of Laurel, N. C., has been incorporated by G. McN. Pate, Z. V. Edwin and others. The company is capitalized at $25,000 to operate an electric light and power plant in Laurel.

Trade Publications

HANGER OUTLET.—The Frank Adam Electric Company, St. Louis, Mo., has put out a folder describing a flush outlet on which an electric fan may be hung.

HANGERS.—In catalog B-18 The Thompson Electric Company, Cleveland, Ohio, tells how to use reflectors with Thompson safety disconnecting hangers.

FIXTURES.—Catalog No. 5 of the Reflectolyte Company, St. Louis, Mo., is now being distributed.

STOKERS.—In publication No. 30 the Sanford-Riley Stoker Company of Worcester, Mass., describes its stokers from the standpoint of adaptability.

PLASTIC MOLDING.—A booklet giving information on plastic insulating compounds and suggestions on molding them has been prepared by the Shaw Insulator Company, 5 Kirk Place, Newark, N. J.

TRANSMISSION-LINE EQUIPMENT.—Hickey & Schneider, Inc., 439 Jersey Street, Elizabeth, N. J., have issued bulletin No. 15 describing transmission-line and station equipment.

OIL PURIFYING.—The De Laval Separator Company, 165 Broadway, New York City, and 29 East Madison Street, Chicago, has issued several booklets on the De Laval method of purifying and reclaiming lubricating, cutting, hardening and fuel oils, by the use of motor-driven separators.

OIL ENGINES. — The Allis-Chalmers Manufacturing Company of Milwaukee, Wis., has issued bulletin No. 1537 giving details of its Diesel type oil engine, to assist in ordering repairs and spare parts.

MOLDED MATERIAL. — The Belden Manufacturing Company, Twenty-third Street and Western Avenue, has issued buletin No. 1208 on Beldenmold molded pieces made from "Condensite," "Bakelite" and "Redmanol".

GALVANOMETERS.—"Paul" Unipivot galvanometers are the subject of bulletin No. 100 recently issued by the Rawson Electrical Instrument Company, Central Square, Cambridge, Mass.

RECTIFIERS.—The St. Louis Electrical Works, 4060 Forest Park Boulevard, St. Louis, Mo., is circulating bulletin A on its type M U alternating-current battery charger.

INSTRUMENTS.—Herman H. Stich & Company, 15 Park Row, New York City, have prepared bulletin 105 (AA) on their "Monopivot" galvanometers, micro-ammeters, milli-voltmeters and milli-ammeters.

New England States

SKOWHEGAN, ME.—It is reported that the Central Maine Power Company is planning the construction of large power house which will have five water turbines, one of which, it is stated, will generate more power than is at present produced in Skowhegan.

WINDHAM, ME.—The Newhall plant of the E. I. du Pont de Nemours Company which has been destroyed by fire will be rebuilt in the immediate future. The new building will be operated by electric power.

SPRINGFIELD, MASS.—The Cheney Bigelow Wire Works has completed arrangements for the construction of the proposed new one and two-story brick addition to its plant, about 45 ft. x 450 ft., to be located at Warwick and Heywood Streets. Contract for the structure, which is estimated to cost about $100,000, has been awarded to L. S. Wood, 14 Stockbridge Street, Springfield.

SPRINGFIELD, MASS.—Plans have been prepared by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., for the erection of a large new one-story concrete and steel machine shop to be located in the East Springfield, Mass., section. The new structure, with machinery and equipment, is estimated to cost approximately $400,000. Bernard Prack, Keystone Building, Pittsburgh, is architect.

HARTFORD, CONN.—Contract has been let to the Stone & Webster Engineering Corporation, Boston, Mass., by the Hartford Electric Light Company for the erection of the proposed new power station, to be located in the south meadows district. It is proposed to construct the plant on the unit plan to comprise two units, the first section being three-story, about 200 ft. in length, of brick, concrete and steel. The second section will be constructed at a later date.

NEW HAVEN, CONN.—Notice of an increase in the capital of the Acme Wire Company, 973 Dixwell Avenue, from $1,500,000 to $3,000,000, for general business expansion, has been filed with the Secretary of State. The company specializes in the production of electromagnets, magnet wire, and allied products.

Middle Atlantic States

FILLMORE, N. Y.—The water rights of Wiscoy Falls have been purchased by the Genesee Valley Power Company. It is reported that they will extend the present line to Belfast, Belmont and Angelica, and develop an additional 600 hp.

FREEPORT, N. Y.—Plans for improving the municipal lighting plant include the retubing of two of the power house boilers and replacing the present steam engines with oil engines.

MEDINA, N. Y.—The Western New York Utilities Company, Inc., has had plans prepared for the erection of a new electric light and power plant at Clarendon, Orleans County. The company has been granted permission by the Public Service Commission, Albany, to proceed with the work.

NEW YORK, N. Y.—Plans are under consideration by Edwards & Company, Exterior Avenue and One Hundred and Fortieth Street, manufacturer of electrical products, for the erection of a new addition to its plant for increased operations. The structure will be two-story, brick and concrete, about 60 ft. x 95 ft.

NEW YORK, N. Y.—A new boiler plant to provide for increased power facilities, will be erected at the Fordham Hospital, Crotona Avenue and Southern Boulevard. Plans for the structure are being prepared by the Board of Trustees of Bellevue & Allied Hospitals, 415 East Twenty-sixth Street.

ROME, N. Y.—In connection with the proposed expansion plans of the Rome Wire Company to include the operation of the plant of J. J. Carrick, Inc., Clyde Avenue, near Kensington Avenue, Buffalo, N. Y., formerly used for the manufacture of shells, recently acquired, contract has been awarded to the John W. Cowper Company, Inc., Fidelity Building, Buffalo, for remodeling and improving the works to suit the new line of manufacture, as well as for the construction of two new one-story additions, 120 ft. x 240 ft., and 100 ft. x 280 ft., respectively, to cost about $250,000. A building to be used for office purposes will also be erected. The plant will be devoted to the production of insulated wire. H. T. Dyett is president.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

SCHENECTADY, N. Y.—The Mica Insulator Company, 68 Church Street, New York, will build a large new addition to its local plant. Plans are being arranged for the construction of a three-story reinforced concrete building, estimated to cost about $150,000, to provide for increased capacity. The company's plant is devoted to the production of insulation specialties. W. L. Stoddard, 9 East Fortieth Street, New York, is architect.

WATERTOWN, N. Y.—The Beebbe Island Syndicate is understood to have commissioned J. G. White & Company, Inc., 43 Exchange Place, New York, to prepare preliminary plans for the erection of a large new hydroelectric plant on Beebe Island, near Watertown. The proposed station is estimated to involve an expenditure of about $1,000,000.

EAST ORANGE, N. J.—Plans are being arranged by the City Council for the installation of a new electric street-lighting system in Main Street and Central Avenue.

NEWARK, N. J.—The Independent Lamp & Wire Company, Inc., 1733 Broadway, New York, with plant at Weehawken, N. J., is planning for the early construction of the proposed new plant to be located on property bounded by Runyon Street, Hillside and Belmont Avenues, Newark.

OLDWICK, N. J.—Plans are under consideration by the Borough Council for the immediate installation of a new electric street-lighting system throughout the municipality.

READINGTON, N. J.—The Readington Township Committee has under contemplation the installation of a new electric street-lighting system in the Three Bridges section, including the establishment of an electric plant to be located in the Rockefeller Mills property.

TRENTON, N. J.—The Blabely Laundry Company, 11 South Warren Street, will build a new laundry plant at Brunswick Avenue and North Montgomery Street, estimated to cost $100,000. Considerable electrical and mechanical equipment will be required for the works, which will be one-story, about 85 ft. x 180 ft. Contract has been let to the N. A. K. Bugbee Company, 206 East Hanover Street.

CHESTER, PA.—Considerable refrigerating apparatus and electrical equipment will be required in connection with the construction of the proposed new local ice-manufacturing plant of the W. F. Koelle Company, Twenty-sixth and Oxford Streets, Philadelphia, Pa., contract for which has been awarded. The new plant will have a capacity of 60 tons, and will be about 85 ft. x 130 ft.; it is estimated to cost $200,000, including equipment.

CLEARFIELD, PA.—The Penn Public Service Corporation is arranging plans to increase the capacity of its generating plant at Rockwood. The company is also planning for the formation of a subsidiary organization, which latter company will purchase a large tract of property in the vicinity of Seward, Pa., to be used as a site for a new power station. The proposed new station will have an initial capacity of 30,000 kw., to be increased at a later date to 80,000 kw. The Penn Company recently completed plans for the issuance of bonds for $4,000,000, to be used for proposed expansion.

PHILADELPHIA, PA.—A new one-story brick and concrete power plant and engine house will be erected at the plant of Charles E. Dearnley, at Bayton Street and Chelten Avenue. The structure will be about 36 ft. x 90 ft.

PHILADELPHIA, PA.—Contract has been awarded to the Philadelphia Electric Company for the furnishing of electric service to the townships of Cheltenham and Springfield.

POTTSTOWN, PA.—Sotter Brothers, Inc., manufacturer of boilers, stacks, etc., will build a large new addition to its plant for increased operations. Contract for the works has been let to the McClintic-Marshall Company, Pittsburgh. The proposed addition will be one-story, about 95 ft. x 120 ft., and is estimated to cost about $100,000, including machinery and equipment. H. M. Lessig is president.

READING, PA.—The Metropolitan Edison Company is making rapid progress on the construction of its new 66,000-volt high-tension transmission line to Pottsville, approximately 36 miles. The company plans to use the line for furnishing electric energy to the upper Schuylkill River valley and the lower anthracite region in this vicinity, and in connection with the work two new transformer stations will be erected at Hamburg, about 18 miles from Reading.

ELKTON, MD.—The Perryville Electric Company has arranged for the disposal of its local plant and property to the Havre de Grace Electric Company. The new owner will continue the operation of the plant.

FREDERICK, MD.—The Farmers' Association is considering plans for the immediate construction of a new local hydroelectric plant, to be devoted to electric energy for local business interests.

HAGERSTOWN, MD.—Plans are being arranged by the Street Commissioners for a bond issue of $300,000, the proceeds to be used for the construction of a new municipal electric plant on Antietam Creek.

NORFOLK, VA.—A three-story fireproof brick and concrete building is to be erected by the Automatic Soda Fountain Corporation which was recently chartered with a capital of $500,000. The building will be 100 ft. x 100 ft. and with the necessary equipment will cost about $75,000.

PETERSBURG, VA.—The Petersburg Silk Hosiery Corporation, recently organized with a capital of $500,000, is planning to install 42 electrically driven knitting machines with a daily capacity of 1,800 doz. pairs of silk hose. The cost is estimated at $300,000.

WARRENTOWN, W. VA.—Improvements being considered by the Warrentown Electric Light & Power Company include the installation of a 90-kw., 60-cycle, 2,200-volt generator, and a 150-hp. boiler, and the erection of 5 miles of transmission lines and street lighting system. M. J. O'Connell is the secretary-manager.

North Central States

LANSING, MICH.—It is reported that an additional municipal electric light and power plant is to be constructed at a cost of about $2,000,000 to satisfy the power demands made by local industrial expansion.

SAGINAW, MICH.—It is reported that as soon as a $6,000,000 bond issue is authorized by the state securities commission, the Consumers' Power Company will put into execution plans for the construction of a steam electric generating plant at Milwaukee. The project is estimated to cost $5,000,000 and is made necessary by repeated demands for increased power all through that vicinity.

CARROLLTON, KY.—Plans are being made for the construction of an electric light and power plant to cost $32,184. The contractors are Frazier & Morrell of Lexington, Ky., the engineer, J. H. Brock of the same city.

DAWSON SPRINGS, KY.—It is reported that nineteen additional buildings of the United States Public Health Sanitarium are to be equipped with power plants and mechanical equipment, for which the Treasury Department at Washingotn has appropriated $381,530. S. W. Rittenhouse, contractor, of Washington, D. C., is in charge of the work.

HAZARD, KY.—Contemplated additions to the steam generating plant of the Kentucky & West Virginia Power Company include the installation of a 3,000-kw. turbine with surface condenser, two new 800-hp. boilers, underfeed stokers and auxiliary operating equipment.

MAYKING, KY.—A new power plant is to be added to the plant of the Pine Creek Coal Company.

COLUMBIA CITY, IND.—In order that their farms may be supplied with electric lights and power, the farmers in this vicinity have organized a light and power company which will supply current only to members. Work on the plant, which is to be situated on the Eel River, is already under way. C. M. Koontz is president of the association.

ELWOOD, IND.—The Pittsburgh Plate Glass Company will expend $100,000 for new factory buildings.

HAMMOND, IND.—The La Salle Steel Company will erect a new plant in Hammand to employ between 800 and 1,000 men. The new buildings will be of steel, glass and concrete.

LOGANSPORT, IND.—Ward Brown and J. W. Sherrick of Indianapolis, owners of the Barnett Hotel, which was recently destroyed by fire, are working on plans to erect a $500,000 hotel for this city.

MUNCIE, IND.—The Big Four Railroad Company will award contract March 1 for a two-story reinforced concrete freight house, to cost $150,000.

CHICAGO, ILL.—Plans are being considered to completely reorganize the city's present lighting system. The project as planned would necessitate a bond issue of $15,000,000.

EAST ST. LOUIS, ILL.—The Railroad Administration is planning the construction of a steel transfer barge to handle freight by the Mississippi River barges and connecting railroads. The barge, which will be able to take care of 20,000 tons of freight each week, will be electrically operated. The contract for construction has been awarded to the Dubuque Boat & Boiler Works of Dubuque, Iowa.

EL PASO, ILL.—The El Paso Telephone Company plans to rebuild its line this season. Most of the cable will be installed underground.

EVANSTON, ILL.—The Davis Hotel, to cost $1,800,000, will be erected by Henry T. Davis.

TRACY, MINN.—In order to meet the ever-increasing demands for electric power, the Citizens' Light, Heat & Power Company is planning to double the generating capacity of its plant by installing a new 365-hp. Diesel engine direct connected to a 2,300-volt generator, at an estimated cost of $50,000. Emil W. Erick is the president.

DAVENPORT, IOWA. — The Nelson Manufacturing Company of St. Louis will erect a four-story reinforced concrete warehouse, 96 ft. x 140 ft., to cost $175,000.

GREENFIELD, MO.—A new system to connect with Osceola is being contemplated by the Greenfield Light & Power Company of which Colin K. Lee is the superintendent. The probable cost is set at $35,000.

INDEPENDENCE, MO.—The City Council has under consideration plans for improving the municipal electric lighting plant. The new equipment to be installed at a cost of about $60,000, includes engine, generator and auxiliary equipment.

KANSAS CITY, MO.—The Kansas City Telephone Company will install 10,000 automatic telephones this year. The general offices will be removed in April to the new building at Eleventh and Oak Streets. Following the installation of the first 10,000 automatics, the equipment in the entire city will be changed to that type. The final elimination of the present manual system will not take place for about seven years, according to estimates of the company.

KANSAS CITY, MO.—Plans are being prepared for the erection of a $1,750,000 interurban station to be erected by various interurban companies operating in the vicinty of Kansas City.

Southern States

BENSON, N. C.—Bonds to the amount of $50,000 have been issued for the construction of an electric light plant. L. Gilbert is the clerk.

CHARLOTTE, N. C.—A six-story fireproof garage of reinforced steel and concrete is to be built by C. C. Coddington. The building will be 90 ft. x 198 ft. and will have 100,000 sq.ft. of floor space. Equipment to be installed includes two freight and one passenger elevator, a water-cooling system, steam-heating plant, compressed-air chutes, and a repair shop, the total cost approximating $350,000. Albert Kahn, of Detroit, Mich., is the architect.

GASTONIA, N. C.—The Loray Mills, manufacturers of sheetings, etc., are planning to spend $1,000,000 in improving and enlarging their plant. The steam and big electric motors and drives are to be replaced by small motors each driving small sections of the machinery; the number of spindles will be increased from 57,000 to 90,000; and 150 bungalows will be built for operatives, together with dormitories, barber shops, locker rooms, cafeteria and a laundry.

HERTFORD, N. C.—The plant of the Major & Loomis Lumber Company has been destroyed by fire at an estimated loss of $150,000.

KINSTON, N. C.—The city is planning to spend $125,000 in improvements to the electric light plant under the direction of W. C. Olsen, consulting engineer, of Sumter, S. C. Jos. G. Dawson is the mayor.

MOUNT HOLLY, N. C.—The capital of the Catawba Spinning Company has been increased from $200,000 to $500,000, and the company plans to build a two-story addition, 190 ft. x 75 ft., and install 6,000 additional spindles.

NEWBERRY, S. C.—The city has under consideration plans for installing a municipal electric light plant. Eugene S. Blease is the mayor.

ALMA, GA.—The city has under consideration the construction of an electric lighting system. The present plans call for a 50-hp. oil engine, a 37½-kva. generator, a pole line, etc. A. B. Mercer is the mayor; the engineer in charge is J. B. McCrary Company of Atlanta, Ga.

ATLANTA, GA.—Extensive improvements contemplated by the Johnson Paint Company include the erection of a brick and tile fireproof factory, 140 ft. x 100 ft., at a cost of $100,000, and the installation of stone mills, mixers, grinders, electric elevators, heating plants, etc. The contractor is Hard & Adams.

ROME, GA.—An additional 85,000 sq.ft. of brick and concrete is to be added to the plant of the Anchor Duck Mills, maunfacturing cotton duck. The new plant, to cost about $200,000, will be run by electric power. J. A. Glover is president; J. F. Dupre Sons Company, contractor.

CEDAR KEYS, FLA.—L. A. Toler has under consideration the installation of an electric light plant and the construction of a one-mile transmission system.

PALATKA, FLA.—The city is contemplating the installation of a white way lighting system of approximately 100 lamps. J. H. Randolph, city engineer, will be glad to receive communications from manufacturers with reference to this proposition.

SARASOTA, FLA.—It is reported that bonds will be issued amounting to $35,000, to cover the cost of improvements and extensions to the municipal electric light and power plant.

VERO, FLA.—Bonds to the amount of $30,000 have been voted by the city, the proceeds to be used in enlarging the electric light plant.

CHATTANOOGA, TENN.—The Turner Construction Company of New York is building a reinforced concrete three-story mill, 312 ft. x 132 ft., and a two-story warehouse, 116 ft. x 62 ft., for the Thatcher Spinning Company, manufacturer of hosiery yarn. The new machinery is to be electric driven, and 30,000 additional spindles are to be installed as well as fire-protective apparatus. H. S. Thatcher is the secretary-treasurer.

BIRMINGHAM, ALA.—The Chickasaw Shipbuilding & Car Company, which is a subsidiary of the United States Steel Corporation is planning to spend several million dollars in building a plant for the manufacture of steel cars and steel frames.

BIRMINGHAM, ALA.—Charles R. Reid, president of the Baker-Reid Lumber Company, is planning to install a planing mill with a monthly capacity of 150 carloads. The new mill will cost about $50,000 and will be run by electricity.

SELMA, ALA.—The Vredenburg Lumber Company is planning to rebuild the mill which was recently burned at a loss of $150,000.

CLARKSDALE, MISS.—The city is considering a bond issue of $500,000 to cover the cost of city improvements to the light, water and street systems.

LITTLE ROCK, ARK.—Bonds for $375,000 have been issued to cover the cost of improvements and extensions to the power plant of the Little Rock Railway & Electric Company in accordance with its plans for increased capacity. Boilers and other new equipment will be installed.

SELMA, LA.—It is reported that the Grant Timber & Manufacturing Company, dealers in pine and hardwood, are planning to install two sawmills with a combined daily output of 150,000 ft., at an estimated cost of $200,000. Thrall & Shea, of Lake Charles, La., are the contractors.

HOUSTON, TEX.—W. H. Irvin is planning to double the capacity of his ice plant and candy factory which has a daily capacity of 50 tons, and increasing his storage capacity to 5,000 tons by an addition that will cost approximately $400,000.

NAVASOTA, TEX.—A new power plant to cost, together with the necessary equipment, about $60,000, and with a capacity of 250 hp. is to be constructed under the direction of the Chamber of Commerce.

SLATON, TEX.—A franchise for the installation and operation of an electric light and power plant has been granted to Lewis H. Fuller with the proviso that the plant shall be in operation by June 14, 1920.

Pacific and Mountain States

CENTRALIA, WASH.—Surveys are being made by the Sherman County Light & Power Company for a new steam electric power plant. The total estimated cost is given as $500,000.

OLYMPIA, WASH.—The city is considering the installation of cluster lights in the downtown district, at a cost of $20,000 to $25,000.

VANCOUVER, WASH.—It is reported the Northwestern Electric Company plans the construction of a huge electric power project to cost possibly $5,000,000. G. C. Pierce, vice-president and general manager, announces that the company has crews making preliminary surveys of the north fork of the Lewis River, where water will be dammed and the power house erected.

WENATCHEE, WASH.—The Wenatchee Valley Gas & Electric Company, through Receiver R. T. Lovell, has let a contract for the construction of a concrete building, 40 ft. x 60 ft. in size, adjoining the gas plant operated by the company here. This will be used to house the new steam generating station, with capacity of 1,000 hp., which is expected to be in operation by April 1. The total cost of the new plant is placed at $80,000.

PORTLAND, ORE.—The North Portland Box Company is planning to rebuild their power plant which was recently destroyed by fire at an estimated loss of $25,000.

PORTLAND, ORE.—A new power plant to cost in the neighborhood of $800,000 will be constructed by the Pacific Power & Light Company at Young's Bay, where a site of about 15 acres has been obtained.

PORTLAND, ORE.—E. G. Hopson, engineer, 205 Central Building, Portland, has filed application with the State Engineer at Salem, to take 1,400 second feet of water from the Metolius River in Crook County for commercial power and light purposes. The concern will construct a dam 50 ft. high and 500 ft. long at the top, of cyclopean concrete, the headgate and semicircular canal also to be of concrete. Turbines will be connected with electric generators and a fall of 140 ft. is expected to develop 18,000 theoretical horsepower. The cost of the project is placed at $1,300,000. It is expected work will begin immediately after enactment of federal legislation now pending permitting utilization of power on public lands. Mr. Hopson has also filed application to take 1,200 second-ft. of water from the Metolius River in Crook County for commercial light and power. The dam here will be 20 ft. high and 650 ft. long, built of rockfill and concrete with headgate and circular canal of the same material. It is expected 43,000 hp. will be generated.

SALEM, ORE.—Farmers in the surrounding country are petitioning the Portland Railway, Light & Power Company to extend its lines so that their farms may be electrically lighted.

BAKERSFIELD, CAL.—The San Joaquin Light & Power Corporation has under consideration the construction of a new plant approximately 35 miles west of Bakersfield. The first unit is to be erected immediately at a cost of approximately $1,000,000, and will furnish 17,500 hp.. The new plant will be run by natural gas which is now going to waste and when completed will have a generating capacity of 75,000 hp. The estimated cost of the entire project is $6,000,000.

FILLMORE, CAL.—Surveys are being made for a large electric power plant to be constructed by the Sespe Light & Power Company. Frank Lock is the engineer in charge.

HOLTVILLE, CAL.—It is reported that the Holton Power Company is contemplating the construction of several new hydroelectric plants in southern California as well as other improvements for which a total of $1,500,000 has been allotted. It is also reported that another appropriation of $200,000 has been made by the same company for the purpose of constructing a power line in the **Palo Verde Valley** to Blythe and Ripley.

OAKDALE, CAL.—The Pacific Gas & Electric Company, which has recently leased the Sierra & San Francisco Power Company, is contemplating the construction of a new reservoir at Stanislaus to cost about $1,000,000. It is reported that work on this undertaking will be begun at once.

REDDING, CAL.—The Pit River Power Company is planning to build a power plant which, with its equipment, will cost over $10,000,000. Surveys for the project have been completed in the vicinity of Copper City.

STOCKTON, CAL.—The Western States Gas & Electric Company has petitioned the California Commission for authority to issue preferred stock of par value of $603,000 in order that the company may carry out its construction plans for 1920.

WESTWOOD, CAL.—Owing to the fuel shortage, the Red River Lumber Company is planning to build a hydro-electric plant on Feather River, with a generating capacity of about 4,000 kw. to be used in driving the machinery of the company's sawmills.

OGDEN, UTAH—The city has under consideration the construction of a municipal electric light plant. The possible sites for the plant are in South Fork Canyon. Frank Francis is the mayor.

TUCSON, ARIZ.—Plans are under consideration for installing a local electrical plant either on a co-operative basis or as a municipal project.

Canada

EDMONTON, ALTA.—The Utilities Committee have under consideration additions to the power house which are estimated to cost $200,000. C. E. K. Cox is the city clerk.

BRANTFORD, ONT. — The Dominion Steel Products Company is planning to build a foundry at an estimated cost of $150,000.

REGINA, SASK.—It is reported that a theatre is to be built by the Trans-Canada Theatres, Ltd., at an approximate cost of $250,000.

Record of Electrical Patents

Notes on United States Patents

(Issued Feb. 3, 1920.)

14,798. Swaging Machine; Thomas A. Edison, West Orange, N. J. App. filed Jan. 21, 1919. Manufacture of styli for phonograph records.

1,329,384. Electrode Holder; Louis A. Eckenrode, Chambersburg, Pa. App. filed April 25, 1919. Avoids fusion and current losses.

1,329,413. Method of Joining Structural Steel Members by Electric Welding; Charles H. Kicklighter, Atlanta, Ga. App. filed Sept. 18, 1919. Light portable welder for crane operation.

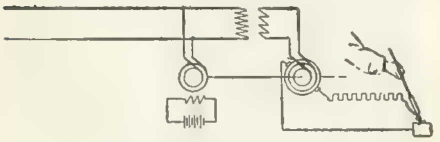
1,329,432. Method of and Apparatus for Fault Location on Electrical Conductors; Clarence E. Rogers, Oakland, Cal. App. filed June 11, 1917. Slide-wire Wheatstone bridge for wires having unlike resistances per unit of length.

1,329,448. Electrical Coupling; Adolf von Post, London, Eng. App. filed April 5, 1916. Plug for connection beneath table.

1,329,488. Electrical Heating System; William Whelan, St. Joseph, Mo. App. filed Aug. 17, 1918. For boilers supplying steam or hot water for houses.

1,329,508. Ignition Mechanism for Internal-Combustion Engines; Arthur O. Dady, New York, N. Y. App. filed July 27, 1917. Either magneto or battery current for ignition.

1,329,520. Machine for Electrically Welding the Calk or Toe-Piece Upon Horseshoe Blanks; Cyrus M. Garvin, Pittsburgh, Pa. App. filed May 18, 1915. Uses transformer and induction coil.



No. 1,329,532—Arc Welder Apparatus

1,329,530. Arc-Welding Electrode; Robert E. Kinkead, Cleveland, Ohio. App. filed Nov. 1, 1919. Electrode to supply iron vapor for arc maintenance during puddling.

1,329,532. Arc-Welder Apparatus; James F. Lincoln, Cleveland, Ohio. App. filed Oct. 30, 1918. Single-phase rectified current supply with non-inductive resistance for arc circuit to repair sheet and cast metals.

1,329,555. Electrical Plug; Webb L. Smith, San Francisco, Cal. App. filed Aug. 30, 1918. Permits cord to twist.

1,329,557. Germicide Attachment for Telephones; John A. Stransky, Pukwana, S. D. App. filed Feb. 20, 1919. Antiseptic tablet held laterally on inner face of diaphragm and within mouthpiece.

1,329,592. Attachment Plug for Electric Heating Devices; William N. Furthmann, Chicago, Ill. App. filed April 19, 1919. Adaptable to all forms of contact prongs or fingers.

1,329,630. Method of Insulating Wire; John J. Reinhold, Marietta, Pa. App. filed Jan. 9, 1917. Asbestos-covered wire, rolled, pressed and coated.

1,329,639. Light Signal; Clarence S. Snavely, Edgewood Borough, Pa. App. filed Nov. 19, 1915. Filament occupies predetermined position with relation to lamp bulb.

1,329,640. Adjustment of Incandescent Lamps; Clarence S. Snavely, Pittsburgh, Pa. App. filed Nov. 19, 1915. Applying heat to render filament movable with respect to bulb.

1,329,654. Ignition Mechanism for Internal-Combustion Engines; Arthur O. Dady, New York, N. Y. App. filed July 27, 1917. Efficient spark at low engine speeds.

1,329,656. Insulator; Arthur H. Fargo, Poughkeepsie, N. Y. App. filed April 3, 1914. Knob insulator loosely assembled and ready for use.

1,329,658. Telephone Headband; Hugo Gernsback, New York, N. Y. App. filed April 21, 1917. Adjustable headband without spring clamps.

1,329,672. Wireless Signal-Receiving Apparatus; Ernest C. Mignon, Elmira, N. Y. App. filed Nov. 29, 1916. Inductances providing practically non-leaking magnetic fields.

1,320,688. Television and Telephotographic Apparatus; André D. Voulgré, Bayonne, France. App. filed April 1, 1916. Transmits luminous impressions.

1,329,733. Magnetic Chuck; Oakley S. Walker, Worcester, Mass. App. filed March 8, 1919. For small pieces of work.

1,329,758. Oscillating-Current Generator; Lee de Forest, New York, N. Y. App. filed March 26, 1915. Hollow grid-shaped electrode interposed between hot and plate electrodes in vacuum.

1,329,761. Electrolytic Oscillator; Edward G. Gage, South Norwalk, Conn. App. filed July 13, 1917. For radio-telegraphy or radio-telephony.

1,329,770. Insulator; Robert M. Johnston, Detroit, Mich. App. filed Jan. 11, 1916. Prevents deterioration from excessive dielectric stress and from differences in coefficient of expansion of metal parts and of insulating material.

1,329,780. Power-Transmitting Apparatus; Justin Lebovici, Oakley, Ohio. App. filed Sept. 13, 1917. Automobile transmission system adjusted electromagnetically.

1,329,799. Control System for Rectifiers; Henry K. Sandell, Chicago, Ill. App. filed Sept. 11, 1916. For synchronously driven commutating rectifier for charging batteries.

1,329,842. Means for Neutralizing Interference; William H. Martin, New York, N. Y. App. filed Feb. 28, 1919. Obtained by varying magnitude of impedance.

1,329,890. Welding Machine; Amédée G. F. Fargues, Lyons, France. App. filed May 9, 1918. Forms T-joints.

1,329,892. Projection Apparatus; Howard T. Flanigan, Buffalo, N. Y. App. filed June 24, 1916. Carbons mounted at angle to one another.

1,329,897. Device for Taking a Regulable Constant Continuous Current from an Alternating-Current Line; Heinrich Greinacher, Zurich, Switzerland. App. filed Feb. 5, 1919. Closing alternating-current circuit with adjustable-resistance rectifier and condenser.

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1,329,926. Inductor-Alternator; Henry J. Podlesak, Chicago, Ill. App. filed Dec. 16, 1916. Rapid diverting of magnetic flux through unwound polar projections.

1,329,928. Sound-Magnifying Phonograph; Edwin S. Pridham and Peter L. Jensen, Napa, Cal. App. filed July 3, 1916. Combination with sound box of talking machine, microphone transmitter and sound amplifier.

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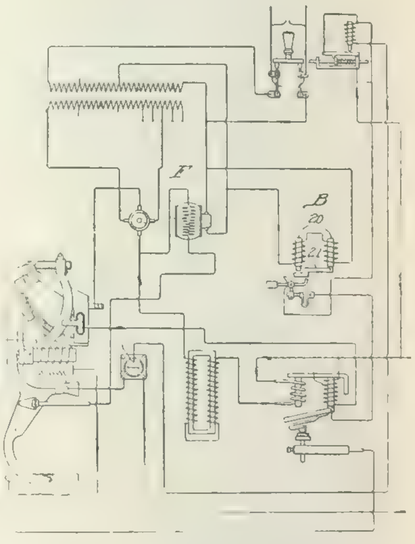

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1,330,021. Dynamo-Electric Machine; Hayner H. Gordon, Washington, D. C. App. filed Dec. 12, 1916. Windings of magneto continuously connected to the spark plugs of engine.

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1,330,038. Electric Generator; Leon J. Le Pontois, Lakewood, Ohio. App. filed Oct. 14, 1914. Utilizing flux of permanent magnet for ignition purposes.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 75 New York, Saturday, February 28, 1920 *Number* 9

Industrial Truck Records

HAPHAZARD records of industrial electric truck performances—or no data at all—are holding back the realization of maximum efficiency in operation in many establishments. It is time for electrical and production engineers to analyze and synthetize truck operations to the end that wasteful handling may be cut to the quick, volume of service checked against running and overhead costs, and transportation units concentrated when and where they are most needed.

Progress in Maine

A BIG advance in hydro-electric and steam-plant interconnection in Maine is forecast in the proposed merger of the Central Maine Power, the Androscoggin Electric and smaller companies. Great opportunities exist in the Pine Tree State for co-ordinating electrical supply from various watersheds. If the popular opposition to power exportation can be overcome as it is bound to be in time by suitable engineering publicity, all New England will benefit, Maine itself even more than by pursuing the present narrow policy of intrastate distribution.

Profits on New Devices

NEW electrical products must win their way upon their service record rather than upon first cost. It is better to introduce superior commodities on the basis of a fair initial profit, and reduce the selling price as mass production lowers expenses per unit marketed, than to sell at a loss in order to popularize the articles merchandised and then be forced to raise the price to secure a fair return. Superior service and maximum quality command better prices than mediocre performance. No sensible buyer begrudges a fair profit on a new device which is worth more than its cheaper competitors.

Making a College Self-Supporting

FOR generations our universities and colleges have played the rôle of deserving beggar. They have cooled their heels in the anterooms of the millionaires and have stood on the public highways with extended cap. The results have seldom realized the hopes of the self-sacrificing officials to whom the unpopular task of solicitation and collection has fallen, but the method appeared to be obligatory. It has remained for the Massachusetts Institute of Technology to find an avenue of escape from this vicarious mendicancy by placing its resources at the service of industry on a business basis. As explained in a recent issue of the ELECTRICAL WORLD, for an annual retainer of from $1,000 to $25,000 it undertakes to arrange consultations, investigations, tests or research with its staff of technicians, or to put its client in touch with outside assistance. The magnitude of the project is evidenced by the signing already of contracts totaling nearly a million dollars. Several great electrical companies have taken advantage of this new educational policy, of which the mutual benefits should be equal.

Explain Capital Needs to Public

CENTRAL STATION expansion must go forward notwithstanding the present high costs of construction. The public demands additional service and will pay for it if that service is of high quality. Later, when lower prices apply to extensions of plant and lines, the necessity of committing capital to larger duties in these days of acute inflation will be recognized and due allowance established by fair-minded commissions. Clear-cut statements of policies and needs, however, will play increasingly important parts in the raising of funds in future public utility expansion. Too often in the past perfectly honorable statements of construction costs incurred and liquidated by notes have not been segregated in a way to render them valuable indices of capital requirements. Simpler groupings of costs will help both the commissions and the public to understand the real needs and opportunities of the companies.

The Coal Situation

THE wage increase of 14 per cent which coal operators are trying to pass on to public utilities has called forth protests from all quarters, and justly so, for it means that this increase will in turn be assessed against the public. The bituminous-coal operators, in spite of their agreement with Dr. Garfield as Fuel Administrator to accept and absorb the 14 per cent increase in miners' wages to the end that the burden should not be placed on the public, have entirely changed front, and in billing the public utilities for this wage increase in cents per ton under existing contracts are effectively shifting their own burden to the utilities and then to the public which the latter serve. This is so because public utilities are regulated by state and local authorities and are unable to earn more than a fair rate of return, so that any material increase in operating expenses must be passed to the consumers. It is an unfortunate side of the situation, for the public had been led to believe that the miners' wage increase had been absorbed by the coal operators and that President Wilson had said so in December, 1919. Evidence on the points involved has been presented to the United States Bituminous Coal Commission and to a sub-committee of the Senate committee on interstate commerce which has been investigating the coal situation. The matter is now under consideration. But even though it be settled in favor of the utilities the fuel situation from the viewpoint either of cost or of future deliveries, is not settled. There are three other points at issue. First, the practice of the Railroad Administration and the railroads to confiscate for railroad use the coal consigned to public utilities should be stopped. Second, government supervision over the delivery and prices of coal should be continued until conditions are normal and some governmental machinery should be set up to rule on questions of prices and confiscation that come up daily. Third, a lower price for coal delivered during summer months should be made and a seasonable freight rate established in order to make increased storage feasible even by those companies where the rehandling cost is a considerable item. This would assist the miner in maintaining uniform production throughout the year, and with such a storage plan public utility companies would be relieved of the anxiety attending uncertain deliveries and commandeering procedure which they are now experiencing, especially in New England.

A Super-Power Zone—A National Need

NO BODY of men more distinguished than those who met at the midwinter convention of the American Institute of Electrical Engineers in New York on Feb. 19 could have declared itself in favor of prompt consideration of the means whereby industries in the Northeast seaboard states can be supplied with adequate power and whereby our fast-diminishing fuel reserves can be conserved and railroad congestion can be relieved. They have decided that these pressing problems should be given immediate attention and have recommended to the board of directors of the Institute that a committee headed by W. S. Murray, the exponent of the proposed solution, be immediately appointed to take some definite action. Are those of the engineering profession who were not present at that meeting going to sit by indifferently and let this committee act alone? Because the problems are national ones and do not merely confront a limited section of the country or concern a few, the committee needs all the advice and suggestions possible and engineers must come forward and give their assistance. Every one knows that the industrial power demand is already greater than the supply and is increasing at a rate much greater than extensions along the old lines can meet. In the zone considered—from Washington to Boston and inland 100 to 150 miles—the present estimated machine capacity is 17,000,000 hp., and it has been doubling about every five years. Nearly 70,000,000 tons of coal are now being burned annually for the railroads and industries in this zone. Besides, this fuel is being transported by already congested railroads that ought to be relieved in order that they may carry other materials needed in all parts of the country.

By the establishment of interconnected super-power plants, consisting of generating stations in the soft and hard coal fields, at developable water-power sites and in large load centers, and by electrifying industries and railroads in this section, Mr. Murray estimates that the existing load factor of 15 per cent can be raised to 50 or 60 per cent. This will mean that one pound of coal can do the work that two pounds does now, thus relieving the railroads of the work of transporting one-half of the coal required for light and power purposes. It also means that 30,000,000 tons of coal can be saved each year in this section—a fact well worth considering when it is realized that our fuel resources will be exhausted at the present rate of consumption in about one generation if some radical change in furnishing power needs be not made. By the savings that will result and by the reduction in railroad maintenance expenses coming from railroad electrification a total annual saving of something like $300,000,000 can be effected. Besides this, the more complete electrification of industries from an economical source of energy supply will help these industries to stay the rising price of living which has been brought about by the greatly increasing price of labor. Are these benefits to be ignored or considered of merely local effect?

As reported on pages 486 to 488 of this issue, notable authorities in the manufacturing, consulting engineering and central-station fields have said that the apparatus for equipping the proposed system will be available and that practical operation of the system is feasible. While the estimates of the actual benefits which will result should be checked and while the details of laying out and operating such a system have to be worked out, it cannot be denied that some such system as Mr. Murray proposes should be put into effect in the immediate future and that plans should be formulated for financing it.

The latter aspect is of no small importance. Mr. Murray has suggested that four ways present themselves. The securities could be underwritten by the federal government, by the states or by private interests, or private-interest securities could be guaranteed by the federal government or the states. These methods and others should be carefully considered, but, above all, it should be remembered that the benefit which will result will be nation-wide and that therefore assistance of some kind should be obtained from the nation. On this subject particularly the A. I. E. E. committee should be well advised, and when the method of financing shall be finally determined it should be backed by the active support of all engineers. Finally we urge that any plan which is selected take advantage of existing generating facilities such as those in Philadelphia, New Jersey, New York and Boston, and that everything that money can buy, that human foresight can ordain and that engineering ability can provide be used to assure continuity of service.

World Market for Domestic Apparatus

THE people of the world are still in a very large degree depending upon tallow candles, kerosene and gas with which to light their dwellings. Domestic electric lighting is almost unknown in Russia, and even in America, where we are prone to boast of our high type of advancement in all things electrical, we find about half of the people dwelling in houses unlighted by electricity. Results of an investigation undertaken by the Electrical World on this subject, as given on pages 484 and 485, may prove surprising to some in the industry. European cities are to a large extent electrically lighted, but more than four-fifths of the population are living in houses into which central-station service has not yet obtained admittance. The proportion of South Americans living in electrically lighted houses is not over two or three in a hundred.

The foreign market for domestic lighting equipment is a wide one. However, it needs close examination.

Certain apparatus which will prove acceptable in the islands of the Archipelago will find small call in the mountains of the Balkan States. The newer countries, and the countries in South America, are not yet educated to the advantages of quality products but favor the low-priced and consequently cheaply constructed devices. Prior to the war German designs of electrical apparatus were in high esteem in many countries, but this trade has in no small measure shifted to American makes. Whether or not it can be held will depend upon the kind of attention and service that is given to these new fields by those who have secured the business mainly because there was no other source of supply. A careful study of living conditions and the same attention to electrical methods and good engineering practice that is promoting good lighting in this country must likewise be advocated abroad.

Central-Station Power for a Steel Mill

A STEEL mill presents a load which is notoriously difficult to carry on account of the enormous fluctuations presented even with carefully planned flywheel reserve. To deliver power for such a load from the central station needs exceptional care in planning the installation and tact in operation. The account we publish this week of the operation of a steel plant with power from the Peoria (Ill.) central station illustrates very forcibly both the difficulties of the situation and the ways in which they may be successfully met. The particular mill considered is nearly 5 miles (8 km.) from the Peoria station. The peaks imposed by the heavy blooming mill recur about every five minutes and may reach nearly 5,000 kw. with a frequent and fairly steady demand for 3,500. The top load from the whole mill may reach 6,000 kw. momentarily and 4,000 for a fifteen-minute integrated demand. To meet this the Peoria station had about 12,000 kw. capacity in six 2,300-volt units, supplying most of the existing load directly, but a portion by transformation to 13,200 volts. The latter voltage seemed desirable on account of the growth of the transmitted power load, so when the steel mill had to be served a 7,500-kw. turbo-generator capable of delivering the higher voltage directly was provided. In addition, two 4,500-kw. banks of transformers of between 13,200 volts and 2,300 volts were also provided. Thus the heavy steel-mill load can be isolated from the city lighting and power for ordinary operation, while all generators are available for delivering either voltage to the lines when it becomes necessary.

Relief for the Lamp Socket

THE marked increase in the use of electrical appliances in the home in the solution of the servant problem brings up with renewed importance the question of how these appliances are to be connected to the circuits. There is only one answer—through separate outlets. Long cords dangling from the lamp sockets of chandeliers and wall brackets are not only unsightly but place the sockets under double and severe duty except with low wattage, thus imposing a limitation on the service. The importance of the separate outlet will be the theme of a paper to be presented at the Pasadena convention of the National Electric Light Association next May by Garnett Young, who has drawn up a plan of action for an educational campaign along these lines. The aim of this campaign, which is already under way on the Pacific Coast, is to teach not only the home seekers but architects and builders as well that a house is not planned as it should be unless adequate provision for labor saving by electricity is made. It is estimated that the average cost of putting in outlets after the house is completed is five times what they would cost if they were in the plans at the outset—an unnecessary expense that householders are naturally reluctant to meet. Once the point is properly brought home to the designers and builders, due consideration for their clients' needs will lead them to provide in the original plans for correct and modern wiring and, more than that, for ample floor room to accommodate all the appliances that may be desired.

The benefit to the electrical industry of such an educational campaign is many-sided. Additional sales of energy will, of course, come to the central station—in the main a "daytime load" and therefore particularly desirable. Manufacturers are also bound to gain immediately. Above all, the campaign will result in better service to the public. Incidentally this campaign should furnish an opportune time for the discontinuance of the terms "lamp socket" and "current-consuming devices" and the substitution of the more descriptive name, "labor-saving devices."

A Despot Conspiring with Electricity

THE enigmatic recluse who from the seclusion of the Kremlin governs part of what was once Russia astonished a New York *World* correspondent with whom he recently condescended to talk by a totally unexpected answer to the question "When do you think communism will be complete in Russia?" Said Lenine:

> We mean to electrify our entire industrial system through power stations in the Urals and elsewhere. Our engineers tell us it will take ten years. When the electrification is accomplished it will be the first important stage on the road to the communistic administration of public economic life. All our industries will receive their motive power from a common source, capable of supplying them all adequately. This will eliminate wasteful competition in the quest of fuel and place manufacturing enterprise on a sound economic footing, without which we cannot hope to achieve a full measure of interchange of essential products in accordance with communist principles. Incidentally, in three years we expect to have 50,000,000 incandescent lamps burning in Russia. There are 70,000,000 in the United States, I believe, but in a land where electricity is in its infancy more than two-thirds of that number is a very high figure to achieve. Electrification is to my mind the most momentous of the great tasks that confront us.

It is no new thing for despots to accomplish great undertakings along the lines of civilized development. Some among the Pharaohs, Caesars and Bonapartes of all ages have promoted agriculture and commerce, built splendid cities and created a factitious if not a real prosperity in their realms. But there is something startlingly modern in this pronouncement from the man who now wields the broken scepter of the Romanoffs. If his power is indeed destined to endure for the ten years he arrogates to himself, and if his program of electrical development is to be translated into action, Western nations, and electrical engineers above all, will watch with intense interest its physical progress and its influence upon Russian thought and politics.

Charles Proteus Steinmetz

An engineer-scientist whose gifted genius is widely reflected in electrical and chemical experimentation, research and design

WHEN Frank Sprague as president of the A. I. E. E. introduced Charles Proteus Steinmetz as the author of a paper on "The Law of Hysteresis" on Sept. 27, 1892, he said: "His work in the past has been most important in its character, and this paper will fully support the reputation he has already earned." At that time Dr. Steinmetz had been in this country just three years, three months and twenty-six days. He arrived June 1, 1889, a steerage passenger on the liner *La Campagne* with less than ten dollars in cash but with a letter of introduction that secured employment with Rudolf Eickemeyer at Yonkers, N. Y. Here in a small plant an opportunity was offered for him to apply the scientific training he had received abroad in a study of the magnetic properties of iron suitable for alternating-current motors. During the summer of 1890 he was engaged on the design of a single-phase commutator motor and in conducting hysteresis tests. In the *Electrical Engineer* for Dec. 17, 1890, Dr. Steinmetz presented, in an article entitled "Notes on the Law of Hysteresis," results of his findings. On Jan. 19, 1892, further results were given in an Institute paper. This led up to the second Institute paper on Sept. 27 of the same year and was all that was known of the man, then only twenty-seven years old, who flashed so suddenly into prominence. Since then, although always working unostentatiously, his genius has become recognized everywhere, and on old and new problems alike his opinions are eagerly sought. To him is due much in alternating-current motor design and in electrical and chemical research. Although Dr. Steinmetz lives for his work as chief consulting engineer of the General Electric Company, he frequently lectures and he finds time to take an active part in the work of national engineering organizations, having been president both of the A. I. E. E. and the I. E. S. He is also a prolific writer on general engineering topics and the author of several well-known textbooks on electrical engineering and mathematics.

Development of Automatic Hydro-Electric Generating Stations

Automatic Operation and Remote Control Especially Applicable to Small and Medium-Size Developments—Use of Synchronous and Induction Generators for This Service—Automatic-Control Devices Proved Reliable

By T. A. E. BELT

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THE automatic hydro-electric generating station is a new development, and a potent one, in the science of electrical engineering. The application of automatic control to generating stations, which is an outgrowth of the automatically controlled rotary-converter substation, first appearing in 1913, has proved, from the standpoints of economy and reliability, to be advantageous and useful. That the automatic hydro-electric generating station is an accomplished fact, with many possibilities demonstrated, is further proved by the two years of successful operation of a plant installed by the Iowa Railway & Light Company at Cedar Rapids, Iowa. Both the synchronous and the induction type of generators should be considered for any particular conditions.

From a technical viewpoint, there is no limit to the capacity of generating stations for which automatic-control equipment can be designed. However, in a large, manually operated station the cost of operation becomes a small part of the total cost of energy, so that the saving by the elimination of an operating force may not justify the small additional risk involved in the entire absence of all manual operation. Furthermore, in large stations a complicated system switching may require operators of good judgment, whose services cannot easily be dispensed with.

In medium-sized plants automatic equipment may be used, which simplifies the operation and protects the apparatus to such an extent that only one watchman with little technical ability is required for general duties around the plant. This is especially true where the plant under consideration is one of several feeding into a transmission system. Such automatic equipment has been proposed for plants as large as 12,000 kva.

THE FIELD FOR HYDRO-ELECTRIC GENERATING STATIONS

At present the greatest field for hydro-electric generating stations is that of the medium-sized and small plants, auxiliary to a larger system, for in such plants no operators need be stationed. A periodic inspection by a line patrolman or any other qualified person is the only attendance required.

In many places throughout the country are small, undeveloped water-power sites, which are capable of generating power with a comparatively small capital investment in the plant. If the operating force of such a plant can be eliminated, the cost per kilowatt-hour of output may be very attractive. The management of a 20,000-kva. or 30,000-kva. system is usually ready to welcome the addition of a continuous 500-kw. load. Conversely, a continuous load of 500 kw., pumping into the system at a low cost per kilowatt-hour, should likewise be welcomed.

Control schemes may be roughly divided into two classes: First, the remotely controlled station, in which the generator leads run to the main station, where the generator is synchronized by hand; second, the entirely automatic station, where the generator is automatically synchronized into the transmission network.

SCHEMES FOR THE REMOTELY CONTROLLED STATION

Scheme No. 1.—Referring to the simplified wiring diagram, Fig. 1, a semi-automatic plant is controlled from some other station by means of a three-phase power line and two additional conductors for controlling the waterwheel gate opening. The operator first closes the control switch, which causes the waterwheel gate to open, thus starting the generator. The field of the generator is connected to the armature of the direct-connected or belted exciter by the closing of the contactor in the main field circuit, and the generator builds up voltage as the speed increases. The operator has a synchronism indicator across the oil circuit breaker in the hand-controlled station and adjusts the speed and synchronizes the generator as if it were a machine in the same plant. After the generator is synchronized, the load, which is under the operator's control, may be adjusted to any desired amount. In order to have a lower value of excitation for synchronizing than that required under full-load operation, resistance is inserted in the generator field circuit. This resistance is automatically short-circuited by a contactor when the two stations are connected.

The automatic station, when it is connected to the system, operates at constant excitation, which is practicable because it is in parallel with another station where the voltage is under the control of operators. If the remotely controlled generator is overexcited for the kilowatt load carried, a leading current is supplied to the system, which improves the power factor, provided that the system load demands a lagging current.

The control scheme just described may be used when the waterwheel wicket gates are operated by a remotely controlled governor, or by an electrically operated valve which controls a hydraulically operated piston connected to the wicket gates. If desired, a motor-operated wicket gate may be used, which makes a third control line necessary if three-phase power is used for operating the motor.

Scheme No. 2.—Where the distance between stations is great, the cost of conductors for waterwheel gate control may amount to a considerable sum, but by a scheme slightly different from the one above these control wires can be omitted, leaving only the three-phase power line between stations.

Referring to the simplified wiring diagram, Fig. 2, the operator starts the station by impressing fractional voltage on the line. The fractional voltage may be obtained either from a starting compensator or from taps on transformers, provided that such are available.

The generator in the remotely controlled station is equipped with an amortisseur winding and starts as an induction motor. As the generator comes to synchronism the exciter builds up voltage and excites the generator field, thus pulling the generator into step. Ammeters, which are provided in the control station, indicate when the generator pulls into step, and the operator then opens the fractional-voltage supply and closes the line oil circuit breaker, thus applying full voltage to the remotely controlled generator. The closing of the oil circuit breaker causes contactor *A* to close, which applies full excitation to the generators and opens the waterwheel gate to full-gate position. The gate motor is operated from direct current supplied by the exciter.

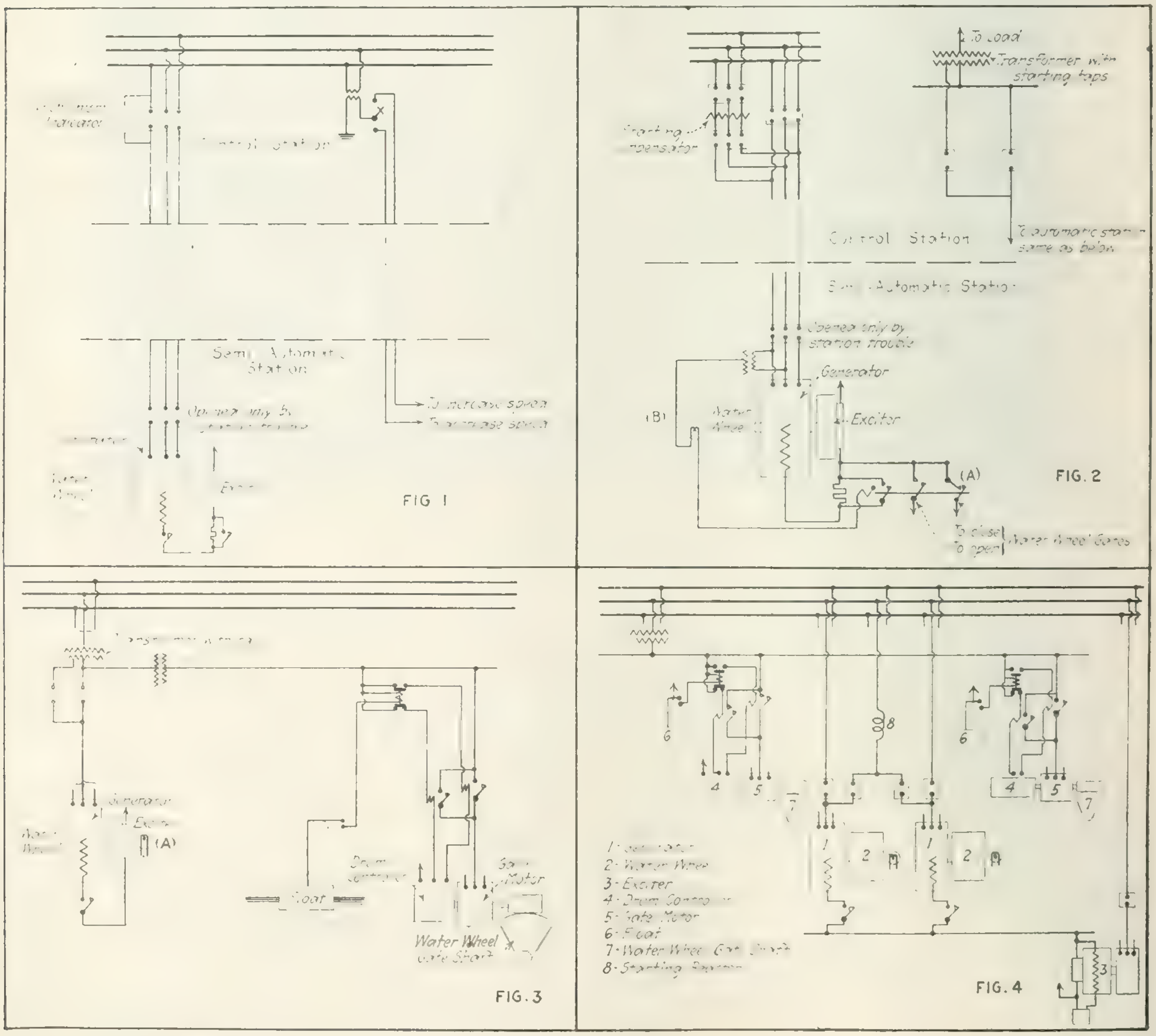
To close down the remotely controlled generator, the operator opens the oil circuit breaker in the main station. The generator then speeds up, and centrifugal switch *B* breaks the coil circuit of contactor *A*, which drops out and completes a circuit to close the gate. The contactor is arranged to insert resistance in the exciter field circuit, which prevents the generator voltage from rising above normal value.

Control of the Entirely Automatic Plant

Scheme No. 1.—The entirely automatic station differs from the remotely controlled station in that the power line does not necessarily pass through a manually operated plant but may be tapped directly into the transmission network.

The contacts of the float switch, illustrated in Fig. 3, close when the water level in the forebay rises to a predetermined level, thus energizing the upper set of contacts of a relay and causing the contactor in the gate-motor circuit to close. The closing of this contactor applies voltage to the polyphase gate motor, which is connected to the waterwheel wicket gate through proper gearing.

The motor opens the gate approximately 20 per cent of full gate opening, which admits sufficient water to start the waterwheel. At 20 per cent gate opening, the gate-motor contactor is dropped out by the breaking of its coil circuit, which is opened by one of the drum-



FIGS. 1, 2, 3, 4—WIRING SCHEMES FOR REMOTE-CONTROLLED AND AUTOMATIC HYDRO-ELECTRIC PLANTS

(1) Remotely controlled station with and (2) without pilotwires; (3) full automatic control of one generator by relay in forebay, and (4) same scheme applied to two or more generators.

controller segments. The drum controller is driven through suitable gearing by the gate motor. The wicket gate stays in the 20 per cent position until the waterwheel comes to nearly synchronous speed, when the contacts of centrifugal switch *A*, driven from the shaft of the generator, close, thus bridging the break in the drum-controller segment and causing the gate motor to continue to open the gate. The proper segment on the drum controller then causes the fractional-voltage oil circuit breaker to close, thus connecting the generator to the fractional-voltage transformer taps. A drum-controller segment, then making contact, causes the generator-field contactor to close, the closing of which excites the generator pulling it into step. The fractional-voltage oil circuit breaker is tripped, and the main-line oil circuit breaker is closed by means of controller segments operating on the proper control circuits. The gate motor continues to open the wicket gate until the drum controller stops it at full gate opening. The generator is thus properly connected to the bus and operates at a load corresponding to the head of water available. If the level of the water in the forebay falls to a predetermined minimum, the station is automatically shut down. If desired, it may be started or stopped, independently of the float switch. by means of pilot wires from a manually operated station.

If the head of water is constant and full kilowatt output from the generator is desired at all times, the motor-operated wicket gate may be dispensed with and the waterwheel provided with fixed wicket gates. A motor-operated or hydraulically operated valve can then be used for starting and stopping the station.

Scheme No. 2.—An automatic control for two or more generators is shown in wiring diagram, Fig. 4. Such an automatic control is especially applicable in low-head installations, because where the operating speed is low directly connected exciters are expensive.

The control equipment for each generator is similar to that described under scheme No. 1 of the entirely automatic station, except that the fields of all the generators are excited from a common exciter and fractional voltage is obtained during the starting period by means of a synchronizing or starting reactor. The exciter is driven by an induction motor, which is started by closing the main-line oil circuit breaker, either automatically, through a control circuit on the drum controller, or by hand if it is desired to have the set operate at all times.

The several float switches are adjusted so that the contacts close in succession. The contacts of the first float switch close when the water level is sufficient to carry full kilowatt output from the first generator. If the water continues to rise, the contacts of the second float switch close, and the second generator is placed in operation. If the flow of water is sufficient, the contacts of the third float switch close, and the third generator is connected to the bus. This sequence of operation is continued for as many equipments as may be installed.

SYNCHRONOUS VERSUS INDUCTION GENERATORS

The control schemes outlined above are for use with synchronous generators. The control equipment may be somewhat simplified if an induction generator is installed, but the characteristics of such a generator make its installation in the majority of cases wholly undesirable.

As in the case of an induction motor, the induction generator is dependent upon the system to which it is connected for its excitation. For example, take the case of a 500-kva., 0.8 power-factor induction generator, 300 wattless kva. must be drawn from the line. The wattless exciting current, which lags 90 deg. behind the power current, must be supplied by the synchronous machines connected to the system, or, in the case of an extensive high-voltage overhead system, it may be partly or wholly supplied by its condenser effect.

In a high-head installation requiring a high-speed generator the induction type will usually cost less than a corresponding synchronous generator with its exciter. In a low-head installation requiring a slow-speed generator the induction type may equal or even exceed the cost of the synchronous machine.

In selecting the type of generator for an installation the following points should be considered:

1. Whether or not the lagging exciting current taken by an induction generator will be detrimental to the operation of the system.
2. Whether or not it will be advantageous to relieve other generators of part of their wattless lagging current by the installation of a synchronous machine.
3. The relative cost of a synchronous versus an induction generator.

PROTECTIVE DEVICES REPLACE OPERATORS' ATTENTION

In any remotely controlled or automatic generating-station installation certain protective devices are necessary. For small stations the degree of protection need not be so complete as for larger stations where a number of large machines are involved. Protection should be provided in any installation against hot bearings, overloads and overspeed.

1. *Hot Bearings.*—If the bearing temperature of a generator, a waterwheel or an exciter exceeds a predetermined maximum value, a thermostat relay is used to open the master-control circuit, which closes down the machine in trouble and prevents its restarting until an inspection of the overheated bearing is made.

2. *Overloads.*—With a constant head of water and a constant waterwheel gate opening, no continued overloads can be imposed upon the generator. A waterwheel, properly chosen for the capacity of the generator which it is to drive, will impose a severe overload upon the generator only with a radical increase in the head of water above normal value. The loss of excitation of the generator or a considerable drop in system voltage will overload the generator. However, if overload occurs from any cause, overload relays are used to disconnect the generator from the line and close down the station.

3. *Overspeed.*—A centrifugal switch, driven by the generator, is arranged to operate, in case of overspeed, to close down the station.

4. *Other Protective Devices.*—Other refinements in the application of protective devices may be added:

(a) Relays for differential protection from internal generator trouble.

(b) Low-voltage relays, to prevent single-phase starting or operation.

(c) Relays for overvoltage protection of the generator and exciter.

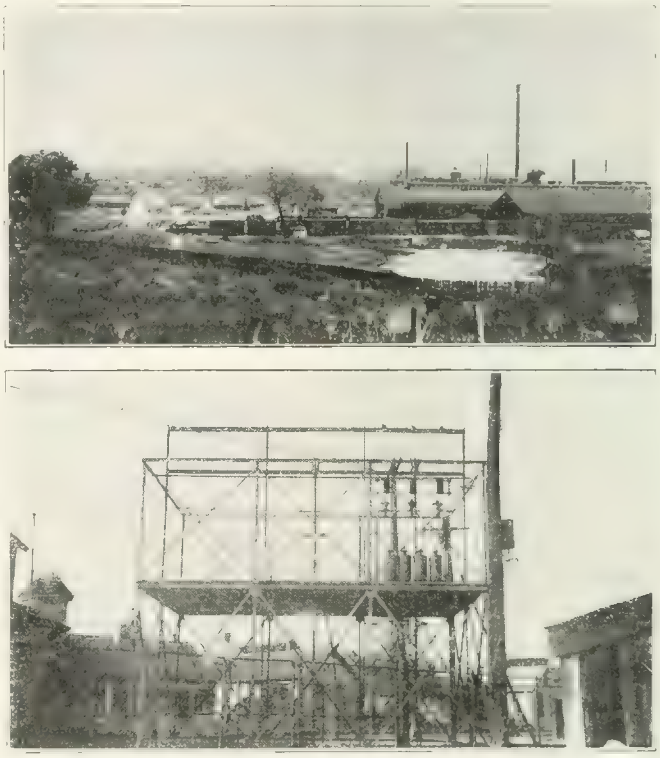
How these principles have been applied to automatic- and remote-controlled hydro-electric plants will be discussed by the author in an early issue of the ELECTRICAL WORLD.

Preparing to Carry a Steel-Mill Load

Construction and Rearrangement the Peoria (Ill.) Central Station Company Found Necessary To Serve a Mill Requiring 1,500,000 Kw.-Hr. a Month with a 4,000-Kw. Demand to Turn Scrap Iron Into Barbed Wire and Fence

ELECTRICAL energy from the central station of the Central Illinois Light Company is now being used by the Keystone Steel & Wire Company of Peoria, Ill., in practically every operation between its three open-hearth furnaces and its loading platforms for outgoing freight. Most of the raw material comes to the open-hearth furnaces in the form of scrap, for which Illinois in general and Chicago in particular is a great central market. Sometimes, however, ingots are purchased ready for reheating because the capacity of the remainder of the mill is greater than that of the three open-hearth furnaces. The furnaces are the limiting factor of the mill at present. The outgoing freight consists mostly of barbed-wire and woven-wire fence, originally intended to provide entanglements for the enemy army but now used to bar out encroaching cattle from cultivated areas.

When the question of serving this mill was first discussed engineering problems arose because the load involved was so large in comparison with the total load of the central station which was about to serve it and because it was the central station's first attempt at taking on this class of business. How these problems were worked out and what results have been obtained from their solution will be shown in this article. Briefly the work of preparation consisted of making additions to the generating station, reconstructing one substation and erecting another new one, building a transmission line of heavy carrying capacity, and learning a few points of difference that should be observed in operating the central station when such a load is connected to it. The results that have been obtained from successfully carrying out this program are shown in a load analysis given below.



FIGS. 1 AND 2—GENERAL VIEW OF KEYSTONE STEEL & WIRE PLANT AND RISER SUBSTATION

FUTURE DEVELOPMENT IS BIG FACTOR CONSIDERED IN CHOOSING STATION ARRANGEMENT

Before the steel-mill load was taken on the generating station had only recently been remodeled internally and housed in a modern building. It contained six 2,300-volt, three-phase, 60-cycle generators rated at 5,000 kw., 3,000 kw., 1,500 kw., 1,000 kw., 800 kw. and 600 kw., respectively. They served some city load at the generator voltage and some outlying coal-mining and industrial power load at 13,200 volts.

The transformation was made in a step-up substation adjacent to the power-house. With the necessity of adding more generator capacity for the steel-mill load already apparent, it was a question whether the company would continue to buy 2,300-volt generators and transform enough energy to 13,200 volts to serve the power load or would depart from the 2,300-volt standard and install a 13,200-volt generator. The rapidity with which the power load was growing made the 13,200-volt seem the logical choice, but an argument against it was the fact that with two generator voltages in the station some of the advantage of diversity is lost.

With all these points in mind, a scheme was worked out which retains all of the advantages of both plans. A 7,500-kw., 13,200-volt generator, replacing a vertical 1,000-kw. turbine, two 1,000-hp. Springfield boilers and two 4,500-kw. banks of 13,200/2,300-volt transformers were purchased, and the main station apparatus was laid out as shown in the one-line diagram (Fig. 4). This arrangement, which increased the total station rating to 19,400 kw., has many advantages. Both the 2,300-volt and the 13,200-volt loads can be served from either the 2,300-volt or the 13,200-volt generators at times of light load. On peaks all generators can be operated and the total load can be apportioned among them at will, taking full advantage of all diversity. Another advantage is that the city's lighting and small power is isolated from the heavily fluctuating power loads. This to a certain extent tends to help regulation. Furthermore, when more generators are needed in the future an intelligent choice between 2,300-volt and 13,200-volt types can be made, depending on the probable growth of the two classes of load. It is not the plan to go to 13,200-volt generation exclusively. It is expected that the 9,000-kw. transformer bank will provide ample transfer facilities for many years to come. In actual operation no practical difficulties with this layout have developed.

At the same time these changes were made a new station intake was constructed, travelling screens were installed and the adjacent step-up substation was rebuilt and increased in size. The substation contains an interesting example of open tubular copper-bus work for 13,200-volt construction. This work was all made necessary by the addition of the Keystone steel-mill load.

The steel mill is about 4.75 miles (8 km.) from the power house. Between the two the transmission line consists of both underground and overhead construction. The underground section comprises two 7,500-ft. (2,300-m.) lengths of three-conductor No. 2/0 13,200-volt paper-insulated cable laid from the power house to a riser station. The two lengths of cable are operated in parallel as one line. A single larger cable might have been selected for this service if the ducts, already laid, had not limited the cable diameter.

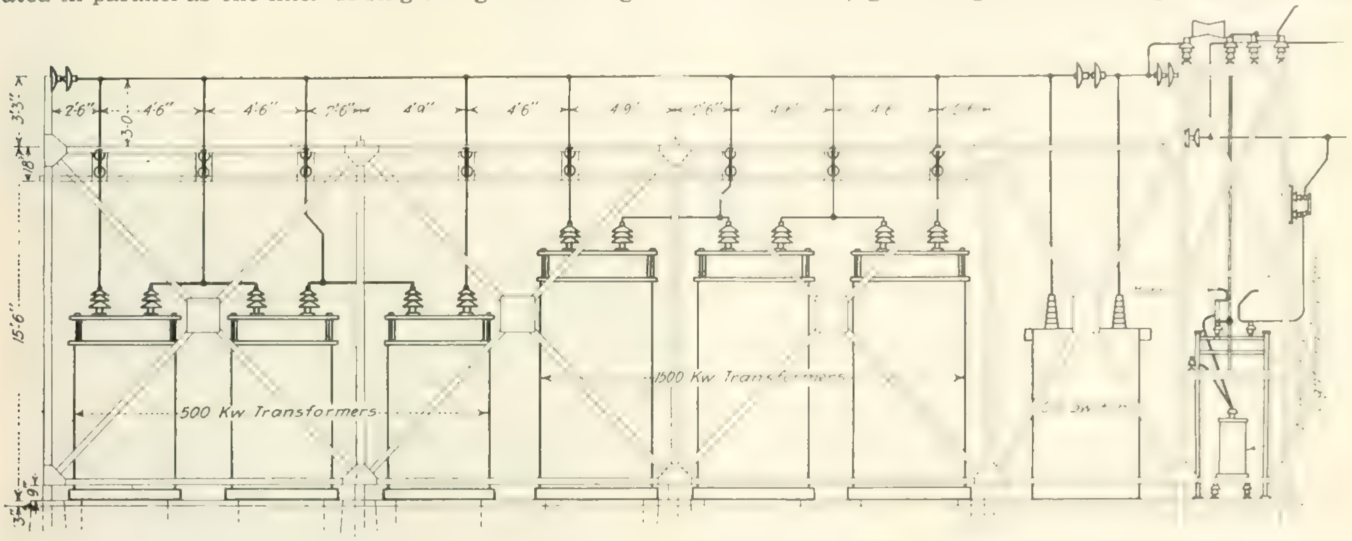


FIG 3—SECTIONAL ELEVATION OF TYPICAL TRANSFORMER UNITS AS INSTALLED ON AN ANGLE IRON STEEL STRUCTURE

The riser station is in itself a feature of the line. It is an outdoor steel structure in the outskirts of the city at which the cable is brought up in an iron pipe riser and is connected to the aërial lines through a G. & W. disconnecting outdoor-type pothead. Here also one aluminum-cell lightning arrester is installed to protect the cable. This arrester is charged daily by a patrol man. It is the plan that ultimately this riser station, which has spare capacity of five additional circuits, will also act as a terminal for other 13,200-volt circuits now reaching the power-house on pole lines.

The aërial lines from the riser station to the steel mill consist of 3.5 miles (6 km.) of three No. 4/0 bare copper conductors carried on wooden poles with "flat-top" construction. This line is designed for loads up to 5,000 kw. An auxiliary service for emergencies is also carried to the steel-mill substation. It consists of three No. 2 conductors which tap the existing transmission line between Peoria and Pekin. Over this connection the steel mill can take only 2,500 kw.

At first some trouble on the steel-mill line was experienced at dead-ended crossing spans. The pins on all such arms were grounded, and it was a common occurrence for lightning to shatter the insulators or to cut the jumpers around the dead ends. In the original construction 15,000-volt insulators were used on these poles. These were later changed to 22,000-volt units with only slightly better success. Bayonets have now been placed on all poles. This has stopped the trouble.

At the steel mill the receiving substation is an outdoor structure with its steel-frame supports for buses and switches built against one side of the brick-walled machinery house. Transformers and aluminum-cell lightning arresters are set on concrete bases slightly above the ground level. The circuits are arranged so that a bank of three 1,500-kw. transformers operates in parallel on the high-tension side with three 500-kw. units to reduce the potential from 13,200 volts to 2,300 volts. An oil switch is installed in the main line between the incoming circuit and common bus which feeds the transformers. On the low-tension side of the transformers separate 2,300-volt circuits, each equipped with an oil switch, go through wall bushings into the machinery house, where the 2,300-volt switchboard carrying the 2,300-volt distribution bus is installed. However, between the distribution bus and the transformers a single metering bus has been constructed so that the energy from both banks of transformers can be measured on one set of instruments. The instruments used, in addition to current and potential transformers, consist of a 1,500-amp., 2,300-volt, three-phase, three-wire watt-hour meter and a type P. 5.2 General Electric demand meter.

In order to get detailed records as well as to insure against unnoticed inaccuracies, the meters at the steel mill are read every day by the steel-mill force and twice a week by the central-station man. Ordinarily the mill will take about 1,500,000 kw.-hr. a month with a demand of about 4,000 kw. The average total monthly output of the central station is about 4,526,000 kw.-hr. and its peak

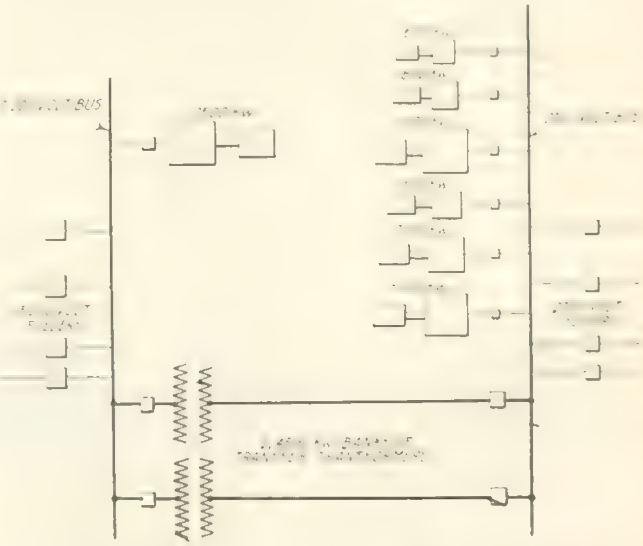


FIG. 4—THE 13,200-VOLT BUS WAS INSTALLED TO HANDLE THE STEEL MILL LOAD

is around 14,000 kw. From these data it may be judged that the steel mill is an important customer.

When the load was first taken on there was some apprehension as to its probable effect on station regulation because of the heavy power demands created by the operation of the blooming-mill repeater. This repeater is an apparatus which reduces a hot bloom from a 4-in. by 5-in. (10-cm. by 12 cm.) section to a 1.5-in. (3-cm.) round rod in a single operation. It is a part of the blooming mill and is operated by the 2,500-hp. motor which drives the blooming mill. Under favorable conditions with the metal at a correct temperature the operation takes about 2,000 kw. to 2,500 kw. for from twenty seconds to fifty seconds. But if the metal should be a trifle too cold, as it sometimes is, even heavier power demand for a similar period may be expected from this one operation. Ordinarily one ingot is ready to go through the repeater about every five minutes. The operation of the blooming mill in the interim creates still further but less intense fluctuations. The whole load of the mill has been known to show momentary power swings of 6,000 kw. The highest fifteen-minute integrated demand on record is 4,176 kw. This comes from an installation with an approximate total connected load of 9,000 kw. and with no power supply but the central station, except a waste-heat steam turbine which can be relied on for only about 600 kw. Aside from the trouble anticipated from the repeater no difficulties were expected from the steel mill load. The rod mill causes no trouble at all.

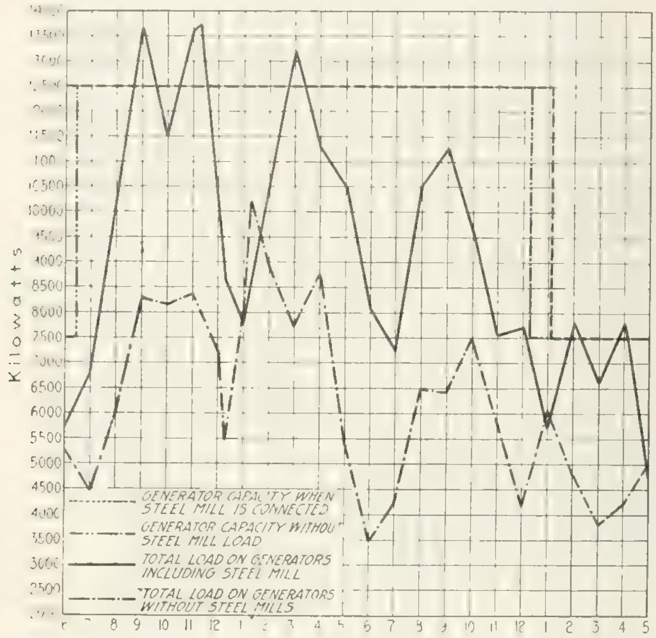
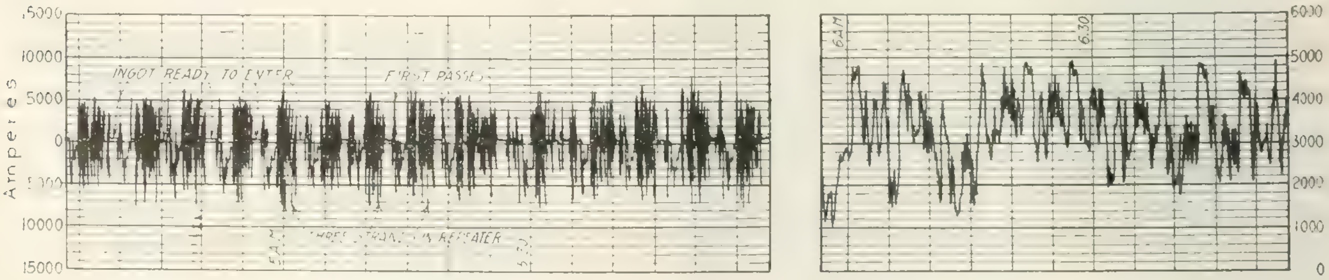


FIG. 5—HOW THE GENERATING EQUIPMENT SERVES THE LOAD AT MAXIMUM EFFICIENCY



FIGS. 6 AND 7—THE FLUCTUATIONS IN THE STEEL MILL LOAD ARE DUE PRINCIPALLY TO THE BLOOMING MILL, AS OBSERVED FROM THE REGULAR PEAKS AT FIVE-MINUTE INTERVALS

Now even fears for the voltage regulation at the central station on account of the repeater have passed. The voltage chart shows a line as steady as could be drawn. The only precautionary measures taken consist of asking five minutes' warning by telephone when the mill load is to come on. It has also developed that boilers cannot be taken out of service with the same freedom as formerly, for when the mill load does come on boilers must go on the line to handle it.

Power is to be available each day for the requirements of the steel plant. In general, the rolling mills will not operate from 6 a. m. Sunday until 6 a. m. Monday, making a power reduction of 2,000 kw. to 3,000 kw. However, operations may proceed during some Sundays and for short intervals almost any Sunday.

The power station is to be notified at all times when power for one or both rolling mills is not required for periods longer than one hour.

Whenever the power-station operating conditions necessitate reduction of power supplied the matter should be taken up with the steel-plant power-station operator. In each case the power-station man calling the steel mill's power-station operator should give his name and state the cause of the power reduction, the probable length of its duration and the amount it is to be reduced. The steel-plant power-station operator will then take care of the situation and make a report in writing concerning the reduction. It should be borne in mind that it takes a few minutes to reduce the power demand, as steel which may be in the rolls must be finished. Furthermore, it is highly desirable that when required the steel plant should be notified of this so that operating conditions may be adjusted to the expected situation with a minimum of loss. Considerable may be done in this direction, as in any central station operating difficulties do not usually cause trouble which requires action within a few minutes. In many cases, if the steel plant had ten to twenty minutes' notice, it could so adjust its furnace heating that the excessive loss it would otherwise suffer might be considerably reduced.

Load curves showing the characteristics of the total power-house operation and of the steel-mill operation are shown in Fig. 5. The two station-load curves are typical of a day when the steel mill is running and of a day when it is not running. The reason the latter curve shows an apparent excess of generator capacity being carried throughout the day and evening is that it is more economical to run the 5,000-kw. and the 7,500-kw. machines than either of the larger machines with one of the small units. On the other hand, the curve for the day when the steel mill is on shows that the smaller and less economical machines are not started unless overloads on the two larger and more economical units are especially severe. This practice is said to be perfectly safe, since the steam end of the largest turbine is good for 9,000 kw.

Graphic instrument charts from the steel mill (Figs. 6 and 7) show the fluctuating characteristics of the blooming mill's demand and indicate its effect on the total mill load. A study of the recording ammeter chart (Fig. 6) shows that an ingot enters the rolls about every five minutes and that the peak demand for power comes near the end of the duty cycle when there are three strands of metal in the repeater at one time. This record shows 8,000 amp. on the peaks, but it is not uncommon to reach 10,000 amp. on the same operation.

The effect of this blooming-mill and repeater operation on the total mill load is shown in Fig. 7. Operation during the hour which this chart represents was interrupted several times, but the steady recurrence of the peaks every five minutes can be easily discovered. The peaks shown reach about 4,800 kw. momentarily, the demand being fairly steady around 3,500 kw.

Data on the amount of electrical energy necessary to produce a ton of wire fence are not available at this mill since the management has not kept its records on a basis comparable with those in other similar mills. Since the mill has been in operation the chief endeavor has been to reach 100 per cent production so that little time has been available to look into unit production costs. This will be attempted later.

MOTOR-GENERATOR AND MAIN-ROLL MOTOR IN THE STEEL MILL

While in general the drives in the Keystone Steel & Wire Company's Mill at Peoria are similar to all modern reversing equipments, in that the well-known Ward-Leonard field control and equalization of demand by suitable alternating-current-direct-current flywheel-motor generators are employed, certain modifications in design and arrangement have been introduced. The main motor, built in a single unit, had at the time it was built a larger capacity than any other single-unit reversing motor in this country, with the exception of an exact duplicate installed by the Ashland Iron & Mining Company. The induction motor is rated at 2,000 hp. at 360 r.p.m., 2,300 volts, and the generator at 2,000 kw. at 360 r.p.m., 500 volts. The flywheel weighs 110,000 lb. (50,000 kg.). The liquid slip regulator in the secondary circuit of the induction motor provides for an automatic retardation and acceleration of the flywheel, thus enabling it to absorb the peak demand of the mill during successive passes. Contrary to general practice heretofore, complete current-limit automatic magnetic control for starting and plugging the flywheel set from the master controller is provided. This arrangement, while considerably more expensive than the customary use of a slip regulator for starting and slip regulation, permits, by the movement of a single master controller, normal starting and stopping, or in emergency will bring the set to rest in four or five minutes instead of several hours as would be required under the influence of friction and windage only.

The main-roll motor has a guaranteed continuous rating of 2,500 hp., from 40 to 120 r.p.m., with a temperature rise not to exceed 50 deg. C. The question of maximum momentary rating is simply one of commutation, and in factory test and under actual operating conditions since installation it has been conclusively shown that the maximum momentary guaranteed values of torque and horsepower were very conservative. While the guaranteed emergency torque was but 850,000 lb. at 1 ft. radius (115,000 kg.-m.) from 0 to 40 r.p.m., the motor has actually developed 1,100,000 lb. (150,000 kg.-m.).

In spite of its tremendous power and massive construction, the acceleration characteristics are excellent. Complete reversal from 120 r.p.m. forward to 120 r.p.m. reverse can be obtained in approximately five and one-half seconds, or from 50 r.p.m. forward to 50 r.p.m. reverse in two seconds. The rotor can be rocked in its bearings backward and forward through an arc of 10 deg. to 15 deg. as rapidly as the master controller can be moved, or from fifty to sixty times per minute.

EQUIPMENT SIMPLIFIED THROUGH USE OF SHUNT-WOUND MOTOR.

The remarkable speed characteristic is largely due to the use of a fully compensated shunt motor and the elimination of the compounding which, previous to this installation, had been in general use. Compounding, while affording considerable protection to the motor, of necessity gives a drooping speed characteristic and consequently a sluggish drive as compared with a simple shunt machine. The use of the shunt-wound motor further simplifies the equipment by the elimination of the series-compounding exciter as well as the series field on the motor itself.

Because of the intermittent character of the load, low average speed and idle intervals, forced ventilation is supplied, with provision for washing and humidifying the air before it enters the motor.

The Keystone Steel & Wire Company is under the management of Peter Sommer and his sons. The work of preparing the plant and lines of the Central Illinois Light Company to take the steel-mill load was carried out under the direction of R. S. Wallace, vice-president and manager, and L. Owen, general superintendent. The turbine at the central station and the large equipment at the steel mill were furnished by the General Electric Company, the transformers were supplied by the Westinghouse Electric & Manufacturing Company.

Water Shortage May Cause Curtailment of Power in California

AN UNUSUAL shortage of water in California is seriously affecting power companies. Reservoirs in central California are at their lowest mark. The Pacific Gas & Electric Company has decided to refuse all new applications for light and power and may be forced to cut down power supply to large industrial consumers, owing to water shortage. The district forecaster of the United States Weather Bureau at San Francisco declares that present indications point to a protracted dry spell with the probability of no rain in February. The situation is further complicated by heavy demands made by farmers for electric power for pumping, the seasonal rains having failed. Southern California rainfall conditions were bettered by general heavy rains on Feb. 8 and 9. Precipitation in the Los Angeles district is now greater than that of last year to corresponding date by more than five inches. The San Joaquin Valley as far north as Stockton has received much needed rain. Fresno had the best downpour of the season.

Domestic Electric Service Among the People of Foreign Countries

The Results of a Survey Made by the Electrical World Show the Tremendous Possibilities For Expansion in the Electrical Industry in Various Foreign Countries—Japan Shows Greatest Progress in Electrical Installations

IN ORDER that a more general idea may be obtained of the potential market for small household electrical devices throughout the world, a survey has been undertaken by the ELECTRICAL WORLD in which an effort has been made to estimate as closely as possible the number of people who receive domestic electric lighting service in various foreign countries. The results as given in the diagram in page 485 and in the accompanying table must not be confused with the population residing in electrically lighted communities or within the possible service area of central stations. The estimates include only that portion of the population actually living in electrically lighted dwellings. The estimates have been made after a thorough research through Government conservation and consular reports, census figures, handbooks, company production reports and such information as has been published in books and magazines. Reliable data in several of the larger foreign countries are not obtainable, and no estimate involving these countries has been made.

NUMBER OF PEOPLE LIVING IN ELECTRICALLY LIGHTED DWELLINGS IN VARIOUS FOREIGN COUNTRIES

Country	Population	Dwellers in Electrically Lighted Abodes Number	Per Cent
Algeria	4,800,000	4,500	0.09
Argentina	7,833,000	437,500	5.6
Australia	5,792,000	650,500	11.2
Azores	260,000	2,500	1.0
Belgium	7,571,000	106,000	1.4
Bermudas	23,000	3,500	14.6
Bolivia	2,890,000	3,000	0.1
Canary Islands	600,000	22,000	3.6
Chile	3,506,500	16,000	0.4
China	320,650,000	240,000	0.08
Cuba	2,469,000	37,000	1.5
Egypt	11,207,000	25,000	0.2
France	39,601,500	2,475,000	6.3
Guatemala	2,145,000	20,500	0.95
Holland	6,492,000	22,000	0.34
Italy	36,120,000	3,874,500	10.7
Japan	53,697,000	24,308,500	45.3
New Zealand	1,099,500	157,000	14.3
Norway	2,391,500	527,000	22.0
Portugal	5,957,000	19,500	0.33
Roumania	7,508,000	56,000	0.75
Russia	164,737,500	448,500	0.26
Siam	8,309,000	20,500	0.25
Spain	20,356,000	564,500	2.7
Sweden	5,679,500	946,000	16.7
Union of South Africa	6,600,000	216,000	3.3
United Kingdom	46,089,000	7,791,500	16.8

Electric lighting in the homes of the Old World is as yet in its infancy. Candles, kerosene and gas are still quite generally used for domestic illumination, except in some of the more progressive nations. In Europe the people of Great Britain, Sweden, Norway and Italy are fast adopting electric lighting in their dwellings. In these countries extensive transmission lines are being extended into the rural districts, and the electrically lighted homes will in the future not be confined almost wholly to the urban districts. The number of electrically lighted dwellings in this portion of the world should materially increase in the next few years. The New World, including in this term Australia, New Zealand and Japan, has adopted domestic electric lighting quite generally, although a large proportion of the population of South America can never be considered as potential users of electricity.

Russia, despite her hugeness and potential power, has not progressed very far. Out of 1,802 chief towns, there are only 886 lighted at all, and of these seventy-four are provided with electric light, thirty-five with gas and the remainder are lighted by kerosene lamps. In Central Asia electricity is unknown, and in Siberia one city only is lighted by gas and eight by electricity. In the Caucasus and Poland oil lighting is as a rule employed. Out of 224 towns in these districts, 172 are lighted by oil, eleven by electricity and eleven by gas.

SWEDISH GOVERNMENT IS EXTENDING ITS TRANSMISSION SYSTEM INTO RURAL DISTRICTS

France, in many ways one of the most progressive nations of the world, is many years behind the United States in methods of installation, standard of quality and perfection of apparatus and materials. The men who served in France with the American Expeditionary Forces need no statistics to prove to them the low percentage of French people living in electrically lighted dwellings. In fact, the estimate here given will probably seem far too high to most of these men. In Sweden the government, in an effort to stem the tide of migration from the country to the cities and towns, is extending the electric transmission systems into the rural districts as fast as possible, and the number of electrically lighted dwellings in that country naturally will materially increase during the next few years.

Japan appears to lead the foreign-speaking world in the percentage of inhabitants in electrically lighted dwellings. According to Japanese government data, at the end of 1915 there were 3,051,975 families using electric lights with 7,536,930 lamps in use, an average of 2.5 lamps per family. The size of the average installation, however, is pitifully small. The following table gives the rating of the lamps:

Candlepower	Number of Lamps	Percentage of Total
Less than 10	3,569,277	47
10	2,806,066	37
16	822,471	11
Over 20	340,515	5

The average time that the lamps are used at night is 2.54 hours. Only 2.2 per cent of the total number of families supplied were served through meters, and the number of lamps they use represents about 15 per cent of the number of lamps. In 1915 approximately 40 per cent of the total number of lamps used were of the metal-filament type. Figures up to Sept. 30, 1917, show that in Japan there were 530 electric power and light systems, forty-two electric tramways and forty-eight combined railway and lighting systems, together with 1,609 private and 121 government-owned plants with fifty-three of the latter and six of the former under construction. Japan is manufacturing large quantities of small household electrical devices, and the figures given cannot be considered as entirely representative of the foreign market for these goods in that country.

In China the electrical industry is as yet in its infancy. On Jan. 1, 1918, there were in that country eighty-seven central stations, of which sixty-two were in China proper and twenty-five in Manchuria. On this date the electrical energy supplied for motors and lighting throughout China totaled 72,000 hp. and 1,375,000 cp. respectively. Electric lighting, however, is becoming very popular among the better classes in the interior cities, and small gas and kerosene generators supplying 200 lamps are now being used by many private concerns.

Siam has recently awakened to the advantages of electricity. Bangkok, the capital, was in 1917 the only city in Siam having electric light and power, but much activity has developed lately.

The Commission for the Conservation of Power in Canada, in its report issued in the spring of 1918, gives 663,048 consumers of power in the Dominion, divided among the various provinces as follows:

	Consumers		Consumers
Alberta	40,734	Ontario	236,312
British Columbia	73,438	Prince Edward Island	2,319
Manitoba	58,378	Quebec	192,236
New Brunswick	14,085	Saskatchewan	24,991
Nova Scotia	19,795	Yukon	660

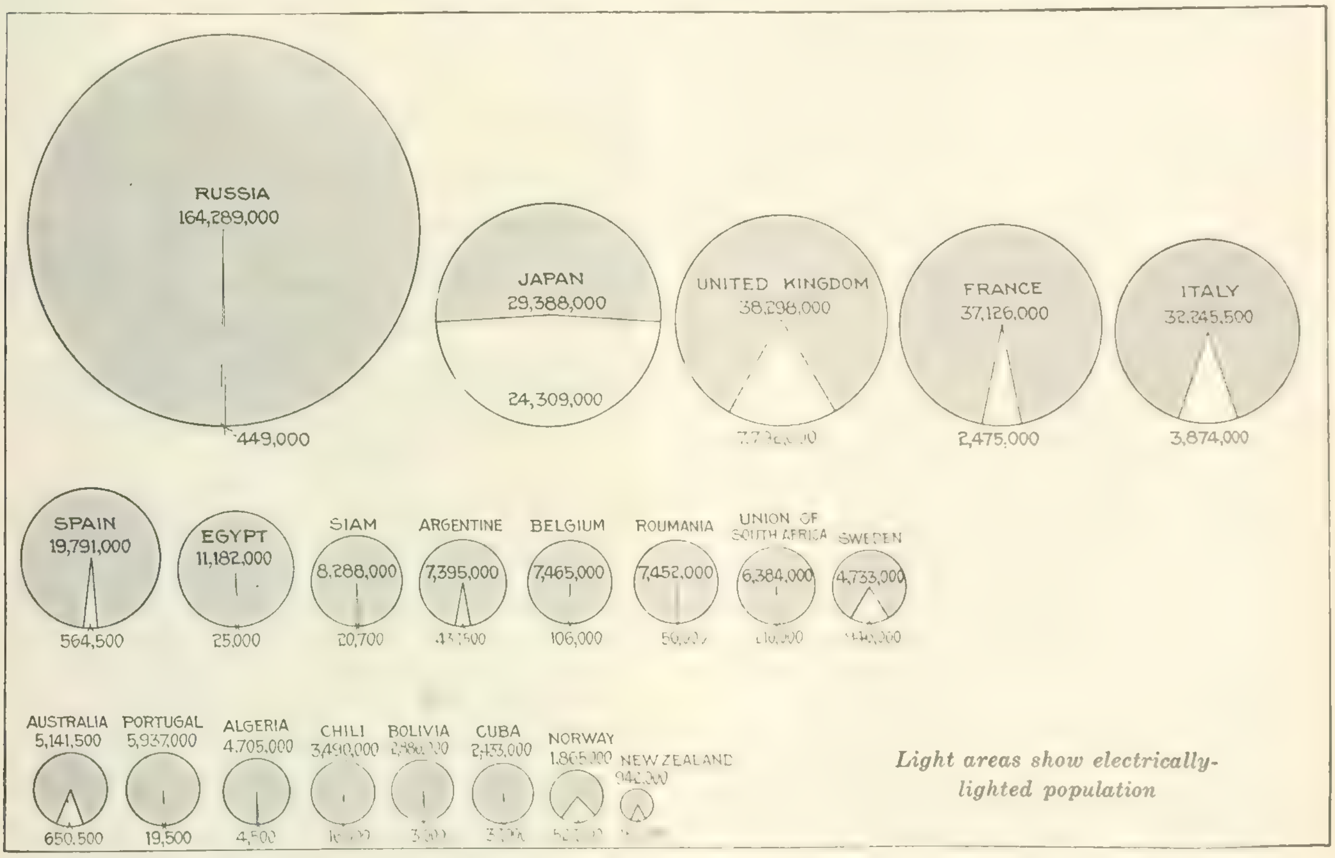
However, no data are obtainable as to the proportion of these consumers using energy for illuminating and power purposes respectively.

In Argentina there are estimated to be more than 350 central stations at the present time, but most of these are small. In Buenos Aires, one of the most progressive cities of the continent, only about 10 per cent of the population are active consumers of electricity, or about 160,000 out of 1,600,000.

No dependable data are available relative to the proportion of the population of Brazil living in electrically lighted dwellings.

Although Bolivia is the fourth largest country in South America and has a population of 2,500,000, it is doubtful if it will ever be a good market for electrical goods, as not more than 250,000 persons can be considered as possessing potential purchasing possibilities.

In Chile domestic electric lighting is as yet not extensively employed and the market for small household electrical devices is only slightly developed.



REPRESENTATION OF THE EXTENT TO WHICH THE PEOPLES OF THE WORLD LIVE IN ELECTRICALLY-LIGHTED HOMES

The population of Australia is only about 5,792,000. Of these about 80 per cent live in the three states of Queensland, New South Wales and Victoria. Again, about 40 per cent of all the population is centered in the capital cities of the states, and if totals are taken for all cities with a population of more than 4000 it will be found that 50 per cent of the people are accounted for. There are no great numbers of colored people among the population, and the aborigines, who number a few hundred thousand in all, do little systematic labor as a rule. On the whole, Australia has a large percentage of people who can afford to live well, and there is no real poverty such as exists in other countries of the world. The proportion of the population using domestic electric service will probably increase materially as the advantage of this system of illumination is better appreciated.

The standard of living of the people of New Zealand is good, and there is an absence of a poor class. However, there are many modern conveniences of which the people have not taken advantage. In the electrical field this is quite noticeable and is possibly due to some extent to the rigid and expensive requirements of the fire underwriters.

Midwinter Convention of the A. I. E. E.

Enthusiastic Discussion on Super-Power Zone for Northeast Seaboard—Committee Recommended to Put Plan in Execution—Features of Technical Papers and Discussions

THE outstanding feature of the midwinter convention of the American Institute of Electrical Engineers, held in New York on Feb. 18 to Feb. 20, inclusive, was a discussion on "Economical Supply of Electric Power"—a symposium on super-power plants and transmission for the Northeast seaboard zone. It was led by W. S. Murray, consulting engineer, New York, and was contributed to by many engineers prominent in the manufacturing, consulting and central-station fields. Emphasis was laid on the enormously increasing power demand, the shortage of power available, the decreasing supply of fuel, the congestion of railroads and the present financial loss due to wasteful use of coal that can only be offset by generation of power in super-power plants connected by super-power transmission lines. The ability to supply apparatus for such a system was ably discussed by manufacturers' engineers; the feasibility of the plan was demonstrated by consulting engineers, and central-station executives and engineers showed that this super-power zone can be established most expeditiously and economically by building the system around large existing central stations as a nucleus.

To get something accomplished before the situation becomes any more serious, a motion was carried recommending to the board of directors that a committee be appointed to carry on the work and that W. S. Murray be chairman.

Participation of engineers in public affairs was urged by President Townley in his address. As reported in last week's issue of the ELECTRICAL WORLD, he stated that it had been decided to operate through the agency of representatives of all engineering societies rather than by the formation of one national society of engineers.

A proposal was made to standardize symbols for use in electrical diagrams, and a tentative list of the more fundamental symbols was offered for criticism or approval. The paper was read by E. J. Cheney for a sub-committee of the standards committee of the institute. Constructive suggestions were made by W. S. Gorsuch for devising statistical reports of steam-power-plant performance which would make results in different stations comparable.

Communication engineers were greatly interested in a very comprehensive report by J. H. Bell on the operation and critical comparison of the more important forms of printing telegraphs, which are rapidly coming into use.

A new method of separating the no-load losses in electrical machinery was reported by C. J. Fechheimer and some interesting oscillograms showing the momentary drop in voltage when load is applied to direct-current generators were discussed by A. L. Ellis and B. W. St. Clair.

Dr. P. G. Agnew reported the development of a very simple and ingenious vibration galvanometer which the members considered especially useful because it would be little affected by extraneous mechanical vibrations.

The dinner-dance at Hotel Astor, Thursday evening, was well attended as usual and constituted the social function of the convention. On each day of the convention various excursions were conducted by the entertainment committee to places of engineering interest.

Aside from those already mentioned seven technical papers were presented. Features of most of these with the high points of the discussions are reported here.

SUPER-POWER SYSTEM

Economical Power for Industries and Railroads

Consulting Engineers, Central-Station Men and Manufacturers Discuss Feasibility, Cost and Benefits of Super-Power Zone and Logical Method of Establishing It

UNUSUAL interest was demonstrated in the super-power zone plan which W. S. Murray has been advocating some time for the Northeast Atlantic seaboard and on which he, with several prominent engineers like W. L. R. Emmett, J. F. Johnson, H. G. Reist, F. D. Neubury, W. B. Potter, Philip Torchio, Percy H. Thomas, W. D. A. Peaslee and A. O. Austin, contributed a symposium at the Thursday morning session. Other notable men such as John W. Lieb, Prof. M. MacLaren, Prof. C. F. Scott, David Rushmore, E. E. F. Creighton, N. W. Storer and S. T. Dodd took active and enthusiastic parts in the discussion.

The super-power plan, as briefly summarized by Mr. Murray, provides a means by which a present estimated machine capacity of 17,000,000 hp.—10,000,000 hp. for industrial purposes and 7,000,000 hp. for the railroads—in a region between Boston and Washington and inland from the coast 100 to 150 miles, now operating with a load factor not exceeding 15 per cent, can be lifted to a load factor of greater than 50 per cent and possibly to 60 per cent, and a means by which, conservatively speaking, one ton of coal will do the work of two or three, the railroads within the above zone and those carrying coal into that zone being thereby relieved of transporting one-half the amount of coal required for power and lighting purposes. In short, the value of machine capacity from a utilization standpoint will be increased from threefold to fourfold and coal resources for the purposes named be conserved twofold. The saving of $300,000,000 a year that would result from the establishment of a super-power zone would represent 24 per cent on the investment required, to say nothing of the benefit to the public as a whole. It is hoped that a bill appropriating money for this national need will be presented before Congress by July 1, otherwise the plan will have to be financed by backing it with government bonds, interstate bonds or private capital.

GREATEST TURBINE DEVELOPMENT WILL COME THROUGH CO-OPERATION

Mr. Emmet's contribution, though brief, not only brought out the fact that individual turbine sizes are now available for zone power application but pointed to his belief that still better results can be accomplished by co-operating in the art of power production. The best steam-turbine stations operating under favorable conditions can deliver a horsepower-hour in the form of electricity with an expenditure of 1 lb. of coal, while 4 lb. are required to deliver a horsepower-hour to the drawbar of a good steam locomotive. While the comparison of efficiency between the large power station and the smaller engine or turbine equipment used in small stations and isolated power plants is less striking than that with the locomotives, it is nevertheless highly unfavorable to the small plant, and this is fully demonstrated by the rapid growth in the use of central-station power in industrial plants large and small. The important requirements for economical power production in turbine stations are large and continuous demand, facilities for economical purchase, handling and storage of fuel, and an ample supply of condensing water.

Power delivered near centers of demand where load factor is high has a much higher value than that produced in remote places; that is, it pays to transmit power long distances for occasional or irregular demand, while for large and continuous demand it is profitable to produce it locally.

Constant output at as near normal capacity as possible is the first requisite to high efficiency or its equivalent, low cost of production, Mr. Johnson pointed out. The greatest amount of saving in cost of production of power is to be made by the discontinuance of the many small and medium-size generating stations, many of which contain apparatus which is obsolete, incomplete or uneconomically arranged, and replacing them with large-capacity stations designed for maximum reliability and efficiency.

Generating stations of from 200,000 kw. to 300,000 kw. capacity, employing generating units of from 50,000 kw. to 75,000 kw. capacity, would involve no difficulties of design, construction or operation, and from such stations a steam consumption rate of 10 lb. per kilowatt-hour or less and a total station rate of less than 1½ lb. of good-quality coal per kilowatt-hour output should be obtained.

NO HESITANCY SHOULD EXIST REGARDING GENERATORS

So many generators of 30,000 kva. to 50,000 kva. are at present in operation, giving satisfactory results, that there need be no hesitancy in considering generators such as those now used or larger, said Mr. Reist. In the super-power zone under consideration there would probably be at least five generating units in each installation, so that repairs and inspection of the units could be made without much reduction in output at any point. Any reduction in output would have to be supplied from neighboring power houses. The potential of these generators should be within the limits of experience—that is, not above 13,200 volts and preferably lower, if this does not cause inconvenience in the lines leading from the generators to the step-up transformers. Careful attention must be paid to the design of the machine so as to keep all its parts reasonably cool. An improved method of cooling which has been adopted in a few cases is to inclose the air used in cooling the generator completely and to recirculate it, thus not taking in any new air.

This closed system of ventilation offers some advantage in extinguishing internal fires since it will be possible to retain gases or vapors, which may be used in putting out the fire.

On account of the great capacity of the lines in such a large system, there may be some advantage in the use of induction generators. Mr. Reist expressed the belief that it is possible to construct induction generators in sizes comparable with the most efficient operation of the turbine.

Mr. Newbury said: "The generating element in the proposed Boston-Washington power supply system does not involve anything new or untried. The individual power stations need not, and probably would not, be any larger than stations now in operation, or under construction: Certainly any probable station involved could be designed with generating units of the size now available. Mr. Newbury advocated developing the super-power system around existing large central station.

ELECTRIFYING RAILROADS WOULD SAVE 14,000,000 TONS OF COAL

Every form of railroad service now performed by steam locomotives can be performed by electric locomotives, and performed better and more economically, said Mr. Potter. In support of the latter statement he pointed out that as many ton-miles can be handled by 1 kw.-hr. using electric locomotives as can be handled with 6½ lb. of coal using steam locomotives. As a result the traffic now handled within the super-power zone by steam locomotives could be carried on by electric locomotives with 6,000,000,000 kw.-hr. or with a power demand of 750,000 kw., which would be equivalent to a saving of 14,000,000 tons of coal annually. Furthermore, the maintenance expense would be reduced $15,000,000 annually, estimated on a conservative basis.

The statement made by Mr. Potter that an electric locomotive can do anything that a steam locomotive can do, and do it more economically, was repeated by Mr. Storer. Furthermore, electrification means conservation of fuel and labor. The latter is particularly important since labor cannot be hired at the present price and as a result transportation is greatly handicapped. Two-thirds of the 21,000,000 tons used by railroads in the super-power zone annually could be saved by electrification, Mr. Storer contended.

COAL WILL ALWAYS BE PREDOMINATING SOURCE OF ENERGY IN EAST

By carefully compiled figures Mr. Torchio demonstrated that water power can never be expected to contribute more than 10 per cent of the power requirements in the super-power zone under consideration and that steam will have to be relied on for the majority of power demanded. On the other hand, water power must be assiduously utilized to minimize the amount of coal that must be burned. In the Mountain and Pacific States water powers predominate, so that they could, if totally developed, supply more than six times the power demands there.

Regarding the investments required for hydroelectric and steam plants, Mr. Torchio pointed out that a steam plant costs only about one-third or one-fourth what a water-power development does with transmission connections and steam reserve, so that it follows that every dollar invested in steam plants will make available several times more power than the same amount invested in hydroelectric plants. Except where the water flow is very uniform or the price of coal very high, the operating cost per kilowatt-hour will usually be lower for steam plants than for hydroelectric. Some detailed figures were presented comprising the cost of operating both kinds of plants under various conditions of flow, coal price and load factor. Recognizing these economic conditions, it become evident that hydroelectric developments yielding large amounts of continuous power should be employed to serve industries which require large amounts of continuous power like electrochemical and electrometallurgical plants.

In view of the facts presented the greatest benefits to all concerned will result from further centralizing power production and further interconnecting the great central stations so that neighboring plants may interchange energy. In addition, modern generating equipment should be substituted for older equipment and the more economical apparatus be utilized to carry loads while the less economical should be held for reserve service. Possibly new plants should be located in coal fields or at by-product gas and coke works. However, Mr. Torchio expressed himself in favor of tidewater plants instead of plants at mine mouths to avoid jeopardizing the continuity of service.

Considerable information and data were also presented by Mr. Torchio on the supply and consumption of coal by territories and classes of industries and the relation which the potential water powers bear to the amount of coal used.

ECONOMY AND FEASIBILITY OF SYSTEM DEMONSTRATED

The chief factors underlying the economy and operative feasibility of the proposed super-power system were considered by Mr. Thomas. To arrive at some tangible results he assumed a main trunk line from Washington, D. C., to Lawrence, Mass., passing through the major intervening cities three tap lines supplying power (1) from the soft-coal fields on the upper Susquehanna, (2) from the hard-coal fields, probably supplemented by Susquehanna and Delaware River water powers, and (3) from a large hydro-electric plant on the St. Lawrence River in the vicinity of Cedar Rapids. Then the principal equipment necessary was outlined and the operating methods were discussed. Finally, the cost of providing such a system was estimated, and the very satisfying conclusion was reached that the scheme would be both feasible and economical. For a system involving 900,000 kw. in super-power plants at the places mentioned and including the equipment for 700 miles of transmission line he estimated a cost of $150,000,000. No spare lines were provided for, since, in Mr. Thomas' opinion, they would not be necessary with the rugged construction assumed.

INSULATORS RATED AT 350 KV. AVAILABLE

The utilization of 220,000 volts or higher for the transmission of power in this super-power system is not a problem that holds any terrors for insulator manufacturers, said Mr. Peaslee. In fact, he declared that his company is now prepared to provide insulators for voltages up to 350,000 and is ready to guarantee them.

Mr. Austin pointed out that a transmission line operating at 220 kv. will involve large conductors which would give a high degree of mechanical reliability not afforded in smaller systems. Besides, the insulators which would be required would make the system free from lightning trouble. It is now possible, he said, to procure insulators such that a single string will carry the line and at a cost probably not more than 50 to 60 per cent of that required for 110 kv.

TOTAL OF 700,000 KV. AVAILABLE FROM SUSQUEHANNA AND DELAWARE RIVERS

Professor MacLaren estimated that the total load which would exist in eastern Pennsylvania, New Jersey and New York City, if all industries were served from this system, would be about 2,600,000 kw. at the present time. At present the public utilities in this territory are carrying about 1,000,000 kw. The additional power could be supplied from hydro-electric developments on the Susquehanna and Delaware Rivers and from steam plants at the anthracite mines. The largest single development projected for the Susquehanna River is at Conowingo with an initial rating of 125,000 kw. and a yearly output in a dry year of 700,000,000 kw.-hr. With a relatively small amount of river control it would be possible to increase the output at this point and develop other sites which would yield 200,000 kw. to 300,000 kw. and 1,500,000,000 kw.-hr. annually. Plans are well advanced for the development of a series of hydro-electric plants on the Delaware River which will produce 250,000 kw. and 1,000,000,000 kw.-hr. annually. It does not appear feasible at the present time to operate steam plants larger than 300,000 kw. in the anthracite region. By the erection of plants in this region and the electrification of mine operations the coal now used for these operations (8,000,000 tons) would be sufficient to supply all the needs of the coal companies and in addition generate 600,000 kw. at 50 per load factor.

Professor Scott referred to the enormous growth of the electrical industry in the last thirteen years and painted a picture of the growth that may be expected in the near future. With the load doubling every five years, he said, it is absolutely essential to consider some means of providing the power immediately and economically. The super-power system offers a solution.

Mr. Rushmore pointed out that with labor becoming more expensive by the minute the situation can only be saved by electrifying industries promptly. At the suggestion of Professor MacLaren and Mr. Rushmore, Mr. Buck made a motion recommending that the board of directors appoint a committee to develop the super-power system, with W. S. Murray as chairman. It was carried.

Mr. Creighton announced that in a very short time means will be provided for removing trouble from lightning in a few hundredths of a second.

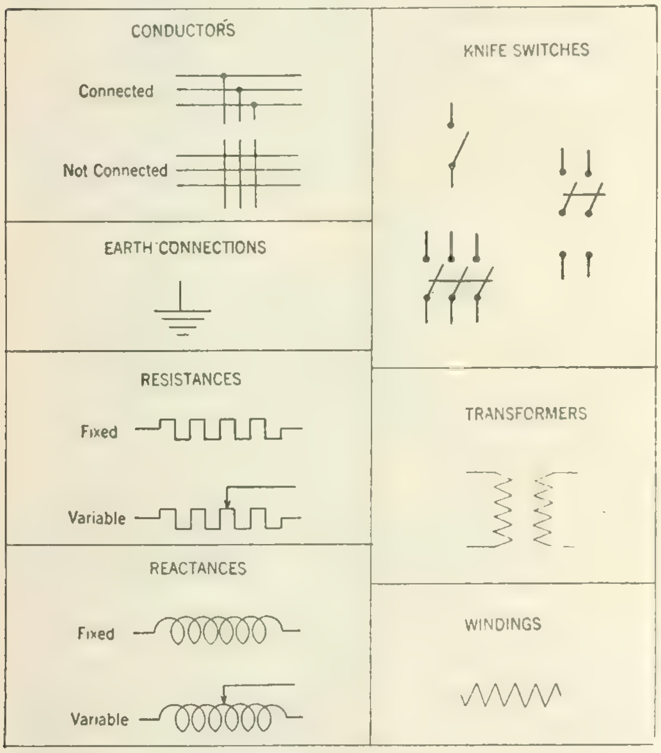
CONTINUITY OF SERVICE PRE-EMINENT

Mr. Lieb declared that the supply of adequate and economical power is the most important problem before the nation today and that it is fortunate that the movement to establish an interconnected system in the zone considered has been initiated at this time. Engineers should avoid arguing among themselves regarding the details of how this plan should be put into effect, however, he warned, since such disagreement would be liable to frighten away the investors who will be required to finance the project. Procrastination in starting action was also decried, since every delay makes mechanical execution of the plan more difficult, owing to new apparatus being installed every day that cannot readily be tied together. To illustrate this point Mr. Lieb referred to the impossibility of connecting one system that was badly in need of power during the war with another that had the power available simply because of 2½ cycles difference in frequencies. If the interconnections proposed are made, continuity of service should be assured by everything that money can buy, that human foresight can propose and that engineering ability can provide, Mr. Lieb said. He expressed the deepest concern upon this point, saying that the seriousness of interrupted service in such cities as New York, even for a short time, is impossible to exaggerate.

STATISTICS AND SYMBOLS

Standardizing Electrical Symbols

AN APPEAL for the standardization of symbols for electrical diagrams was made in a paper entitled "Standard Graphic Symbols," by Edward J. Cheney of the Public Service Commission of New York. Mr. Cheney offered a tentative set of symbols which, he said, were simple and commonly accepted. Some of the more important are shown here. He urged that the work be continued and that the members criticise his proposal. In the discussion following it was generally agreed that a good start had been made, but some modifications were proposed by Prof. Walter I. Schlichter, A. B. Smith, Dr. P. G. Agnew, H. R. Summerhayes and O. C. Traver.



SOME PROPOSED STANDARD GRAPHIC SYMBOLS

Prof. Schlichter said he favored the use of two parallel lines following the conventional practice of radio engineers, for the condenser symbol instead of the one used by power engineers. Mr. Traver pointed out that the committee on protective devices was considering changing the relay symbols. It was also suggested that relay symbols which do not show voltage connections are inadequate.

Improved Statistic for Steam-Power Plants

W. S. GORSUCH, Interborough Rapid Transit Company, New York, in a paper on "Essential Statistics for General Comparison of Steam-Power-Plant Performance," outlined statistics, described as "coal characteristics of the plant" and "load characteristics of the plant," by which fairly close comparisons can be made of the efficiencies between different plants without going into thermal characteristics and power costs. The data necessary for this purpose are as follows:

I. *Coal Characteristics of the Plant*

(1) Average B.t.u. supplied to plant per hilokatt-hour net output.

(2) Thermal efficiency of plant in per cent.

(3 Average B.t.u. per dollar, coal as received (moist basis).

(4) Coal factor or pounds of coal per kilowatt-hour net output (moist basis).

(5) Average B.t.u. per pound of coal as received (moist basis).

(6) Cost of coal per ton (2,240 lb.) delivered alongside the plant.

(7) Kind and character of coal.

(8) Cost of coal in cents per kilowatt-hour net output.

II. *Load Characteristics of the Plant.*

(9) Average daily load factor of load.

(10) Maximum load for the year.

(11) Yearly load factor of load.

[Interval of maximum load fifteen minutes or one hour, depending upon character of load.]

(12) Kilowatt-hours net output for the year (kilowatt-hours sent out from the alternating-current bus).

(13) Installed rated capacity, that is, the aggregate maximum continuous rating of the generators in kilowatts.

(14) Average kilowatt-hours net output per kilowatt installed rated capacity.

He showed how these statistics bring out essential points by illustrative data for two plants.

Philip Torchio advocated the use of such statistical forms by the public utilities commissions, but E. J. Cheney replied that operating companies already complain that the commissions ask too much. R. S. Hale of Boston urged the expression of load factor in hours rather than percentages.

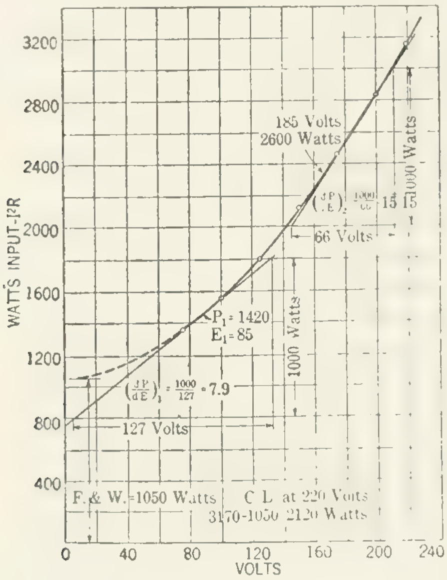
METERS AND MEASUREMENTS

Determining Iron-Losses in Electrical Machinery

A METHOD of separating iron losses from the friction and windage losses of an electrical machine that differs from the ordinary method was explained by Carl J. Fechheimer. Use is made of a curve obtained by running the machine as a motor at constant speed with different voltage impressed on the armature. By substituting in a formula values obtained from the curve which is plotted between volts and watts input the values of the individual losses at any voltage may be determined. This equation is: $P = P_w + P_o (E/E_o)^n$, in which P = total loss, P_w = windage loss, P_o = iron loss at voltage E_o, E = any voltage, and n = an exponent representing the rate at which iron loss increases with voltage.

It has been found by experiment that n is constant so long as iron is not operated above the saturation point. Therefore to simplify computations all values substituted in the equation are for operation of the machine below this limit, which with ordinary iron is about 12,000 lines per sq.cm. for the core and 16,500 lines per sq.cm. for the teeth.

Transposing P_w in this equation, taking natural logarithm, differentiating with respect to E, and solving: $P_w = P - \frac{E}{n} \quad \frac{(\delta p)}{(\delta E)}$. As $\frac{\delta p}{\delta E}$ is the slope of the curve at any point, the value of n may be determined by taking any two points P_1 and P_2 on the curve (below the saturation point) and solving the equation:



CURVE USED TO SEPARATE LOSSES IN AN INDUCTION MOTOR

$$P_w = P_1 \quad \frac{E_1}{n} \quad \frac{(\delta p)}{(\delta E_2)} = P_2 - \frac{E_2}{n} \quad \frac{(\delta p)}{(\delta E_2)}.$$

Since quantities except n in these equations may be determined form the curve n may be computed after n is known it may be substituted in the quantity $\frac{E}{n} \quad \frac{(\delta p)}{(\delta E)}$, which equals with the iron loss at any voltage E.

In discussing the subject Professor Karapetoff suggested adding another member to the above equation to make a more general formula which would apply to any condition of saturation. The equation he suggested was this: $P = P_w + kE^n + aE^2$ where a is another constant. Among others entering the discussion were W. F. Dawson and Prof. W. I. Slichter.

Inherent Regulation of Continuous-Current Circuits

THAT the voltage changes inherent in direct-current circuits upon change of load are independent of the IR drop and speed of prime movers was pointed out by A. L. Ellis and B. W. St. Clair in their paper. In arriving at this and other conclusions a number of possible conditions were considered, the first being the case of throwing an ideal non-inductive resistance on the circuit of a separably excited generator carrying no load. Owing to the inductance of armature and leads, current cannot be supplied instantly, and as no current was flowing before load was applied and current did flow afterward, obviously it must have increased from zero value. As $E = IR$, the voltage must drop to zero at the instant the load is applied, and increase along a simple exponential curve depends only upon the time constant of the circuit, to the value equal to the generated voltage minus the internal IR drop. The drop to zero is, therefore, fundamental and is independent of the type of the generator, its size, its generated voltage or the value of the applied load. These variables influence only the time of recovery to normal voltage and the form of the recovery curve.

If, as in all practical cases, inductance exists in the leads of the external circuit, the voltage at the generator terminals should drop instantaneously to a value approaching zero as the inductance of the external circuit approaches zero. The case which has the most practicable application is one in which an inductive load is added to a non-inductive load. In this case there is an instantaneous drop in voltage, but never to zero. The instantaneous drop is approximately equal to the voltage of the machine multiplied by the ratio of the added inductance to the sum of the added load and machine inductances. The voltage builds up from this value along an exponential curve of four terms. The current builds up from zero according to an exponential curve of two terms. This explains the flickering of many lamp circuits and leads to some rather unusual conclusions regarding the means of improving the instantaneous regulation of circuits where flickering of lamps is objectionable. The voltage changes are inherent in such circuits, and in general are in large measure independent of the cross-section of feeder or service lines. No matter how large the cross-section, there will be a voltage dip that is inherent in the circuit, and if the inductance of the series circuit is large enough the application of a load will cause flicker.

These fluctuations being dependent upon the inductance of the circuit for their duration, attempts at their elimination by the compounding of machines are obviously steps in the wrong direction. Better instantaneous regulation will be obtained from shunt machines than from compounded ones, owing to the lesser inductance of the former. Not only does compounding lead to a great duration of transient conditions but the extra windings have no effect on the generated voltage of the machine until the current has risen well along the recovery curve. The disturbances of large loads applied to lines can be mitigated by the insertion of suitable values of inductance coils of low resistance in series with the applied loads. In general the larger the value of the inductance applied the smalled will be the effect of a given load on the rest of the line. The fundamental principles involved in this application were discussed under the second case of load increments. It was there shown that the greater the ratio of the applied inductance to the machine inductance, the less will be the instantaneous drop.

Among those who discussed the subject were H. R. Summerhayes, Dr. C. L. Sharpe and M. E. Thompson.

Oscillograms and Their Tests

THE relation of the oscillograph to its purpose, an oscillograph-meter to determine the resonant frequency of the instrument, and some laboratory experiments were the topics of a joint paper prepared by Dr. A. E. Kennelly, R. V. Hunter and A. A. Prior. The paper showed that all mechanical-vibrator oscillographs behave differently at different frequencies. If the instrument has been calibrated at the fundamental frequency of an alternating wave, the apparent harmonic components require correction. As a means for estimating the amount of correction, an auxiliary vibrator or oscillograph meter is employed to measure the resonant frequency of the instrument. Another factor entering into the correction is the "bluntness" of resonance, or the ratio of the damping factor to the resonant angular velocity. By observations on a number of instruments the resonant frequencies were found to lie ordinarily between 1,200 and 5,000 cycles and the bluntness between 0.05 and 0.83, depending on the damping liquid.

M. E. Brown and B. W. St. Clair took part in the discussion.

Accuracy of Commercial Electrical Measurements

CONDITIONS affecting meter accuracy and the probable error of different instruments were treated by H. B. Brooks. He said among other things, that 1 deg. C. change in temperature affects the accuracy of some millivoltmeters about 0.4 per cent, direct-current wattmeters 0.1 per cent, and some direct-current voltmeters, moving-iron ammeters and electrodynamic voltmeters practically not at all.

Phase relation in instrument transformers is another source of error that must be taken into account if extreme accuracy is sought. Voltage transformers tested by the Bureau of Standards have shown a phase-angle error ranging from 2 min. to 69 min. at no load and 38 min. to 62 min. at full load. Current transformers should have phase angles less than 1.5 deg. at 60 cycles or 3 deg. at 25 cycles (both at 0.5 amp. secondary).

The induction-type watt-hour meter can be made independent of frequency changes at constant speed.

Watt-hour meters can be adjusted to correct for an average value of phase displacement as well as transformation ratio. However, change of wave form has raised errors of 3 per cent and even 15 per cent.

A voltmeter draws current and disturbs the potential it is measuring, and an ammeter likewise changes the current when it is introduced into a circuit. To correct these errors a second reading should be taken in each case after a known resistance has been inserted in series with the meter.

Numerous improvements and developments are desirable. For instance, instrument transformers should be smaller and more accurate; the instrument maker should give more data on the accuracy of his instruments, and all instruments should be marked with a symbol to show the operating principle. For important alternating-current metering installations a more accurate meter should be made, even if more expensive or heavier. For this purpose the braking flux of the permanent magnets should be largely increased and a higher grade of steel should be developed for use in the potential magnet.

New Forms of Galvanometers

DR. P. G. AGNEW described "A New Form of Vibration Galvanometer" which drew forth much favorable comment. This instrument is of the moving-iron type and consists essentially of a fine steel wire, mounted on one pole of a permanent magnet and so arranged that the free end of the wire may vibrate between the poles of an electromagnet through which the current to be detected passes. A great advantage of this galvanometer is said to be that it is not sensitive to interference from mechanical vibrations. Dr. Agnew said it was also sturdy, responds quickly and has a high degree of sensitivity. The vibrators have been made for both 25-cycle and 60-cycle work. The importance of vibration galvanometers in alternating-current measurements work, particularly for null methods, was brought out.

In the absence of T. R. Harrison and Paul D. Foote, authors of the paper on "A Precision Galvanometric Instrument for Measuring Thermoelectric Emfs.," this was presented by H. B. Brooks. It was shown that a new principle has been developed whereby an ordinary millivoltmeter may be converted into an instrument in which the usual errors arising from a variable line resistance are entirely eliminated. The instrument measures true emf., it was said, in a simple circuit, or if connected across a resistance or network through which a current flows it indicates the potential drop which would have existed had the instrument not been connected. In this respect it functions as a potentiometer, yet it does not operate on the potentiometric principle since it does not require a standard cell (or the equivalent) or an auxiliary battery, the only emf. employed in the adjustment being that of the source measured.

In answer to a question regarding the range of frequencies for which a vibrator of the kind described could be tuned, Dr. Agnew put the range at about 5 per cent. Dr. J. B. Whitehead described a scheme for measuring small alternating currents through the agency of a direct current galvanometer and a kenetron tube. W. D. A. Peaslee called attention to difficulties in thermocouple measurements at the high temperatures used in firing porcelain insulators. The papers were further discussed by Dr. A. E. Kennelly, Dr. C. H. Sharp, P. E. Klopsteg, Prof. J. H. Morecroft and E. M. Hewlett.

COMMUNICATION

Great Interest Shown in Printing Telegraphy

COMMUNICATION engineers were much interested in the paper entitled "Printing Telegraph Systems," by John H. Bell, New York City. On account of the fact that the subject is not well covered in the literature, Mr. Bell gave a thorough description of the operation of the Creed, Murray and Siemens and Halske High-speed systems of telegraphy as well as the Baudot and American multiplex. He only included systems designed to handle traffic at 100 words per minute or more.

The speaker then summed up the characteristics of all these systems. He said that there is not much difference in speed of service between high-speed and multiplex methods, but there is some advantage in multiplex due principally to the fact that no time is lost in preparation for sending. All the printing telegraph systems discussed show improved accuracy over the ordinary Morse operation. Some increase in output is made possible by printing, but a considerable increase is possible with the keyboard perforator. Receiving and sending, moreover, are both less exacting of the operators. Results of tests on British systems, where the average messages are twenty-four words, were given as follows: Baudot multiplex, 43 messages; Wheatstone with Creed, 35; Morse sounder, 31; Wheatstone, 26.

Regarding maintenance, the figures are not yet conclusive, the speaker said. To show the possibilities of line economy it was estimated that a saving in capital cost on the order of $7,560 is possible on a 270-mile (430-km.) line by the use of the synchronous type of printing telegraphy. In the matter of flexibility, Mr. Bell said, the multiplex systems have undoubted advantages in linking several offices with a minimum of line.

MAXIMUM OUTPUT NETWORKS FOR TELEPHONE SUBSTATIONS

"Maximum Output Networks for Telephone Substation and Repeater Circuits" were considered by George A. Campbell and Ronald M. Foster of New York City. In the paper presented on this subject ideal telephone substation and repeater circuits are shown to present output and input requirements which can be met by a type of circuit containing four resistances each of which has maximum output. Maximum output is found to involve biconjugacy, *i.e.*, the four resistances fall into two pairs without active electrical connection between the two resistances of either pair. All circuits meeting these requirements with the minimum number of elements are enumerated, and the necessary formulas for proportioning these circuits and also circuits having superflous elements are derived.

To open the discussion the chairman, Donald McNicol, called upon Major-General George O. Squier and General Edgar Russel. Both of these gentlemen expressed their appreciation of the value of the papers presented and said that the American multiplex had played an important rôle in the field operations in France during the war. It was brought out in the discussion that printing telegraphy has already come into extensive commercial use with signal success. Among those taking part in the meeting were C. E. Davies, H. A. Emmons, P. M. Rainey, J. P. Edwards, E. R. Shute, R. E. Chetwood, O. B. Blackwell, John H. Cuntz and Lloyd Espenshied.

MISCELLANEOUS

Opposition to Daylight Saving

IN A PAPER on "Daylight Savings," Preston S. Millar, of New York City, said that the scheme worked seriously to the disadvantage of the agricultural class and that this was more important than the recreational advantages to city dwellers. Mr. Millar offered statistics indicating that the total output of central stations and gas companies is reduced about 3 per cent during the seven summer months, while the reduction in lighting alone is estimated at 8 per cent. The annual saving on this basis should be about $19,250,000 in electric light bills, or a reduction in coal consumption of about 495,000 tons per year.

Researches in the literature available led the speaker to the conclusion that those in favor of daylight saving are principally the well-to-do urban and suburban dwellers. The industrial workers, he said, seemed rather opposed to the plan. The great opposition, of course, comes from the dairymen and truck gardeners generally. In view of the "class" opposition to the measure Mr. Millar urged that those in favor of daylight saving should arrange the hours of their own business, rather than seek to effect a change in the clock.

Dr. P. G. Agnew questioned the opposition of the general agricultural class, asking if it might not be merely a case of inertia. It was pointed out by E. H. Martindale that Mr. Millar's figures did not include private and industrial plants, but it was said that no data on saving in these and street railway cars are available. The discussion indicated that no data is at hand to show the effect of increased daylight on factory production. Mr. Millar felt that the farmers' opposition was decidedly real. The paper was also discussed by J. Macfarlane Moore, C. R. Underhill, R. S. Hale, A. B. Smith, Selby Haar and Walter Schlichter.

Measurements with Synchronous Commutators

PRECISE measurements in connection with certain methods of determining crest values of high alternating voltages were investigated and reported in a paper: "Notes on the Synchronous Commutator," by J. B. Whitehead and T. Isshiki. One of the commonest of these methods is that in which a condenser, in series with a low resistance, is placed across the voltage source and the voltage drop over the resistance, due to the charging current, measured by a direct current instrument with high series resistance, through a synchronous commutator. The pulsating character of the current gives rise to possible errors due to the influence of capacitance and reactance. These were investigated by the authors of the paper. In using the synchronous commutator in a series connection serious errors may arise. Used in shunt, however, the commutator is said to be far more reliable and this method is to be preferred, it was said. The paper was discussed by E. D. Doyle, Dr. A. E. Kennelly and Prof. J. H. Morecroft.

Manufacturers Urged to Show Devices Connected to Outlets

THROUGH its advertising and publicity service bureau, the National Electric Light Association is drawing to the attention of electrical manufacturers the desirability of their co-operation with other departments of the electrical industry in educating the public to a larger appreciation of the necessity for adequate outlets in homes and offices. With this end in mind, P. L. Thomson, chairman of the adequate outlets division of this bureau, believes the time has come for manufacturers of appliances to show their devices connected with baseboard and chair-rail outlets, rather than directly to wall or ceiling lighting fixtures. The same thing is, he says, true of manufacturers of wiring devices, fittings, etc., as regards their publicity matter, whether it be "direct-by-mail," local or national.

Some manufacturers of wire who have built their publicity around the idea of the wider use of devices have found that the emphasis of this point of view has been a potent factor in building good will for their particular product.

Manufacturers are therefore urged by the division to keep this subject in mind when ordering printed matter, in the belief that this is a course which will not only be of benefit to the industry as a whole, but will react to the good of the manufacturers themselves.

Readers' Views and Comments

Need for Standard Frequency

To the Editor of the ELECTRICAL WORLD:

SIR: I have read the editorial in the Dec. 27 issue of the ELECTRICAL WORLD entitled "Customer Tolerance" and would like to state that, unfortunately or otherwise, the Southern California Edison Company's system has a frequency of 50 cycles and it is therefore utterly impossible to accept a standard 60-cycle apparatus for this system owing to the high core loss and other losses which occur when an attempt is made to run 60-cycle apparatus at a frequency of 50 cycles.

If it were possible for all of the electrical public utilities to adopt and use a standard piece of apparatus, it would greatly facilitate the work of the manufacturing companies, and we should probably be able to get our apparatus cheaper and more promptly. I sincerely hope that when we standardize heavy railroad traffic we shall come down to a common standard, be it direct current or alternating; but, judging from present indications, the Westinghouse Electric & Manufacturing Company building one standard and the General Electric Company another, we shall very likely have the non-interchangeable railroad, as with the New York & New Haven and the New York Central in New York City.

Los Angeles, Cal. J. A. LIGHTHIPE.

The 50-Degree Motor

To the Editor of the ELECTRICAL WORLD:

SIR: The article on the 50-deg. motor by A. C. Bunker in your issue of Jan. 10 is very timely. As far as the writer can learn from inquiry and experience, the 50-deg. motor was produced because it is cheaper to build than the 40-deg. motor of the same horsepower rating, and therefore means a greater profit to the manufacturer, provided that the users can be duped into buying them. These motors are sold largely to small buyers who employ no engineer and who buy on a horsepower basis, very often not knowing the power to be developed by the motor. Such buyers do not know the difference between 40 deg. and 50 deg. rise, if the rise is ever brought to their attention by the salesman. This information is seldom volunteered, and when it is mentioned emphasis is laid on it being standard.

In the older types of motors, commutation was usually the limit. Improvements in design have practically removed this limit, and now heating is the limit. The raising of the heating limit to 50 deg. has done the manufacturers considerable harm in giving the users the impression that the motors now being made are not so good as the older types. This harm has been due to the motors not being able to deliver the output because they have no overload capacity as to heating or are operated under conditions which affect the normal output and therefore reduce the rating.

In most cases where a 40-deg. motor has been replaced by a 50-deg. motor of the same horsepower rating the user has been dissatisfied. The purchasers of motors have been so accustomed to buying 40-deg. motors with leeway in them that the 50-deg. motor is not proving popular except in installations where the heating effect is equivalent to a motor rated at least 15 per cent less; but even in such cases the voltage must be favorable, otherwise the shunt fields will be apt to run dangerously hot. In the writer's opinion, it is a question either of educating the purchaser of the performance of the 50-deg. motor, in order to make it satisfactory in general service, or the manufacturers of such motors returning to the 40-deg. motors. It is a big undertaking to educate the layman on the technical features of motor design and application.

Birmingham, Ala. H. M. GASSMAN.

Dr. Whitney's Inspiring Viewpoint on Research

To the Editor of the ELECTRICAL WORLD:

SIR: I was so impressed with Dr. Whitney's article in the issue of the ELECTRICAL WORLD for Jan. 17, 1920, that I cannot refrain from making some running comments on it. I believe the author from which he quotes is wrong. It wasn't a pocket-knife, that's too mollycoddlish and dainty—it was a good husky jack-knife. It seems to me that no one could read Dr. Whitney's glowing rhapsody without being swept off his feet and taking an oath there and then to devote the remainder of his life to research. He is certainly a master at that subtle and at the same time most effective thing in the world, inspiration. I have often been told that this and that member of his able corps accomplished this or that. My response invariably has been, "How could they help it—it was Whitney who inspired them." And nothing was ever truer. And I know that no small part of this inspiration comes from the wonderful grasp and understanding that he has.

So intimate is his knowledge as to what is actually going on inside, that he canot speak of the simplest chemical fact without some added little phrase, such as we run upon in the article, that "there are seventy-odd *decaying* elements." Another one—who has ever heard of *diluting* magnesium with chromium? I can understand how, as it seems to me, chromium could be diluted with magnesium, that is, how syrup at 12 lb. to the gallon could be diluted with water at 8 lb., but the reverse of this is hard to see by a crude mind like mine—you see I am of the jack-knife variety. By reading between the lines in his expressions one catches a glimpse of the fact that he sees many things that are not vouchsafed the ordinary mind.

In the matter of voice projection, it is a far cry from the voice tube to the wireless telephone, but Dr. Whitney strews the path connecting these with such dazzling lure that hundreds of our young men will want to pick up frayed ends and scraps of truth and weave many another such connecting chain. All my boys have been interested in his analogue of the college sporting table and groups of engineers in action. The whole keynote of making the work interesting and holding out the proper lure to the youthful, eager mind is fine; but where are we to find others like Dr. Whitney who can put it over.

I have read the article only twice, but I am going to read it again, because of its off-hand sprightly style, up to the minute modernity, and because I feel that it holds so much of inspiration for every one cracked on the "cause why" as I am. I certainly congratulate Dr. Whitney and hope he will do it again and often.

Brooklyn, N. Y. ELMER A. SPERRY.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Failure Averted by Inspecting Interior of Oil-Switch Tanks

WHEN inspecting oil switches central-station operators usually devote a considerable amount of time to the operating mechanism of the switch, but seldom do they inspect the interior of the oil tank to determine whether or not the insulating material with which the tanks are lined has warped or is out of place. One company which has insisted on inspectors looking into the condition of this insulating lining recently discovered that the lining in some of its oil-switch tanks had warped almost enough to prevent proper operation of the switches. In this case it was felt that the adequate and proper inspection saved not only oil-switch failure but also a series of severe service interruptions which might have occurred.

Data on Transmission and Distribution Losses

DATA in the accompanying table represent actual measurements of energy losses during the period from Jan. 1, 1918, to March 1, 1919, in six small towns in Illinois. Energy to supply these towns was purchased at 33,000 volts, was metered at 2,300 volts and then stepped up to 6,600 volts and supplied to the substations at the various towns through 21.75 miles (34 km.) of three-phase and 13.7 miles (22 km.) of single-phase line. All of the lines are of No. 6 hard-drawn bare copper wire.

DISTRIBUTION AND TRANSMISSION LOSSES ENCOUNTERED IN SERVING SMALL TOWNS

Data for the period from Jan. 1, 1918, to March 1, 1919

DISTRIBUTION

Energy Delivered to Substations, Kw.-Hr.	Energy Sold, Kw.-Hr.	Energy: Unaccounted for, Kw.-Hr.	Losses, per Cent
1—534,998	428,747	106,251	19.9
2— 9,200	7,039	2,161	13.5
3— 63,280	50,471	12,809	20.2
4— 43,640	38,003	5,637	13.0
5— 7,480	5,221	2,259	27.5
6— 87,920	53,124	34,796	39.5
*7—	126,015		
872,533	708,620	163,913	18.78

TRANSMISSION

	Kw.-Hr
Energy delivered to substations	872,533
Energy purchased	923,708
Energy unaccounted for	60,175
Losses, per cent	6.45

TOTAL

	Kw.-Hr.
Net energy sold	708,620
Energy purchased	932,708
Energy unaccounted for	224,088
Losses, per cent	24.02

LOSSES OF TOTAL ENERGY PURCHASED

	Per Cent
Distribution	17.57
Transmission	6.45
Total	24.02

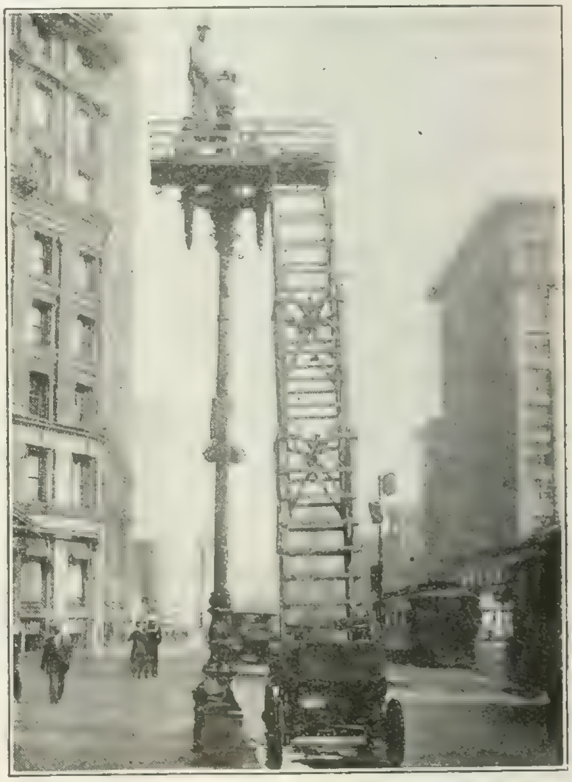
* Wholesale.

The data showed that approximately 18 per cent of the energy delivered to the substations was lost in distribution to the customer and that 6.5 per cent of the energy purchased at the end of the transmission line was lost in transmission to the substations.

In town No. 6 there was previously in existence a municipal plant which furnished service to that community. The distribution system there had been entirely rebuilt, but the town was far from being saturated so that the loss ran high. In town No. 5 some of the energy consumption listed under "wholesale" should be included.

Adjustable Tower Truck for Lamp Inspection

ON ACCOUNT of the vibration of the street-lighting fixtures of San Francisco, which also serve as trolley poles, the arc-lamp globes have to be inspected every ten days. To facilitate cleaning and inspection, a tower truck has been built to be used for any height of pole in the city.



GLOBE CLEANED BY MEANS OF VACUUM CLEANER

The end of the hose connected with the vacuum cleaner is placed in the globe so that it removes the soot and deposits it in a bag fastened under the raised platform.

On the top of the tower truck a vacuum-cleaner apparatus and a testing set are mounted. The vacuum cleaner is used to suck from the globes the soot that results from burning of the electrodes. If the soot is allowed to collect and should become wet, it would cause the current to leak between the two electrodes and extinguish the lamp. All of the working parts of the vacuum apparatus are under the tower platform. The testing set is connected with the storage batteries which operate the motor that drives the truck.

A large cable passing up through the center of the tower transmits the energy for the vacuum cleaner and the testing set. On the top of the platform is a two-pole switch for controlling the vacuum cleaner and the testing set. As a safety device, a special switch is provided which disconnects the batteries from the truck motor when the operator is on the raised platform, thus making it impossible for the truck to be started or the tower lowered accidentally.

In designing the tower, which consists of three sections, it required considerable study to obtain three sections of such a height that when collapsed the tower would clear the trolley wires and when raised would reach to a height that would enable the operator to reach the highest lamp, which is 35 ft. (10.5 m.) above the street. Hinged railings were used and so arranged that they can be folded when the tower is lowered, to enable it to pass under the trolley wires.

Maintaining Proper Temperature for Mercury-Arc Tubes

MERCURY-ARC rectifier sets have been used by the Portland Railway, Light & Power Company for some time, the first installation consisting of oil-cooled constant-current transformers with air-cooled tubes. These tubes were cooled by a blast of air from motor-driven fans provided for that purpose. In the newer installations the transformers are air-cooled and the tubes immersed in oil, each in a separate tank of transil oil cooled by circulating water coils. The constant-current transformers are very simple in operation, but the tubes require careful attention. Temperature conditions are especially important. If the tubes become cold, they are slow to pick up and difficulty is encountered with static. It is important in the use of air-cooled tubes to avoid any direct draft or cold air against the tubes for an hour or so before the tubes are started. In the case of oil-cooled tubes it is practicable to install some heating device in or about the tank to keep the oil at an even temperature at all times when the tubes are not in operation. It has been found that quite a satisfactory method for warming up the tubes, and one which is extremely simple of installation and maintenance, is to keep a 50-watt lamp immersed in the oil. This may be lighted when the tubes are not in operation. The best results seem to be obtained with a temperature of 85 deg. F. (29.4 deg. C.) in the oil tank.

OIL IMMERSED MERCURY ARC RECTIFIER KEPT WARM WHEN NOT IN OPERATION

Portland Railway, Light & Power Co., R. W. KIDD.
Portland, Ore.

Middlewestern Coal in Underfeed Stoker

Tests of Stoker with Indiana Mine-Run and Illinois Screenings Show Successful Operation if Boiler Is Not Loaded Over 200 per Cent

THAT fuel of a low grade can be successfully burned on the Riley stoker when the boilers are operated under 200 per cent of rated load was demonstrated in tests made at the Kentucky Avenue station of the Indianapolis (Ind.) Light & Heat Company. A Riley nine-retort, extra-long, underfeed stoker with 161 sq.ft. (15 sq.m.) grate surface was employed. No waterback was used. The boiler, rated at 795 hp., was one of four served in common by one stack, rising 225 ft. (68 m.) above the grate surface and by two fans 25 ft. below the grate surface. Only one of the latter was used in the tests.

TESTS OF LOW-GRADE COAL IN UNDERFEED STOKER

Computations include coal siftings which were not actually consumed and do not account for moisture in steam

Test	A	B	C	D
Duration of test (hours)	6	10	2.5	26.75
Average steam pressure (lb. per sq.in. gage)	177	192	180	170
Average feed-water temperature (deg. Fahr.)	178	192	200	190
Average superheat (deg. Fahr.)	539	526	538	522
Equivalent evaporation per pound of coal as fired (lb.)	9.53	9.22	6.68	6.10
Boiler horsepower	1,957	1,337	1,858	1,537
Per cent of rating	245	168	234	193.3
Efficiency of boiler, grate and superheater (per cent)	81.9	77.4	68.5	64.6
Combustible in refuse (per cent)	23.24	22.4	36.6	25.00
Coal as fired per b.-hp. (lb.)	3.62	3.74	5.17	5.66
Average windbox pressure (in. water)	4.2	1.91	2.91	4.13
Flue gas temp. (deg. Fahr.)	634	542	580	578
CO_2 (per cent)	12.7	11.86	12.5	*10.08
Siftings (lb.)	100	200	......	394

ANALYSIS OF THE COAL

	Indiana Crushed, A	Mine-Run, B	Illinois, C	Screenings, D
Moisture (per cent)	8.26	8.18	9.6	9.68
Volatile (per cent of dry coal)	37.9	40.3	34.6	35.7
Fixed carbon (per cent of dry coal)	49.9	48.7	39.0	38.18
Ash (per cent of dry coal)	12.2	11.0	26.4	25.5
Sulphur (per cent of dry coal)	4.0	2.8	5.0	4.7
B.t.u. per pound of dry coal	12,290	12,590	10,450	10,140

*Low CO_2 may be partly attributed to leak in Orsat respirator found later which may have been present during part of test.

Two tests were run on each kind of fuel. Tests A and B were on the Indiana coal and tests C and D were on the Illinois screenings. After test A had run six hours a clinker estimated to weigh 500 lb. (230 kg.) developed near the center of the grate and could not be broken up in time to hold the load. In this test an abnormally high draft was noted in the last pass of the boiler. As a result, before the next test the baffle at the last pass was cut down 6 in. (15 cm.), leaving 22 in. (70 cm.) between back drum and top of baffle. In test B, run at 168 per cent rating for ten hours, no clinker trouble was encountered. In test C the test was run two and a half hours at 234 per cent rating, and in test D twenty-six and a half hours at 193 per cent rating. Considerable difficulty was caused in the latter by building up of massy clinkers, which had to be pried off the rear wall. The cinders of the Indiana coal did not require wetting, but those of the Illinois screening had to be wet as they burned in the ashpit.

The following conclusions were drawn from the first two tests: (1) Good superheat and dry steam can be obtained; (2) water backs are unnecessary with the Indiana coal; (3) the Riley stoker will burn this coal satisfactorily except when run at a high rating for several hours when serious clinker trouble may be expected. From the last two tests it was concluded that:

From the last two tests it was concluded that: (1) A poor grade of coal can be burned in the Riley stoker but not continuously at a rating over 200 per cent; (2) waterbacks are necessary with coal such as the Carlinville screenings; (3) the combined efficiency of boiler and furnace is 85 per cent of that obtained with the Indiana mine run.

The Riley Stoker Company's figures on analyses of coal, ash and cinders are used, as they are thought to be more accurate than those of the Indianapolis Light & Heat Company. All of the information in this article was supplied by T. N. Wynne, superintendent of the Indianapolis Light & Heat Company.

Precautions for Placing a New Machine in Service

Before Placing Machine in Operation After Its Erection, It Should Be Thoroughly Dried Out Because Dampness May Cause Lowering of Insulation Resistance

IT IS always advisable to make sure that the insulation of an important machine is in good condition before starting. If the windings have been exposed to moisture during or after shipment or erection, dampness will lower the insulation resistance and may allow sufficient current to flow through the insulation to damage it. This is particularly true of direct-current machines, in which the insulation has many more openings than in ordinary alternating-current machines.

If the usual tests show a value of insulation resistance of ½ megohm for moderate-sized machines, full voltage may safely be applied. If the tests show materially lower values, then drying out is advisable.

A small machine, when conditions permit, can be dried out by building a temporary wooden housing or even a rough tent over it and supplying heat by a steam coil or resistance heater placed in the pit. Ventilation may be afforded by means of openings near the bottom and top of the housing to carry away the moisture as it is driven out of the windings.

Another method is to run the machine at about one-tenth speed and dry it out by current generated in the windings by itself. In the case of an alternating-current generator the stator should be short-circuited through an ammeter and enough field excitation applied to cause full-load current in the stator windings.

If it is a direct-current generator, disconnect the shunt field, short-circuit the machine terminals through an ammeter and apply enough exciting current to the shunt field from some separate source of supply to hold the current generated by the armature down to about full-load value. This shunt current must be opposite in direction to that which flows in the shunt field in regular operation, since its duty during drying out is to buck the excitation produced by the series field.

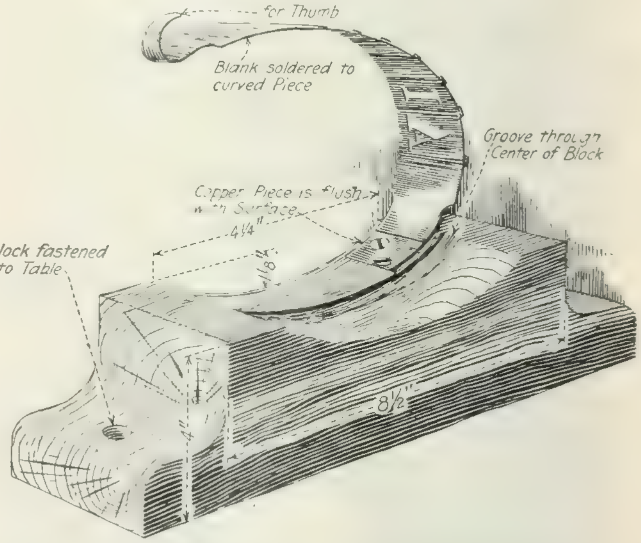
Very little field excitation is needed and extra rheostats in addition to the field regulator supplied for the machine will be required. The short-circuiting connections should be well made and substantial, as they must carry the full-load current of the machine.

A few hours' run on short circuit will dry out any ordinary case of moisture. Longer drying will be needed if machine has been soaked by rain, flood or fire hose. The heat is generated in the copper of the windings and is therefore applied in a most effective manner right at the seat of the trouble.

During drying out the insulation resistance should be tested occasionally. When it is satisfactory the machine can be properly connected, run up to speed and voltage and put in service.

Device for Stenciling Numbers on Round Meters

IN STENCILING the company numbers on round-type meters it is often difficult and awkward for the operator to hold the meter steady. This problem caused so much trouble that the meter department of the Choctaw Power & Light Company devised a method whereby it is possible for one man to number meters as rapidly as another can unpack them or list the serial numbers after they have been numbered. The device consists of a block of wood 4 in. square by 8½ in. long (10 cm. by 21 cm.), with a circular portion cut out as shown. A groove about ¼ in. (6 mm.) wide and ¼ in. (6 mm.) deep is cut down along the longitudinal center line of the block to receive the bead or flange of the meter cover. At one corner of the curved surface is fastened a strip of copper or brass about 1 in. (2.5 cm.) wide, to which is soldered the blank holder or end of the stencil-number "make-up." The other end of the stencil "make-up" is soldered to a piece of copper curved to fit the operator's thumb.


for Thumb
Blank soldered to curved Piece
Groove through Center of Block
Copper Piece is Flush with Surface
4¼"
⅛"
Block fastened to Table
8½

CONSTRUCTION OF METER STENCILER

To use the device the company numbers are slipped into the stencil holder, which is then brought in contact with the meter cover. With his left hand the operator holds the stencil firmly against the meter while he manipulates the stencil brush with his right hand. For this work ¾-in. (18-mm.) "Eureka" brass stencils are used. This device can be used with the General Electric, Westinghouse and Sangamo round-type meters.

P. M. CORDELL.

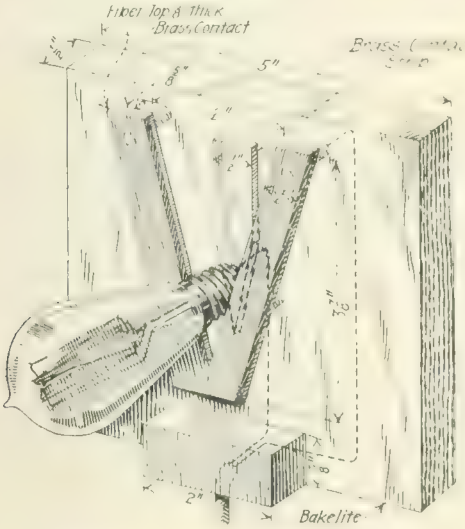
Choctaw Power & Light Company,
McAlester, Okla.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Device for the Rapid Testing of Lamps

IN INDUSTRIAL plants where many lamp bulbs have to be tested before installation the work may be facilitated by use of the scheme evolved at the Ben Franklin Electric Shop, Boston. The device consists of a V-shaped brass contact strip mounted on a "Bakelite" slab and connected to one side of the supply circuit. The other side of the circuit is attached to an intermediate strip of brass secured to the surface of the slab. To provide the proper longitudinal distance between the two contacts of the bulb, the V-shaped strip is mounted on insulating posts of fiber which raise it about $\frac{5}{8}$ in. (16 mm.) above the surface of the slab. In order to test a lamp it is only necessary to make a contact between the intermediate strip and the V-shaped piece by sliding the lamp base along the lower strip until the base strikes the V.



SIMPLE DEVICE FOR TESTING LAMPS

Simple Apparatus for Correcting an Unbalanced Rotor

BALANCING the rotor of an electric motor may be accomplished without complicated apparatus by means of two smooth V-shaped slide rails like those on which motors are mounted. These are set parallel so that the shaft of the motor may rest on them with the rotor between. Both rails are leveled along their length and with respect to each other. If the motor operates with a gear or pulley, this is put on the shaft before testing, because this addition may cause the unbalancing. After placing the rotor on the rails it is rolled gently in one direction and a mark is made on the bottom of the shaft to indicate where it stops. If the rotor continues to stop in the same place on repeating the process, it is out of balance. A lump of putty is then stuck on the rotor exactly above the center of the shaft and the test is repeated until the putty added will overcome the unbalancing.

In order to make the correction permanent a flat piece of iron, slightly heavier than the putty to allow for trimming, may be fastened on the rotor in place of the putty. Sometimes the end plates of the motors have pockets into which lead may be hammered for balancing so that the addition of iron is unnecessary.

Valleyfield, Quebec. L. E. WOOD.

Advantages and Disadvantages of Electric Steel Furnaces*

Direct-Arc Type of Furnaces Favored for Refining Purposes on Account of the Heat Produced by Direct Transmission of the Arc

FROM results of extended experience with electric furnaces for the last few years, the Hess Steel Corporation of Baltimore considers that the most satisfactory refining furnace is the direct-arc type of furnace. Direct transmission of heat through the metal and its surface layer of slag is a valuable characteristic of this furnace, as it insures a hot active slag where it is in contact with the metal surface. In addition relatively little radiated heat is absorbed by the walls and roof, particularly if carbon electrodes are used, because they have an "umbrella" effect that partially shades the roof and walls and forces the heat downward.

To obtain the maximum heat efficiency, the heat input into the bath should be as uniform throughout the area of this bath as possible. Furnaces having bottom heating facilities have definite advantages electrically but rather serious disadvantages mechanically. It is probable, however, that satisfactory methods of applying heat through the bottom and satisfactory lining materials will be developed.

The spreading effect or radiation of heat from electrodes above the surface, or in actual contact with the surface, is limited. Very large electrodes are difficult to obtain and expensive and unwieldy, and a multiplication of electrodes even if arranged in electrically balanced groups, means additional mechanical equipment, increased maintenance and increased delays in operation. It is therefore necessary to compromise and use as deep a bath as is economically possible and yet obtain thorough melting to the deepest point just as rapidly as the charge melts around the edges of the hearth.

The most marked advantage in favor of electric steel, however, is noticeable in dynamic test results, this advantage probably being due largely to the close-grained structure of correctly melted steel.

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*From the discussion on electric furnaces of H. L. Hess before the December meeting of the American Society of Mechanical Engineers.

The possible use in electric furnaces of turnings in any quantity, is desirable, but on account of cost it has several disadvantages. As the electrodes work down through a light pile of turnings, they burn a hole there in the pile, continuing downward until the pile caves in on them. The contacts are bad and the load fluctuates wildly. Electrode consumption is high and it is necessary to charge the furnace several times to obtain the necessary weight of steel.

The costs of making electric furnace steel vary greatly, depending upon the type of steel being manufactured. An ordinary low-chrome nickel-steel for ingots, later to be rolled into billets, bars, etc., may be considered as a possible mean as far as costs go in the production of quality steels. A typical two-slag low-chrome-nickel ingot heat, based on 24-hr. operation, and melted in 6-ton or 7-ton furnaces, will run approximately as per the following figures:

Metal base, metallic addition, flux, re-carbonizing material, raw material handling = \$33.50; charging, melting, molds, ladle, crane, ingot handling and general labor = \$7.00; power, fuel for melting, heating ladles, etc. = \$16.50; general operating, laboratory, water, crane, delay, etc., expense = \$6.25; repairs and renewals = \$4.00 and depreciation = \$2.50, which makes a total of \$69.75.

No overhead is figured in the above.

The approximate time of melting and refining such a heat, may be from 6½ to 8 hrs., depending upon the type of scrap used and the delays incurred in operation. The energy consumption might vary from 750 to 950, depending upon the same factors. Electrode costs before the war when electrodes were of uniformly high quality, has run slightly below \$1 per ton. At the present time, the average electrode consumption is easily double this, and has run, exclusive of breakages, as high as \$4.50 per ton of metal produced. These figures, that might be considered abnormally high by the manufacture of certain grades of steel, follow the production of high-grade material, where every precaution is used to obtain maximum quality of product, and where unusual care is employed in the selection of raw materials, in thorough refining, and in the elimination of possible foreign inclusions such as slag and dirt of any character.

Utilization of Available Equipment Saves Mine from Shutdown

By the ingenious utilization of available electrical equipment in a coal mine when it was cut off from the regular energy supply a complete shut-down and a serious flood were averted. The emergency arose when a severe sleet storm crippled the transmission system which supplies the energy for the mine pumps and a motor-generator set feeding hauling locomotives and mining machines. The direct-current equipment is also fed by a local steam-driven, direct-current generator operating in parallel with the direct-current side of the motor-generator. By operating the locomotives and mining machines from the steam-driven generator during an eight-hour shift and after that period operating the motor-generator set inverted to develop alternating current for the pumps, complete interruption of mine operations and a serious flood were avoided.

The alternating-current motor which had to operate as a generator is a synchronous machine rated at 2,200 volts, 60 cycles and 1,200 r.p.m. Its field is excited from the direct-current generator.

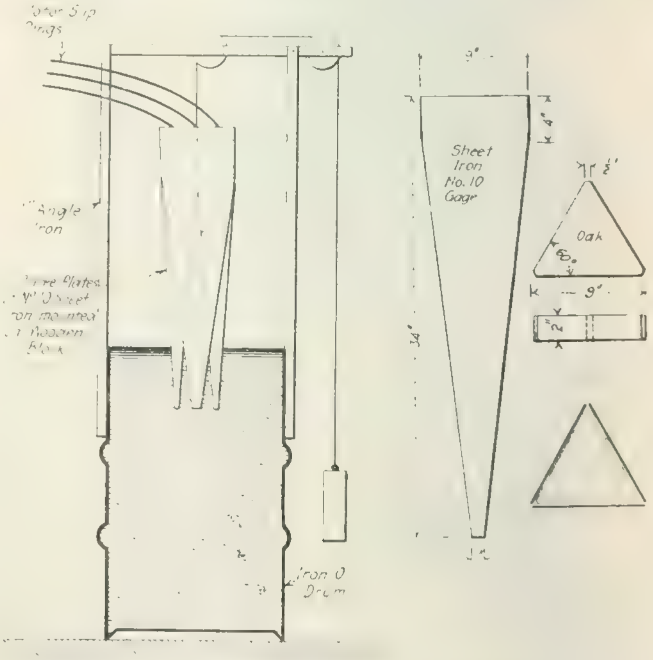
Several difficulties had to be overcome in order to operate under these conditions because no apparatus had been provided for such an emergency. As the larger part of the load was centrifugal pumps, the direct-current generator, acting as a motor, was converted from a compound to a shunt machine by connecting the negative bus to the equalizer. This change produced a very constant speed. No frequency meter was available, so the speed had to be checked with a tachometer at frequent intervals to keep the frequency normal. Furthermore, there was no equipment for starting from the direct-current side. This was accomplished, however, by the use of a controller and rheostat taken from a 10-ton Goodman locomotive.

The emergency method of operation successfully carried the coal company over the period of interrupted service and enabled it to continue operation while other mines in this field were forced to close until the public-service company restored conditions to normal.

Cambria, Ill. L. HUNDLEY.

Liquid Rheostats for Temporary Installations

In Europe, liquid rheostats are used extensively for starting or varying the speed of induction motors having phase-wound secondaries, but in this country they have not met with much favor except for motors of the larger sizes. Drum controllers with cast-iron grid resistors give excellent service in starting motors and a sufficient number of steps for most variable-speed work. There are occasions, however, when liquid rheostats are of great service in making temporary replacement of damaged controllers, and substantial savings may sometimes be effected by permanently installing this form of rheostat.



DETAILS OF CONSTRUCTION OF LIQUID RHEOSTAT

The common form of liquid rheostat consists of three oil barrels, each having a copper plate resting on the bottom and another suspended in such a manner that the distance between the plates may be varied. This form of rheostat is simple to construct but takes up too much room.

A liquid rheostat which requires one barrel, and one moving part is shown in the illustration. The plates (three in number) are made of No. 10 gage sheet iron and are arranged in an equilateral triangle, about a wooden block, which insulates the plates from each other and forms the support by which they are suspended. It is important that edges of plates be close together as shown. An iron oil drum should be used, although a wooden barrel will do if an iron plate is placed in the bottom to help complete the secondary circuit when the motor is operating at full speed. The electrolyte is a solution of soda ash (sodium carbonate) in water.

When the electrodes are raised and only the tips of the plates are in the solution the resistance is maximum, owing to the distance between the plates and the small portion in contact with the electrolyte. As the electrodes are lowered more surface comes in contact with the electrolyte and the distance between the plates becomes shorter. Thus the resistance is reduced. When the electrodes are lowered till the widest portion of the plates is immersed the resistance is negligible, owing to the short distance between the plates and to the amount in contact with the electrolyte.

Liquid rheostats of the form and size described have been used to start motors up to 300 hp. By varying the strength of the electrolyte they may be used for either light or heavy starting duty. The type shown controls a 200-hp. motor used in starting a large frequency changer. It cost less than $50 installed.

This type of rheostat has been used for continuous service in varying the speed of motor-driven blowers and compressors. When so used it is necessary to add a cooling coil similar to those used in water-cooled transformers. This should be made of ¾-in. (19-mm.) iron pipe, of six turns, 1 in. (2.5 c.m.) apart. It should be suspended as near the top of the solution as possible. The amount of cooling water necessary will depend on the size of the motor and the amount of variation required. The size of rheostat described will give 50 per cent speed reduction continuously with a 100-hp. motor without overheating

RALPH MCKINNEY,
The Brown Company, Electric Repair Department
Berlin, N. H.

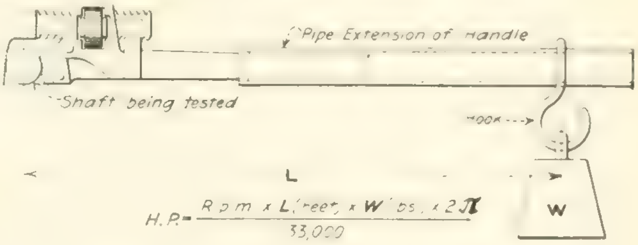
Incomplete Repairs Cause Second Failure

BECAUSE of the fact that material and labor are both expensive and scarce, great care has been exercised in making repairs to see that no material should be wasted. While this practice has much to commend it, still it can easily be pushed too far. It ought to be realized that any electrical plant which has suffered a partial burn-out has had all its conductors subjected to a very heavy overload, and that the insulation covering the conductors, as well as the insulating washers and sleeves which separate live heads, has also been badly strained as regards both mechanical and insulating properties. Such material should be looked on with the greatest suspicion. Within the last few months several plants have experienced second break-downs a few weeks after a repair had been carried out. Generators and motors, and in two cases transformers, were included, and in every case the second breakdown was undoubtedly due to the use of material "saved from the wreck."

MARK MEREDITH.
Liverpool, England.

Motor-Starting Torque Determined by Weighing Turning Effort

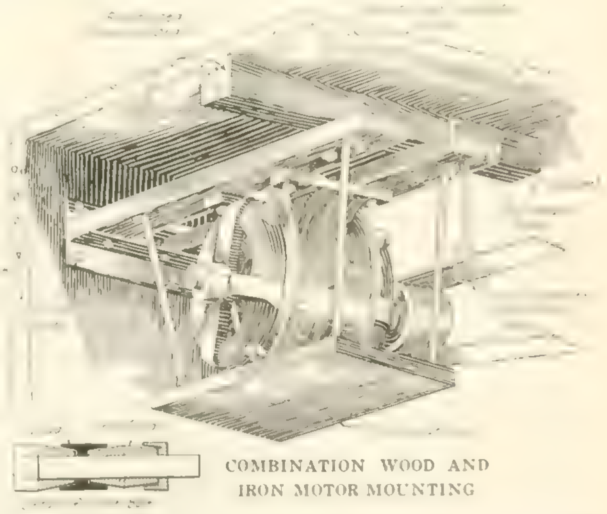
WHEN investigating motor trouble or planning a motor drive it is often necessary to find out the dead load on the motor in horsepower. Some motors (induction and synchronous) cannot start at full load although, once started, they can pull two or three times, their rating. Therefore it is advisable to determine the starting effort or "static torque" required. This can be accomplished by means of a pipe wrench, a piece of pipe, a hook and a weight combined as shown. The weight is gradually increased until the pull effected causes the shaft to start to turn. By noting the horizontal distance in feet from the weight to the center of the shaft on which the wrench is gripped, the weight applied and the normal speed of the shaft, the torque can be calculated. The horsepower required to start the motor from rest will be given by the formula $(\text{R.p.m.} \times L \times 2\pi \times W) \div 33{,}000$.



PIPE WRENCH, PIECE OF PIPE AND WEIGHT ARRANGED TO MEASURE "STATIC TORQUE"

Motors Mounted on Combined Wood and Iron Beams

BOTH installation and replacement are facilitated by means of the motor support shown. It consists of channel-iron pieces attached to angle irons on the wall at one end and held by bolts through concrete beams at the other end. In the channels are 2-in. by 6 in. (5-cm. by 15-cm.) wooden beams so arranged that the motor can be placed in any position along their length. The wooden beams in the channels also serve to cushion vibrations and thus reduce noise. The angle-irons are fastened to the wall by "cinch" bolts.



COMBINATION WOOD AND IRON MOTOR MOUNTING

To prevent the belt slipping from the pulley, a guide is attached to the beam as shown. Dripping oil is collected in the pan supported below the motor.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Brooklyn Company Changes Contract Order Routine

SOMEWHAT radical changes in organization and methods for the handling of contract order routine, billing and collecting work have been recently adopted by the Brooklyn Edison Company at the suggestion of President M. S. Sloan.

A department under control of the treasurer, known as the commercial bureau, for years had been handling meter reading, billing, collecting and also orders between the date of contract and connection, in so far as records, obtaining of permits, registration of certificates and forwarding of orders to and obtaining of information from meter and distribution departments were concerned. This bureau also maintained inspectors who followed wiring progress and "disconnect" and "re-connect" work. This bureau has now become solely a credit and collection, or accounts receivable, bureau. Its other activities have been divided among other departments. Meter reading, billing and a portion of the inspectors' functions have been taken over by the auditor. The sales department will now issue orders, after credit approval, directly to the distribution and meter departments. The records of work in progress will be kept in these two latter departments, and information from them will be given to the sales department for conveying to the public upon inquiry.

The primary idea of President Sloan in making these changes was to cut down the time between contract and connection by eliminating unnecessary agencies and by providing the shortest, simplest and most logical machinery for filling orders, to the increased satisfaction of customer and company.

Merchandising Methods Used to Sell Securities

THE merchandising experience of the Public Service Company of Northern Illinois has led the management to believe that the public favors a small payment down and the balance in extended payments each at least as small as the initial deposit. The company also believes that the public should be humored to the extent of being allowed to buy in this manner if it so desires. Consequently, when the company recently had a block of stock to sell it followed this merchandising policy and made the terms $5 down and $5 per month. Gratifying results were obtained from the start.

The offering consists of a block of the company's 6 per cent cumulative preferred stock at the par value of $100, but each purchaser is limited to five shares. The buyer is charged 5 per cent interest on the deferred payments, but during the period of the installment payments the 6 per cent dividends paid on the stock are credited to the buyer's account. This results in a credit of $5 to the buyer in the course of twenty months so that he is required to make only nineteen payments of $5 each in order to obtain the hundred-dollar share of stock.

The company is selling the stock to its customers and to employees through the agency of teams made up from the latter. Competition between the different teams is stimulated by prizes to the most successful ones each week.

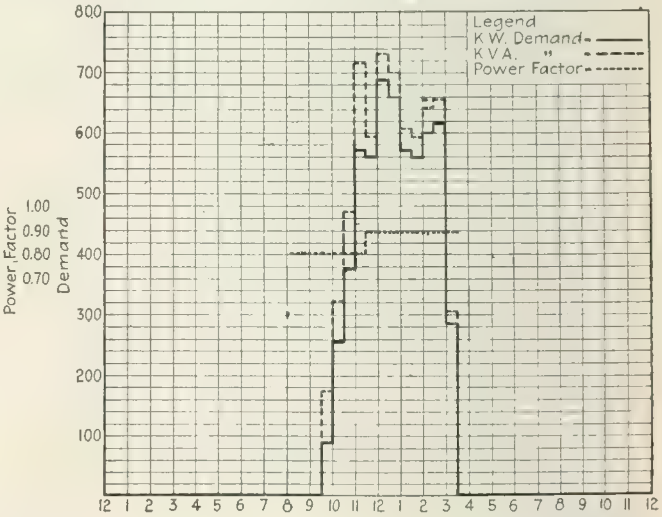
Electric Furnace Load Advantageous

High Power-Factor Obtained in Making Steel Castings—Off-Peak Service Convenient and Flexible

By Fred C. Hard

Edison Electric Illuminating Company of Boston

WITH the growing popularity of the electric steel furnace among foundrymen and manufacturers of steel castings, the questions of capacity, load factor and other requirements to be met by central stations in serving this class of business should be considered.



TYPICAL LOAD CURVE FOR ELECTRIC FURNACE DURING ONE HEAT

In territories where large blocks of energy have been made available through hydro-electric development the question of supplying service may not involve so many engineering problems as arise with furnaces in prospect or already installed on the lines of steam generating stations in or near manufacturing centers, where lighting and power loads are carried on the same lines or on combination circuits.

An interesting electric furnace load has recently been taken by the Edison Electric Illuminating Company of Boston, in the plant of the Hub Electric Steel Casting Company, South Boston. A typical load curve for this furnace during one heat is shown in the accompanying illustration. The furnace is of the latest Heroult design rated at 2 tons and operated with a basic lining. Energy is supplied by a 6,900-volt, three-phase line running direct from the L Street generating station of the Boston company to the Hub plant, a distance of about three-fourths of a mile. Energy is purchased on the regular B-1 heating rate and about 2,800 kw.-hr. are required for each heat run, a yield of about 1.47 lb. of steel per kilowatt-hour.

The high power-factor of the direct-heating arc type of furnace is well illustrated in this case, starting with the furnace cold at 80 per cent and raising to 94 per cent throughout two-thirds of the run. The opportunities such a load offers for off-peak development are apparent. The maximum load imposed was about 688 kw., and it is worth noting that this peak occurred during the noonday period when most central stations sustain a decided drop in output. Throughout the greater part of the run, or for four hours out of six, the maximum variation in the load was about 130 kw. The furnace carbons, 14-in. in diameter, are supplied with three-phase energy at 105 volts.

Departure from Rates Justified

IN A RECENT rate hearing in New England the opponents of the central station brought up the fact that a large industrial customer received a lower power rate than the minimum published on the company's regular schedule. The utility found it necessary to set forth the reasons for the discrepancy over an eleven months' period and accordingly presented a five-page typewritten explanation for the benefit of the commission. The main points covered may be helpful to other companies although at this writing the hearings are not concluded.

The lowest rate on the utility power schedule is $0.034 per kilowatt-hour, applying to an energy consumption of 40,000 kw.-hr. or more per month. A 20 per cent increase in power rates was established last fall, making the rate $0.0068 higher, or a total of $0.0408. A discount of 1 cent per kilowatt-hour for prompt payment brings the present minimum to $0.0308.

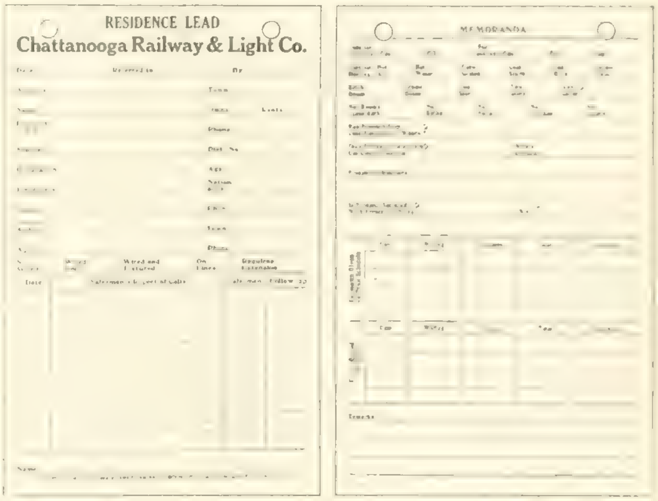
First cost of transformers		$1,856.25
Transportation and erection		1,000.00
Total		$2,856.25
Fixed charges (interest, 6 per cent; taxes, 2 per cent; maintenance and depreciation, 7 per cent; total, 15 per cent), or	$428.43	
For eleven months		$392.70
Losses in transformers (600 kw. times 2 per cent times twenty-four hours, times 365 days)	105,120 kw.-hr.	
Or in eleven months	96,930 kw.-hr	
Total at the contract rate of $0.0253		2,437.90
Installation and investment cost for a 300-kw. synchronous condenser	4,700 00	
Fixed charges as above (15 per cent or $707) or for eleven months		646 25
Total		$3,476.85

The large industrial customer in question received an average rate for the eleven months' period of $0.0253 per kilowatt-hour, based on an original rate of $0.015 with a coal clause added and the 20 per cent increase above noted. The energy consumption of the customer was 805,960 kw.-hr. In this case, however, the customer purchased 600 kw. in transformers at the time of the contract (1917). He met the cost of their transportation and erection, bears the transformer losses, and has also installed and runs at his own expense a 300-kw. synchronous condenser for the betterment of the system power factor. These factors were evaluated as shown in the table.

The average cost per kilowatt-hour for 805,960 kw.-hr. becomes $0.0043 for the extra burdens assumed by the customer. The total cost to the customer is then his actual rate of $0.0253 added to the burden cost of $0.0043, or $0.0296. The difference between this rate and the lowest on the published schedule is $0.0012 per kilowatt-hour, amounting to but $966 on the total energy consumption for the eleven months and justified by the further fact that the losses incurred in operating the synchronous condenser are not separably measured.

Form Used to Make House-Wiring Survey in Chattanooga

IN CONDUCTING a recent survey of the city of Chattanooga to determine the number of houses possible of connection to the lines of the central-station company the form of which both sides are shown in the accompanying illustration was used. This form was printed in duplicate, and one copy was kept as a record for the office file while the other was held by the salesman and filled in and finally turned over to the contractor.


RESIDENCE LEAD
Chattanooga Railway & Light Co.

MEMORANDA

FRONT AND BACK SIDES OF FORM GIVING HOUSE-WIRING DATA

Royalty Basis Used for Leasing Water-Power Sites

A WATER-POWER site on the Dead River, Michigan, was leased for ninety-nine years by the Cleveland Cliffs Iron Company, Ishpeming, Mich., on a royalty basis of $5 per horsepower-year. This unit of horsepower-years is based on the energy output of the plant and not on its maximum demand. The horsepower-years on which the company has to pay royalty are obtained by converting the kilowatt-hours generated per annum into horsepower-hours per annum, the result being divided by 8,760, the number of hours in a year. The charge is therefore equivalent to a royalty of $5 for about 6,570 kw.-hr. generated and is independent of the load factor at which the plant operates.

O. D. McClure, chief mechanical engineer of the company, recommended this form of agreement to his company because its disbursements under this agreement are in direct proportion to the benefits received.

Explaining Rate Differences

Cost Per Kilowatt-Hour Must Be Variable, Since Installation and Distribution Costs Vary With Consumer Density

IN A RECENT talk on "The Elements of Rate Making," delivered before the San Francisco Electrical Development League, the reasons for differentiation in electric service rates were clearly set forth by W. G. Vincent, Jr., valuation engineer for the Pacific Gas & Electric Company. The manner in which Mr. Vincent presented the case is illustrative of what may be done by the central station in placing this matter properly before the public.

The speaker first undertook to answer the often-asked question why kilowatt-hours cannot be sold like merchandise or potatoes—that is, at the same price to all, regardless of time, place or quantity of use. "One kilowatt-hour has no more resemblance to another in the service rendered, value or cost than the potato resembles the alligator pear, although both may have the same food value," he said.

COMPARATIVE COSTS OF SUPPLYING FACTORY AND COMMUNITY

	Factory	Town	Total
Consumers	1	10,000	10,001
Demand, kw	4,000	4,000	8,000
Investment			$2,100,000
Sales per kilowatt-hour per day	96,000	18,000	114,000
Sales per kilowatt-hour per year	35,040,000	6,570,000	41,610,000
Fixed charges, 12 per cent			$252,000
Operating expenses			$480,000
Total costs			$732,000
Kilowatt-hours generated	38,500,000	9,636,000	48,130,000
Average revenue required per kilowatt-hour, cents			1.75
Fixed charges:			
12 per cent on plant	$60,000	$60,000	$120,000
12 per cent on local	6,000	126,000	132,000
Total	$66,000	$186,000	$252,000
Operating expenses			
Exclusive of plant	$2,000	$78,000	$80,000
Plant, exclusive of fuel	20,000	20,000	40,000
Fuel	288,000	72,000	260,000
Total	$310,000	$170,000	$480,000
Total costs	$376,000	$356,000	
Average cost per kilowatt-hour, cents	1.08	5.36	1.75

To illustrate his point that an electric company cannot base its charges for service upon an even system such as that employed by the merchant, Mr. Vincent produced a chart upon which was shown an electric power house from which lines radiated east and west. One line, running eastward, connected with a factory which consumed a supply of 4,000 kw. of electric energy, day and night; another line of equal length in a westerly direction ran to a town where a supply, also of 4,000 kw., was distributed among the inhabitants. The cost of the electric power plant was given at $1,000,000 and the cost of the two lines therefrom at $50,000 apiece, but it was shown that while the cost of distribution to the factory began and ended with the fifty-thousand-dollar line the cost of distribution to the city took in an electric substation, valued, say, at $100,000, and a network of distributing lines to the various residences, offices, stores and buildings in the town which represented a cash investment on the part of the electric company of about $900,000. It could be seen clearly from this diagram upon what theory the electric company is compelled to make its charges for electric service; in other words, that the small consumer demanding service at the peak-load time and whose consumption of that service is not upon any regular or steady-flow basis must, in all fairness, pay for that service.

To supplement this chart Mr. Vincent showed the accompanying table representing the various elements that go into the rate-making schedule. This table shows in one column the conditions affecting the one consumer to the eastward of the power plant, namely, the factory; in the other, the ten thousand consumers in the town among whom a supply of energy equal to that supplied the factory is distributed. It was shown by this table that while the average cost to the company per kilowatt-hour supplied to consumers from this power plant was 1.75 cents, yet the average cost of supplying the town was no less than 5.36 cents as against 1.08 cents per kilowatt-hour supplied the factory. It was also pointed out that the cost of supplying the smaller lighting consumers of the town was really much in excess of the average of 3.36 cents per kilowatt-hour, while the cost of supplying the larger power consumers would be less than the average.

Benefits of New England Interconnection

CENTRAL-STATION service is attaining wider fields of usefulness than ever before owing to the spread of interconnection, declared L. L. Elden, electrical superintendent of the Boston Edison company, before a recent meeting of the company section of the National Electric Light Association. Since the middle of 1918 a great deal of study has been given to this matter in eastern Massachusetts.

Within the last year an important connection has nearly been completed between the Boston Edison system and the lines of the New England Power Company by which 15,000 kw. can be transmitted, with a minimum yearly guarantee of 35,000,000 kw.-hr. For several months a connection has been in successful operation between the Boston system and the plants of the Revere, Malden and Salem companies, and during a recent period of equipment trouble at the Salem tidewater station the Boston company supplied additional energy to the communities involved. Another very important interconnection is now under way between Boston and the Quincy-Weymouth district. It is estimated that these three interconnections will increase the gross output of the Boston Edison company by about 20 per cent and enable a larger amount of "wholesale" power service to be rendered over areas hitherto supplied by relatively small stations.

This tendency toward the supply of energy over interconnected lines on a wholesale basis to distributing companies or centers has brought about a growing interest in various kinds of power service. For many years, Mr. Elden pointed out, a 2 per cent plus or minus regulation has been required in high-quality lighting service at Boston. A variation of 3 per cent above or below normal does not produce so great a candle-power variation with the tungsten lamp as did the old 2 per cent variation with the carbon incandescent. For the past year, therefore, on the Boston system, a regulation of 4 per cent has been regarded as satisfactory, and if closer regulation is wanted, the customer is required to install the necessary equipment on or near his premises. Five "unregulated" substations have been placed in service on the Edison system and have given excellent results in the last two or three years, and it is planned to install at least five more substations of this character in 1920.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Motors, Generators and Transformers

Starting Conditions of Synchronous Machines.—**Alfred Hay** and **F. N. Mowdawalla.**—The conclusions reached in this paper may be thus summarized: (1) During the initial stages of the starting period the field should be kept open. If the induced voltage exceeds the limit of safety, a field break-up switch should be provided. Closing the field circuit not only largely increases the current during the initial stages of the starting period but may entirely prevent the machine from running up to synchronous speed. This is due to the single-magnetic-axis effect of the field winding. (2) If the field is kept closed and the machine only reaches a speed in the neighborhood of half-synchronism, there is no tendency to lock into exact half-synchronism. (3) There is a distinct advantage in short-circuiting the field after it has reached a value not differing greatly from synchronism. This will facilitate the final locking into synchronism.—*Journal A. I. E. E.*, January, 1920.

The Technical Story of the Synchronous Converter.—**B. G. Lamme.**—The various steps in the development are described, covering many of the earlier troubles and methods tried for overcoming them. The early evidences of hunting which eventually led up to the use of copper dampers, emf. regulation, 60-cycle converters with their ups and downs and final success, the three-wire converter, the inverted converter, the application of commutating poles, the coming to the synchronous booster and the split-pole types of converters—all are discussed in this article, along with little incidents connected with the engineering and commercial side of the growth.—*Journal A. I. E. E.*, January, 1920.

Lamps and Lighting

Diffused Reflection and Transmission of Light.—**A. P. Trotter.**—It is shown how specular reflection can be separated from diffused reflection by drawing an internal calculating circle instead of the circumscribing circle of Bouger and Blondel, and how when rectangular co-ordinates are used instead of polar ones diffused reflection is represented by a curve in some cases closely representing the probability curve or curve of frequencies, and it is suggested that there is a rational connection with the statistical function.—London *Illuminating Engineer*, September, 1919.

Series System of Street-Lighting Distribution.—**W. P. Hurley.**—The writer claims that lamps designed for series operation are very simple and more efficient than are the multiple type. The maintenance of constant power at the lamp terminals where lamps are thinly scattered over a wide area is much easier with a series system of distribution than with any other. The burning of all street lamps in the city for certain specified hours makes it desirable to turn the whole circuit on and off from a certain point, so that such a system, whether series or multiple, cannot be used to distribute power for other purposes. The two essential pieces of apparatus required for a series system are the constant-current transformer and the film cut-out socket. Both are very simple and reliable even with unskilled operators.—*Journal A. I. E. E.*, January, 1920.

Single Light Compared with Cluster Units for Street Lighting.—**S. L. E. Rose** and **H. E. Butler.**—The article deals with two types of ornamental incandescent street-lighting units, the five-light cluster unit of ball globes and the modern single-light unit. The author considers the cluster unit inefficient and gives his reasons to show why it is inferior to the single-light unit.—*General Electric Review,* December, 1919.

Generators, Transmission and Distribution

Dielectric Power Loss and Ionization Voltage in Underground Cables.—**F. M. Farmer.**—The power loss in the dielectric should be as low as feasible because it permits a higher rating. The change of the dielectric loss with temperature should be a minimum in order that the critical temperature where the thermal conditions become unstable may be as high as possible. The ionization voltage marks the limit of the voltage at which a cable can be operated without raising any question of risk. How much higher a cable can be operated is yet to be determined, but it is desirable to know where the beginning of the danger region is, particularly when the information can be obtained from the tests for dielectric loss with little additional effort. The rating of a cable both as to current and voltage is undoubtedly affected to a very considerable extent by the thoroughness of the treating process. Gas and moisture left in the insulation cause an unnecessary loss which reduces the current-carrying capacity while gas lowers the maximum safe operating voltage.—*Paper presented at the Convention of the Association of Edison Illuminating Companies,* Sept. 15, 1919.

A Swiss Interconnecting High-Tension Bus.—Plans are under way to interconnect all more important power plants in Switzerland by means of a 150-kv. aluminum line across the entire country. A society with a capital of 3,000,000 francs has been formed to prepare for the realization of these plans, and the erection of part of the projected line was started early in 1919.—*Elektrotechnische Zeitschrift,* Sept. 18, 1919.

High-Voltage Power-Transmission Problems.—**W. W. Lewis.**—The voltages which have come into use for power transmission within the past few years have presented many problems not encountered in dealing with more moderate potentials. Electrostatic capacitance is a factor which cannot be neglected in calculating the characteristics of long high-voltage lines, and while in general the charging current is beneficial to the operation of a fully loaded line, its presence may demand serious consideration on a lightly loaded circuit. For the calculation of any lines which have so far been built, one or two terms of the convergent series formulas developed by Dr. Steinmetz are sufficiently accurate, but it is possible that voltages and lengths of line may soon be reached where it will be necessary to employ the rigid hyperbolic formulas: The author discusses some of the phenomena encountered with high-voltage transmissions, the practical aspects thereof and the theoretical considerations involved. He gives a table showing the principal power systems operating at about 70,000 volts, of which there are eighty. Fifty of these systems employ a voltage of 100,000 or more.—*General Electric Review,* November, 1919.

Improvement of Power Factor in Electric Supply Systems.—In this article are considered the ill effects of low power factor and methods of correcting it.—London *Engineer,* Nov. 14, 1919.

The Water-Power Resources of India.—A preliminary report of the study of the water-power sites in India which have heretofore been neglected. It is said that the water power amounts in the aggregate to more than 50,000,000 hp., much of which is capable of immediate economic development.—London *Engineering,* Oct. 31, 1919.

Line Construction in New Zealand.—This bulletin contains the new regulations issued for the control of conditions under which electric lines are to be erected in the Dominion of New Zealand.—*Public Works Department, Wellington, New Zealand,* Sept. 25, 1919.

Features of Design in Large Hydraulic Turbines.—F. H. ROGERS.—The author states that the problem of producing highly efficient hydro-electric generating units devolves equally upon the hydraulic and the electrical engineer. The ever-increasing demands for power require more and more efficient use of potential water power. In view of the tendency toward units of larger size, a gain of even a small percentage in over-all efficiency becomes of importance. The author analyzes problems encountered in designing wheels of high efficiency for both high-head and low-head applications. The relative importance of losses occurring in penstock, runner and draft tube at various heads and specific speeds is discussed in detail, and attention is called to conditions under which certain of these losses become sufficiently important to warrant considerable effort to minimize them.—*General Electric Review,* November, 1919.

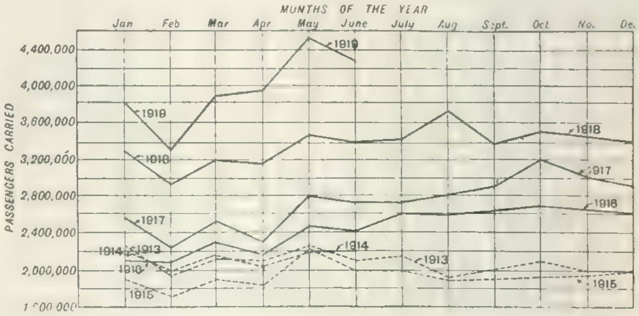
Traction

Railway Electrification in Switzerland.—K. SACHS.—This article gives a résumé of the development up to date of electric traction in Switzerland and discusses at some length the various systems and types of locomotives employed. — *Elektrotechnik und Maschinenbau,* June 8 and 15, 1919.

Electric Traction in Italy.—L. VON VEREBELY.—A descriptive article dealing in great detail with the present status of electrification of heavy traction in Italy. The paper offers a great number of photographs of different types of locomotives employed and contains an unusual number of numerical data relating to rolling material and plant.—*Elektrotechnik und Maschinenbau,* May 18 and 25 and June 1, 1919.

A 3,000-Volt Direct-Current Passenger Locomotive.—W. D. BEARCE.—It is said that the original electric locomotives of the Chicago, Milwaukee & St. Paul Railway were of the geared type and differed for freight and passenger service only in the gear ratio. The advantages of the gearless type of construction, however, for passenger service has been demonstrated by the gearless locomotives of the New York Central Railway, and a similar type has been developed for the C., M. & St. P. These locomotives are now being placed in operation and will eventually replace the geared type of passenger locomotive, which will be assigned to freight service with a change of gear ratio. The mechanical and electrical features of these new locomotives are described in this article.—*General Electric Review,* December, 1919.

The Future of Electric Traction.—ROGER T. SMITH.—The writer states that practically all of the electrified railways in England are of the surburban type. Some particulars are given for the London and South-Western electrified suburban system. The length of route electrified is 49 miles and the length of single track is 152 miles. The seven months' operation in 1919 shows that with electrified operation the traffic not only was restored but was rapidly increased after electrification.—London *Electrician,* Nov. 21, 1919.



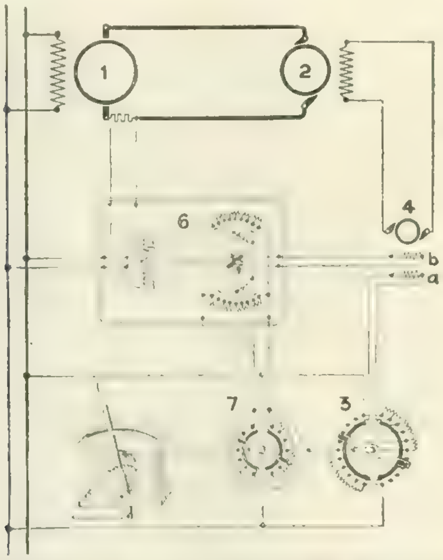
UPPER CURVE SHOWS TRAFFIC AFTER ELECTRIFICATION

Installations, Systems and Appliances

Automatic Push-Button Elevators.—H. L. KEITH.—In this article is described the electrical system by which elevators are operated without the use of an attendant. The system is applicable to hospitals, clubs and apartments where the traffic is not heavy.—*Electric Journal,* December 1919.

Recent Development in Oil Circuit Breakers.—J. W. UPP.—The writer states that the more recent advances in oil-circuit-breaker developments have been along the following general lines: (1) Standard-unit method of construction; (2) increase in interrupting capacities; (3) increased safety, easy inspection and adjustment and quick replacement. In breakers that are made in large quantities the standard-unit types are always cheaper than other breakers of equal quality made for similar service, and the time to manufacture and deliver are lessened considerably. In the case of circuit breakers which have to interrupt circuits carrying very large amounts of power, the quantity of gas generated and the danger of the arc stabilizing are so great that it becomes desirable to use some limiting means to reduce the gas volume, the arc spread and the accompanying gas explosive pressures. This is accomplished by the use of a strong metal vessel attached to the lower end of the insulating bushing. By means of these chambers the time required to rupture the arc resulting from a given load and load condition is greatly reduced. Moreover, the volume of gas generated within the oil tank is reduced and this gas is directed downward into the oil and cooled, which reduces its volume and also makes impossible its igniting any explosive charge of gas which may be above the oil level in the tank.—*General Electric Review,* November, 1919.

Electric Mine Hoists.—HACAULT.—In continuing the discussion of electric hoisting machinery the author gives a thorough analysis of the Ward-Leonard system of speed control. Features of the system are great range in speed, possibility of regenerative braking and high economy of speed variation. By compounding the excitation machine for the generator the speed may be made almost completely independent of the load, so that a definite velocity corresponds to each position of the control lever. Such compounding may be obtained by means of a Brown-Boveri regulator, controlling the current in an auxiliary field winding on the exciter, as shown in the figure. The regulator is actuated by a turning magnet (6), whose field winding is connected across the resistance (5) in the circuit between generator (2) and hoist motor (1). Speed diagrams indicate that considerable time saving may result from the use of automatic braking equipment, controlled from a depth indicator. Usually the direct-current generator is directly coupled to an induction motor, and to avoid sudden load peaks in the three-phase supply system during acceleration, it is provided with a heavy flywheel (Ilgner system). The most economical load-equalizing system, however, is to put the direct-current generator on the same shaft as the turbo-alternator which supplies the mine with power. By employing a sensitive governor for the turbine the speed variations may easily be kept below 1 per cent, and very high economy is contained, since the energy storage takes place in the steam boilers themselves.—*Revue Générale d'Electricité*, Nov. 1, 1919.



COMPOUNDING THE GENERATOR IN MINE HOIST SYSTEMS

Units, Measurements and Instruments

Standardization of Electrical Indicating Instruments.—G. Y. ALLEN.—The writer describes the standardization of indicating instruments for radio service which was brought about by the urgent demands of the great war. He states that the benefit derived by the combatant governments during the war should now be equally shared by the manufacturer and user if the program then formulated shall be faithfully carried out in future developments.—*Electric Journal*, Nov. 1, 1919.

Meter Work of a Municipal Electricity Supply System.—W. H. BAYNES.—In part I of this paper the writer points out the importance of accurate meter work and gives a description of the laboratory equipment for testing. Routine methods of handling the whole meter department work are outlined. In the second part are considered the various types of watt-hour meters and the advantages and disadvantages of each are set down. The necessary tests for determining the performance of these meters are enumerated, and the accuracy of these various methods is discussed.—*Transactions of South African Institute of Electrical Engineers*, September and October, 1919.

Telegraphy, Telephony and Signals

Austrian Portable Sets for Wireless Telegraphy.—EUGEN NESPER.—The article describes a number of war-type radio-telegraphic sets of Austrian manufacture. In one small trench station a 1.5-hp. gasoline motor, belt-connected to an alternating-current machine, supplies the energy for a quenched-spark transmitter. The alternator is provided with a commutator for charging a small storage battery, supplying direct current for vacuum-tubes, but in an emergency the machine may be run as a converter from the battery. A naval spark station of 400 km. (250 miles) radius is illustrated, where direct receiving on a crystal detector is employed on a continuous range of 150 m. to 6,000 m. wave length. Even in airplane stations the spark transmitter was used, but vacuum tubes were employed as detectors and for audio amplification.—*Elektrotechnik und Maschinenbau*, April 6 and 13, 1919.

Variation in Direction of Propagation of Long Electromagnetic Waves.—A. HOYT TAYLOR.—A method of compensating the minimum and increasing the accuracy of direction-finding settings has been worked out for long waves. It has been shown that deviations of the order of 90 deg. may occur in the line of propagation of the resultant wave front in the case of very long continuous waves. The value of long continuous waves for direction-finder work is, in view of these results, very doubtful. It is said that the results do not cast doubt upon the accuracy of direction-finder observations carried out on short-wave-spark stations. It must be concluded, however, that it would be very dangerous to use long continuous waves for direction-finder work at sea until it has been definitely proved that these variations do not occur when transmission is not partly or wholly over land.—*Scientific Paper No. 353, U. S. Bureau of Standards*, Nov. 29, 1919.

Miscellaneous

German and English Policy in Regard to Public Utilities.—G. SIEGEL.—Recent bills passed in Germany empower the government to take over any electric generating station of more than 5,000 kw. and any transmission lines of more than 50,000 volts at first cost minus depreciation. These and other bills relating to government control in Germany are criticised by the author, who concludes that the corresponding English legislation is greatly superior.—*Elektrotechnik Zeitschrift*, Sept. 18, 1919.

Review of Electrical Engineering in Great Britain.—This is a review of the electrical accomplishments in Great Britain during the year 1919. It covers progress in the national supply scheme, railway electrification, utilization of water power, industrial application and progress in automatic telephones and in wireless.—London *Times Engineering Supplement*, January, 1920.

Some Sidelights on Construction Work.—N. L. REA.—The author considers a number of specific problems in the transportation and erection of electrical machinery.—*General Electric Review*, November, 1919.

TRANSPORTATION in the Eastern States is still far from normal in respect both to interstate freight traffic and local trucking. There have been some shipments through, of course, but deliveries from jobbers' premises have been very much curtailed. Jobbers are able, however, to supply virtually enough material to satisfy the lower demand which is still prevailing.

Wire shipments are lengthening to forty-five and sixty days, and the bookings to date this year are five and one-half times those of the same period of 1919. Tape is getting more difficult to supply, and manufacturers are asking jobbers to anticipate further along their requirements of friction tape.

There is no relief in the situation on pipe, boxes, flexible armored conductor and porcelains, but some good deliveries of loom have been reported. Schedule material is being received in a little bigger volume. Single-phase motors are short all over, and some sizes of weatherproof wire, Nos. 6, 8 and 10, are rather commonly scarce. In the South 10-amp. meters and small transformers are low in stock. General Electric distribution transformers are about 10 per cent higher, fir crossarms are up 12 per cent, Simplex irons have advanced 50 cents and Simplex heating pads $1.50. Boston jobbers have doubled list prices on sockets, switches and plates.

The Canadian Laco-Philips Company, Ltd., has taken out a license under the Canadian General Electric Company, Ltd., to manufacture lamps for distribution in Canada, and in the States the Mazda lamp companies have withdrawn the rider specifying six turnovers a year, thus bringing the lamp agents back to their previous status.

Shipments from New England jobbing houses to the trade are just beginning to "thaw out." Local express and parcel-post service held the center of the stage for nearly a fortnight. Incoming freight is still badly delayed.

New England electrical utilities are breathing more easily as the flow of coal into the Northeast increases, and it is believed that the crisis that threatened suspension of service during the present winter is past. Industrial consumers are worried over the outlook for coal diversion to foreign buyers, and unless domestic needs are first met much distress will be experienced.

The Springfield (Mass.) central-station company plans to increase its capital by $800,000 to meet the cost of vitally necessary extensions of plant.

The Central Maine Power Company is about to purchase the Androscoggin Electric Company of Lewiston and two smaller properties.

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

A record gathering of Montreal electrical manufacturers, jobbers and contractor-dealers as well as electric light men was held in that city on Feb. 18 and 19 and a movement for co-operative organization was launched enthusiastically.

A big fuel saving as an outcome of co-operation between the results department and the operating men was claimed by T. J. Nolan, Toledo Railways & Light Company, at a meeting of the station-operating committee of the Ohio Electric Light Association.

The Washington award of the Western Society of Engineers will be presented to Herbert C. Hoover at Chicago tonight.

An over-all efficiency of 80.67 per cent from the use of pulverized coal under central-station boilers was set forth in a paper read at Milwaukee by John Anderson, chief engineer of the Milwaukee Electric Railway & Light Company.

New securities of public utility companies to the amount of $2,734,400 have been authorized by the Wisconsin Railroad Commission in the last two months, and applications for $5,035,950 more are pending.

The United States Senate has ratified the trademark convention with the South American republics as embodied in the Nolan bill.

At the A. I. E. E. midwinter convention W. S. Murray summarized the plan for a super-power zone on the Northeast Atlantic seaboard which is attracting the attention of electrical engineers everywhere.

Much interest in printing telegraphy was shown at the A. I. E. E. convention in New York.

White Sulphur Springs has been chosen for the annual convention of the A. I. E. E. about the end of June.

Transportation arrangements for the N. E. L. A. convention at Pasadena in May are reported as well under way.

The cut made by the House committee in the estimates for promoting foreign trade is severly criticised by the Secretary of Commerce.

Standard graphic symbols, improved statistics for steam power plants, daylight saving and synchronous commutators were among the topics discussed at the Institute's midwinter convention.

Several papers falling under the general classification of "Meters and Measurements" were presented at the A. I. E. E. meeting in New York. Carl J. Fechheimer, A. L. Ellis and B. W. St. Clair, Dr. A. E. Kennelly, R. V. Hunter and A. A. Prior, H. B. Brooks, and Dr. P. G. Agnew were the contributors of the papers.

At the joint meeting of the Pittsburgh sections of the A. I. E. E. and the A. I. and S. E. E. the industrial value of graphic instruments was dwelt upon by J. W. Esterline and discussed by many members.

Rain in California, while not heavy, did much to lessen demand for power for irrigation.

President Ballard of the N. E. L. A. has arrived in California after a successful trip in Eastern and Southern States.

Floods on Salt River and Tonto Creek in Arizona caused much damage to engineering works below the Roosevelt Dam, menacing the power house at the dam.

The Secretary of War has signed the governmental permit for the electrification of the Illinois Central Railroad within Chicago, and the companies have posted a two-million-dollar bond to guarantee completion of the work on schedule.

The industrial and domestic power committee of the A. I. E. E. has formed a sub-committee to investigate and publish data on domestic power applications.

At an executive meeting of the Arizona Gas, Electric Light and Power Association the power shortage in the state was considered, and an appeal to the Public Service Commission for relief will be made.

William L. Goodwin and Samuel A. Chase are to address a series of meetings of electrical interest in Southern cities.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

Sulphur Springs Selected for A. I. E. E. Convention at End of June

WHITE SULPHUR SPRINGS, Va., was chosen by the directors of the American Institute of Electrical Engineers at their meeting last week in New York as the place for the annual convention in June. With that end in view negotiations are now being conducted with the hotel people and will, it is expected, probably be concluded by the beginning of the week. It has been necessary to hold the convention a week later than originally planned. Should negotiations be satisfactorily concluded the convention will be held at the Green Briar Hotel June 29 to July 2.

The Institute has had considerable difficulty in making arrangements for the annual convention this year because those places most suitable for conventions could not furnish accommodations so late in June. The demand this year by regular patrons has been unusually heavy and is for much earlier accommodations than has been customary.

Incidentally the Institute board was of the opinion that a place nearer the Western membership than New York or New England or nearby points was advisable. The hotel accommodations, its accessibility, its golf course and the fact that plenty of room was available for meetings, in addition to the circumstances mentioned above, were largely the reasons for choosing White Sulphur Springs.

Thirty-Day Trip Planned for N. E. L. A. Red Special

TRANSPORTATION arrangements for the Pasadena convention of the N. E. L. A. in May are well under way, and according to the first announcement made this week, George W. Elliott, master of transportation, is providing accommodation to suit those desiring side trips as well as those wishing to make the trip quickly.

The Red special from New York will be a thirty-day trip, taking the Southern route out. After allowing sufficient time for the convention and side trips, the special will proceed to San Francisco and then to Portland and Seattle and back over the Canadian Pacific. The Northwest Electric Light Association will have charge of the entertainment in Portland and Seattle and has arranged among other things for a trip over the famous Columbia River drive. Reservations are already being received for this trip from manufacturers and others as well as electric light company representatives.

Other special trains will run direct to the convention and arrangements are being made for transportation at special rates.

Mr. Elliott, who will be aided by assistant masters of transportation in various parts of the country, reports that Kansas, Colorado and Nebraska have already signified their intention of having special cars and other states have made inquiries in that direction.

Answers to the questionnaires which were sent out calling for indications of representation at the convention from the member companies, M. H. Aylesworth, executive manager of the association, stated to a representative of the ELECTRICAL WORLD, are highly encouraging, and a very large attendance is anticipated.

Even at this early date reservations are being received for rooms. The Hotel Huntington will be taken over entirely by those coming from the East, while the West coast attendance will be housed in adjacent hotels.

Cut in Foreign Trade Promotion Estimates Serious

THE cutting of the estimates for promoting foreign trade from $1,658,000 to $490,000 in the legislative, judicial and executive bill, as reported by the appropriations committee of the House a week ago, is characterized by Secretary of Commerce Alexander as the most serious blow ever aimed from within at the foreign trade of the United States.

The bill aims, the secretary states, to abolish the commercial attachés entirely, which service as now conducted costs $165,000. At least fifteen trade commissioners who are reporting on rapidly changing conditions abroad, he points out, must be recalled by May 1.

If this bill is passed as it stands, the secretary states that he will have to close up almost all of the district and co-operative offices of the Bureau of Foreign and Domestic Commerce in this country. There are now district offices in New York, Boston, Chicago, St. Louis, New Orleans, San Francisco and Seattle. In conjunction with the local chambers of commerce there are co-operative offices in Baltimore, Philadelphia, Pittsburgh, Cincinnati, Dayton, Los Angeles, and Portland, Ore.

Finally, he states, the reduction means smaller "Commerce Reports," which are issued daily, and delayed trade figures.

At the present time the ELECTRICAL WORLD is able to report monthly figures on electrical exports as compiled by the Bureau of Foreign and Domestic Commerce in not less than five weeks after the close of any month.

Medal Awarded to Hoover by Western Engineers

ON SATURDAY evening of this week Herbert C. Hoover is scheduled to address the Western Society of Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Institute of Mining and Metallurgical Engineers at the Hotel Sherman, Chicago. At this meeting the Washington award of the Western Society of Engineers, which was founded by John W. Alvord, is to be presented to Mr. Hoover.

A. I. E. E. Collecting Data on Electrical Household Appliances

THE industrial and domestic power committee of the American Institute of Electrical Engineers has formed a sub-committee to investigate domestic power applications. This sub-committee proposes to collect data on all kinds of electrically operated household appliances, including those that are motor-driven and electrically heated. The program of the domestic power application committee includes the publishing of monographs in which different household appliances will be discussed in detail, information being compiled on such points as the design and type of motor used, operating cost, saving obtained over other methods, and other useful information to engineers, architects and housewives. Many photographs will also be included of actual household appliances that can be obtained. This new departure on the part of the American Institute of Electrical Engineers will aid in acquainting the public with the practical features and usefulness of electrical appliances. Hans Weichsel, chief designer of the Wagner Electric Manufacturing Company, St. Louis, Mo., is chairman of the domestic power application committee.

Coal Operators' Policies Differ in Assessing Increase to Utilities

IN PASSING on to public utilities the 14 per cent increase in miners' wages where contracts existed on Oct. 30, 1919, the coal operators of different sections seem to be following different policies in applying the increase. At the hearing of the United States Bituminous Coal Commission held in Washington, D. C., on Feb. 17, it was brought out that the coal operators in Indiana have assessed to the public utilities the 14 per cent increase in miners' wages but not to an amount exceeding the price fixed by the government. Coal operators in other states, however, have applied the increase regardless of the government price. On the legal phases of the question there seem to be differences of opinion. H. B. Spencer, purchasing agent for the United States Railroad Administration and chairman of the central coal committee, has held that the 14 per cent increase in miners' wages cannot be applied in contracts between the railroad and coal operators, while special counsel for the Fuel Administration maintains that it can be so applied.

Other features of the hearing before the commission, including the testimony of public utility representatives, were given in last week's issue, page 453.

Problems of Radio Legislation to Be Outlined

John V. L. Hogan, recently elected president of the Institute of Radio Engineers, at its meeting to be held on Wednesday at the Engineering Societies Building, New York, will discuss in his presidential address the gains to be secured from proper supervision of radio communication, the undesirability of several proposed measures, and the technical aspects of radio communication which have a direct bearing upon governmental regulation.

Mr. Hogan, who is manager of the International Radio Telegraph Company, has based his paper upon a questionnaire on radio regulation submitted to the entire membership of the Institute, which embraces not only the radio profession in the United States, but includes as well leading radio engineers in foreign countries.

Arizona Association Seeks Relief in Power Shortage

THE Arizona Gas, Electric Light and Power Association met in executive session at Phoenix on Thursday and Friday of last week in order to discuss the general power situation in the state and to prepare an appeal to the Public Service Commission for relief. Advantage was also taken of the presence of R. H. Ballard, president of the National Electric Light Association, and the first session, on Feb. 19, was given over to a discussion of association affairs. Mr. Ballard reviewed briefly the changes in personnel at headquarters, the determination of those in charge to give service to all member companies, the decentralization of association work through geographical sections and the plans and program of the Pasedena convention next May.

W. H. Onken, Jr., editor of the ELECTRICAL WORLD, spoke of the bright future which the electrical industry faces and the obligations which rested on the electric lighting companies to expand and develop so that there should be no shortage of power. K. E. VanKuren, chairman of the Commercial Section of the Pacific Coast Section of the National Electric Light Association, outlined the features of the California electrical co-operative campaign and its many advantages to all branches of the electrical industry.

As a result of the deliberations of the managers of Arizona public utilities, it was very apparent that the electric light and gas properties of the state will be seriously crippled and handicapped in rendering service unless they are allowed an increase in depreciation reserve to provide for replacement of property at higher prices. The members of the association appeared later before the Public Service Commission, presented their case and were assured by the commissioners that such relief would be given.

Power for Electrochemical Purposes to Be Discussed at Boston

A JOINT meeting of the A. I. E. E. with the American Electrochemical Society will be held in Boston on April 9. Two topics of especial interest to electrical engineers will be discussed as follows: "Electrically Produced Alloys" and "Power for Electrochemical Purposes." An excursion to the plant and research laboratories of the General Electric Company at Lynn has been arranged and a joint smoker will also be held on the evening of April 8.

The meeting of the A. E. S. opens on April 8 and on April 10 there will be a technical session at which papers will be read dealing with electric furnace problems including their control.

Ballots have been mailed for the election of officers by the A. E. S. indicating that the candidates for the presidency of the society are W. S. Landis and Acheson Smith.

Record Montreal Meeting Voices Need for Organization

DURING the two days of Feb. 18 and 19 the electrical industry of the Province of Quebec met on a common ground in numbers never before attained in that territory. Manufacturers, jobbers, electric-light men and contractor-dealers, some from as far west as Vancouver, gathered to hear from William L. Goodwin and Samuel A. Chase the ways and means which have put the electrical industry of the United States on a higher plane in the last few years.

Considerably more than four hundred sat down at the opening luncheon on Wednesday, many of them to hear for the first time the story of an industry more closely knit together through organization. As a result the four branches of the industry, in addition to the engineering branch, took steps to create a committee to seek out the ways and means of forming what probably will be an organization of the industry in the Province of Quebec. A smoker on Wednesday evening permitted those attending to meet in a very informal way and enabled them to discuss among themselves the points which had been brought out in the afternoon session by Messrs. Goodwin, Chase, Rockafellow, Calder and McIntyre.

MONTREAL DINNER OF THE ELECTRICAL INDUSTRY OF THE PROVINCE OF QUEBEC

Thursday was a day of meetings, with a luncheon of manufacturers and jobbers—the branches of the industry which have working associations—and an afternoon session of the four branches to discuss merchandising. Thursday evening's banquet concluded the schedule and brought together about three hundred men. Addresses in both French and English by public men of the province touched on the desirability of privately owned utilities and encouraged co-operation in the industry. A particular feature was the breaking of the line of cleavage between the French and the English interests in the electrical trade—an important factor in Canadian relations.

On Friday many who had remained over discussed at luncheon and dinner the relations between manufacturer and jobber or distributer.

Edison Pioneers to Erect Memorial Arch at Menlo Park

PLANS are under way by the Edison Pioneers to erect a memorial arch to Thomas A. Edison at Menlo Park. The arch will be located on the Lincoln Highway at that point. This organization will also erect stone pedestals and tablets at Menlo Park to mark the places where Edison began his early work along different lines of investigation.

At the annual meeting of the Edison Pioneers, on Edison's birthday at the Orange Laboratories, Feb. 11, it was voted to amend the constitution so that associates of Edison up to the twentieth century can be admitted to membership. Heretofore membership has been confined to associates up to and including 1885.

Major W. J. Hammer, president of the Edison Pioneers, estimates that up to the beginning of the twentieth century 1,000,000 people had been directly connected with Edison through his different activities. The officers of the organization for the coming year are: President, William J. Hammer, New York; first vice-president, Alfred W. Kiddle, New York; second vice-president, Samuel Insull, Chicago; third vice-president, Charles L. Edgar, Boston; fourth vice-president, Sidney B. Paine, Boston; historian, W. H. Meadowcroft; treasurer, Frederick A. Scheffler, New York; secretary, Robert T. Lozier, New York. The executive committee appointed by President Hammer includes the following: Francis R. Upton, Orange, N. J.; John W. Lieb, New York, and Dr. E. G. Acheson, New York.

W. L. Goodwin to Address Contractor-Dealer Meetings in the South

A SERIES of meetings of electrical interest in Southern cities have been scheduled at which W. L. Goodwin will be the principal speaker and explain the details of the Goodwin plan, its objects, and the things which it stands for in the development of the electrical business by the central station, the jobber, the manufacturer and the contractor-dealer. The first meeting of the series will be held at Jacksonville, Fla., on March 15. Other meetings have been scheduled as follows: New Orleans, March 17; Birmingham, Ala., March 18; Memphis, Tenn., March 19; Little Rock, Ark., March 20; Nashville, Tenn., March 22; Knoxville, Tenn., March 23; Chatanooga, Tenn., March 24; Atlanta, Ga., March 25 and 26; Columbia, S. C., March 27; Charlotte, N. C., March 29 Mr. Goodwin will be accompanied by Samuel A. Chase, who will also address the meetings at the points named.

Value of Graphic Instruments Industrially Is Emphasized

THE value of obtaining and analyzing graphic charts in central stations and industrial concerns was emphasized by J. W. Esterline, president of the Esterline Instrument Company, in a paper presented before a joint meeting of the Pittsburgh sections of the American Institute of Electrical Engineers and the Association of Iron and Steel Electrical Engineers on Feb. 21. Three important general uses for graphic instruments were cited, namely, (1) to determine central-station charges, (2) to ascertain operating characteristics of installed machines, and (3) to facilitate proper selection and layout of equipment. To show how improper operation or inefficient labor can be detected Mr. Esterline interpreted several typical curves. The use of graphic instruments for the latter purpose is very important, said Mr. Esterline, because in 275,000 industrial plants of this country nearly 17 per cent of the total production expense is for wages.

Going into the detailed uses of graphic charts, he pointed out that they can be employed to compare the efficiency of individual workmen or entire shifts, to study machine power requirements over duty cycles or longer periods, to determine productivity of machines and workmen, and to ascertain the effects of poor power factor. Besides, these charts will enable the detection of slowness in starting work, running of idle machines during noon hour, improper grouping of machines, and incorrect starting of motors. Specific examples of these uses were cited.

In the discussion of the paper by D. M. Petty, Martin Dale, L. B. Vanderbilt, M. Sparks, O. Schaumberg, R. F. Gale, J. F. Kelly, M. Gadsby, C. L. Taylor and Mr. Esterline it was brought out that there is a need of a graphic instrument which will measure and record kva. demand and one that will measure and automatically compute a charge on the combined reactive kva. and the kw. demand. One engineer said an instrument for this purpose is made in France but that he had been unable to locate the manufacturer.

It was suggested by D. M. Petty that if thirty-five or forty graphic instruments were operated by synchronized clocks a transmission company might be able to determine the cause of trouble not otherwise traceable. This synchronization of clocks has been permitted by using the Western Union clock mechanism, by the Warren clock and by electromagnetic devices, it was said, but so far there has been only a small demand for such devices.

Great Business of General Electric Company Requires More Capital

A SPECIAL meeting of stockholders of the General Electric Company has been called for March 16, to vote upon a proposition to increase the authorized capital stock of the company from $125,000,000 to $175,000,000 Charles A. Coffin, chairman of the board, states in a circular to the stockholders.

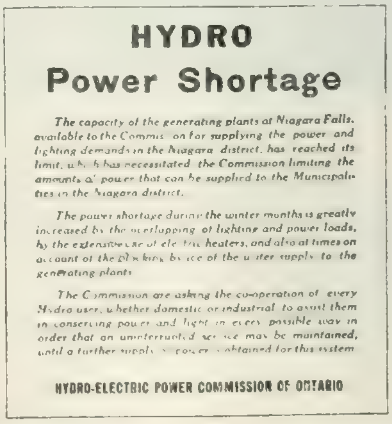
The proposed increase is to enable the company to obtain additional working capital from time to time through subscription thereto by the stockholders, to provide shares for distribution of the usual semi-annual stock dividends, and for other corporate purposes. The present authorized capital is $125,000,000, of which $122,968,400 is now issued and outstanding, leaving in the treasury unissued $2,031,600.

The volume of orders received by the company for the past six months, it is stated, has been at an unprecedented rate and far beyond the capacity of the company's existing production facilities.

A careful survey of the financial and factory requirements of the company made by its officials as of Jan. 31 indicated that there would be needed therefor during the next twelve months about $30,000,000, which includes provision for the payment of the company's $15,000,000 three-year notes maturing July 1, 1920.

To apply on these requirements, the company, as reported in the ELECTRICAL WORLD for Feb. 14, has sold $15,000,000 twenty-year 6 per cent debentures. It is the view of the directors that further funds should be provided by subscription to increased capital stock to be offered later to shareholders and by the sale of securities owned by the company.

Power Shortage on Hydro System



HYDRO

Power Shortage

The capacity of the generating plants at Niagara Falls, available to the Commission for supplying the power and lighting demands in the Niagara district, has reached its limit, which has necessitated the Commission limiting the amounts of power that can be supplied to the Municipalities in the Niagara district.

The power shortage during the winter months is greatly increased by the overlapping of lighting and power loads, by the extensive use of electric heaters, and also at times on account of the blocking by ice of the water supply to the generating plants.

The Commission are asking the co-operation of every Hydro user, whether domestic or industrial, to assist them in conserving power and light in every possible way in order that an uninterrupted service may be maintained, until a further supply of power is obtained for this system.

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO

THIS *advertisement was recently published in the newspapers of Toronto, and throughout the Province of Ontario where the Hydro-Electric Power Commission furnishes towns and industries with Niagara power. Troubles from ice have affected the normal output of generating stations, necessitating the switching off of feeders for short periods and in some cases the unavoidable shutting down of industrial plants.*

Fuel Main Power Source in East

Summary of United States Geological Survey Report for Four Months Shows Water Power Predominant Only in West and Southeast

THE comparative importance of water and fuel as sources of energy in the production of electrical power in the United States during the first half of 1919 is shown by the accompanying diagram. The diagram and percentage are derived from figures issued by the United States Geological Survey covering the first half of the year with the exception of May and June.

In the section east of the Rockies the predominance of fuel-burning power plants over the hydro-electric plants is striking, especially in the Central States. The Central States diagram, however, is slightly misleading in that practically all the Northwest Central States show a predominance of water-power plants, while other isolated Central States, such as Michigan and Alabama, indicate the same preponderance.

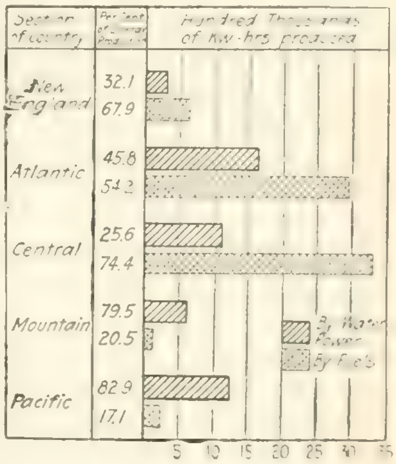
SUMMARY OF CENTRAL-STATION ENERGY PRODUCTION FROM FUEL AND WATER POWER FOR FEBRUARY, MARCH, APRIL AND JULY, 1919

State	Thousands of Kilowatt Hours Produced		Consumption of Fuels		
	By Water Power	By Fuels	Coal, Short Tons	Petroleum and Derivatives, Barrels	Natural Gas, Thousands of Cu.Ft.
Alabama	126,546	24,132	73,787	32	
Arizona	25,711	74,620	25,151	339,385	
Arkansas	308	26,599	42,829	1,842	429,402
California	832,703	222,656	....	1,096,965	711,266
Colorado	57,361	60,965	149,609	467	....
Connecticut	43,674	143,765	251,783	1,148	*44,690
Delaware		20,215	29,927	17	
Dist. of Columbia		75,103	85,253		
Florida	3,289	32,878	15,267	124,369	4,029
Georgia	138,801	24,931	54,032	2,793	
Idaho	167,571	1,799	440	39	
Illinois	62,350	784,199	1,308,671	9,242	......
Indiana	13,583	213,293	585,407	1,437	8,054
Iowa	193,417	97,134	297,353	2,980	
Kansas	4,384	123,015	198,063	227,724	316,526
Kentucky	16	75,681	154,408	1,403	...
Louisiana	....	59,106	53,392	119,605	215,773
Maine	75,374	459	1,572	31	...
Maryland	1,342	60,153	98,815	97	5,850
Massachusetts	97,548	402,897	533,079	76	....
Michigan	227,139	390,175	497,593	638	....
Minnesota	131,683	60,236	147,996	3,840	....
Mississippi	.....	20,641	62,203	1,444	....
Missouri	16,872	153,135	340,364	92,990	......
Montana	307,350	3,440	21,477	2,012	3,787
Nebraska	4,127	64,512	122,619	13,841	....
Nevada	11,039	1,705	713	4,721	......
New Hampshire	20,891	10,135	18,355	46	....
New Jersey	697	308,265	459,158	354	....
New Mexico	337	6,030	16,243	5,403	...
New York	851,007	1,124,280	1,393,385	2,815	518,626
North Carolina	180,035	28,900	62,409	80	
North Dakota	....	9,264	63,072	2,136	
Ohio	12,928	775,920	1,214,784	3,034	1,420,081
Oklahoma	660	53,691	42,506	44,397	1,834,289
Oregon	113,367	16,375	1,101	68,263	
Pennsylvania	228,721	957,518	1,599,488	349	190,815
Rhode Island	2,570	83,832	95,183		
South Carolina	173,229	15,042	36,476	355	...
South Dakota	13,834	10,997	26,689	12,826	
Tennessee	159,177	4,023	99,316	333	
Texas	1,046	181,039	115,180	719,026	648,381
Utah	58,437		157		
Vermont	63,232	1,515	5,109	8	
Virginia	74,969	71,838	119,698	449	
Washington	304,581	18,290	11,555	76,564	
West Virginia	6,012	236,647	286,158	207	704,840
Wisconsin	170,457	118,310	243,470	2,445	
Wyoming	737	13,553	50,828	30,380	18,096
Totals	4,979,265	7,321,904	11,118,119	3,018,527	7,079,586
Total by water power and fuels,		12,301,169			

* Artificial gas.

The passage by Congress of the water-power bill, which now seems assured, is expected ultimately to effect considerable changes in the relations shown between the two sources of power, but naturally these changes will not be immediate because large water powers cannot be developed in much less than two or three years. The growth will probably be most noticeable in the New England and Atlantic States, where markets for power are already fully established. The Mountain and Pacific States possess by far the largest quantity of potential water power, but the present power market in that section is for the most part fully supplied. Large increases of hydro-electric power plants there can hardly be expected notwithstanding the advantages offered by the proposed water-power legislation. Some water-power development will take place, of course, to supplant the fuel oil now being used.

A very high proportion of the Central States' power plants are below 2,500 kw. installed capacity, and the absence of large potential water powers except in the northwestern portion of the section makes greatly increased hydro-electric development improbable in this section as a whole. While the diagram gives output for only February, March, April and July, still the relation between the two classes of energy is clearly indicated.



COMPARISON OF TOTAL ELECTRICAL PRODUCTION DURING FEBRUARY, MARCH, APRIL AND JULY, 1919, USING FUEL AND WATER AS MOTIVE POWER

Campaign Against Theft of Electrical Energy in Missouri

A LAW passed by the last Missouri Legislature, more stringent than the one formerly in force, has led to a renewed campaign in that state against the theft of electrical energy. The Union Electric Light & Power Company of St. Louis is proceeding actively in this matter, and J. M. Scott, president of the Missouri Association of Public Utilities, has had prepared through the Kansas City Electric Light Company suggestions for newspaper advertisements to be used by members of the association. These advertisements aim both at the moral education of the thoughtlessly dishonest and at the intimidation of confirmed thieves by dwelling on the penalty attached to the misdemeanor and on the fact that the presence of "current jumpers" is now prima facie evidence of guilt, while under the old law it was necessary for the company to prove that the offender was knowingly diverting electricity. Theft of electrical energy is punishable by maximum penalties of $1,000 fine, one year in jail, or both. The offender in addition can be made to pay for the energy wrongfully diverted on the basis of an estimated bill. It is believed that energetic prosecution will result in a decrease in the number of offenses, which in the past have been committed in the well-to-do as well as in the poorer quarters of the cities, and that the publicity being given the subject will have a further deterrent effect.

Important Power Merger Planned in Maine

THE Central Maine Power Company is negotiating for the purchase of the Androscoggin Electric Company of Lewiston, Me., the Oxford Electric Company and the Knox County Electric Company. It is hoped to consummate the deal within sixty days. As a result of this purchase the Central Maine company will supply service to twelve additional municipalities—Lewiston, Auburn, Mechanic Falls, Norway, Paris, Oxford, Rockland, Thomaston, Rockport, Camden, Warren and Poland Springs—and the merger will add ten thousand customers to the Central Maine system. The existing steam and hydro-electric plants of the companies will be interconnected. A transmission line will be built from the Farmingdale station of the Central Maine company to the Deer Rips station of the Androscoggin company, and another line will connect the Androscoggin and Oxford companies.

The combined generating capacities of the plants involved, including the hydro-electric additions now under construction or in immediate contemplation, total about 32,000 kw. The Portland-Lewiston interurban electric railway and the Rockland, Thomaston & Camden Street Railway are included in the proposed purchase. The combined companies will within the year add over 15,000 kw. of hydro-electric generating capacity to their output, or nearly as much as the present combined peak loads of the systems.

To Correct South American Trademark Evil

BY PASSING the Nolan and Merritt patent bills the Senate on Feb. 21 practically assured the final enactment of these measures, which it is declared will be of great value to all manufacturers who sell to the Latin-American trade.

The Nolan bill ratifies the trademark convention adopted in Buenos Aires Aug. 20, 1910. The convention already has been ratified by the South American republics.

One of the Senate amendments attaches the Merritt bill to the Nolan bill. It is understood that the House will accept a conference report containing the Merritt bill in addition to the measure that passed the lower house. This proposed legislation is designed so that the manufacturer in the United States may trademark the name of his own product if he has used it in foreign commerce for two years.

Financing Presages Big Utility Growth in Wisconsin

PUBLIC utilities of Wisconsin are coming into the market for large sums of money for developing new properties, making improvements and extensions to existing plants and funding outstanding floating debts. The Railroad Commission has in the past two months authorized the issue of securities amounting to $2,734,400, and there are pending applications for $5,035,950. Of the total, $500,000 represents note issues, $1,499,000 bond issues and $5,771,350 is in the form of stock, either common or preferred. Issues involving $100,000 or more are as follows: Peninsular Service Company, $100,000; Wausau Telephone Company, $160,000; Colfax Light & Power Company, $182,900; Peninsular Power Company, $250,000; Interstate Power Company, $272,800; Wisconsin Valley Electric Company, $350,000; Wisconsin River Power Company, $500,000; Big Falls Water Power Company, $1,000,000; Wisconsin Gas & Electric Company, $1,000,000; Eastern Wisconsin Electric Company, $1,200,000; Milwaukee Electric Railway & Light Company, $2,133,700.

Co-operation in Operating Department Brings Big Fuel Saving

IN A DISCUSSION of the relation of the personnel of the organization to operating results, T. J. Nolan, Toledo Railways & Light Company, stated before the station-operating committee of the Ohio Electric Light Association at the Waldorf Hotel, Toledo, on Feb. 18 that the co-operative spirit existing between the results department and the operating men had brought about a reduction in the heat units in B.t.u. per kilowatt-hour from 42,000 to 33,000 at the Water Street station, or a material reduction in fuel costs. J. T. O'Connor, superintendent Acme Power Company, talked on the plans for the future development of this plant to an ultimate capacity of 200,000 kw. A. B. Stizer, Republic Engineer, Inc., discussed the problem of standardizing maintenance and how it affects reserve capacity. Leroy Kramer, vice-president Willys-Overland Company, told the members about some of the production problems in the manufacture of automobiles. In the afternoon an inspection trip was taken to the plant of the Acme Power Company, where a 20,000-kw. turbine is being installed.

Over-All Efficiency of 80.67 per Cent with Pulverized Fuel

A STORY of accomplishment after two years of experimenting with the use of pulverized coal under central-station boilers was set forth in a paper presented by John Anderson, chief engineer of power plants of the Milwaukee (Wis.) Electric Railway & Light Company, before employees and guests of the company in Milwaukee last week. A complete test over a period of five days on five 468-hp. boilers equipped with the "Lopulco" pulverized fuel-burning system in the company's Oneida Street plant showed an actual over-all efficiency of 80.67 per cent as against 76.80 per cent for modern stokers operated under similar conditions in the same plant. The net efficiencies after accounting for all incidental costs were 72.32 per cent and 70.88 per cent respectively, a difference in favor of pulverized fuel of 1.44 per cent.

The energy consumed by the pulverized-fuel equipment averaged 22.45 kw.-hr. per ton. The drying of the coal required 25.66 lb. (11.6 kg.) per ton. The total cost of operating and maintaining the pulverizing installation was 32.5 cents per ton of coal fired.

A plant of less than 2,500 developed boiler horsepower, according to Mr. Anderson, should not consider using powdered fuel, because of the cost of installing and operating the required equipment. The cost of preparing the coal, it was pointed out, will ordinarily vary from 25 cents to 50 cents per ton, depending upon the size of the plant and the amount of coal handled.

Sixteen per cent or 17 per cent CO_2 can be obtained in the flue gases from pulverized fuel, it was stated; but, if maintained, it will result in flame temperatures which will destroy the brickwork.

Dr. George Otis Smith Points Out Value of Reasonable Coal Storage

AN ADDRESS on "Engineering as Prosperity Insurance" was made by Dr. George Otis Smith, director of the United States Geological Survey, before the Engineers' Club of Philadelphia recently. Dr. Smith declared that building for the future is engineering and that industrial prosperity can be assured only by engineering advances.

In the course of his discussion Dr. Smith mentioned several matters which are of particular interest to the electrical industry. In addition to the super-power-station plan of Secretary of the Interior Lane, which has been fully presented in previous issues of the ELECTRICAL WORLD, Dr. Smith mentioned the following matters:

The official estimates of the potential water power in the United States when figured on an 80 per cent efficiency indicate in round numbers a minimum of 30,000,000 hp. and a maximum of 60,000,000 hp. The water power now utilized, however, is less than one-third of the minimum potential power. Or, taking a world view of the water-power situation, we find our country standing third in potential resources, with about 7 per cent of the world supply, but first in rank, as determined by developed power, with 45 per cent of the world's supply. Canada, France and Norway stand next in order as to power developed, but the total of all three is only half the water we use.

As a suggestive comparison, I have taken the coal consumption of six large typical power companies—companies having an aggregate installed capacity of nearly 700,000 kw.—which furnish electric current to a trunk-line railroad and several street-railway systems as well as general lighting and power service in metropolitan districts. The daily average coal consumption of these companies by months during ten months of last year furnish a curve that shows a seasonal fluctuation similar to that of mine output, but the departures from the base line representing the average for the whole period are much smaller—92 per cent is the spring low peak and 110 per cent is the winter peak.

Applied to the general curves of soft-coal production for several years, this consumption curve of six companies shows that for three-fourths of the time such power companies could exert a helpful influence on the market, even if they bought their supply from day to day. The storage of anything like a reasonable tonnage of coal at such plants would still further smooth out the curve and help to put the coal industry on a better basis. The influence of such consumers is well worthy of consideration, for these six companies alone use nearly one-half of 1 per cent of the soft coal mined. It is also doubtless true that by connecting up such power units into a single system the improved load factor would tend to smooth out the curve of coal consumption, and the pooled purchase of coal would further help abate the seasonal demand which is today the greatest evil in the bituminous coal industry.

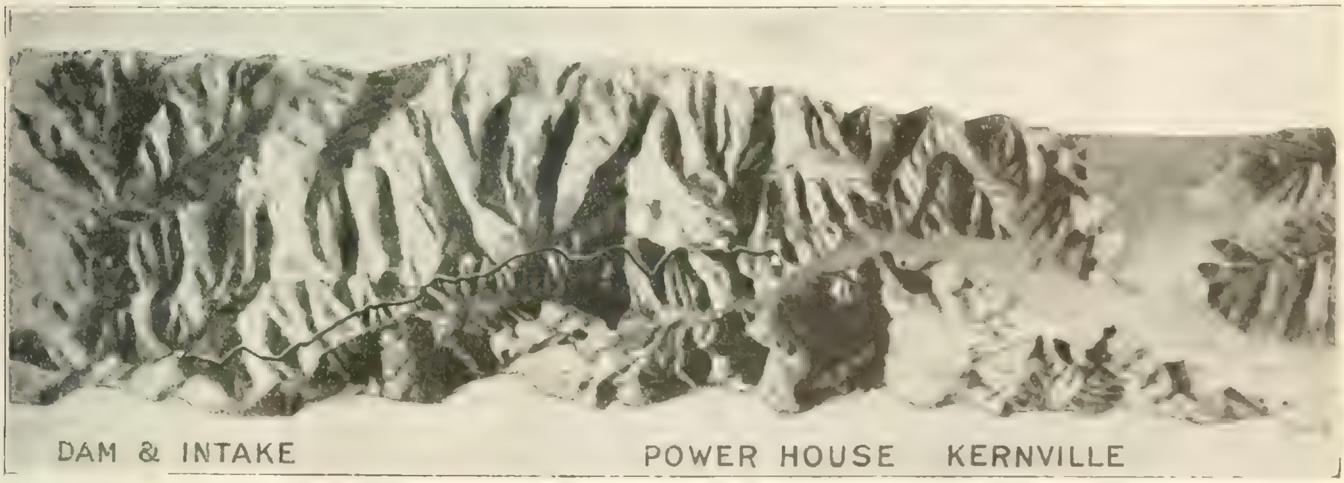
Growth of Philadelphia Electric Company's Business

FIGURES issued by the commercial department of the Philadelphia Electric Company show that the company has regained the nominal advance as estimated in 1915 but interferred with by war operations. The total number of new contracts signed in 1919 was 27,345, as compared with 19,746 in 1916. Of the 1919 contracts 17,835 were signed in the last half of the year. The total amount of energy contracted for in 1919 was 58,919 kw., as compared with 54,537 kw. in 1916, 40,341 kw. of the former amount being taken in the last six months.

In the first two weeks of the new year thirty-seven contracts, for 5,000 kw., were signed, an increase of 4,875 kw. over the first two weeks of last year. This means that 46,741,000 kw.-hr. more were sold in these two weeks than in the same period of 1919.

IN GENERAL *it is a time to conserve, to retrench rather than to reform, a time to stabilize the administration of the present laws rather than to seek new legislation. Not law, but perseverance and patience.*—GOVERNOR COOLIDGE *of Massachusetts.*

Construction for Plant No. 3 on Kern River



This relief map conveys a graphic impression of the difficulties to be encountered in the installation of hydroelectric generating plants in the West. It was made by the Southern California Edison Company and covers that portion of the Sierra Nevada Mountains in which the Kern River runs. The Kern River No. 3 plant of the Southern California Edison Company is being constructed at this location, and it is planned to put it in operation within the next six months.

The line drawn on the map illustrates the course of the tunnel line from the dam to the forebay of the power house, which is in approximately the center of the map. The tunnel line, as shown by the conduit traverse, will be approximately 8 miles (12.8 km.) long.

Greater Lighting Intensity a Vital Factor in Production

AS A PART of a constructive program in the field of industrial lighting the Illuminating Engineering Society at its regular monthly meeting on Feb. 11 took a step in the direction of interesting the industrial plants of the country in the beneficial results to be obtained from extraordinary increases in light intensity. A committee consisting of Clarence L. Law of the New York Edison Company and Francis E. Cady of the National Lamp Works, with others to be selected later, was appointed to devise some method whereby a committee representing various industrial and other corporations could be organized under the society's auspices to consider the relation to increased production of light intensities higher than heretofore deemed necessary or advisable.

It is proposed that this committee should have ten members, who will finance the investigation and research by purchasing a place on the committee for a definite period of time. This will not be a committee of the Illuminating Engineering Society, but is to be assisted and sponsored by the society.

A committee of the society which is revising the constitution to make it more workable has been requested by the council to incorporate in the changes an increase in dues of 50 per cent on all classes of membership. The society points out that this is done because of increased expenses and the consequent necessity for more money.

Members will have an opportunity to vote upon this increase by letter ballot when the proposed new constitution is offered. No changes will be effective, however, until next year.

Hoover's Plan for Curing Nation's Economic Ills

GOVERNMENT ownership of public utilities received a severe condemnation from Herbert C. Hoover in his inaugural address before the American Institute of Mining and Metallurgical Engineers on Feb. 17, when he said that there are many fundamental objections to a continuation of the nationalization of railway and shipping necessitated by the war. Destruction of personal initiative and the dangers of political domination that can grow from governmental operation were held to be the main objection.

Mr. Hoover outlined the economic ills now suffered by the nation, suggesting a remedial program in which he emphasized the constructive part the engineer can play.

In the return of the railways to private control he calls for energetic enlargement of equipment, better service, co-operation with employees and the least possible advance in rates, together with freedom from political interest.

In order to build up and protect national expansion in foreign trade Mr. Hoover sees the necessity for the retention of a large fleet under the American flag, the desirability of holding a considerable government fleet and consequently the necessity of building up an enormous shipbuilding industry. To accomplish this object he would have the government continue to let some ship construction contracts to the lowest bidders.

The co-ordination of expenditure on public works and technical services in the Department of the Interior, rather than in nine different government departments, was advocated in the interests of prevention of waste through departmental competition.

Because it provides a basis of organization that does not paralyze administrative efficiency, like the system now in force, Mr. Hoover recommended the adoption of a federal budget.

As a way out of the labor problem, he holds to the re-establishment, through organized representation, of that personal co-operation between employer and employee in production that was a binding force when the nation's industries were smaller and less specialized.

"The attitude of refusal to participate in collective bargaining with representatives of the employees' own choosing," he said, "'is the negation of this bridge to better relationship."

While holding no brief for unlawful radicalism, which can be handled by the police, the speaker stated that he sometimes felt that lawful radicalism in politics is less dangerous than reaction, for "radicalism is blatant and displays itself in the open."

"If America is to contribute to the advance of civilization," Mr. Hoover concluded, "it must first solve its own problems, must first secure and maintain its own strength. The kind of problems that present themselves are more predominantly economic—national as well as international—than at any period in our history. They require quantitative and prospective thinking and a sense of organization."

Chicago Credit Men Vote to Change Name

AT THE twenty-fourth annual meeting of the Electrical Credit Association of Chicago, held on Feb. 10 and 11 at the Hotel LaSalle, it was decided to change the name of the organization in such a way that it would not seem to be purely a Chicago association. The members favored a name that would indicate the connection with the national association and also the territorial range of activities of the Chicago section. The name recommended for adoption was the National Electrical Credit Association, Central Division.

Territorial chairmen in their reports on conditions in the various sections stated, without exception, that credit conditions were the best in history. This was attributed to present market conditions favoring the seller and the credit man being able to turn down a dubious account owing to the volume of business being larger than his house could handle.

In an address on "A Salesman's Viewpoint," J. O. Presbrey, General Electric Company, said that the credit man should have confidence in the salesman's judgment of a customer from the moral-risk standpoint, while the salesman should look at every prospective sale from the credit man's viewpoint. The speaker held that the value of rejected orders deserves the same attention as is paid to bad accounts. T. K. Quinn, National Lamp Works, explained the new method of jobbers' compensation on lamps on the basis of turnover. C. E. Vandel, Western Electric Company, Kansas City, discussed municipal credits as related to municipally owned plants. At the banquet on Feb. 10, T. G. Soares of the Chicago University was the principal speaker, his subject being "Full Steam Ahead."

Officers elected for the new year were: President, H. W. Wilkins, Belden Manufacturing Company; vice-president, E. G. Gilmore, Western Electric Company.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Selling Stock in Home District.—The San Joaquin Light & Power Corporation has begun its campaign to sell its new issue of stock to the par value of $3,500,000 in its own district, using as a basis the "self-interest plan" evolved by A. E. Wishon, assistant general manager, and outlined by him in the ELECTRICAL WORLD for Dec. 13, 1919.

Tidal-Power Investigations in France.—The government committee charged with investigating the possibility of using the tides to generate electricity in France has reached conclusions so favorable that it has been decided to enter upon practical experiments with this end in view. One test will be made in the Department of Finistère and another at Saint-Brieuc in the Department of Côtes du Nord.

Electric Drive and Fuel Saving in England.—It was asserted in a report made by a sub-committee of the official body appointed in England to deal with coal conservation that if the existing methods of driving machinery throughout the country were replaced by electric drive, the energy being generated in large national power stations, an economy of about a hundred million tons of coal a year could be effected.

Profit Sharing in the Brooklyn Edison Company.—According to figures lately presented by Vice-President W. F. Wells of the Brooklyn Edison Company, 7,000 shares of the company's stock, valued at more than $700,000, are held by employees. Under the profit-sharing plan adopted in 1910, more than $100,000 was last year credited to the accounts of a thousand employees in the Brooklyn Edison investment fund, the amount for each individual being determined by his earnings and length of service.

Unusual Engineering Problem at Cedar Falls, Wash.—In the development of water power at Cedar Falls, Wash., by the city of Seattle it was found impossible to impound water behind a concrete dam at a certain location because the leakage was twice the normal flow into the reservoir. For two years attempts to blanket the leaks have been made without success. J. D. Ross, the city's engineer, has finally proposed a plan for the solution of the difficulty which, while it will not include use of the dam as originally planned, will increase the available output of the plant from 6,000 kw. to 18,000 kw. and decrease the unit cost from $582 to $313 per kilowatt. It is estimated that $800,000 a year in fuel cost will be saved by the development.

Prize-Winning Poster for Electrical Show.—The prize of $100 for the best poster design to advertise the Cleveland Electrical Show next month has been won by Paul Shively, a senior in the Cleveland School of Art, in competition with more than fifty others, and his design is reproduced here. The Electrical League of Cleveland is arranging to carry through other methods of interesting the public in the show, such as exhibits in the lobbies of banks and other buildings and the construction of an "electrical road" to the show auditorium. P. B. Zimmerman is chairman of the publicity committee.

An Engineers' Building for San Francisco.—A movement is under way in San Francisco for the erection of an Engineers' Building in which all the engineering bodies of that community can have headquarters. The proposal involves the erection of a modern skyscraper type office building of fifteen stories, the upper two of which are to be occupied by the Engineers' Club of San Francisco. Support is already assured from the professional engineering societies, the San Francisco Electrical Development League and other organizations. Manufacturers of technical supplies and materials, merchants dealing in these wares and technical publications, as well as individual engineers and contractors, are expected to fill the offices of the new building, which is to be erected in a central location soon to be determined on. Engineering commissions of state and national governments are also to be asked to maintain their central offices in the building. The plans contemplate the inclusion of meeting places for the organizations, adequate dining rooms and an auditorium large enough to accommodate a joint meeting of all the engineering societies. The engineers who have the project in hand are pushing it with energy and determination, and it is thought that they will meet with entire success in the campaign begun to raise the funds.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Wisconsin Electrical Association.—The annual meeting of the Wisconsin Electrical Association is announced for March 24 and 25 at the Hotel Pfister, Milwaukee.

New Student Branch.—A student branch of the A. I. E. E. has been organized at the Oklahoma Agricultural and Mechanical College with Earl Gray as president.

American Electrochemical Society, New York Section.—The subject of the meeting of this section to be held on Friday, March 26, will be "Peace Uses for War Products."

Southwestern Electrical and Gas Association.—The sixteenth annual convention of this association will be held at Galveston, Tex., on May 13, 14 and 15, headquarters to be at the Hotel Galvez. The secretary announces that the proceedings will surpass those of all previous conventions in interest and value and that a record-breaking attendance is expected. An invitation is extended to all delegates en route to the Pasadena convention by the Southern Pacific Railway to "stop off" at Galveston and attend the meetings as guests of the Southwestern association.

Institute of Radio Engineers, Philadelphia Section.—A regular meeting of the Philadelphia Section of the Institute of Radio Engineers will be held on the evening of Friday, March 5, at the Randal Morgan Laboratory of Physics, University of Pennsylvania, Philadelphia. A paper on "The Cathode-Ray Oscillograph and Its Applications in Radio Work" will be presented by Lewis M. Hull, associate physicist at the Bureau of Standards, Washington, D. C. This paper will deal with the development of a satisfactory form of high-frequency oscillograph and its various uses in high-frequency research.

Indiana Electric Light Association.—The new-business committee of this association will meet in Fort Wayne on March 4. The program includes addresses by S. W. Greenland, Fort Wayne, and P. H. Palmer, Kokomo; "Domestic Refrigeration," by Robert Montgomery, Louisville, Ky., discussion by Wallace Lee, H. E. Grant and H. E. Crane; "Industrial Heating," by R. Thurman, Muncie, discussion by George A. Neal, M. S. Caldwell and A. Nelson; addresses by Samuel Adams Chase of Pittsburgh, William L. Goodwin of New York, C. B. Young of Rochester and J. A. Janney of Chicago. Charles B. Hart, chairman of the commercial section of the association, will preside.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Limitation of "Going Value."—"Going value," it is asserted in a recent decision of the New York Public Service Commission, Second District, is recognized by the laws of the state to be limited to expences incurred in the earlier years of the life of a utility in building up its business and not recovered from the public in the way of earnings.

Passing Expenses on to Customers.—While a utility should not be permitted to pass along to its patrons all the burdens imposed by the war conditions, said the Pennsylvania Public Service Commission in dismissing a complaint against an increase made in the rates of the Philadelphia Suburban Gas & Electric Company, it must maintain its plant in an efficient manner and to a reasonable extent may ask that it be reimbursed for its increased operating costs.

Proper Basis of Discriminatory Rate.—As a result of an investigation into the rates and practices of the Coleman-Pound Light & Power Company, the Wisconsin Railroad Commission declared that an electric utility is justified in offering a low rate to obtain a large customer which could not be had otherwise, provided that such rate is sufficiently high to pay the output costs of the service and a part of the fixed costs, as this will reduce the amount of fixed costs to be paid by the other consumers.

Municipal Electric Service in California.—In a complaint made by the Pacific Light & Power Corporation against the city of Pasadena for rendering electric service outside of its corporate limits without a certificate of convenience from the Railroad Commission, the commission held that such certificate is not required where it is shown that such service was being rendered prior to the effective date of the public utilities act; but the commission ordered the city to file with it a complete rate schedule.

Improper Method of Providing Depreciation Funds.—The Maryland Public Service Commission, passing on an application for increased rates, laid down the principle that it is grossly unfair to present and immediately future patrons to provide in rates large sums of money either to pay for deferred maintenance accruing during the period of the war or to set up depreciation reserves which could have been easily set up had dividends upon the common stock not been paid during the period of the war.

War Emergency Passed.—In view of the probable continuance of abnormally high prices of labor and materials, the Maryland Public Service Commission recently held, rates should no longer be fixed on the basis of a war emergency or upon fair value, but rather on the corporate requirements of the utility concerned.

What Constitutes a Reasonable Return.—In permitting an increase in fares on petition of the United Railways & Electric Company of Baltimore, the Maryland Public Service Commission declared that a public utility is entitled to receive from the public a sum not only sufficient to pay operating expenses, taxes and a fair return upon the fair value of the property used in the public service, but in addition thereto a sum sufficient to maintain such property in repair and replace such portions of it as may be worn out in the public service.

Operating Expenses — Depreciation Fund.—In a recent decision affecting interurban railways, the California Railroad Commission announced that it had definitely adopted the policy to recognize as operating expenses all increases in labor costs. In regard to depreciation it declared that a depreciation fund should be sufficient to allow for the replacement of such depreciable items of property at the end of a reasonable expected life as should be taken care of through the fund. The safety of a depreciation fund should not be sacrificed to a possible high rate of interest, but it is preferable to require merely that all earnings by the fund shall be added to the reserve, rather than to require an accounting on a strictly sinking-fund basis at a definite rate of interest, irrespective of whether or not the fund actually was able to earn the fixed rate.

Principles Governing Appraisal in Consolidation Proceedings. — Passing upon a petition for the purchase and consolidation of six power and light companies, the Vermont Public Service Commission declared that an appraisal of value would be defective where the unit prices were the abnormal wartime prices, where no allowance was made for depreciation and where a reasonable return on the amount of the appraisal would impose an undue burden upon the ratepayers. The commission refused to allow as the value of certain water rights an amount more than three times the price paid therefor, or to permit the issuance of long-term securities to pay for undeveloped water powers where the testimony did not disclose any present plans to develop these powers. It also refused to permit the issuance of new securities to approximately double the value of the properties to be acquired or the purchase of certain power properties of a railway company where the properties so purchased would come into the hands of the new corporation charged with the payment of the entire bonded indebtedness of the railway company.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Where Assumption of Risk Is Not a Valid Defense.—A servant who gives notice of dangers which the master agrees to remedy does not assume the risk of injury by remaining at work for a reasonable time, according to a decision of the Appellate Court of Indiana. (125 N. E. 580.)

Responsibility for Insulation on Jointly Occupied Poles.—It has been held by the Supreme Court of Pennsylvania in a case where a telephone lineman was killed by contact with an uninsulated wire of the Erie County Electric Company that the electric company was liable for damages and could not recover them by suit against the telephone company, notwithstanding that the wire in question had been bracketed by the telephone company on a telephone pole. The court maintained that inasmuch as the telephone company's poles had been placed in accordance with orders from the municipal authorities, who had granted it the right to occupy the street jointly with the electric company, the latter company not objecting, it was the duty of the electric company to see that its wires were properly insulated. (108 A. 524.)

Public Service Commissioner's Power to Increase Rates Fixed by Contract.—In an action brought by the city of New York against the Public Service Commissioner for the First District of the State of New York and the receivers of the Manhattan & Queens Traction Corporation for a writ of prohibition compelling them to desist from proceedings intended to bring about an increase in fares, the New York Supreme Court held as follows: "In view of the fact that the railroad applicant is seeking to change the present status, coupled with the fact that the Court of Appeals has already unequivocally decided that the Public Service Commission in a case such as the case at bar has not jurisdiction to grant permission to increase the fare, which decision has been expressly affirmed in two later decisions of the same court. it would seem that the procedure adopted for testing the substantial question of law involved (without the expense and delay and possible injustice incident to a hearing and appeal) should be the proper method. In addition, it would seem to be a sufficient answer that the alternative writ of prohibition granted should only prevent action permitting an increase of fare and should not prevent such other action as the commissioner has jurisdiction to perform." Judgment granted accordingly.

Robert E. Barrett, formerly construction engineer with the Turners Falls (Mass.) Power & Electric Company, has been appointed treasurer of the Holyoke (Mass.) Water Power Company, succeeding the late Wallace E. Sawin. Mr. Barrett was resident engineer in the construction of the Hampden steam plant of the Turners Falls company at Chicopee, Mass., and has had an extended experience in hydro-electric plant building and water-storage development and administration.

Lewis E. Ashbaugh, who has been connected with the hydraulic division of the J. G. White Engineering Corporation for the last twelve years, has become connected with John R. Procter, Inc., of Bayonne and New York. Mr. Ashbaugh is to be the sales engineer at the New York office, in charge of installations of fuel-oil apparatus and other electrical equipment for power and lighting purposes.

F. H. Knox, vice-president and general manager of the South Carolina Light, Power & Railways Company, Spartanburg, S. C., has been elected president of the Columbia Railway, Gas & Electric Company and the Parr Shoals Power Company, Columbia, S. C., to succeed Edwin W. Robertson, who has resigned. Mr. Knox joined the company in Spartanburg as chief engineer in 1899 and took charge of its construction work, later being promoted to be vice-president and general manager.

Herbert A. Gidney has resigned as general auditor of Charles H. Tenney & Company, Boston, to become general auditor of the Gulf Properties, Pittsburgh, Pa. Mr. Gidney has been in the service of the Tenney organization for nearly twenty years, working upward from the meter department of the Malden (Mass.) Electric Company to the chief executive accounting post in the Boston office in general charge of accounting in all the Tenney properties. During the war Mr. Gidney served in the auditing division of the Ordnance Department at Washington, with the rank of lieutenant-colonel. He presented an admirable paper upon the work of the department at the 1919 convention of the N. E. L. A. in Atlantic City.

D. S. Kondo left Japan on Jan. 27 for the purpose of studying the big transmission systems in the United States. He has been a government electrical engineer and director of the Electrical Exploitation Bureau in charge of supervising the electrical industry in general. He was at one time a vice-president of the Electrical Society of Japan and of the Illuminating Engineering Society of Japan. He gave up all other connections last October to start plans for vast hydro-electric transmission work as managing director and chief engineer of the Japan Hydraulic Power Company. It is proposed to build a system extending over 200 miles and operating at not less than 150,000 volts, distributing many thousands of electrical horse power.

Men of the Industry

Changes in Personnel
and Position—
Biographical Notes

R. C. Starr, construction engineer of the San Joaquin Light & Power Corporation of Fresno, Cal., will have charge of the design and construction of the Kings River project which has recently been entered upon by that company. This is to involve an ultimate development of more than 200,000 kw., with two 60,000-kw. plants on the North Fork of the Kings River to operate under approximately 2,500 ft. head each, a record in high-head construction for this country. Mr. Starr has for many years been engaged in important hydro-electric construction work in the West. He was graduated from the University of Michigan in 1907 and engaged in construction work in Detroit until he went to the Far West in 1909. For some time he was associated with Stone & Webster in Seattle, holding the positions of resident engineer on the construction of a 10,000-kw. plant at Snoqualmie Falls, Wash., and later on the White River development of the Puget Sound Traction, Light & Power Company, where the most powerful high-head turbine in the world was installed. Mr. Starr acted as assistant superintendent of construction on the Big Creek project of the Southern California Edison Company, and later he held the position of hydraulic engineer with the Pacific Light & Power Corporation and the Southern California Edison Company, which involved the completion of the second 150,000-volt Big Creek transmission line and the raising of the Lake Huntington dam, where all concrete-pouring records were broken. After another brief interval of work with Stone & Webster as superintendent of construction in charge of other important work in the Northwest, Mr. Starr accepted in April 1919 his present position with the San Joaquin Light & Power Corporation, where he has directed the Kerckhoff power project. He is now completing plans for the Kings River development.

R. C. STARR

I. S. Hall, formerly office manager for Charles H. Tenney & Company, Boston, has been appointed general auditor of the Tenney organization, succeeding H. A. Gidney, resigned. Mr. Hall has had a wide experience in association with the executive direction of the Tenney properties.

William C. Billings, formerly electrical engineer with the Cumberland County Power & Light Company, Portland, Me., and recently engaged in hydro-electric work in the Pacific Northwest, has joined the electrical engineering staff of the Edison Electric Illuminating Company of Boston, Mass.

Obituary

J. C. Johnson, who had held the position of superintendent of the Southern Utilities Company, Centerville, Iowa, since May, 1919, died on Jan. 2, from influenza.

Howard Joslyn, who until June 1919 was city electrician of Seattle and who was well known in electrical engineering circles of the Northwest, died Jan. 15. After being graduated from Wabash College in 1888, Mr. Joslyn went to Seattle and shortly afterward to Tacoma as a representative of the Westinghouse Electric & Manufacturing Company. Subsequently he served as city electrician for several years in Tacoma. He returned to Seattle in 1898 as purchasing agent for the Snoqualmie Falls Power Company, and in 1904 became city electrician for Seattle, a position he retained until last June, when he resigned to devote his time to his personal interests. Mr. Joslyn was a member of the American Institute of Electrical Engineers and of the Pacific Northwest Society of Engineers, being secretary of the latter organization at the time of his death.

Roys Nelson Strohn, vice-president of the Western United Gas & Electric Company of Aurora, Ill., died at his home Jan. 23, a victim of influenza. Mr. Strohn became identified with the Aurora properties in 1899 and with Col. I. C. Copley organized the La Grange Gas Company in 1900. Several years later, when that company was merged with the companies of Aurora, Joliet and Elgin into the Western United Gas & Electric Company, Mr. Strohn became vice-president and treasurer of the larger company, which position he has held since. Mr. Strohn during the war was associated with Red Cross work overseas. He was purchasing agent for the Red Cross in the city of London, and then he was transferred to Paris, being on duty in that city during the second great German drive and during its bombardment.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Code Wire Being Booked at Double Last Year's Rate

RUBBER-COVERED wire manufacturers are booking orders for total code wire at five and one-half times the volume of orders taken over the first six weeks of last year, and of this business orders for No. 14 have increased fourteen and one-half times. Estimated total code sales booked all over the country for the first six weeks of the present year amount to more than $5,000,000, or at a rate of over $40,000,000 a year. Last year's bookings were estimated at $21,000,000, just half of the present rate.

Estimates of sales booked over this same period of six weeks of No. 14 code wire amount to $2,333,000, which is at a rate of $20,000,000 for the year. This also is double last year's business for this size of wire.

An interesting analysis of code wire orders to date is that, although the year opened with a high percentage of orders for No. 14, for the next three weeks, during which time more than half of all the orders were booked, the percentage of No. 14 to total code dropped off nearly one-half. This would give rise to the assumption that a great amount of wire of a current-carrying capacity higher than No. 14 was being ordered in anticipation of requirements for larger construction at the time when this wire should be delivered in the early spring. No. 14 is being booked from wire producers now in amounts that represent about half of all the code wire booked. This is apparently in line with the amount of light circuit wiring for which supply jobbers are preparing when spring building shall open up. Over the first six weeks of last year the ratio of No. 14 to total code was only 17 per cent.

Manufacturers are quoting shipments of forty-five to sixty days on present bookings. At the opening of the year shipments were being made in about thirty days.

Canadian Manufacturers Need More Support from Jobbers

IN ORDER to encourage Canadian manufacturers of electrical materials, Canadian goods should sell in that country for slightly under what American goods would command. For materials of similar manufacture and quality this in general applies at the present time. But not in all cases can Canadian goods be bought in Canada at prices under those which rule for goods from the States. In some factories north of the line more labor is required to do the same amount of work as is done below the line, with a resulting higher producing charge. This at times is even sufficient to overbalance the difference in cost of importing into Canada raw materials and finished product. Without doubt the factor of quantity production enters into the proposition to some extent.

At the same time, certain Canadian jobbers are endeavoring to obtain from their manufacturers sufficient protection to enable them to import goods from the States at a price lower than that charged by the Canadian manufacturers. If anything were going to kill Canadian industry, it seems that this action on the part of these jobbers would be an important factor in bringing it about. Of course, where quality or delivery might enter, the question of importation over home goods is legitimate. Canadian factories are as badly handicapped, in proportion, today as American factories because of lack of raw materials, transportation and the short labor market, and regardless of the tariff and an exchange of about 17 per cent extra, much American electrical material is being used. If Canadian manufacturing is to be built up, it seems as if this desire on the part of certain jobbers to have protection from their own manufacturers so they can import similar goods certainly ought to be curbed.

Jobbers Have Ordered Heavily in Anticipation of Active Year

JOBBERS in the New York territory of the Eastern district are looking forward to a year of heavier business than that just passed. They have ordered further in advance than ever before and in larger amounts. In view of this fact, whenever the question has been asked as to whether or not they could utilize all their stocks if every manufacturer should fill every order on time, almost without exception the answer has been an affirmative. Very few jobbers say they would be swamped with goods. In fact, most of them say they would be glad to get more. So, although the booking has been at such a heavy volume, apparently it has not been done merely in order to cover, with the hope of getting some orders through, but with some real regard to the needs of the electrical supply industry this year.

Requirements of heating devices for the entire year are being, or have been, booked. This is an unusual condition for a line a short time ago considered seasonal. Jobbers are attempting to take care of their needs well into the fall on such material as pipe, flexible armored conductor, metallic and non-metallic flexible conduit, boxes, knobs, cleats, locknuts and bushings. Shipments on schedule material are likewise well along in the year. It is felt that the building needs of the territory can be slightly bettered this year and that every bit of wiring material that can be manufactured can be put to use. Consequently it comes down to a case of production. An evidence that caution is being practiced is the attitude of one jobber in canceling an order for pipe. His order would have been accepted by the manufacturer for December shipment, although the original quotation was for August shipment.

Stocks are very incomplete. Even before the snows tied up transportation, jobbers were making only hand-to-mouth deliveries on the wiring materials heretofore mentioned. In the spring, however, it is expected that conditions will be better as manufacturers of pipe, boxes and porcelain should have their added capacity in shape to turn out more material. Lamp stocks fell off a month ago, and it was with difficulty that even incomplete stocks were maintained, with the long shipments prevailing. That situation is better at this time and should improve with the spring months. The rate of turnover of agents' stocks will be watched much more closely this year than heretofore.

Fans have been ordered in better quantity than ever before, and at least one manufacturer already has his stocks well distributed in his agents' warehouses. Collections are being watched very closely. At the same time, the credit standing of the contractor-dealer is improving at a very encouraging rate. As an instance, during the year 1919 the contractor-dealers of one prominent supply jobber with a wide territory came from twelfth place to third place, and with that in view other jobbers should have less trouble in the coming year with their credits as regards this class of customer.

The first month started off with a very high rate of sales and was limited only by the amount of material which was brought in. February's sales, on the other hand, have been fewer because of an epidemic of sickness, bad transportation and curtailed building on account of the cold weather. March buying is expected to start in at an increased rate. Building materials are in better volume than for some time, and it is felt in the building materials trade that prices have about reached their peak. The attitude of certain building interests in postponing the execution of their plans because of high material costs may have some bearing on a lower materials market.

Lamp Manufacturers Withdraw Turnover Rider From Agents' Contract

As AN echo of the discussion which the Mazda lamp companies occasioned when they submitted to the lamp agents their recent lamp rider calling for six turnovers a year, these companies have entirely receded from their position that this number of turnovers was practicable.

When this proposed action was placed before the jobbers in Cleveland last November, the opinion was virtually unanimous that six turnovers a year were impossible, especially under present shipments. The manufacturers have taken into account the opinions of their agents in this matter, because of the close association of these agents with the trade, and have just withdrawn the rider, leaving the agents on the same basis as heretofore. There rests with these agents merely the moral persuasion to shoot for the highest rate of turnover possible.

Trend in Commercial Fixture Design Toward Use With Gas-Filled Lamp

DEFINITE tendencies in lighting fixtures are more easily discernible today than they have been for several years past. This is true for industrial types, commercial types and residential types. It is perhaps because planning and designing done during the war have all at once crystallized into actuality. In the industrial and commercial fixtures the prevailing influence on design has been the greater knowledge of the operating requirements of the gas-filled incandescent lamp. For use with this type of lamp, reflectors have been developed consisting of a dome and a skirt of porcelain-enameled steel. This is most commonly exemplified in the R.L.M. standard which has come into such common use that its characteristics are well known. The tendency to follow this general design is quite marked and is fairly well understood by the trade.

On the other hand, developments in the totally or partly inclosed fixture for gas-filled lamps have not been as widely heralded. In the earlier days these fixtures were all built with ventilating openings at the top and the bottom so that air could circulate past the bulb of the lamp. Dependence for the circulation was placed on the heat from the lamp itself, it being expected that the hotter air within the fixture would create a chimney effect to cool the lamp and parts of the fixture. There were several errors in this assumption. The first was in estimating the value of the chimney effect. The inclosed column of air under consideration was in most cases less than a foot long, and with such a short air column the temperature differences were not enough to create a real draft. What was created was a gentle suction which was sufficient only to suck in dirt particles to deposit on the lamp bulb and the fixture interior. Moreover, once these were inside the unit and were deposited, there was slight chance of any air current dislodging them. This type of fixture for these reasons sometimes gave more trouble from dirt than did a bare lamp from which dirt might be blown off. This same ventilation idea had the further disadvantage that it collected all of the heated air and carried it up around the neck of the lamp and around the wires leading into the fixture, which are two places where cooler operation is desirable. Many of these difficulties could not be foreseen, of course, and it is only since practice has brought them out that improvements have been possible.

The way out of these difficulties, according to present tendency, seems to be through totally inclosing the fixtures and making them dust-tight and nearly air-tight. Where air spaces were once thought necessary in fixtures clear glass has now been substituted. Even at the fitter it seems likely that oiled felt or a similar substance will be used to check this last path by which dust might enter the inclosing globe. A felt joint is considered advisable here to permit the fixture to breathe. As the air within the diffusing globe expands with heat it is driven out, and as the unit cools it draws air in. If the new air enters through oiled felt, it will lose most of the solid particles it carries. In the general group of fixtures that fall in this class are many designs intended for a variety of uses, but the broad tendency is for total inclosure to reduce maintenance labor to a minimum.

Dutch Lamp Manufacturer Licensed by G. E. to Make Lamps in Canada

THE Just & Hanaman fundamental incandescent lamp patent, under which virtually all lamps are manufactured in the United States, apparently is considered fundamental in Canada, according to the announcement which has been made just this week to the effect that the Canadian General Electric Company, Ltd., has issued a license to the Canadian Laco-Philips Company, Ltd., to manufacture incandescent lamps in Canada for distribution in that country. Up to six months ago the Laco company was a vital factor in the distribution of lamps in Canada, but since that time it has not imported any from Holland, it is stated, because of high manufacturing costs in that country.

The Canadian Laco-Philips Company's interests will organize a new company and are arranging to have the stock largely in the hands of Canadian electrical interests in different parts of Canada, and will continue to have, as heretofore, a Dominion wide distribution of lamps under the trade-name "Laco." The company has, however, no license to import lamps. Arrangements are being made to take over one of the existing lamp companies of Canada so that the manufacture in that country will very shortly be commenced.

It was only in the Feb. 21 edition of the ELECTRICAL WORLD that announcement was made covering the combination of the Philips Incandescent Lamp Works in Holland with the Edison Swan Electric Works, Ltd., in England.

Necessity of Financing Foreign Trade Through Foreign Investments

IN SPITE of the drop in foreign exchange, electrical exports have been maintained because of credits in this country and because of the urgent need for the goods abroad. This large export business can hardly be expected to last, however, in the face of the depreciation which foreign exchanges have suffered. Europe can buy only on long-time credit which banks at the present time are virtually unable to furnish.

In this connection Richard S. Hawes, president of the American Bankers' Association, in an address on "The Banker and the Electrical Industry," given before the St. Louis Electrical Board of Trade on Feb. 3, stated that the United States is drifting into a fog of economic conditions and that financiers have no precedents to guide them in their efforts to improve matters. He was very optimistic about the future, however, and was confident that solutions would be found for the problems now facing the country.

Mr. Hawes said, speaking of the two ways in which exports of electrical and other commodities could be financed, that the method of government aid was out of the question. The remaining method was by the sale of foreign securities in this country, and on this point the electrical industry should understand, said the speaker, that the solution of foreign trade finance rested with the investing public of America. He thought that through the formation of a holding company which would buy foreign securities and guarantee them to American investors some of the surplus purchasing power of the country, which far excelled its producing power during the last six months, could be diverted into foreign channels. This plan is now being considered by a committee of financiers, Mr. Hawes added.

The foregoing applies more particularly to exports to Europe, which is buying more than it sells. The reverse is true of South America and Japan, for the United States is shipping gold to those countries to cover the trade balance against it. One way to help bring the trade balance in favor of this country is for the electrical industry to increase its business with South America and Japan. At the rate at which gold is now being shipped out of the country it is said that the surplus of the precious metal will disappear in about six months unless more gold is received from abroad.

Metal Market Situation

TOWARD the end of last week copper inquiries began to turn into orders for domestic consumption, and substantial sales for shipment during the last part of the second quarter were made by producers at 19 cents. After the holiday the sales kept up, and quite a volume of business in rather small lots is being done for May and June delivery. Producers are holding their prices firm at about 19 cents not only for nearby delivery but also for delivery through June, although some little amounts of prompt copper have gone for a shade under this figure.

The outside market also is experiencing a stronger tone, and some sales have been made at prices slightly above those of the producers. Most of the buying in both markets, however, is for the second quarter. The third quarter is not lacking in attention, but sellers are not very anxious to book any of the inquiries that are about for deliveries as far ahead as that. For this position producers are quoting 19.75 cents f.o.b. refinery, while the outside market is quoting 19.50 to 19.75 cents.

Copper production is still being held in leash to a certain extent as the producers feel that it would be unwise to open up and free a greater tonnage than can be used at this time. It is probable, however, that with another big movement of the metal, such as was occasioned in December and January, the producers would bring about a general expansion of their production, and such an era of heavy buying would not be unexpected late in March.

Copper export buying has fallen off a bit in the last few days, but foreign stocks are getting low, and it will be a case of discontinuing activities in those countries or submitting to unfavorable exchange rates. The probabilities are that foreign buying will pick up again because the manufacturers are not of a disposition to give up entirely.

The leading lead-producing company has again raised its quotation 25 cents, bringing spot lead in New York to 9 cents a pound. The outside market, of course, has followed and is still slightly above this producer's price. Demand has not let up nor has the supply caught up. In fact, production has not increased in a satisfactory manner, and the opinion has been expressed among the trade that it is no larger than it was a year ago.

NEW YORK METAL MARKET PRICES

	— Feb. 16 —	— Feb. 24 —
Copper	£ s d	£ s d
London, standard spot	118 5 0	121 0 0
	Cents per Pound	Cents per Pound
Prime Lake	19.00	19.25
Electrolytic	18.50	18.75 to 19.00
Casting	18.00	18.62½
Wire base	22.25	22.25
Lead, trust price	8.75	9.00
Antimony	11.62½	11.62½
Nickel, ingot	43.00	43.00
Sheet zinc, f. o. b. smelter	12.50	12.50
Spelter, spot	9.05 to 9.15	9.35
Tin	59.75	64.25
Aluminum, 98 to 99 per cent	31.00 to 32.00	31.50 to 32.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.50 to 17.00	16.50 to 17.25
Brass, heavy	9.50 to 10.00	9.50 to 10.00
Brass, light	8.75 to 9.00	8.75 to 9.00
Lead, heavy	7.25 to 7.37½	7.25 to 7.50
Zinc, old scrap	5.00 to 5.12½	5.00 to 5.12½

THE WEEK
IN TRADE

IT CANNOT be said that stocks are catching up in any volume to do more than begin to supply the demand which carries over from day to day. However large the shipment, it frequently goes to consumers without passing through warehouses. The lull in the supply business in the East is temporary, and jobbers feel that it will pass with the tie-up in transportation, both interstate and local.

Some manufacturers are booked so far in advance they are requesting their customers to go elsewhere. Not only manufacturers but also many jobbers are quoting prices which shall prevail at time of shipment on such material as conduit, flexible armored conductor, boxes and locknuts and bushings. Much other long-time shipment material is on this basis.

Rubber-covered wire shipments are lengthening again, but at that it is in better jobber stock than weatherproof, especially in sizes Nos. 6, 8 and 10. Loom continues low, although some lots are getting through better. Schedule materials are in better supply. Particular shortage is in materials using steel in their make-up. Single-phase motors are still short, and in the South distribution transformers under 25 kva. and 10-amp. meters are low in supply.

Cross-Arms, simplex irons and heating pads and General Electric distribution transformers are higher in price.

NEW YORK

Supply sales are still on a diminished scale. Freight movement is still slow and local transportation is badly handicapped because of blocked streets. However, jobbers have sufficient material to supply the daily needs of the trade, although they cannot fill complete orders on many of the wiring supplies. Jobbers are recalling prices on conduit, flexible armored conductor, locknuts and bushings and outlet boxes, and are quoting for future delivery on prices which shall prevail at that time.

Friction tape is suffering a shortage and manufacturers are urging the trade to anticipate their requirements well in advance. Stocks are very short. Price advances are placing it about on a par with rubber tape.

Cross-Arms.—Prices of fir cross-arms advanced 10 per cent on Feb. 20. This advance is effective on Eastern shipments. It is expected that pins and poles will follow later.

Tapes.—Friction tape prices have advanced so as to place this material almost on a par with rubber tape as far as price is concerned. One grade of common friction tape is selling for 48 cents in 100-lb. lots, with rubber at 50 cents. One jobber reports no stock of friction tape but expects some in two weeks.

Rigid Conduit.—Small stocks can be found here and there. Many jobbers are paying premiums for delivery. One-half-inch black may be bought at just under $79 in 1,000-ft. lots. At least one jobber has had ½-in. galvanized offered to him at $91, although from another source it was quoted at $80.

Flexible Armored Conductor.—The trade is being supplied in a hand-to-mouth way; No. 14 double strip is bringing around $96 and $99 in 1000-ft. lots.

Lamps.—Large stocks are reported by certain agents, but the 100-watt size is reported short from other sources.

Non-Metallic Flexible Conduit.—Loom seems to be coming in a little better; small sizes are scarce, but conditions are better in the larger sizes.

Schedule Material.—Poor deliveries are keeping stocks low. Certain manufacturers say they are many months behind on shipments and one advising those wishing to book orders to buy elsewhere.

Heating Appliances.—Stocks are in extremely poor condition because of the delivery situation and sales must be made from supplies affording very little choice.

Moving-Picture Cord.—A shortage is reported on account of the asbestos situation, with no immediate relief in sight. The demand is heavy.

Park Cable.—Manufacturers are behind on shipments because of the shortage of the steel covering. Municipalities are ordering in good amounts for their spring extensions.

Wire.—Prices are holding steady. No. 14 rubber-covered is selling for $12.50 to $13 for 1,000 ft. Deliveries from the mills are getting a little longer again, about forty-five days ruling.

Transformers.—General Electric distribution types of 33,000 volts and less and 500 kva. and less are up about 10 per cent, as of Feb. 9.

CHICAGO

Jobbers in this section state that the most important feature of present business conditions is not the volume of business that can be secured but rather the service that can be given customers. The uncertainty of obtaining goods of all kinds from manufacturers, with the attendant slow deliveries to customers, is making the paramount issue that of the customers' good will. With the thought that unsatisfactory service will prove to be a boomerang affecting future business at a time when business conditions may not be so good, one large concern is paying salesmen a bonus on the basis of satisfied customers rather than on the volume of orders brought in. There is a growing feeling among manufacturers and jobbers that orders which cannot be filled are a detriment to the good will of the establishment. Believing that price revisions will be downward before the year is over houses are being set in order for that eventuality. In all probability some lines have not reached the price peak and further advances may be expected. Among such items are control equipment and sheet-steel products. Business in pole-line material is picking up about a month earlier than in other years. This is thought to be due to the experience the trade has been having with slow deliveries. New building is being curtailed to a considerable degree by the scarcity of labor and to an even larger extent by the shortage of nearly all materials. A third large central station in this territory has decided to install an automatic rotary converter substation. Building permits in Chicago for the week ended Feb. 21 amounted to $2,700,000. Four large apartment buildings were included in this list.

Wire.—Stocks of wire are in fair shape in most cases. Weatherproof is in the majority of cases not so well stocked as rubber-covered. Prices remain steady with rubber-covered No. 14 at $12.50 per 1,000 ft. in 5,000-ft. lots. Weatherproof is quoted at $31.75 per 100 lb. for No. 6, in quantities from 100 lb. to 500 lb. No. 8 is quoted at $32.75 per 100 lb. in the same quantities.

Non-metallic Flexible Conduit.—Stocks are low in loom. Several houses state that they have had no loom stocks for several months, any that is received going direct to the trade. Quotations are being made on $\frac{7}{32}$-in. in 5,000-ft. lots at $33.50 per 1,000 feet.

Flexible Armored Conductor.—Stocks are very low and prices have been withdrawn in numerous cases. Quotations of $100 per 1,000 ft. are being made on No. 14 two-wire in coil lots.

Conduit.—Prices are fairly uniform with quotations on delivery basis in most cases. Deliveries are very slow with stocks in poor condition.

Knobs and Tubes.—Prices are stationary with stocks very low as a rule. The demand is heavy.

Motors.—Motor prices are about 10 per cent higher in lines manufactured by the smaller companies as compared with the larger companies. Stocks are low in small motors.

Cross-Arms.—On Feb. 20 an advance of about 12 per cent was announced. Stocks are fairly good at present as they have been built up in preparation for the spring business.

Schedule Material.—Stocks are unusually spotty. The trade has learned to anticipate its needs, and in some cases contractors are well stocked on all items.

Heating Appliances.—The volume of business has fallen off somewhat, but it is still as large as can be handled in good shape.

BOSTON

Orders continue to pour into the jobbing houses at a record-breaking pace, notwithstanding the almost complete paralysis of railroad freight transportation resulting from recent storms. City deliveries are being made without serious trouble, and improved mail service has resulted in a marked gain in collections. The peak of the influenza has passed, and better labor conditions are anticipated in the immediate future. Prices continue firm, with advances locally in armored flexible conductor, Simplex irons and heating pads. Stocks are chaotic as to make-up, many broken types and sizes being noted. Appliances are running scarcer, but wiring materials apart from porcelain are in better supply. A leading jobber states that up to Feb. 18 his business this month ran far ahead of the entire month a year ago, and the indications are that he will double his 1919 business this year. Single-phase motors and non-metallic flexible conduit are very scarce. Building operations continue to show expansion. The United Electric Light Company, Springfield, Mass., will build a 10,000-kva. substation this year to serve the north end of the city and has contracted for a 25,000-kva. turbo-generating unit within the past few days. Important housing plans are going forward in the Connecticut Valley.

Wire.—Prices are steady and the supply is good. Rubber-covered wire is quoted on a 30-cent base, weatherproof at 29 to 30 cents, and bare at 26 cents. No. 14 rubber-covered brings $11.50 per 1,000 ft. Demand is healthy.

Flexible Armored Conductor.—This material is quoted at $98.50 this week for No. 14 single-strip and $108.50 on double-strip, in coil to 1,000-ft. lots, showing an advance of $3.50 to about $5 over a week ago. Stocks are low and no immediate betterment is expected.

Metallic Flexible Conduit.—Very little of this material can be had, and jobbers are looking out for old customers only. A 15 per cent discount off list is quoted, with active demand.

Non-Metallic Flexible Conduit.—Prices are steady at $37 per 1,000 ft. for $\frac{7}{32}$ in. and $40 for ¼-in. sizes in coil to 1,000-ft. lots. The market is almost exhausted.

Porcelain Tubes.—Standard packages sell, when obtainable, at $9 per 1,000 in the 3-in. size. Famine conditions prevail in many stock rooms.

Nail-it Knobs.—These are almost out of the market. One jobber drew a carload shipment from the railroad raffle a few days ago, but the knobs never reached the sidewalk in front of his stock room. A recent quotation is $28 per 1,000, in barrel lots.

Sockets.—On Feb. 9 leading Boston jobbers doubled the manufacturers' list on Bryant, Hubbell, Pass & Seymour, Paiste, Cutler-Hammer and Weber sockets, switches and plates and established the following discounts: Less than ½ standard package, 30 per cent; ½ standard package, 42½ per cent; standard package, 55 per cent. The supply is at present good, with pulls quoting at 50 cents, keys at 28 cents and keyless at 26 cents, in case lots. One jobber had 50,000 pulls on hand Monday.

Rigid Conduit.—Demand far outruns supply. Black pipe, ½-in., is quoted at $83.75 per 1,000 ft. and white at $88.85. Shipments are very uncertain, and there is no likelihood of an adequate supply for some time.

Dry Cells.—A fair demand and reasonably good stocks are noted. No. 6 cells bring $32.90 per 100, and the ignition type $33.90, in barrel lots.

Appliances.—Simplex irons have advanced from $7 to $7.50 list and heating pads from $9.50 to $11 list. Manufacturers of electric tableware are swamped with business. Jobbers are ordering well into the fall. Washers and cleaners are in great demand, but transportation conditions are slowing down deliveries. Much interest is being displayed in electric mangles. Toasters are running low.

Motors.—Single-phase motors are quoted around twenty-two weeks' delivery. Polyphase motors of 1,800 r.p.m. rating are scarcer, but the 1,200-r.p.m. units are easier at the moment. Motors of 75 hp. rating and over are much more available, and not a few odd sizes are to be picked up readily.

ATLANTA

Influenza, which is almost epidemic throughout a large portion of the Southeastern territory, has failed as yet to cause any appreciable slowing down in the amount of orders received. Many firms, however, are reporting insufficient help owing to employees being away on account of illness, and outgoing shipments are therefore somewhat interfered with.

Despite an increase in price in nearly all lines of building materials, announcements of new construction continue to be received. Plans have been announced for the construction of a new office building, several large apartment houses and a number of new store buildings in Atlanta, while reports from all of the Southeastern cities show similar activities. A great many of the smaller towns are announcing construction of hotels.

The increasing difficulty in obtaining supplies of all kinds is reported by all jobbers. Stocks are becoming more and more scant, while supplies of material into which steel enters largely are practically wiped out. This difficulty is on the increase and is having a tendency to slow down construction, with the consequence that labor is reported easier than has been the case for some months past.

Bank clearings continue to show a healthy gain and collections throughout the territory are reported fair.

Conduit.—If possible, the conduit situation is worse than heretofore reported. Jobbers are receiving only small allotments on their orders and are reporting these allotments taken forty-five to sixty days in advance.

Armored Conductor.—No stocks worth mentioning are in the territory. Deliveries are slow, reported at approximately three months, but prices remain steady. No. 14, two-conductor, lots of 1,000 ft. to 2,500 ft., commands $108.90 per 1,000 feet.

Wire.—A slight improvement is noted in the wire situation. Several large shipments have been received, and this has served to relieve the shortage. There is still considerable difficulty, however, in obtaining No. 6, No. 8 and No. 10 weatherproof. Shipments are fair, with rubber-covered on 28-cent base and weatherproof on 29-cent base.

Non-Metallic Flexible Conduit.--One jobber reports the receipt of a large shipment which will serve to fill a great many of the back orders, relieving the tension somewhat. The demand continues brisk, and in the face of slow deliveries this relief will be only temporary. Prices, $\frac{5}{16}$-in., lots 250 ft. to 1,000 ft, $4.14 per 100 ft.; $\frac{7}{32}$-in., lots 250 ft. to 1,000 ft., $3.80 per 100 feet.

Transformers.—Stocks of distributing transformers up to 50 kva. are reported spotty, the demand for the more popular sizes having depleted local stocks despite fair shipments of approximately four weeks. High-tension outdoor-type, however, are not to be had under sixteen to eighteen weeks, all local stocks being exhausted. Prices have advanced approximately 10 per cent on the high-tension type of transformer.

Meters.—Good stocks of 5-amp. meters are reported, but there is a shortage in the larger sizes. There is an excellent demand and business is double that of last year. One large manufacturer reports several of the moderate-sized utilities having standardized on the 10-amp. size in place of the 5-amp. size.

Schedule Material.—Poor shipments are causing stocks to become rapidly depleted. Jobbers fear a severe shortage unless production is materially increased.

Electric Arc Welders.—A broadening market is reported for this specialty, the growth of manufacturing concerns throughout the section creating considerable demand for this class of electric apparatus.

SAN FRANCISCO

Rain has softened the ground and relieved the great distress, but as only an inch of snow fell on the Sierras, it is probable that measures similar to those effective in war time will be passed regulating the unnecessary consumption of electricity. Cattle men were on the verge of shipping cattle out of the state to Texas.

Cross-Arms.—The 5-ft. four-pin arm in average quantities sells for about 10 cents each f.o.b. Pacific Coast points, and the 3¾-in. x 4¾-in. power arm, with the spacing required by law, for 12½ cents in the same size. These prices are about 15 per cent over those prevailing during last year. Distributers' stocks are good, since the mills have generally caught up on back orders and new orders have been scattering.

Poles.—Prices are steady, stocks are fair, and the call is reasonably good. Shortage of power through lack of water will curtail 90 per cent of extensions contemplated during 1920, it is said, but orders for linking up systems will continue a demand that will be fairly steady through the coming year.

Insulation Material.—The call for friction and rubber tapes is very steady, although confined to commercial grades. The demand for the higher-priced tapes seems to be decreasing year by year. Present prices on 8-oz. rolls of friction and rubber tape, respectively, in the standard quantity of 100 rolls, are 27 cents and 29 cents per pound. Business is very good because of many standard wiring jobs, but calls for other insulating material, such as insulating tape and cloth, is not so good as it was in 1919. The rewinding and repair of motors has dropped appreciably.

SEATTLE—PORTLAND

Business in this territory is flowing along smoothly with no particular increases or decreases. Both jobbers and retailers report house-wiring devices, domestic appliances, ornamental lighting fixtures, lamps, etc., moving well.

Demand for heavy power apparatus and accessories required by ship-building plants and allied industries is at a minimum. In the Seattle district, particularly, steel ship building is practically at an end for the time being. Yard owners, according to reports, are still negotiating for contracts, but no awards have been made public. However, the award of a considerable number of drydock and remodeling contracts by the Emergency Fleet Corporation is replacing some of the shipyard work. Machine shops and foundries are operating to capacity, despite the loss of a heavy volume of shipyard work formerly handled by them, and the demand from this quarter for motors, etc., has kept up satisfactorily. The Seattle schoolboard has instructed the school architect to prepare plans immediately for school structures to cost $1,300,000, and bids will be called for at an early date. Indications are that big business building, aside from residence construction, will be carried on to a considerable extent in the Puget Sound district commencing this spring.

The Portland district reports business good throughout the district. The only difficulty for the coming year, which is growing more serious each week, is the inability to deliver goods sold. Items which until recently could be promised for shipment in six or seven weeks are now uncertain for six or seven months' delivery.

An electrical manufacturing plant in Seattle will shortly begin operation, manufacturing from 100 to 200 electrically operated washing machines per month.

Table Stoves.—Several Seattle retailers report the demand for this type of appliance steadily on the increase, and considerable difficulty is experienced in maintaining a semblance of fair stocks. Prices show no increase.

Electric Ranges.—Demand for these is showing a satisfactory increase. Several large apartment house projects in the city plan to install electric ranges throughout. Stocks are in fair condition.

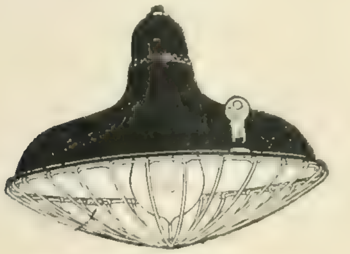
Schedule Material.—In the face of a brisk demand jobbers' stocks are well maintained, although unless deliveries are made shortly from Eastern factories, a shortage will develop. Prices are steady.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Lamp Guards Fit Steel Reflectors

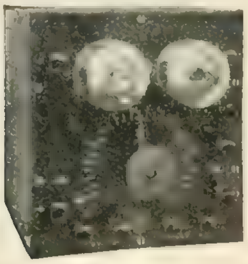
Steel lamp guards designed to fit on any type of metal reflectors are being offered by Frank W. Morse, 289 Congress Street, Boston. These reflectors are of heavy galvanized steel with electro-welded joints. They clamp around the edge of the reflector and are held firmly in place by a screw-eye bolt. Padlocks are furnished with the guards if desired. The guards are made to fit reflectors from 6 in. to 24 in. in diameter. A shallow type of guard is made for bowl-shaped reflectors, and for the street-lamp type of reflector guards 11 in. or 12 in. deep are used. The guards are provided with a hinge so that lamps may be removed without unbolting the guard from the reflector.



MADE FOR ANY REFLECTOR

Two-Stage Amplifier and Detector

Two amplifying transformers mounted on one base make up the two-stage amplifier of the International Radio Telegraph Company, 326 Broadway, New York City. This apparatus is designed for use with standard audion tubes having four-contact bases. The amount of amplification is variable by means of a filament rheostat which controls both tubes. This amplifier, it is claimed, will ordinarily give about 350 times the signal intensity had by connecting the telephone directly to the audion, and a single stage will usually give about twenty times this intensity. A modification is provided by a switch which changes the internal connection to either one-stage or two-stage as may be required. This amplifier may be used as a single-stage device even though one of its tubes is broken or burned out. Should it be desired to use the amplifier with a crystal detector, a modified transformer can be supplied for the first stage.



TWO-STAGE RADIO AMPLIFIER

Compact Motor-Driven Air Compressor

For use where floor space is scarce, as in salesrooms, oil-filling stations, etc., a motor-driven air compressor is being manufactured by the Brunner Manufacturing Company, Utica, N. Y. The 32-gal. tank rests on a cast-iron base which supports four pipes holding the frame for the power plant. This plant consists of an air compressor with a displacement of 2½ cu.ft. of free air per minute and a ½-hp motor which it is said will start the compressor against 130 lb. pressure without overloading. The motor is furnished in alternating-current or direct-current type for 110 and 220 volts, and also for 32 volts direct current. The floor space taken is 20 in. x 22 in., and the height is 56 in.

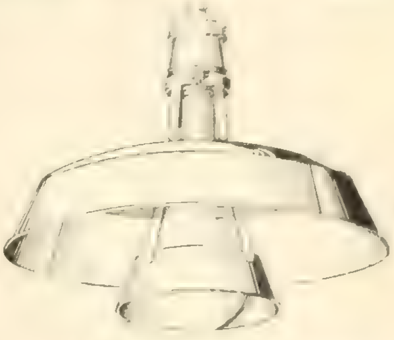
WILL FIT INTO A CORNER

Foot-Operated Tumbler Switch

Solid construction, compactness and reliable operation are features of a tumbler switch for use on vacuum cleaners, washing machines and other household appliances which has been developed by the General Electric Company of Schenectady, N. Y. The switch has a very heavy nickel cover with a rugged porcelain base, and the handle is of compound. The construction is of sufficient strength to permit of the switch being operated by foot, and such operation is further facilitated by the fact that the knob is knurled to prevent the foot from slipping. It is rated at 3 amp., 250 volts, and at 5 amp., 125 volts.

Industrial Lighting Unit

The Luminous Unit Company of St. Louis has a new development in industrial lighting called the "Industrolite." Both reflecting members of the new unit are porcelain-enameled, and supports are nickel-finished. The dark brown of the outside of the large shade contrasts with the white porcelain. Heavy construction of all parts, the manufacturer says, insures permanence and freedom from trouble. The unit is made in two sizes, 75-watt and 200-watt.



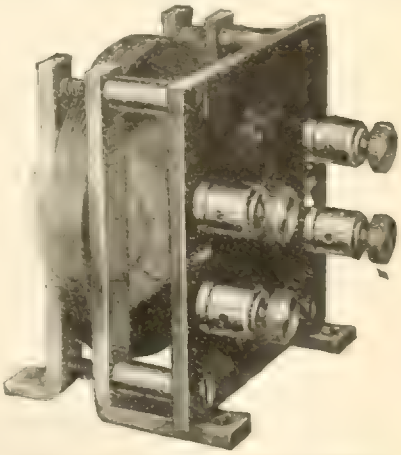
HAS TWO REFLECTING SURFACES

Lineman's Safety Belt

A belt for electrical linemen has been put on the market by the Industrial Products Company, 1001 Chestnut Street, Philadelphia. The belt is in two parts, a body belt and a safety strap. The body belt is 2 in. wide with a 3-in. leather cushion inside which is looped around the D rings. The safety strap is 2 in. wide and 6 ft. long. The buckle is protected by leather reinforcement.

Radio Amplifying Coil

An amplifying coil with iron core designed to operate with the vacuum tube detectors now on the market has been developed by the Clapp-Eastham Company, Cambridge, Mass. Two or more of these coils may be used with as many amplifying tubes and still greater amplification be secured. This coil is supplied mounted, as shown in the illustration, for screwing to a table, or without the iron stand for mounting on a panelboard.



AMPLIFIES VACUUM-TUBE CURRENTS

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE WIRT COMPANY, Philadelphia, Pa., manufacturer of electrical supplies, will erect a new addition for increased capacity, and plans have also been made by the company for alterations and improvements in the existing works.

UNITED WIRE AND SUPPLY COMPANY, Auburn, R. I. plans for the construction of a two story addition to its Cranston plant. The structure will be about 40 ft. x 250 ft. and is estimated to cost $100,000.

THE SELECTED ELECTRIC APPLIANCE COMPANY, Providence, R. I., has filed notice with the Secretary of State of an increase in its capital to $60,000 to provide for general business expansion.

NEW PLANT FOR HURLEY COMPANY.—The Hurley Machine Company, Chicago, is extending its manufacturing facilities into two additional plants. The company's plant No. 1 at Fifty-fourth and Cicero Streets, Chicago, will continue to be operated at its full capacity, plant No. 2 will be started at Halsted and Fulton Streets, and plant No. 3 will be opened at Waukegan, Ill. It is planned that in the year 1920 this company shall do four times the amount of business which it did in 1919. According to the company's January report, it did about $6,000,000 worth of business in 1919, and therefore, according to its estimates, it should do about $24,000,000 of business in 1920. This figure may be compared with a figure of $50,000,000, which is said to be the total production of the washing-machine industry for 1919.

HURLEY MACHINE COMPANY'S ANNUAL SALES CONFERENCE

THE TRENLE PORCELAIN COMPANY, East Liverpool, Ohio, suffered $75,000 loss in a fire on Jan. 20. The company, which manufactures electro-porcelain, will rebuild its factory at once, it is reported.

THE VAN DORN ELECTRIC TOOL COMPANY, Cleveland, Ohio, is building a four-story addition of 30,000 sq.ft. of floor space for the manufacture of portable electric drills, reamers and grinders.

THE AMERICAN NATIONAL EXPOSITION, INC., 132 West Forty-Second Street, New York City, announces that an exhibition of American manufactures will be held under its direction in Buenos Aires next November.

C. W. CURTISS and A. B. CHASE, recently general manager and factory manager, respectively, of the Splitdorf Electrical Company, Newark, N. J., have formed plans for the organization of a new company to specialize in the manufacture of electrical goods. The new interests have acquired property at Plane; Hackett and Warren Streets, formerly the Hedenberg Iron Works, about 191 x 370 ft., for the proposed new plant. It is understood that the new works will be erected on the unit plan, the initial building to be about eight-story with construction work to be inaugurated early in the spring of the coming year, and estimated to cost about $400,000. About 130,000 sq. ft. of floor space will be utilized.

THE VACUUM CLEANER SPECIALTY COMPANY, INC., New York City, during December received a formal complaint from the Federal Trade Commission because of "disparagement of competitors' goods."

G. L WASHINGTON of the Westinghouse Electric International Company has left for Cuba to join the sales department of the Havana office of the company

THE BLAW-KNOX COMPANY, Pittsburgh, Pa., announces that O. A. Olstad, formerly connected with the New York office, has been made manager of the New England territory, with offices in the Little Building, Boston, succeeding A. W. Ransome, who has been appointed manager of the Pacific Coast territory, with offices in the Monadnock Building at San Francisco, Cal.

THE MARTINDALE ELECTRIC COMPANY, 11737 Detroit Avenue, Cleveland, Ohio, is the new name of what was formerly The Handy Supply & Manufacturing Company, the change dating from Jan. 1. E. H. Martindale is president and general manager and only recently resigned as sales engineer of the National Carbon Company to become president of The Handy Supply & Manufacturing Company. Mr. Martindale is a graduate of Case School of Applied Science, class of 1908, a member of the board of directors of the American Institute of Electrical Engineers and spent a year in France as captain in an engineering regiment. In addition to its business in commutator stones, commutator slotting files and insulating varnishes, the Martindale Electric Company will act as exclusive agent for Volk refillable fuses, Marble-Card direct-current motors and generators, St. Louis Electrical Works alternating-current motors and Chandeysson industrial sewing-machine motors, as well as distributing products of the Efficiency Electric Company.

THE REMMERT MANUFACTURING COMPANY'S electric washing-machine factory at Belleville, Ill., was destroyed by fire on Jan. 27. Seven hundred finished machines and a large stock of materials were also destroyed. The work of rebuilding the factory was started almost immediately, and the company hopes to begin making washing machines again by March 1.

THE CENTURY ELECTRIC COMPANY, St. Louis, Mo., is proceeding to increase its manufacturing facilities about 60 per cent by the erection of a 180-ft. x 106 ft. six-story factory building near the present plant. The company has purchased sufficient ground to provide for the growth of its business for some years to come. The present addition is to permit expansion in the lines of alternating-current motors.

THE LAPP INSULATOR COMPANY, Le Roy, N. Y., announces that it is proceeding immediately to the erection of an additional factory and the installation of considerable new machinery to increase its capacity 60 per cent within the next five months. The capital is also being increased from $150,000 to $500,000 to take care of rapidly increasing business.

THE GENERAL INSULATE COMPANY, Brooklyn, New York, at it's board of directors' annual meeting in January voted to increase the capital stock of the company from $50,000 to $250,000.

THE KING MANUFACTURING COMPANY, St. Joseph, Mo., manufacturer of street lighting standards, fixtures, etc., is building a forty-thousand-dollar foundry.

R. E. UPTEGRAFF, designing engineer with the Adams-Bagnall Electric Company (as stated in the May 10, 1919 issue of ELECTRICAL WORLD) announces his resignation as of Jan. 31. He is to continue his engineering work with Rutherford & Uptegraff, First National Bank Building, Pittsburgh, Pa.

THE RHODE ISLAND GLASS COMPANY of the General Electric Company has begun work on an addition to its plant at Central Falls, R. I. The new building will be about 50 ft. x 96 ft. and will be three stories high.

THE GENERAL LEAD BATTERIES COMPANY, 123 West Fifty-sixth Street, New York, manufacturer of storage batteries, has made plans for the erection of a plant at Lister Avenue and Chapel Street, Newark, N. J., to cost $150,000.

THE MAYTAG COMPANY, Newton, Iowa, has under way a five-hundred-thousand-dollar factory expansion involving a foundry, 310 ft. x 134 ft., and a four story addition to the washing-machine assembly building, 520 ft. x 90 ft.

H. N. SPENCER, president of the Howell Electric Motors Company, Howell, Mich., announces that the brass foundry, shipping and reserve stock rooms were destroyed by fire of unknown origin on Feb. 16, with a loss of approximately $30,000. The main factory building was not damaged, and production, at a rate of one-half time, was started the next morning. A temporary building is now in course of construction, and contracts have been let for a building 140 ft. x 60 ft. It will be entirely of steel and concrete and will be started at the earliest possible moment.

THE BOSTON BELTING COMPANY, Boston, Mass., announces through its president, W. E. Hardy, that W. E. Hardy, F. H. Rice and H. H. Whitesel and associates, who have been operating the Boston Belting Corporation (so far as production and sales are concerned), have purchased and taken over all assets of the corporation which relate to the mechanical rubber-goods business. The Boston Belting Company, whose major assets had been transferred to the Boston Belting Corporation some two years ago, had never been dissolved. Consequently, on Nov. 6, when Thomas A. Forsyth and J. H. D. Smith resigned as directors and president and treasurer respectively, their positions were filled by the election of W. E. Hardy, president and general manager, F. H. Rice, treasurer, and H. H. Whitesel, director and sales manager. The Boston Belting Company, incorporated under the laws of the State of Massachusetts, was originally established in 1828, and was incorporated by state legislative grant in 1845 as the Goodyear Manufacturing Company, the firm name being changed in 1847.

THE MITCHELL-RAND MANUFACTURING COMPANY, New York City, has sent out cards of samples of armature twines. The company has adopted a new system of gaging these twines, which greatly simplifies the method of determining sizes.

EARL E. WHITEHORN, advertising service for manufacturers and jobbers in the electrical industry, has moved his offices uptown from the Equitable Building, where he has been for several years, to 320 Fifth Avenue. Larger quarters were needed to take care of growth of business.

M. A. BELKIRE, JR., has opened an office for the Booth Electric Furnace Company at 805 Hammond Building, Detroit, Mich. Another branch office has been opened by the company in Birmingham, Ala., in the Brown & Marx Building, in charge of Gassman & Cunningham.

THE ROME ELECTRICAL COMPANY, Rome, N. Y., has completed arrangements for immediate erection of a one-story addition to its plant, about 50 ft. by 90 ft., estimated to cost $20,000.

THE INTERNATIONAL EARTH-BORING MACHINE CORPORATION, Chicago, has, through its board of directors, appointed H. R. Sachse general manager of the corporation, in addition to which he will still retain his position as secretary of the corporation. This company was recently formed for the purpose of manufacturing three types of earth-boring machines which have been developed for drilling holes and setting poles for telephone, telegraph, light, power and railway companies.

THE MULTIPLE STORAGE BATTERY COMPANY, Jamaica, N. Y., has filed notice of an increase in its capital from $50,000 to $200,000 for general expansion.

THE NORTHWEST ELECTRIC APPARATUS COMPANY, 942 Security Building, Minneapolis, Minn., has been organized by John A. Clark, president and manager. Mr. Clark has been manager of the Northwestern branch of the Duncan Electric Manufacturing Company for the last five years and represented the company in that territory for the last ten years. H. R. McCullough, secretary and treasurer, has assisted Mr. Clark for the last five years. The company specializes in Duncan meters and transformers and in motors, generators, switches and protective apparatus. The capitalization is $30,000.

THE PATTEN - BROWN COMPANY, electrical and mechanical engineers and contractors, moved on Jan. 31 from 143 Prince Street to 353 Canal Street, New York City.

THE ACHESON GRAPHITE COMPANY, Niagara Falls, N. Y., has published a booklet entitled "Electric Furnaces" in which the electric furnaces manufactured in the United States are listed, together with the name of the manufacturer and a brief description of each furnace. The furnaces described in the publication include the arc type and those using some kind of resistors, and they are grouped under the headings of furnaces for steel melting, for melting non-ferrous metals and for heat treating. Induction furnaces and those special furnaces which have been developed for different purposes are not listed, though the names and addresses of the manufacturers will be given upon request. The booklet will be revised from time to time to include the new furnaces placed on the market.

Foreign Trade Notes

BAKING BY ELECTRICITY INCREASING IN SWITZERLAND.—According to *L'Exportateur Suisse*, the extraordinary rise in the prices of fuel has considerably furthered baking by electricity in Switzerland, although many ovens existed in that country before the war. Night energy can be supplied by hydro stations at very cheap rates for this service. The same condition applies to Norway and Sweden.

HIGH PERCENTAGE OF AMERICAN ELECTRICAL IMPORTS INTO BRAZIL. - The following table shows in pounds weight the relation of imports of electric motors and wire from the United States and from other countries into the port of Sao Paulo, Brazil, in 1917 and 1918:

	1917	1918
Cable, total	1,240,309	915,462
From United States..	960,038	915,462
Bare wire, total.......	86,220	202,008
From United States..	85,131	201,797
Insulated wire, total...	207,902	156,268
From United States..	206,582	155,547
Motors, total	191,002	90,838
From United States..	139,179	89,228

MICA REMOVED FROM INDIAN AND BRITISH EMBARGO LISTS.—All restrictions on importation of mica from Madras have been removed, and mica blocks, splittings and sheets have been removed from the British list of prohibited exports.

CZECHOSLOVAK GOVERNMENT TO MANUFACTURE TELEPHONE AND TELEGRAPH EQUIPMENT.—The Trade Commissioner at Prague states that with the co-operation of the government of the Czechoslovak Republic a company under the style of the "Telegrafia" is being organized at Prague with a capital stock of one million crowns to manufacture low potential instruments, such as telegraph and telephone instruments, railway signaling apparatus, and individual parts of these instruments, further to equip telegraph and telephone central stations and reconstruct them, standardize telephone and telegraph equipment for central stations, manufacture Bohemian independent types, etc., also to sell their own as well as foreign products of such sort. The Ministry of Post and Telegraphs of the Czechoslovak Republic has the greatest interest in the formation of this new stock company. It has signified its willingness to purchase for its needs all the instruments that will be suitable, as soon as the company commences active operation. Inasmuch as in Prague alone from three to four new telephone central stations are to be constructed, and as materials ruined by war and used by the State today in telegraph and telephone work already call for renewal, the prosperity of the company is securely founded.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A technical engineer for Norway (No. 31,720) is in the United States and desires to secure agencies for the sale of all kinds of electrical goods.

An electrical supply company in China (No. 31,721) desires to purchase electrical appliances.

An agent and factory representative in Spain (No. 31,728) desires to receive from manufacturers quotations on brass wire from 1 mm. to 10 mm in diameter, and brass and copper sheathing.

An engineer from Sweden (No. 31,729), who is in the United States, desires to secure agencies for the sale of electrical goods.

An engineer in Argentina (No. 31,731) desires to secure material suitable for electrical installations in small towns, such as self-contained engine-driven sets.

An importer in Spain (No. 31,732) desires to purchase for own account and secure agencies for electric motors and transformers.

A commercial traveler (No. 31,737), who has represented an American firm in Spain and Portugal, is about to return to Spain, and desires to secure an agency for the sale of electrical goods.

A firm in Brazil (No. 31,766), having recently added a commission sales department, desires to get in touch with exporters specializing in electrical goods.

The American agent of a firm in Holland (No. 31,768) desires to secure the sole agency for an electric hot-water tap or faucet with a wall contact plate.

An electrical supply company in Spain (No. 31,769) desires to represent manufacturers of electrical supplies and apparatus, especially telephone materials, and asks immediate quotations on a 1,000-subscriber automatic telephone equipment.

A firm in New Zealand (No. 31,774) desires to purchase and secure an agency for brass and copper sheets, tubes, rods, etc., and electric motors, direct-current and alternating-current.

The American purchasing agent for firm in Europe (No. 31,776) desires to purchase immediately household labor-saving devices, washing machines, vacuum cleaners, electrical supplies, motors and exhaust and ceiling fans.

A firm in Spain (No. 31,778) manufacturing small direct-connected, motor-driven pumps, and having large facilities for installation and repair work, desires representations of the following lines: electric generators, electric motors, principally of small sizes, wiring devices, and an electric automobile.

An agency is desired by a firm in Spain (No. 31,796) for the sale of telephonic and telegraphic apparatus, motors, generators, cables, electrical instruments, and highpower searchlights suitable for army field operations.

New Incorporations

THE COUNTRY HOME POWER & LIGHTING COMPANY of Louisville, Ky., has been incorporated with a capital stock of $30,000 by W. G. Simpson, Jr., of Louisville, Hubert and Graham Vreeland of Frankfort, Ky.

THE GOODLAND (IND.) MANUFACTURING COMPANY has been incorporated by Lawrence Romine, Dale A. Rowe and E. E. Kertis. The company is capitalized at $250,000 and proposes to manufacture electrical supplies.

THE LA PORTE (TEX.) WATER, LIGHT & ICE COMPANY has been incorporated with a capital stock of $13,000 to construct and operate a water and electric light plant and ice factory. H. R. Dean is among the stockholders.

THE WEBSTER LIGHT & POWER COMPANY of Luckey, Ohio, has been incorporated with a capital stock of $75,000 by Ruben Warnz and others.

THE WEST RIVER POWER COMPANY of Mount Holly, Vt., has been incorporated by R. R. Dan, W. H. White of Belmont, W. G. Russell of Mount Holly and E. J. Horton of Cuttingsville. The company is capitalized at $5,000 and proposes to supply electricity for lamps and motors in Londonderry, Jamaica, Wardsboro, Shrewsbury Wallingford and Mount Holly.

Trade Publications

RESIDENCE LIGHTING.—The National X-Ray Reflector Company, 235 West Jackson Boulevard, Chicago, Ill., is distributing folder No. 100 on the lighting of residences through the use of indirect lighting lamps.

MAGNET WIRE.—The Dudlo Manufacturing Company, Fort Wayne, Ind., has recently issued a folder giving equivalent sizes in other gages and also in metric units of the different sizes of magnet wire from No. 14 to No. 44, together with weights and resistances.

CIRCUIT BREAKERS. — Bulletin No. 47,419-A, superseding bulletin No. 47,419, has recently been issued by the General Electric Company of Schenectady, N. Y., descriptive of its small-capacity industrial oil circuit breakers, type FP-10, 50-amp., 600-volt, for three-phase and quarterphase induction motors of 25 hp. or less.

EMULSIFIER.—The Sharpless Separator Company of West Chester, Pa., describes its motor-driven emulsifier in a recent bulletin.

SEARCHLIGHTS.—The Grether Manufacturing Company of Dayton, Ohio, has recently issued a small booklet descriptive of its hand battery-searchlight for different purposes.

PUMPS.—The Pelton Water Wheel Company, San Francisco, Cal., in bulletin No. 10 describes its lines of centrifugal pumps.

INSTRUMENTS.—Hoyt electrical instruments for dashboard, miniature switchboard, larger switchboard and portable case are described in a recent catalog by the Burton Rogers Company, Boston, Mass.

SAFETY SWITCHES.—The V. V. Fittings Company, Philadelphia, has issued, to be inserted in its catalog No. 21, supplementary pages on its type BE quick-make and quick-break safety switches.

PYROMETERS.—The Brown Instrument Company, Philadelphia, describes in catalog No. 12 its lines of indicating and recording pyrometers.

PLANT EQUIPMENT.—The Star Brass Works, Chicago, has recently issued bulletin No. 6 pertaining to its line of small steam and water-jet apparatus, comprising steam and water siphons or ejectors and also small steam-jet pumps.

ENTRANCE SWITCHES.—The Trumbull Electric Manufacturing Company, Plainville, Conn., describes in a recent bulletin its externally operated entrance switches and meter protective trim.

VACUUM SWEEPER.—Parts 1 and 2 of the sales manual on vacuum sweepers with motor-driven brush distributed by the Western Electric Company of New York City are now available.

FLEXIBLE METALLIC TUBING.—The Breeze Manufacturing Company, Newark, N. J., describes in a folder the many uses of "Fle-x-met," a flexible metallic tubing.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

SPRINGFIELD, MASS.—The Gilbert & Barker Manufacturing Company has awarded the contract for the construction of a new power plant to A. E. Stephens of 145 State Street. The contract also includes alterations to the present plant.

PAWTUCKET, R. I.—The William H Haskell Machine Company has commenced the clearing of a site on Main Street for the erection of an addition to its plant, 81 ft. x 123 ft.

NAUGATUCK, CONN.—Electrical and mechanical equipment will be installed in the new building to be erected by the Naugatuck Chemical Works, to replace its factory recently destroyed by fire with loss estimated at about $100,000

Middle Atlantic States

BATH, N. Y.—The sum of $36,000 has been appropriated by the town officials for the construction of a new municipal electric light and power plant

BINGHAMTON, N Y —In order to satisfy demands for more power, the Binghamton Light, Heat & Power Company will begin work on the installation of new boiler equipment at the Johnson City works. This is in addition to the recently completed work of installing a new turbine unit.

BRONXVILLE, N. Y.—Plans are being considered by the Village Investing Company for a one-story brick power plant on Fairfield Road. The new building, which is to be 26 ft. x 30 ft., will cost in the neighborhood of $20,000.

BROOKLYN, N. Y.—A new ice-manufacturing and refrigerating plant, three-story, 130 ft. x 135 ft., will be erected by the Brooklyn Retail Butchers' Corporation, 3285 Fulton Street, at Atlantic Avenue and Fort Greene Place. The structure, with proposed electrical and mechanical equipment installation, will cost about $400,000. A. Rosen is president

BUFFALO, N. Y.—Application has been filed by the Niagara & Erie Power Company with the Public Service Commission for permission to construct a new electric light and power plant Plans for the new building have already been prepared.

HIGHLAND, N. Y.—The Acme Storage Battery Corporation, manufacturer of storage batteries and other electrical equipment, has increased its capital from $100,000 to $175,000 for proposed expansion

LONG ISLAND CITY, N. Y.—The Astoria Light, Heat & Power Company, Shore Road, has awarded a contract to the George A. Fuller Company, 175 Fifth Avenue, New York, for the erection of a new two-story building, 60 ft. x 362 ft., on Van Alst Avenue, to cost about $150,000, including equipment.

NEW YORK, N. Y.—The Petroleum Heat & Power Company, of 511 Fifth Avenue, is constructing a 3-story reinforced concrete boiler and pumping building, about 30 ft. x 40 ft., at an estimated cost of $51,000.

ROCHESTER, N. Y.—The Ontario Cold Storage Company, E. & B Building, will build a new cold storage and refrigerating plant at Ontario, N. Y., to cost about $100,000, including electrical and mechanical equipment. G. A. Wagner, 12 Amherst Street, Rochester, is architect.

WATERTOWN, N. Y.—A number of industrial interests at this place, including the International Paper Company and the Hinde & Dauch Paper Company, have plans under way for the establishment of a hydro-electric power plant in the vicinity of Sewall's Island, to be operated as a central station for general industrial service. The project is estimated to cost close to $1,000,000.

CAMDEN, N. J.—Up to the present time the Delaware & Atlantic Telephone & Telegraph Company has placed about 95 per cent of its lines underground in the business district, replacing the former overhead system.

IRVINGTON (NEWARK), N. J.—The Lionel Corporation, 605 South Thirty-first Street, manufacturer of electric toys, has filed plans for the erection of a four-story addition to its plant, 75 ft. x 82 ft., to cost about $50,000.

NEWARK, N. J.—A one-story brick power plant, 50 ft. x 100 ft., for works operation will be erected by John M. Campbell & Company, Plum Point Lane, Newark, in connection with the erection of five new buildings at its color and chemical works The project is estimated to cost about $150,000. Percy B. Taylor, Essex Building, is consulting engineer.

NEWARK, N. J.—A power plant, comprising boiler room, engine room and mechanical departments, will be erected by Clark & Company, Rose Street, in connection with the erection of an addition to its plant, 55 ft. x 170 ft., to cost about $150,000. The machinery to be installed will be electrically operated, with motor drive in various departments of the works. Thomas M. Clark is president.

NEWARK, N. J.—The present plans of the General Lead Batteries Company call for a five-story reinforced-concrete factory building to be built at Lister Avenue and Chapel Street. The new plant will cost approximately $150,000.

PHILLIPSBURG, N. J.—The Eastern Pennsylvania Power Company has commenced the installation of additional electric equipment in the local plant of the Warren Soapstone Company for increased power service.

PHILLIPSBURG, N. J.—The General Pulverized Limestone Company has arranged for a lease of the former power plant of the Eastern Pennsylvania Power Company, at Columbia, N. J., for general works service.

SOUTH AMBOY, N. J.—The Board of Trustees is considering plans for extensions and improvements in the street-lighting system. The service is furnished by the Monmouth Lighting Company.

ALLENTOWN, PA.—Electrical equipment and refrigerating apparatus will be installed in the proposed ice-storage plant of the Allentown Merchants' Ice Company at Fifth Street and Sumner Avenue. The capacity of the new plant will be about 5,000 tons.

EASTON, PA.—The Chipman Knitting Mills have enlarged their plant by building new additions and will be in the market for additional central-station service in the near future.

EASTON, PA.—The Dixie Drinking Cup Company is building a new plant and will employ from 400 to 500 persons. The power requirements of this plant will be from 200 hp. to 300 hp. at the start

EASTON, PA —The Pennsylvania Utilities Company has completed the installation of new generating equipment at its power plant at Stroudsburg. Machinery installed at this station has been remodeled and modernized, and the company's substation at Delabole has been rebuilt to allow for automatic operation.

EASTON, PA.—A two-million-dollar cement mill is shortly to be erected about one mile from the present transmission line of the Pennsylvania Utilities Company to the Warren Paper Company. It is expected to have a capacity of 3,000 barrels of cement per day. This new plant will be in operation in the early summer, at which time it will require a large power supply.

GETTYSBURG, PA.—The voters have approved a bond issue of $20,000 for the establishment of a municipal electric power plant for local lighting and commercial service.

HARRISBURG, PA.—The Harrisburg Light & Power Company will make extensions to its substation and transformer plant for increased lighting service in the Fourteenth Ward section.

HAZLETON, PA.—It is reported that extensions and improvements contemplated by the Cranberry Creek Coal Company include the installation of a large quantity of electrically operated mining equipment in the Alliance Colliery, Schuylkill County.

MARIETTA, PA —The Farmers' Electric Company, recently organized, is planning for the operation of a local power plant for light and power service. It is proposed to build a distributing line from Washingtonboro to Mountville, and construction work on this system will be inaugurated at an early date John N Ware is president.

McKEESPORT, PA.—The McKeesport Ice & Cold Storage Company is reported to be planning for the rebuilding of its refrigerating and cold-storage plant, recently destroyed by fire with loss estimated at $125,000, including equipment.

PHILADELPHIA, PA.—A new boiler plant is to be installed in the factory and bleach house which is being constructed at Clearfield and Janney Streets by John Blood & Brothers. The total estimated cost is $40,000.

PHILADELPHIA, PA.—The General Manufacturing Company has filed plans for an addition to its power plant for increased boiler service; improvements will be made in the engine department.

WILKES-BARRE, PA.—An application has been filed with the Public Service Company by the Wilkes-Barre Light Company for permission to issue bonds for $1,000,000. It is reported that a portion of the proceeds of this bond issue will be used for expansion.

BALTIMORE, MD.—In connection with its proposed new plant at Dundalk the Consolidated Gas, Electric Light & Power Company, Lexington Building, will defer calling for bids for the first unit for about twelve months. It is planned to build a three-unit plant at this location.

BALTIMORE, MD.—The Shenandoah Valley Milling Company, 418 Equitable Building, is planning for the erection of a hydro-electric power plant to be used for service at its mill at Front Royal, Va. Albert M. Quick is president.

BALTIMORE, MD.—The Sterno Corporation, recently incorporated with a capital of $500,000, is contemplating the construction of a plant in the Curtis Bay district for the manufacture of alcohol-burning devices for automobile service, electric heating and cooking devices, etc. A large part of the equipment to be installed will be electrical and will cost, together with cost of construction, about $400,000.

EMMITSBURG, MD.—The Board of Trustees, Mount St. Mary's College, is having plans prepared for a new steam-operated electric power plant at the institution to cost about $25,000. Frank J. Baldwin, 328 North Charles Street, Baltimore, is architect.

HAGERSTOWN, MD.—The city is contemplating a bond issue of $300,000 for the purpose of constructing an electric light plant.

QUEENSTOWN, MD.—An electric light plant to cost about $7,000 is being considered by the town commissioners.

North Central States

LITCHFIELD, MICH.—Bonds to the amount of $12,000 have been voted for an electric lighting plant.

ASHTABULA, OHIO.—A bond issue amounting to $300,000 for the erection of a power house has been asked of the City Council.

CLINTON, IND.—The Hatfield Electric Company of Indianapolis, Ind., has received the contract for wiring the new theater building of the Standard Theater Company, which is being erected at a total cost of $125,000.

EVANSVILLE, IND.—The Universal Manufacturing Company, a unit of the Liquid Carbonic Corporation of Chicago, is planning to erect a large addition to the present Evansville plant.

GARY, IND.—The Leonard Tractor Company, capitalized at $2,000,000, will soon begin the erection of factory buildings at Griffith, near Gary.

GARY, IND —The Panic Proof Products Corporation of New York has purchased the Gary plant of the Central Metallic Door Company and will at once begin the erection of additional buildings to cost $1,000,000

INDIANAPOLIS, IND.—The Indianapolis Light & Power Company has awarded a contract to the H. K. Ferguson Company, Cleveland, Ohio, for the erection of an addition to its power plant to cost about $50,000.

INDIANAPOLIS, IND.—Plans are being prepared for a new power plant for the International Printing Company, 230 McCarty Street, to be erected in connection with a new lithographing and paper-box works to cost about $150,000.

SEYMOUR, IND.—The Seymour Water Company will rebuild its steam plant and will also build a new sedimentation basin of 2,000,000 gal. capacity, designed to improve the filtration plant. The company recently installed hydraulic power equipment, and it operates its steam plant only when the condition of White River will not permit the operation of the water-power system.

SHELBYVILLE, IND.—A new boiler plant, 48 ft. x 75 ft.; mechanical drying plant, 41 ft. x 82 ft., and other structures will be erected by Cutainger & Thompson as extensions to their local veneer plant. The work, including mechanical and electrical equipment, is estimated to cost $85,000.

WASHINGTON, IND.—The City Council has under consideration plans for improvements to the municipal lighting plant that will cost between $60,000 and $70,000.

MOLINE, ILL.—The Tri-City Railway Company, Davenport, Iowa, has applied to the Illinois Public Utilities Commission for permission to increase its capital stock $195,000 for the purpose of purchasing all property, tracks and the franchise of the Moline, Rock Island & Eastern Traction Company.

BARTON, WIS.—The Woodford Engineering Company, 118 North La Salle Street, Chicago, Ill., is completing plans for a new two-story machine shop, 44 ft. x 122 ft., at Barton, to cost about $75,000, including electrical and mechanical equipment. M. D. Woodford is general manager.

RACINE, WIS.—The J. I. Case Plow Works Company has under consideration plans for two new foundries. One, a malleable foundry, is to be 150 ft. x 300 ft. and will cost about $110,000; the second, a gray-iron foundry, is to be 130 ft. x 360 ft. and will cost about $120,000.

FRAZEE, MINN.—It is reported that an electric light plant may be constructed at Frazee by L. M. Smith of Hill City, Minn.

DAVENPORT, IOWA.—The Blackhawk Hotel Company will erect four-story addition to hotel to cost $250,000.

JACKS FORK, MO.—The Shannon Public Utilities Company, recently organized for the purpose of developing local water power, expects to construct two dams, the first on Jacks Fork, the second on Current River. The first will be 761 ft. long and 17 ft. high, costing approximately $186,000. At its completion the railroad will be continued to Current River, where the second dam, to cost $280,000, will be built. A 95-mile transmission line is also contemplated to connect Cabook, Summerville, Eminence and Centerville. M. R. Cole, Cabool, Mo., is the engineer in charge.

McLAUGHLIN, N. D.—The city has voted to install an electric street-lighting system. Address the city clerk.

WATERTOWN, S. D.—The Watertown Central Station Heating Company, Watertown, is having plans prepared for the erection of a new electric light and power plant to cost about $175,000. L. A. Larson, 2118 Hendon Avenue, St. Paul, Minn., is consulting engineer.

LISCO, NEB.—The electric light plant owned by the Mitchell Motor Company was recently destroyed by fire at an estimated loss of $40,000.

KINSELY, KAN.—Council has made a contract for plans and specifications for a municipal light and power plant. The franchise of the privately owned plant at Kinsely expires within a year or so, and recently rates have been increased to such an extent that sufficient street lights cannot be afforded. The city owns the waterworks system, and it was decided to build a large light and power plant sufficient to pump the city water, furnish power for other industries and pump water for irrigation in the vicinity of Kinsely.

LAWRENCE, KAN.—Facts and figures being compiled at the reference bureau of the University of Kansas indicate that much attention is being given in Kansas to the construction of electric light and power companies. Five cities have called elections to vote on bond issues of from $2,400 to $3,000 and eight cities have voted bonds for construction of new light plants. Cia*3, Louisburg and Sawyers plan to install new plants. Bernard, Geneseo, Lamar, Meredian, Mount Hope, Oswego, and Tribune have voted bonds of $8,000 to $40,000 for new plants. Hutchinson, Alden, Wetmore, Herndon and Hiawatha will improve their light plants this year.

Southern States

ASHEVILLE, N. C.—The Carolina-Tennessee Power Company is planning for the development of about 60,000 hp. in the new hydro-electric plant on the Hiawassee River in North Carolina and Tennessee. The immediate plans call for two 150-ft. dams, one in Tennessee and the other about 13 miles further north in Carolina. The cost of the entire project will probably exceed $9,000,000. The consulting engineer for the work is W. V. N. Powelson, 61 Broadway, New York City.

ST. PAULS, N. C.—An electric power plant to supply electrical energy to both the town and the mills is being considered by the St. Paul's Cotton Mill Company, the Ernaldson Manufacturing Company and the Alexander Cotton Mills.

ESTILL, S. C.—The construction of a one-story brick electric light plant is being considered by the commissioners of public works. The proposed building will be about 35 ft. x 50 ft. and will be used for municipal service. James Howe is the chairman of the commissioners.

LYERLY, GA.—The city is contemplating the installation of an electric street-lighting system for which the power is to be furnished by the Chattanooga River Power Company. Address the Mayor.

KOSCIUSKO, MISS.—Williams & Lebby, engineers, of Yazoo City, Miss., are in charge of the construction of the city electric light and power system. The machinery to be installed includes a 100-kw. turbo-generator, oil-burning boilers, economizer, etc.

HEBER SPRINGS, ARK.—The Arkansas Hydro-electric Development Company is planning to erect a $5,500,000 plant on Red River, the initial installation to cost about $320,000. The present plans call for the construction of a reinforced-concrete 450-ft. dam, 60 ft. high, at an estimated cost of $120,000, and a 45-mile transmission line with a probable voltage of 44,000 volts. The first installation will be 3,000 hp. E. T. Stanfield is the vice-president and general manager.

LAKE CHARLES, LA.—The Louisiana State Rice Milling Company has under consideration plans for the construction of a new rice mill, to cost about $250,000 to $300,000. The plant will be a fireproof building of concrete and steel.

BRADY, TEX.—The Brady Water & Light Company will construct an electric light plant here. W. O. Kirchner is superintendent.

CISCO, TEX.—It has been reported that the Cisco Gas & Electric Company is planning to spend $100,000 in increasing and improving its facilities. Half of this sum is to be spent in the power house and the other half in extending the pole, wire and fixture system. P. W. Campbell is manager of the company.

EASTLAND, TEX.—The J. E. Lewis Syndicate of Eastland, which has acquired the Breckenridge, Eastland, Ranger, De Leon and Gorman electric light and power plants, has recently completed a high-tension line from Gorman to Dublin. From Gorman this line will be built into the high-tension line the J. E. Lewis Syndicate has strung from Eastland to Ranger. Extensions to Rising Star, Cisco and other Western points are contemplated.

EASTLAND, TEX.—An electric power station is to be constructed by the newly organized Oil Belt Power Company, at a cost of approximately $2,000,000, including the expenditure that will be made in building a system of transmission lines to oil fields, towns and industrial plants within a radius of 50 miles. The new plant will furnish electric power for drilling and pumping oil wells and provide electrical energy for towns and industrial plants. The building will be of steel and concrete construction, 90 ft. square and 60 ft. high. Modern machinery will be installed, including two 3,000-watt steam turbines and necessary boilers giving the plant a capacity of 8,000 hp. Power transmission lines covering the oil fields in this district will carry electricity at 12,000 volts and 60,000 volts. J. E. Lewis of Eastland is vice-president and general manager.

EASTLAND, TEX.—A two-story brick exchange building is to be built by the Southwestern Telegraph & Telephone Company, in which it is planning to install a switchboard with 8,000-line capacity. The total cost will be approximately $25,000.

Pacific and Mountain States

WALLA WALLA, WASH.—Engineer Ernest B. Hussey, employed by the city to make an estimate of cost for a city reservoir, as well as for a hydro-electric plant to be operated in connection with the city water system, has submitted a report to the city water board. The reservoir, as originally planned, would cost $375,000, although new designs are being planned which may cut the cost to $340,000.

ENTERPRISE, ORE.—The Enterprise Electric Company plans the erection of a power plant above Wallowa Lake. The company has filed application with the state engineer to appropriate 60 second-feet of water from the Wallowa River for the development of 1,027 hp.

LA GRANDE, ORE.—The Eastern Oregon Light & Power Company has plans under consideration for the construction of a local steam plant.

PORTLAND, ORE.—It is reported that the Northwestern Electric Company is planning to construct a large hydro-electric plant on the North Fork of the Lewis River at an estimated cost of $5,000,000.

SAN FRANCISCO, CAL.—The Sierra & San Francisco Power Company has been granted a permit to divert 150 cu.ft. per second from South Fork Stanislaus River, which will enable this company to develop 57,272 additional hp.

KELLOGG, IDAHO.—It is reported that plans are now under way for extending the Washington Water Power Company's electric line to the Eagle Creek district from the Murray section on the north side.

HELENA, MONT.—A power line 3 miles in length will be built to connect the lines of the Montana Power Company with the Free Coinage Mine in Lump Gulch district, operated by the Amalgamated Silver Mines Company of Helena. The mine is to be electrified. It is expected that other mining properties along the route of the power line will shortly be electrified.

LIBBY, MONT.—The electric light and power plant of the Libby Water & Electric Light Company has recently been entirely destroyed by fire at a loss of about $30,000. J. S. Kirby, president of the company, has announced that work will be commenced as soon as possible on a new building of the fireproof construction and larger than the original. In addition to a water turbine of 350 hp. a steam auxiliary will be installed with a generating capacity of 400 hp. The cost of the building and new machinery is estimated at $60,000.

Canada

WINNIPEG, MAN.—Tenders will be received at the office of C. J. Brown, city clerk, up to 3 p.m. on March 8, 1920, for the supply and delivery, f.o.b. Lac du Bonnet, Man., of two rotary oil pumps and electrical motors for water turbine governors. Specifications may be obtained at the office of the city light and power department, 54 King Street.

ST. JOHN, N. B.—Charles Brandies is consulting engineer for a new power plant which may be erected on Green River, Madawaska County a short distance above St. Leonard's. A preliminary survey is being made for the plant, which is estimated to cost $500,000.

WOODSTOCK, N. B.—Estimates of the loss caused by fire in the Hayden-Gibson Theater block vary from $100,000 to $150,000.

TORONTO, ONT.—The use of 300-watt nitrogen lamps in lighting St. Clair and Danforth Avenues has been authorized by the City Council.

WINDSOR, ONT.—It is reported that Marcus A. Loew has under consideration plans for the erection of a new theater at an estimated cost of $[illegible].

WINDSOR, ONT.—The commission is considering plans for extending the hydro-electric plant at a cost of approximately $150,000. O. M. Perry is the manager.

Record of Electrical Patents

Notes on United States Patents

(Issued Feb. 10, 1920)

1,330,059. Pole Changer; Hiram D. Currier, Chicago, Ill. App. filed June 28, 1915. Operates harmonic, tuned bells or telephone ringers.

1,330,061. Grade-Crossing Signal; Charles W. Dunham, Edgewood Borough, Pa. App. filed April 24, 1917. Electric pendulum type.

1,330,078. Musical Instrument; Reese B. Kent, Wheeling, W. Va. App. filed Oct. 16, 1919. Operates fingering magnets.

1,330,101. Electric Engine Starter; George W. Wacker, Rutherford, N. J. App. filed Dec. 14, 1917. Reducing gears and unidirectional clutch.

1,330,124. Relay; William F. Krautter, Chicago, Ill. App. filed March 27, 1919. Pole changer with contact springs.

1,330,133. Oscillation Spark Coil and Connection; Edwin G. Northrup, Princeton, N. J. App. filed June 18, 1917. Concentrates energy upon resistor.

1,330,135. Automatically Controlled Electric System; Floyd W. Parkinson, Peoria, Ill. App. filed Nov. 15, 1916. Gas-engine-driven generator for isolated plants.

1,330,153. Electrical Supply Apparatus; Milton Alden, Springfield, Mass. App. filed Nov. 12, 1917. Dentist's electrical instruments.

1,330,161. Spark-Plug Tester; Even Bordahl, Roslyn, S. D. App. filed May 18, 1918. Current passed through portable attachment shows defects.

1,330,165. Magneto Machine; Walter Brown, Racine, Wis. App. filed Jan. 19, 1918. Moisture-proof stator elements.

1,330,177. Trolley Wheel and Harp; John N. Duncan, Boone, Iowa. App. filed April 9, 1918. Removable rotating wheel with stationary bearing.

1,330,182. Self-Cooled Impact Spark Gap; Henry E. Hallborg, Norfolk, Va. App. filed July 20, 1916. Self-contained and fireproof.

1,330,200. Telephone-Exchange System; Alben E. Lundell, New York, N. Y. App. filed Aug. 17, 1916. Indicates number of line.

1,330,202. Telephone-Exchange System; John C. McAuliffe, New York, N. Y. App. filed March 1, 1918. Guard signal used.

1,330,211. Telephone Receiver; Robert Nordenswan, New York, N. Y. App. filed Jan. 4, 1918. Pole piece united to magnet system by low reluctance joint.

1,330,220. Telephone-Call-Distributing System; Edwin H. Smythe, Hubbard Woods, Ill. App. filed March 27, 1918. Plug-terminated connecting circuits for connection with called subscribers' lines.

1,330,221. Telephone-Exchange System; Dawson M. Taggart, East Orange, N. J. App. filed Jan. 4, 1918. Lines terminating at central office interconnected by link circuits.

1,330,226. Telephone-Exchange System; Joseph L. Wright, Cleveland, Ohio. App. filed Oct. 21, 1915. Answering and calling sets of keys for controlling interconnections.

1,330,230. Testing Cut-Out; Percy H. Bartlett, Philadelphia, Pa. App. filed Jan. 22, 1917. Test blocks connecting secondaries of series transformers with current coils of test instruments.

1,330,234. Telephone Set; Willian T. Booth, East Orange, N. J. App. filed April 24, 1917. Intercommunicating type with ringing equipment.

1,330,241. Method of Joining Metal; George A. Cutter, Dedham, Mass. App. filed June 14, 1918. Plates joined face to face by electric welder.

1,330,252. Telephone-Exchange System; Clarence B. Fowler, New York, N. Y. App. filed Jan. 2, 1918. Control energy type for lines terminating at same central office.

1,330,254. Radio-Telegraphy; Leonard F. Fuller, San Francisco, Cal. App. filed April 23, 1917. Signaling apparatus for high-powered stations by direct-current circuit arrangement.

1,330,258. Telephone Switchboard; Albert F. F. Gilson, Closter, N. J. App. filed Dec. 3, 1917. Facilitates fastening of key bases in key shelves.

1,330,271. Testing Transformer; Earle P. Lee, Rochester, N. Y. App. filed March 27, 1919. U-shaped form embraces armature to be tested.

1,330,336. Lamp Support; Morris Ozlek, Philadelphia, Pa. App. filed May 20, 1919. Cluster top.

1,330,337. Electrical Contact System; Granville E. Palmer, Boston, Mass. App. filed Feb. 18, 1918. Translating device operated by contactor responsive to heat, moisture, etc.

1,330,391. Telephone Transmitter; Arthur P. Pinkler, Ridgefield, N. J. App. filed March 2, 1917. Granular carbon resistance.

1,330,398. Differential Magnetic Speed-Changing Transmission Mechanism; Carlos M. Seidel, Habana, Cuba. App. filed Nov. 11, 1916. Armature for forward driving held stationary while driven shaft is reversed through gearing.

1,330,399. Method of Plating Metal Articles; Robert J. Shoemaker, Milwaukee, Wis. App. filed March 5, 1918. Flux contains zinc chloride and tin chloride.

1,330,417. Telephone Exchange System; Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed Nov. 13, 1916. Flexible call-distributing system.

1,330,446. Method of Welding Objects; Charles F. Jacobs, Chicago, Ill. App. filed March 20, 1919. Includes each of two bodies of flux in two circuits.

1,330,464. Finder-Starting System; Charles L. Goodrum, Brooklyn, N. Y. App. filed Sept. 22, 1916. Facilitates handling of calls originating in same group.

1,330,467. Telephone-Exchange System; William H. Harrison, Brooklyn, N. Y. App. filed April 11, 1918. Link circuits for interconnecting lines.

1,330,468. Electric Welding Machine; Myron F. Hill, New York, N. Y. App. filed May 2, 1918. Electrode welds separate metal unions to a number of parts.

1,330,471. High-Frequency Signaling; Burton W. Kendall, New York, N. Y. App. filed Nov. 29, 1915. Oscillations modulated in accordance with speech.

1,330,472. Printing-Telegraph Receiver; Mark B. Kerr, New York, N. Y. App. filed April 20, 1918. Recomposing telegraphic impulses into printed message.

1,330,474. Telephone-Exchange System; Walter C. Kiesel, College Park, Md. App. filed Feb. 1, 1918. Prevents operator listening in.

1,330,477. Electric Heating Apparatus for Metal-Working Machines; Frank P. Kobert, Amityville, N. Y. App. filed April 5, 1917. Preheats work for forging, electric riveting or electric welding machines.

1,330,483. Telephone-Exchange System; Alben E. Lundell, New York, N. Y. App. filed Oct. 8, 1917. Continues hunt for idle trunk in systems employing machine switching.

1,330,491. Vibration-Responses Device; Robert Nordenswan, New York, N. Y. App. filed Aug. 2, 1917. Natural frequency adjusted over wide range.

1,330,507. Electromagnetic Switching Device; Walther Willenbruch, New York, N. Y. App. filed Dec. 30, 1916. Relay with a secondary in shunt with main energizing element.

1,330,520. Electrical Starting and Ignition System; James K. Delano, New York, N. Y. App. filed May 13, 1916. Prevents battery from discharging through ignition circuit.

1,330,532. Electrode Adapter; Charles H. Hazelton, Lakewood, Ohio. App. filed Sept. 9, 1918. For projection apparatus.

1,330,551. System of Control; Samuel B. Schenck, Wilkinsburg, Pa. App. filed Sept. 15, 1916. Obviates reversing switch in railway motor circuit.

1,330,557. System of Control; Karl A. Simmon, Edgewood Park, Pa. App. filed Sept. 15, 1916. Mechanisms govern forward or reversed motor operation.

1,330,558. Parallel Bars and the Like for Magnetic Chucks; Frank L. Simmons, Woodsocket, R. I. App. filed May. 10, 1919. V-block connects poles on face of magnetic chuck.

1,330,561. Contact Tip for Contact Fingers for Electrical Controllers and Switches; Charles Thompson, Toronto, Ont., Can. App. filed Sept. 27, 1919. Made quickly by dies.

1,330,563. Welding Electrode; James M. Weed, Schenectady, N. Y. App. filed Sept. 6, 1919. Spot-welding electrode of a high heat capacity, removable welding tip and spring for exerting pressure.

1,330,565. Switchboard Apparatus; George D. Wolf, Chicago, Ill. App. filed Feb. 5, 1917. For mounting lamp-jack and spring-jack strips in switchboard face.

1,330,566. Engine-Starting Apparatus: Lionel Wolffsohn, Hoboken, N. J. App. filed Feb. 29, 1916. Simplified mechanical connections with source of power.

1,330,567. Electrical Apparatus for Automobiles; Lionel M. Wolffsohn, Hoboken, N. J. App. filed Feb. 10, 1917. Mounting for starter.

1,330,571. Car-Lighting System; Clinton J. Axtell, Schenectady, N. Y. App. filed April 29, 1918. Operated either at high or low luminosity without affecting voltage.

1,330,576. Electric Heat Radiator: Arthur F. Berry, Ealing, England. App. filed Dec. 13, 1915. Produces luminous effects.

1,330,585. Lighting Fixture; Bertram J. Grigsby and Owen E. Grigsby, Peoria, Ill. App. filed Feb. 23, 1917. Removal of shade holder exposes conducting wires.

1,330,589. Motor-Control System; Henry D. James Wilkinsburg, Pa. App. filed April 29, 1915. Primary and secondary windings of alternating-current motor controlled automatically.

1,330,590. Brake Mechanism; Henry D. James, Edgewood Park, Pa. App. filed Dec. 8, 1917. Two electrically operated brakes controlled by one series circuit.

1,330,592. Motor-Control System; Harold L. Keith, Edgewood Park, Pa. App. filed May 14, 1915. Graduated dynamic braking force used.

1,330,616. Motor-Control System; John H. Albrecht, Pittsburgh, Pa. App. filed May 14, 1915. Dynamic braking for planers or other reversible machine tools.

1,330,618. Electrical Apparatus; Joseph Bijur, New York, N. Y. App. filed Dec. 23, 1914. Prevents unauthorized use of car.

1,330,620. Outlet Box; William A. Bonnell, New York, N. Y. App. filed Jan. 30, 1917. Outlet boxes embedded flush with ceiling.

1,330,627. Motor Control; John Eaton, Schenectady, N. Y. App. filed June 18, 1917. Controller driven by a fluid motor.

1,330,634. Drain Device for Storage Batteries; Percy D. Ivey, Guelph, Toronto, Ont., Can. App. filed Feb. 14, 1919. Draining cells preliminary to recharging automobile battery.

1,330,638. High-Frequency Electric Generator; Marius C. A. Latour, Paris, France. App. filed Aug. 2, 1917. Eliminates slot winding.

1,330,642. Electric Toaster; Hubert M. McClain, Rockville, Ind. App. filed July 6, 1918. Spaced for marshmallows.

1,330,702. Adjustment of Electric Lamps; Clinton O. Harrington, Edgewood Borough, Pa. App. filed April 7, 1916. Adjusting location of lamp filament.

1,330,712. Electric Heater for Soldering Irons; William H. Lanahan, Memphis, Tenn. App. filed March 31, 1919. Portable soldering irons heated without adjustment.

1,330,761. Process of Welding Railway Rails; Charles F. Jacobs, Chicago, Ill App. filed Aug. 5, 1915. Union by welding adjacent ends of rails together.

Electrical World

The consolidation of Electrical World, Electrical Engineer *and* American Electrician

Volume 75 New York, Saturday, March 6, 1920 *Number* 10

Data on Household Appliances

IN ITS intention to compile data on electrically operated home devices of interest to engineers, architects and others the industrial and domestic power committee of the American Institute of Electrical Engineers is planning a work from which all branches of the industry will benefit. It will supplement what has already been done along this line and lead to the standardization that is needed in the electrical features of devices such as attachment plugs as well as in switch control, motor designs, wattage of heating elements, nameplate markings and the like. In solving these problems the authority of the Institute will mean much, for it will make available engineering data comparable in value with its recommendations covering other electrical apparatus.

Need for Capital Beyond the Rockies

IN THEIR application to the California Railroad Commission for increased rates the Southern Sierras Power Company and the Holton Power Company made the following statement in requesting a rate that will afford a fair return upon investment: "To meet the needs of rapidly growing business money must be invested in transformers, substations, transmission and distribution systems, which cannot be financed without the receipt of adequate return that will invite the purchase of the securities." For the purpose of determining what constitutes a fair return the two companies are requesting the commission to set a value upon their properties. The rates that the commission fix for these two companies, which are under the same management, will be of general interest when it is recalled that an extensive high-tension system is involved, transmitting electrical energy over lines having their extremities more than 634 miles apart.

The Jones-Reaves Engineering Bill

THE Jones-Reaves bill before the House of Representatives and the Senate is a step in the right direction. It points toward economy and efficiency in the planning and the doing of national engineering work. As outlined elsewhere in this issue, it is designed to create a department of engineering, with a Cabinet member at its head, to handle the engineering work that is now being done in a great many bureaus in the various existing departments of the government. It aims to eliminate waste in office routine, to do away with division of interest, duplication of effort and shifting of responsibility. It provides for the creation of an organization that will, by its unified interest in engineering, promise standardization of methods and a consistent and effective governmental policy in engineering affairs.

It must be realized that to extricate all our national engineering work from its present tangle of red tape is practically impossible unless time is allowed for evolution. Many faults can probably be found in the Jones-Reaves bill. However, its purpose is one of common sense, and its adoption in its present form would greatly hasten the progress needed in handling national engineering work. The bill must be supported by action. Engineers are best qualified to understand the underlying fundamental advantages to be derived from such legislation and should make it their responsibility that the country shall receive its benefits.

Decentralizing Manufacture

TO LIMIT the amount of labor which any single factory disturbance may effect, some employers are following a policy of decentralization in their plant expansion. Instead of adding floor space to existing factories they are renting or building floor space in other cities. This is not a new idea, but such broad and general application of it as is now in progress is something new in the electrical industry. As a policy which will provide a measure of insurance against complete plant shut-down it has been sufficiently well proved to recommend it for consideration wherever expansion on a considerable scale becomes necessary.

Responsibility for Service

THE average central-station customer, it is safe to say, has little conception of the cost in personal effort involved in maintaining continuous reliable service under present conditions of coal supply. It is all in the day's work, of course, but there is a companion picture to the lineman's struggles with the elements in the weary search of the superintendent, assistant manager, or whatever he may be called, for his own coal cars as he tramps snowbound railroad yards and frozen sidings hundreds of miles from his comfortable office, persuades the petty officers of the transportation army to start his fuel moving again toward its destination, and "jollies" the overburdened train crews into keeping particular wheels moving once his prized loads are coupled up. It all counts in the reputation of the industry.

Trade Outlook Improving

FEBRUARY was a hard month. It brought the influenza and blizzard upon blizzard. It cut down working forces, tied up transportation and carried with it a fuel shortage. In other words business suffered. Deliveries that had been bad became worse, except perhaps in schedule material. Orders, however, have been piling up, and there is enough business now on the books to keep factories going many months. But spring is ahead, and transportation is getting better. Furthermore, with the return of the railroads to their owners there are indications that a serious attempt will be made to vindicate private ownership by eliminating the causes which have delayed shipments. This, among other things, should relieve the extreme shortage of steel-electrical materials for electrical manufacturers and give jobbers a working stock of such material as rigid conduit, outlet boxes and steel inclosing boxes.

New Station to Serve Connecticut Network

UNDER the rising demand of the past few years the electrical networks of Connecticut have been growing rapidly, and we are glad to note the completion of a compact and well-planned station as an addition to the resources of the Eastern Connecticut Power Company. This station is described by E. T. Phillips in the current issue. The system of the Eastern Connecticut company runs along the coast between New Haven and Westerly, R. I., with branches northward, and has gradually replaced a number of small central stations and isolated plants, besides feeding the coast-line railway. It had grown until it was already absorbing the supply of four steam stations and one water-power station, and finally the additional power station just completed became necessary. The location for the new plant was carefully considered, the choice falling on a site at Montville, on the Thames, about half way between Norwich and New London. This gave a fair approximation to the center of distribution and an excellent opportunity for growth and the continuous supply of coal by water.

A short dredged channel connecting with the river channel makes it possible to bring coal barges within reach of a gantry crane, which can unload the barges or coal cars standing on a side track with equal facility. A storage capacity of 12,000 tons within easy distance is provided, from which coal is taken by small cars drawn by a little kerosene locomotive and dumped into a hopper. From this hopper it is automatically conveyed through a crusher and so on to the coal bunker at the top of the boiler room. From the same channel the condensing water is taken through a wooden flume to a screen well, and then through a concrete way to the condensers. The building itself, which is well shown in the illustration, is a compact three-story structure provided with two reinforced-concrete chimneys, each serving a pair of 880-hp. (nominal) boilers. These are fired by underfeed stokers and are operated at maximum steam pressure at 275 lb. (19.3 kg.), with a superheat of 125 to 200 deg. The use of fairly large boiler units like these is a commendable feature of the installation. The steam passes from these boilers to a short equalizing header, from which in turn the turbines are fed. These are two in number, each operating a 12,500-kva., 11,000-volt, three-phase generator. The output of these turbines is delivered to two transmission systems, one for the general nearby territory, stepped up to 33,000 volts, Y-connected, and the other, at double this voltage and also Y-connected, reaching clear to the New England Power Company's lines at Millbury, Mass.

A little study of the illustrations in the article will show the compactness and simplicity of the arrangement better than any description. The new plant seems to be an excellent example of an efficient and easily operated station well adapted for feeding an extended network.

Periodic Inspection and Testing Improve Insulator Performance

TO THE data already published on insulators we are glad to add a rather complete conspective view of insulator practice and performance in this country based on returns from some forty transmission companies working at voltages from 11,000 to 150,000 and under all sorts of climatic conditions. Looking over the general list, one is at once impressed with the relatively great difference in factors of safety employed with respect to the insulators. Of course, the rating of insulators is a rather arbitrary matter; but, taking ratings as they go, it is certainly somewhat surprising to find 13,200-volt lines in use with insulators rated from as low as 20,000 volts up to 55,000 volts wet flash-over and 105,000 dry flash-over. Even smaller factors of safety than the lowest here named have been used under particularly favorable conditions. Similar differences in practice existed in the earlier days with voltages of 60,000 and thereabouts, but more recent constructions for voltages at and above this value have passed almost entirely to suspension insulators with very respectable factors of safety from any point of view. Local conditions seem to determine the practices reported, it being very clear that in regions where coastwise storms must be encountered more precautions are necessary than in a high and dry climate relatively free from disturbing influences. The differences, therefore, are less illogical than they seem to be at first sight.

As to testing insulators, it is rather remarkable that more than half the companies from which reports were received make neither preliminary tests on their insulators nor periodical tests after they are in service. Preliminary tests may perhaps safely be omitted in cases where large factors of safety are employed and the factory tests have been thorough. Once the insulators are in service, tests are less easy, and it is not altogether clear what form of tests give the most reliable information. Flash-over and megger tests are most common as preliminaries, the latter being the more generally employed among the companies reporting. After installation the insulators are tested chiefly by the megger and "buzz-stick" methods. Inspection is more easy to carry out than testing, and therefore most companies have patrol men on the look-out for trouble. We are inclined to believe that the practice of one company in insulating its somewhat inaccessible stretches of line with an unusually high factor of safety will tend to more reliable service. Weekly inspection is most in favor and should be, as it sometimes is, made to coincide with periodical testing. The general result of testing and inspection is that all or nearly all of the faulty insulators can be detected and replaced before there is a complete breakdown. The importance of regular testing is strongly borne out by this fact. Systematic examinations of the lines have not, on the whole, been in practice long enough to give a clear idea as to deterioration with age. The general indications from the returns are that recent insulators stand up considerably better than the earlier types, as should be expected from increasing experience in manufacturing and with the real conditions of service.

Disk-type insulators are steadily coming into more use and, at least for the higher voltages, with good reason. They enable a large factor of safety to be obtained at reasonable cost and are certainly less subject to abnormal mechanical strains than the pin-type units. Above all this, a high factor of safety on long and important lines is the one important matter in line design. Not only does it protect against the ordinary strains of service of every kind, but it also affords no inconsiderable protection against lightning disturbances and switching surges, as theory and practice are indicating. If a 50,000-volt line is insulated for 150,000 volts wet flash-over, it has 100,000 volts to the good in lessening the effect of inductive disturbances which result from so-called lightning strokes. A 20,000-volt line insulated with the same factor of safety has only 40,000 volts reserve for contingencies, a fact which explains very simply why, on the whole, the big high-tension systems all have less trouble from lightning than those operating at moderate voltages. As a rule, too, the high-tension systems carry no more current than those at lower tensions and consequently run relatively rather less risk from surges. Given a good factor of safety with careful inspection and periodic testing, real breakdowns from insulator failure ought to be very infrequent.

Attendantless Generating Plants

IN LARGE hydro-electric plants it is not uncommon to find the operating force made up of eight men—three shifts of switchboard operators and generator-room men, a chief operator and a handy man. Where the load amounts to 20,000 kw. or 30,000 kw. the cost of energy at the station busbars is not therefore appreciably affected by the wages of the operating force. In small plants, however, the cost of attendance may become a considerable part of the busbar cost of the energy. To this consideration may now be added the difficulty of getting at moderate cost, men for work which is more or less of a routine nature. Thus there appears to be a well-defined opportunity for the automatic or remote-controlled generating plant. Several of these have recently been constructed, and one has been in service for two years.

An article by T. A. E. Belt in last week's issue gave the outstanding considerations in automatic and remote-controlled generating plant design and details of some interesting schemes for putting the generating units on the line and shutting them down. Experience with synchronous-converter railway substations has been such as to inspire complete confidence in the probable reliability of the controls proposed.

Dr. Steinmetz has created wide interest in the possibility of developing a large number of unused water-power sites through the agency of the induction-generator units. As pointed out by Mr. Belt, however, the induction-generator unit has decided advantages over the synchronous generator only when the head is comparatively high and where the system is extensive enough to make it possible to supply a considerable portion of the induction-generator excitation from the charging current of the line. For lower heads the synchronous generator may prove to be cheaper.

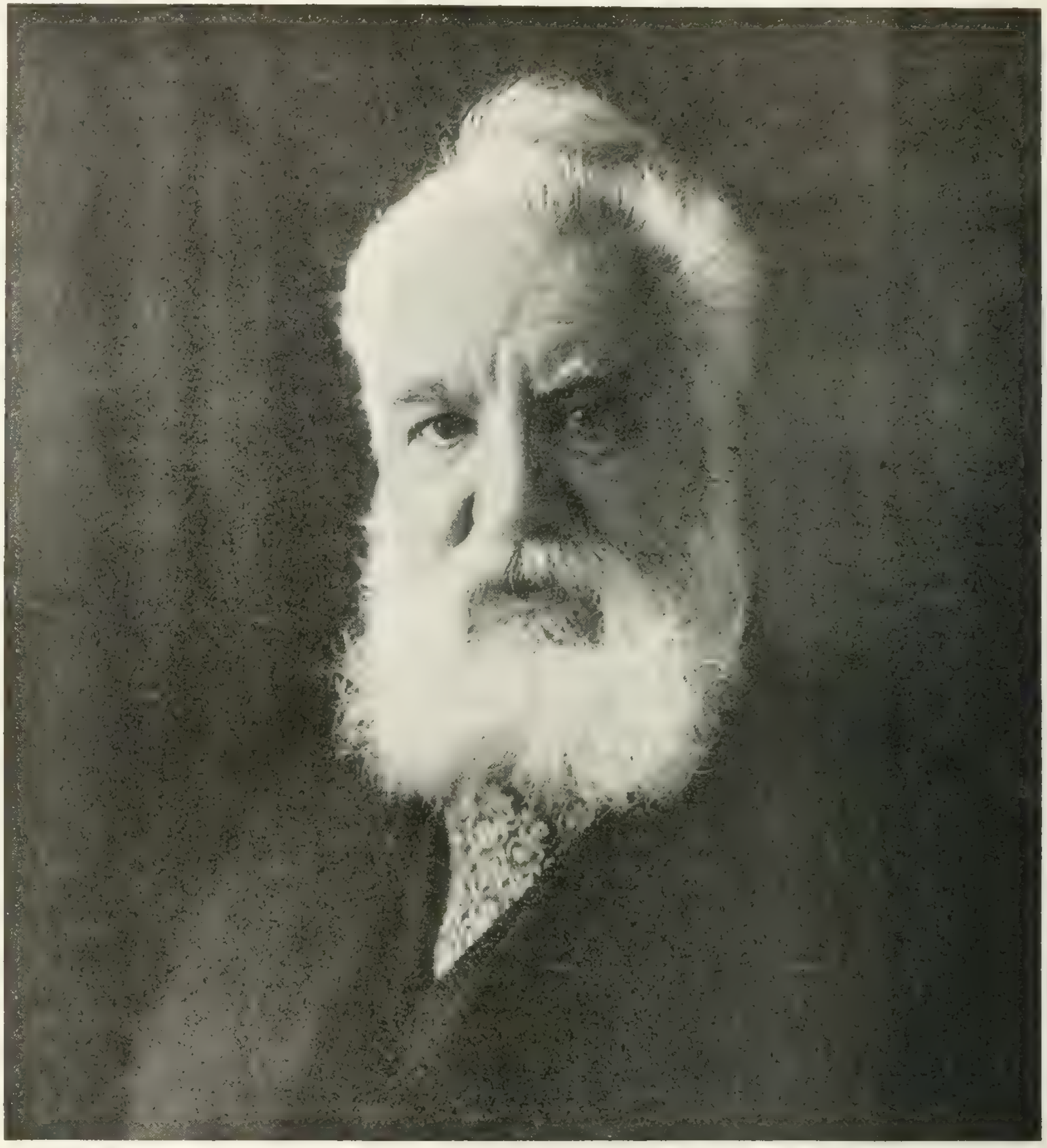
In a later paper it will be shown how the principles discussed by Mr. Belt have been put into practice in both remote-controlled and automatic hydro-electric plants. In due course we shall no doubt have actual operating data from which to draw conclusions regarding the reliability of control in these plants. Specific cost data, showing the increased fixed charges due to the special control scheme and the saving in operating expense, indicating the length of time required to pay for the extra investment, are awaited with keen interest.

Pacific Coast Practice in Cooling Transformers

SOME very instructive experience in cooling transformers on the Pacific Coast is reported this week by G. E. Armstrong. The commonest method of cooling large transformers, such as are used for transmission purposes, is the circulation of water through coils in the transformer case. It appears that trouble has arisen in carrying out this method by reason of the cooling coils becoming clogged with deposits of foreign matter of one sort or another. Water carries with it a certain amount of impurity, either suspended or in solution, and it is found that within the coils two classes of deposits are frequently formed—the first composed of adhering vegetable matter or ordinary sediment, the second corresponding quite accurately to boiler scale, deposited from the mineral matter carried in solution. Aside from this, when iron coils are used, as they generally are, rust forms and still further interferes with the circulation. The commonest method of clearing out the deposits has been to circulate through them dilute hydrochloric acid, starting as low as 3 or 5 per cent and finishing sometimes as high as 25 per cent. Where the scale is mostly of carbonates, this process is very efficacious; where, as sometimes happens, magnesium sulphate is concerned, the acid has virtually no effect, and in some instances it has been found necessary to install new cooling coils. Recently some success has been attained by violently forcing through the coils, under air pressure, sand and water. This is more effective on ordinary deposits of suspended foreign matter than on scale.

In cleaning brass or copper coil, sometimes used, the acid treatment is liable to cause dangerous corrosion, and where a scale has been formed cleaning becomes extremely difficult. The troubles experienced have been sufficiently numerous and serious to call for close attention on the part of engineers. One obvious line of attack which has been tried with fair success is to treat the circulating water for the transformer cooling coils much as if it were for boilers, filtering it and using dissolved scale preventers as in feed water. This ought greatly to diminish the difficulty, although certain waters are likely to prove as unmanageable for cooling coils as for boilers. Aside from this one may turn to the other methods of cooling. Of these we are inclined to agree with the author of the paper that circulating the oil itself through exterior cooling coils is on the whole the best, as giving the most thorough cooling and as a necessary result the best transformer output.

For the smaller transformers the ordinary self-cooled type has come into large use up to about 1,000 kva. In California practice the advantages of painting the transformer cases white as a defense against heating from solar radiation has been found very considerable. On the whole, experience seems to show a decided practical advantage in cooling the transformer oil itself for circulation in cases where pure water is not readily attainable. Failing this, treatment as for boiler scale would seem to be the best procedure.



Alexander Graham Bell

The inventor of the telephone, which today is the most used electrical device in the routine of our business and social affairs

ON A PORCH column at 109 Court Street, Boston, Mass., a bronze tablet bears the inscription: "Here the telephone was born June 2, 1875." This was the location of the electrical workshop of Charles Williams, where Thomas A. Watson made for Alexander Graham Bell the crude instruments of his harmonic telegraph. It was while testing these instruments that the accident occurred which led Professor Bell to discover that the vibration of a steel reed over an electromagnet created electrical impulses which when received on an instrument at the other end of the wire caused a perceptible vibration and a musical tone. The speaking telephone was then born and the harmonic telegraph virtually forgotten. While working out this new idea it was Thomas A. Watson who, on March 10, 1876, heard the first connected speech over a telephone, the command of the inventor: "Mr. Watson, Mr. Watson, I want you. Come here." This message was transmitted between two rooms of an inexpensive boarding house, one Professor Bell's bedroom and the other his laboratory, at 5 Exeter Place in Boston. August 10, 1876, when the first clear transmission of speech took place one way between Brantford and Paris, Ontario; Oct. 9, 1876, when he talked both ways between Boston and Cambridge, Mass., and Nov. 26, 1876, between Boston and Salem, are historical dates during the eight months that led up to the plans for the commercial exploitation of the telephone, after the refusal by the Western Union Telegraph Company to buy the Bell telephone patents for the sum of $100,000. With the selection of the general superintendent of the United States railway mail service as general manager of the American Bell Telephone Company, that man being Theodore N. Vail, the realization of the dreams of Professor Bell in 1875 was made possible, and he has seen the telephone grow into a system of more than twelve million stations—a stupendous achievement entirely within the lifetime of the inventor, who March 4 celebrated his seventy-second birthday.

Eastern Connecticut Served by New Station

Formerly Supplied by Small Isolated Plants Railway Is One of Principal Loads—Factors Taken Into Consideration in Designing Stations

By E. T. PHILLIPS
Superintendent of Power, Eastern Connecticut Power Company

TANK IN FOREGROUND SUPPLIES WATER FOR FIRE PROTECTION, COOLING AND BOILER MAKE-UP

GANTRY CRANE AT LEFT UNLOADS COAL FROM BARGES AND CARS; 12,000 TONS OUTDOOR STORAGE IS PROVIDED

TO SUPPLY power demand in the eastern part of Connecticut, the Eastern Connecticut Power Company has constructed at Montville a power station that is characterized by some very interesting engineering features. Formerly this section was supplied from small central stations or by isolated plants, all of which would have required a considerable outlay of capital to take care of the increased demand caused by war work and to provide for future expansion. This condition applied especially to the railway company operating in this section. This railway company consists of three divisions running along the coast between New Haven Conn., and Westerly, R. I., and operating north through Norwich and Putnam to the state line, its whole demand being supplied by four steam-power stations and one water-power station. On this demand as a cornerstone the present power system was built, and it is the hope of the company eventually to supply most of the load in the Thames, Quinebaug and Shetucket river valleys and to tie in with other power systems in this and neighboring states. When this shall have been done, better load conditions for all the power systems connected should result.

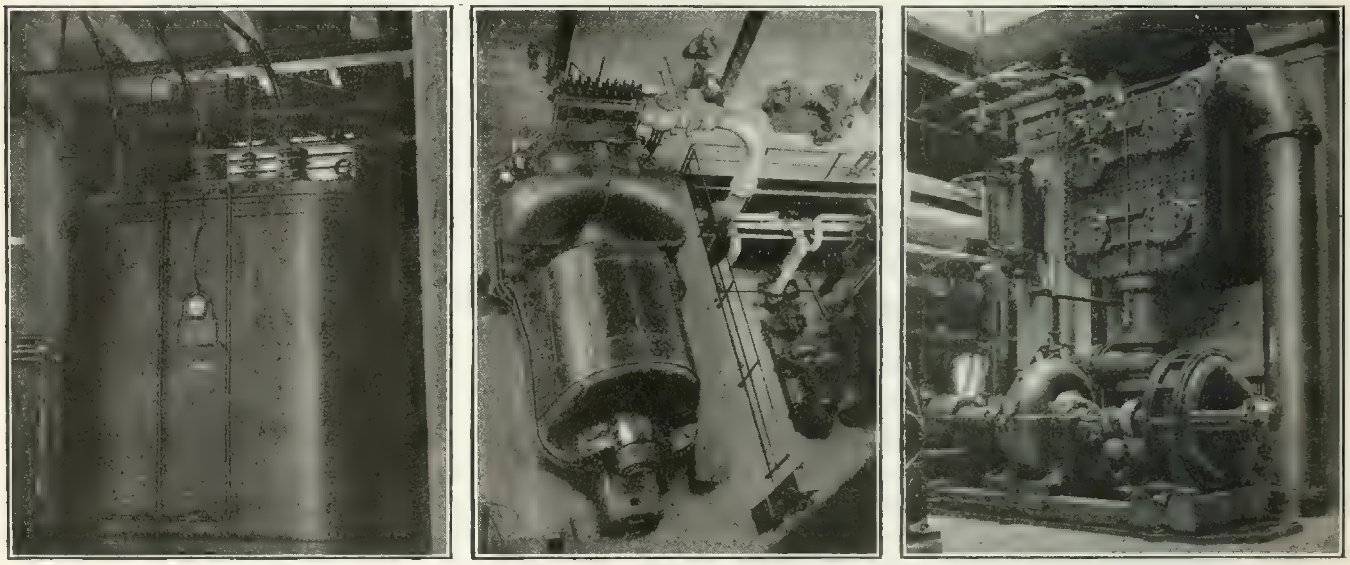
Another consideration which influenced the building of this plant, and which to a great extent was a public-spirited one on the part of those who financed the undertaking, was that a cheap, reliable source of power in this section might attract large industries and thus directly benefit the eastern end of the state and indirectly all of New England. The Thames River is navigable as far as Norwich and is reasonably free of ice during the winter months. In addition, this section is served by two railroad systems which would supplement water shipments.

The first intention was to build the power station in the city of Norwich, but several conditions arose which made it more desirable to locate near New London. Accordingly a site was secured on the Thames River at Montville, approximately midway between Norwich and New London. The main considerations were: First, nearness to center of distribution, having in mind both present customers and future business, whether manufacturing, electric railway, or railroad electrification; second, a better chance to grow with the load without crowding; third, less danger from ice congestion which would prevent shipments of coal by water during the winter.

The power station was erected near the river on a horizontal vein of gravel, 12 ft. to 15 ft. (3.6 m. to 4.5 m.) thick, through which piles were driven for a concrete foundation, a fill being made first around the power-station site with gravel from the high ground back of the shore line. This source also supplied the gravel necessary for all foundation work.

This location permitted an easy solution of the coal-handling and condensing-water problems, a small jetty being formed north of the power-station fill and a channel dredged between the two fills connecting with the river channel. A wharf was built on the power-station side of this channel and a gantry crane provided for unloading the coal from either barges or cars, which may be run under the crane for this purpose. A storage capacity of 12,000 tons is provided between the wharf and the station. Coal is loaded into small cars at this point, hauled by means of a 5-ton kerosene-burning locomotive and dumped into a hopper, from which point it is carried to a double-roll crusher and thence, by means of a vertical bucket conveyor and a combined inclined and horizontal-belt conveyor, to a coal bunker of approximately 450 tons' capacity at the top of the boiler room. From this point the coal is distributed by gravity to the boilers. The condensing water is taken from this channel through a wooden flume to a screen well near the building, thence through a concrete flume to the condensers, the water being discharged through similar flumes to the river south of the station.

The building is divided into three parts—a boiler room, 86 ft. x 80 ft. (26 m. x 228 m.), a turbine room 53 ft. x 91 ft. (16 m. x 28 m.), and an electrical bay 20 ft. x 91 ft. (6 m. x 28 m.). The maximum height of the building is 95 ft (29 m.). Under the boilers and turbines on the ground floor is the auxiliary apparatus. In the electrical bay on the ground level 11,000/33,000-volt transformers, house-service transformers and oil-circuit breakers, and a lavatory. Above this, on the turbine-room level, a 11,000-volt concrete-bus structure is installed. On the same level is the office of the chief engineer. Above and overlooking the turbine room the operating gallery and the office of the superintendent of power have been built. Above is the top gallery, in which the 33,000-volt bus and switching equipment are installed. The connection between the 330-volt side of the step-up transformers and the 330-volt bus is made by means of copper tubing, supported on insulators in wells on the south wall of the building between the lower and upper galleries. From the 33,000-volt gallery the feeders pass through roof bushings to a steel structure on the roof from which the feeders are run to a steel terminal tower in the yard. The 33,000-volt electrolytic lightning arresters are on the roof near the steel structure.



VIEW AT LEFT—METHOD OF SUPPORTING TRANSFORMER LEADS; CENTER VIEW—AT THE RIGHT IN THE PIT IS ONE OF THE TURBINE-MOTOR-DRIVEN CONDENSER-WATER CIRCULATING PUMPS; VIEW AT RIGHT—CONDENSER-WATER CIRCULATING PUMP DRIVEN BY TURBINE AND MOTOR

SEGREGATION OF COSTS—MONTVILLE POWER STATION, EASTERN CONNECTICUT POWER COMPANY

	Per Cent of Total Cost
Dredging, dikes and wharf	10.91
Building substructure	8.0
Building superstructure	17.60
Boilers	8.76
Circulating water tunnels and screen well	2.77
Stokers	2.09
Chimneys, flues and uptakes	1.71
Boiler-room auxiliaries	3.81
Coal and ash handling	4.96
Turbine-room auxiliaries	6.22
Turbo-generators	17.6
Transformers	1.76
Switchboard and wiring	4.84
General water supply	1.73
Traveling crane	0.96
Piping	6.28
Total	100.00

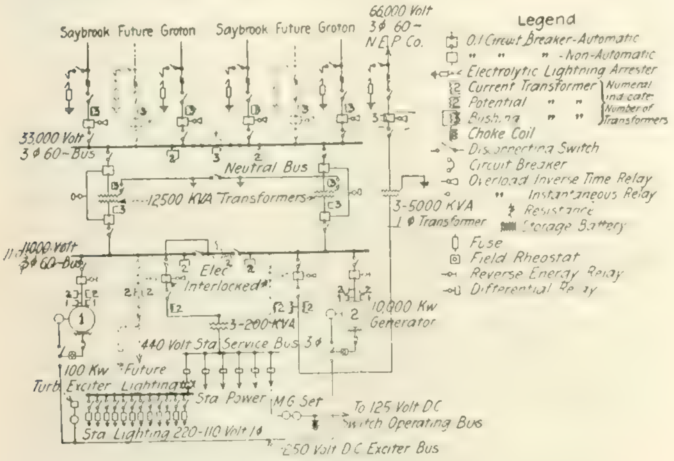
Two tapering reinforced-concrete chimneys are provided. These are over 160 ft. (49 m.) high and have an inside diameter at the top of slightly over 10 ft. (3 m.). The chimneys are supported on and anchored to steel girders under the boiler-room roof, the girders being tied in with the building steel. Each chimney is lined with a 4-in. (10 cm.) perforated radial fire-brick, 50 ft. (15 m.) high, with a 2-in. (5-cm.) air space between the chimney and the lining. Steel flues connect two boilers with the bottom of each chimney.

The boiler equipment consists of four 880 hp. Babcock & Wilcox water-tube boilers set singly and arranged in two rows with a firing aisle between. They are designed to operate at a maximum steam pressure of 275 lb. (19.3 kg.) and a superheat of 25 deg. (70 deg. C.) at 100 per cent rating and 200 deg. (111 deg. C.) at 300 per cent rating. Soot blowers are installed in all boilers, and a steam-flow meter, a CO_2 recorder, a pyrometer and a three-in-one draft gage are provided for each boiler.

Each boiler is also equipped with a Westinghouse underfeed stoker, which receives coal from an overhead bunker through steel chutes in which scales which automatically weigh the coal fed each boiler are mounted. Four geared turbine units drive the stokers, one for each unit. Provision has been made, however, by means of a length of shafting to connect the two stoker-drive shafts on the same side of the firing aisle so that one turbine may drive two stokers. The normal rating of the turbine is 10 hp., which may be increased to 20 hp.

by opening additional nozzles provided for that purpose. A regulator actuated by the wind-box pressure controls the speed of each turbine.

Water for fire protection, cooling and boiler make-up is supplied by wells which are grouped around an elevated 50,000-gal. (190,000-l.) steel water tank, approximately 800 ft. (245 m.) from the power station. Two 500-gal. (1,890-l.) duplex double-acting piston pumps, driven through reduction gears by 25-hp., 440-volt slip-ring motors, pump water from the wells to the tank.



MAIN SWITCH, BUS AND FEEDER CONNECTIONS

Two Cochrane elliptical metering feed-water heaters, each with a capacity of 150,000 lb. to 200,000 lb. (68,000 kg. to 90,000 kg.) of water per hour, are provided for heating the boiler-feed water. In order to insure as pure boiler-feed as possible, the make-up water is evaporated in a high heat-level evaporator system, consisting of three evaporators in parallel, two surface condensers and one open-feed water heater. This system has a capacity of 15,000 lb. (6,800 kg.) of distilled water per hour. Three 4-in. (10-cm.) four-stage double-suction pumps directly connected to turbines are provided for the boiler feed.

Steam is fed from each boiler through an 8-in. (20-cm.) line into a short 12-in. (30-cm.) equalizing header installed near the north wall of the turbine-room basement. From this header a 12-in. (25-cm.) line runs to each turbine. Steam for boiler auxiliaries is obtained from a 6-in. (15-cm.) header in the boiler-room basement. This header is fed by two 4-in. (10-cm.) lines connecting with the 8-in. (20-cm.) lines from the two boilers on the north side of the boiler room. Steam for the turbine auxiliaries is obtained from two 4-in. (10-cm.) steam lines, tapped onto the steam lines leading to their main units.

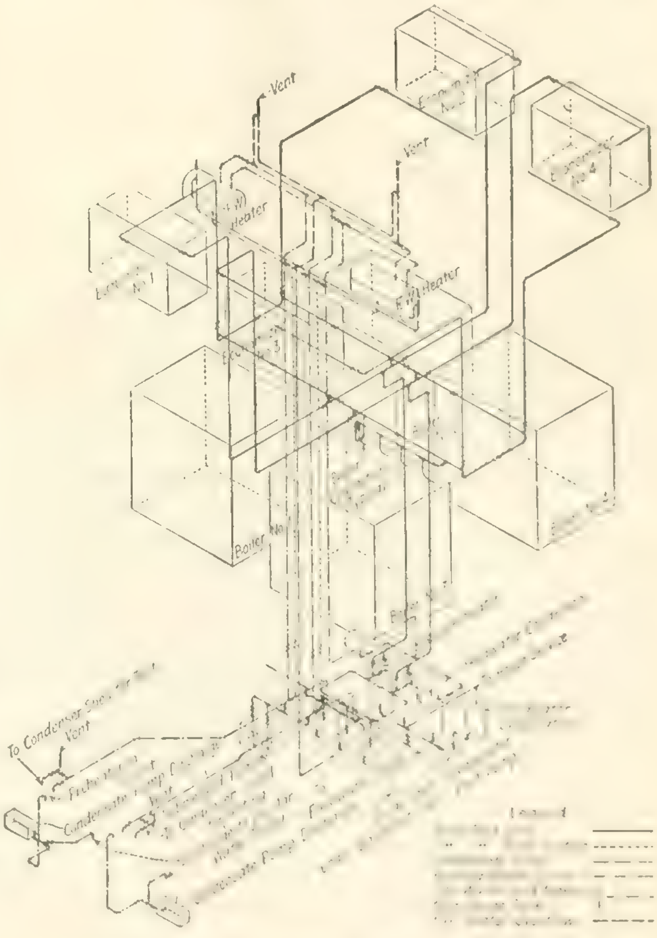
Two horizontal Curtis steam turbines rated at 10,000 kw. (continuous) and 1,800 r.p.m., drive 12,500-kva., three-phase, 60-cycle, 11,000-volt generators. Both direct-connected and auxiliary turbine-driven exciters are provided.

Steam from the turbines is condensed in two Wheeler Admiralty surface condensers connected to the turbines by means of copper expansion joints. Cooling water is provided by double-suction centrifugal pumps. These are directly connected at one end to 440-volt induction motors and at the other end through six-to-one herringbone reduction gears to turbines, this provision being made to permit obtaining a heat balance with different loading of the main units. Two turbo air pumps, also connected through herringbone gears, and two double-suction hot-well pumps complete the condenser auxiliary equipment.

A fan which forms an integral part of the generator rotor draws the cooling air through an air washer which is designed to clean, cool and humidify 30,000 cu.ft. (840 cu.m.) of air per minute.

The leads for the generators are run through conduit to the 11,000-volt switch room. The generator bus, disconnecting switches and oil circuit breakers are mounted in a concrete structure. The bus is sectionalized, power for the auxiliary service being taken from a middle section and one generator connected to each end section. Power for the station service is provided through three 200-kva., 11,000/440-volt transformers.

For service in the surrounding district two 12,500-kva., three-phase, 11,000/33,000-volt transformers, "Y"-connected on the "high" side and neutral grounded, are provided. They are connected to the 11,000-volt bus, one to each section, through disconnecting switches and oil circuit breakers. From the "high" side of these transformers copper-tube connections are run to the 33,000-volt bus, these being connected to the bus through disconnecting switches and oil circuit breakers.



ISOMETRIC DRAWING OF STATION PIPING

To connect with the New England Power Company's system at Millbury, Mass., three 5,000-kva., single-phase, 11,000/66,000-volt transformers, "Y"-connected on the high side and neutral grounded, are provided.

The construction work was done by the Fred T. Ley Company, under the supervision of the Harry M. Hope Company, which acted as engineers for the Eastern Connecticut Power Company.

Determining Losses in Transmission Lines

Short Methods of Determining Voltage Drop and Power Loss in Transmission Lines by Using Two Short Tables Based on Recognized Practice—When Line Construction Does Not Conform to Tables, Solutions Are Approximate

By **OSCAR GAARDEN**
Northern States Power Company

THOSE who have made calculations of losses in transmission lines have no doubt felt the need of some method by which the desired results can be arrived at in practice by more direct methods than by substitutions in long, cumbersome formulas. Usually several tables have to be referred to and interpolations made before the final result has been obtained. Careful revision then has to be made to check the results. These operations are tedious and require considerable time.

Unfortunately the relations existing between power and voltage losses and resistance, inductance and capacity in transmission lines are not capable of simple geometrical solution. However, it is believed that the solution of line-loss problems can be much simplified by the use of only two tables. By placing copies of these tables in a pocket notebook the engineer will be in a position to solve line problems in the field on short notice.

Transmission-line losses are composed of two separate quantities—power loss and voltage loss. In the preparation of tables for these losses the term kilowatt-miles has been employed. This term represents the product of the kilowatts delivered and the length of the line in miles. It is used for the purpose of broadening the application of the tables. It is obvious that the effect of load and distance are of equal weight in the determination of line losses under similar conditions if we neglect the effect of line capacity. A load of 100 kw. transmitted one mile (1.6 km.), will give the same line loss as 10 kw. transmitted 10 miles (16 km.), or 1 kw. transmitted 100 miles (160 km.) under similar conditions as to wire size, spacing, voltage, etc.

Let P = Power loss in per cent of load delivered.
I = Current per wire in amperes.
R = Total resistance per wire in ohms.
r = Resistance of one wire per 1000 ft.
m = Length of line in miles,
$\cos\theta$ = Power factor of load.
E = Line voltage at receiver.

For a three-phase line

$$P = \frac{3I^2R100}{1000\text{ kw.}} \quad (1)$$

But

$$I = \frac{1000\text{ kw}}{E\sqrt{3}\cos\theta} \text{ and } R = 5.28mr.$$

Substituting these values and solving for kilowatt-miles,

$$\text{kw-m} = \frac{PE^2\cos^2\theta}{528000\,r}. \quad (2)$$

Table I was prepared from equation (2). The table gives the values of kilowatt-miles for 10 per cent power losses and 80 per cent power factor for wires of various sizes at voltages commonly used on three-phase lines. For other percentages of power loss the value of kilowatt-miles will be in direct proportion, and for other power factors the value of kilowatt-miles will be in proportion to square of the power-factor ratios. As will be readily seen from equation (2), the values for other voltages will also be in proportion to the square of the voltage ratios. For the wire sizes listed it will then be evident that the power loss can be readily determined for any condition which may come up in practice. For single-phase the values of kilowatt-miles will be one half of those given in the table.

TABLE I—KILOWATT-MILES FOR 80 PER CENT POWER FACTOR AND 10 PER CENT POWER LOSS

For three-phase overhead lines at various voltages—60 cycles.

Safe Carrying Capacity, Amp.	Size of Wire	Voltage at Receiver								
		2,300	4,000	6,600	13,200	22,800	33,000	57,200	66,000	110,000
70	6	163	492	1,339	5,355	15,970	33,470	100,600	133,900	371,850
90	4	259	782	2,129	8,516	25,400	53,220	159,900	212,900	591,360
100	3	327	986	2,685	10,740	32,030	67,120	201,600	268,500	745,600
125	2	412	1,243	3,385	13,540	40,390	84,620	254,200	338,500	940,100
150	1	519	1,568	4,269	17,070	50,940	106,700	320,600	426,900	1,185,600
200	1/0	654	1,977	5,381	21,530	64,220	134,600	404,200	538,200	1,494,800
225	2/0	825	2,492	6,786	27,150	80,980	169,700	509,800	678,600	1,885,000
275	3/0	1,041	3,143	8,558	34,230	102,100	213,900	642,800	855,800	2,376,800
325	4/0	1,313	3,966	10,800	43,190	128,900	270,000	811,000	1,079,800	2,999,000

NOTE—Kw-miles for other percentages of power loss are in direct proportion. Kw-miles for other power factors are in proportion to the square. Kw-miles for other voltages are in proportion to the square. Do not exceed the safe carrying capacity of the wire. For single phase use one half the values for Kw-m given above.

$$\text{Formula—kw-m} = \frac{PE^2\cos^2\theta}{528000r}$$

The preparation of a similar table for line voltage loss is not nearly so simple.

Let I, r, m, $\cos\theta$ and E represent the same quantities as above.

Let A = Loss in line voltage in per cent of E.
Vo = Voltage to neutral at generator.
V = Voltage to neutral at receiving end.
D = Length of line in thousands of feet.
x = Inductive reactance of one wire per 1000 ft.
$z = \sqrt{r^2 + x^2}$ = impedance per wire per 1000 ft.
Tan $\epsilon = x/r$ for any wire.

Then

$\cos\epsilon = r/z$ for any wire.

Refer to the fundamental line diagram in Fig. 1. ON represents the receiver voltage E, $DN = zD$, $DC = xD$, $CN = rD$, θ = the angle of *lag* AON of the line voltage loss (neglecting capacity), angle $DNC = \epsilon$, $HNC = \theta$, and $DNH = (\epsilon - \theta)$.

$$Vo = \sqrt{(V\cos\theta + rdI)^2 + (V\sin\theta + xdI)^2} \quad (3)$$

Let $Z = V/DI$

Then

$$V_o = V\sqrt{\left(\cos\theta + \frac{r}{Z}\right)^2 + \left(\sin\theta + \frac{x}{Z}\right)^2} \quad (4)$$

$$A = 100\left[\sqrt{\left(\cos\theta + \frac{r}{Z}\right)^2 + \left(\sin\theta + \frac{x}{Z}\right)^2} - 1\right] \quad (5)$$

$$\left(\frac{A}{100} + 1\right)^2 = \cos^2\theta + \frac{2r\cos\theta}{Z} + \frac{r^2}{Z^2} + \sin^2\theta + \frac{2x\sin\theta}{Z} + \frac{x^2}{Z^2} \quad (6)$$

Assembling terms, completing the square, extracting the square root and substituting for (cos ε cos θ + sin ε sin θ) its equivalent cos (ε — θ) we have

$$\frac{z}{Z} = \sqrt{\left(\frac{A}{100} + 1\right)^2 - 1 + \cos^2(\varepsilon - \theta)} - \cos(\varepsilon - \theta). \quad (7)$$

but $Z = \frac{V}{DI}$ or $Z = \frac{E^2 \cos\theta}{5280 \text{ kw-m}}$ for three phase lines.

$$\text{hence kw-m} = \frac{E^2\cos\theta}{5280\,z}\left[\sqrt{\left(\frac{A}{100} + 1\right)^2 - 1 + \cos^2(\varepsilon - \theta)} - \cos(\varepsilon - \theta)\right] \quad (8)$$

For leading power factors the angle θ is negative. The term cos (ε — θ) then becomes cos (ε + θ). In Fig. 1 the angle (ε — θ) for leading power factor is *dnh*. If the angle (ε — θ) equals 90 deg., it will be seen that the point *f* very nearly reaches *d*. When *f* falls beyond *d* the voltage is higher at the receiving end than at the generating end.

Table II has been prepared from formula (8). Standard voltages and standard spacings which are common to three-phase systems have been adopted. The table is based on a frequency of 60 cycles per second, a power factor of 80 per cent (lagging) and a voltage loss of 10 per cent. In applying this table it is important to keep within the safe carrying capacity of the wire. The safe carrying capacity for each wire is given in the columns at the left. To obviate the necessity of computing the current for any load it will be found very convenient to prepare a table which gives the maximum safe kilowatt capacity for each wire size at the various voltages. The power factor which is most common, say 80 per cent, should be used in the preparation of this auxiliary table. Another method for quickly determining whether or not a given load is within the safe carrying capacity of the wire is to have an auxiliary table which gives the current in amperes for each load in kilowatts at the various standard voltages.

TABLE II—KILOWATT-MILES FOR 80 PER CENT POWER FACTOR AND 10 PER CENT VOLTAGE LOSS

For three-phase overhead lines at various voltages—60 cycles

*	Size of Wire	2,300		4,000		6,600		13,200			22,800		33,000			57,200			66,000			110,000
						MEAN		WI	RE	SPAC	ING	IN	INCHES									
		19 In	34 In.	19 In.	34 In.	30 In	55 In	30 In.	42 In	55 In.	42 In	55 In	60 In	72 In	81 In.	60 In.	72 In.	81 In.	60 In	72 In	81 In	120 In
70	6 Solid	202	198	610	600	1,640	1,610	6,540	6,470	6,440	19,300	19,230	40,140	39,900	39,770	120,600	120,700	119,700	160,600	159,600	159,100	436,200
90	4 Solid	292	284	884	861	2,340	2,290	9,380	9,240	9,160	27,580	27,310	57,380	56,480	56,310	172,400	170,000	169,500	229,500	225,900	224,200	612,800
100	3 Str.	343	337	1,038	1,021	2,790	2,690	11,150	10,930	10,780	32,620	32,130	66,970	66,260	66,000	201,200	199,400	198,600	267,900	265,100	264,000	716,200
125	2 Solid	406	391	1,230	1,184	3,250	3,120	12,980	12,670	12,500	37,800	37,260	77,280	76,610	75,900	232,100	230,600	228,400	309,100	306,500	304,600	822,800
150	1 Solid	472	451	1,430	1,367	3,750	3,580	15,010	14,600	14,310	43,560	42,700	88,850	87,620	87,050	266,900	263,700	262,000	355,400	350,500	348,200	937,500
200	1/0 Solid	544	514	1,648	1,558	4,280	4,050	16,990	16,600	16,220	49,530	48,400	100,530	98,890	98,520	302,000	297,600	296,500	402,100	395,600	394,100	1,055,700
225	2/0 Solid	610	578	1,865	1,753	4,820	4,540	19,300	18,650	18,180	55,650	54,210	112,450	110,520	109,500	337,800	332,600	330,300	449,800	442,100	439,000	1,167,800
225	2/0 Str.	620	582	1,878	1,760	4,840	4,560	19,380	18,720	18,240	55,830	54,420	113,020	110,960	109,900	339,500	333,900	330,700	452,100	443,800	439,500	1,169,200
275	3/0 Str.	694	647	2,100	1,957	5,400	5,050	21,630	20,780	20,200	62,000	60,250	124,970	123,350	121,600	375,400	371,200	365,800	499,800	493,400	[illegible]	1,290,100
325	4/0 Str.	771	714	2,335	2,160	5,970	5,530	23,870	22,860	22,110	68,200	66,000	136,810	133,830	132,600	410,900	402,700	399,100	547,200	535,400	530,300	1,402,900

* Safe carrying capacity, amp..

NOTE—Kw-miles for other percentages of voltage loss are very nearly in direct proportion. Kw-miles for other power factors below 90 per cent (lagging) are approximately in direct proportion. Kw-miles for other voltages are in proportion to the square of the voltages. Do not exceed the safe carrying capacities given in the columns at the left. For single phase use one half the values for kw-miles given above.

$$\text{Formula—kw-m} = \frac{E^2\cos\theta}{5280\,z}\left[\sqrt{\left(\frac{A}{100} + 1\right)^2 - 1 + \cos^2(\varepsilon - \theta)} - \cos(\varepsilon - \theta)\right]$$

To illustrate the practical application of the tables a simple problem will be solved.

Problem 1.—Length of line 27 miles, No. 6 wire, three-phase, 13,200 volts delivered. (a) What load can be delivered with a power loss of 10 per cent? (b) What will be the voltage loss for a 42-in. (106-cm.) spacing?

Solution.—From Table I, opposite No. 6 wire under 13,200 volts, we find 5355 kw.-m.

Load = 5355 ÷ 27 = 198.3 kw.

From Table II, we find 6470 kw.-m. may be transmitted at a voltage loss of 10 per cent. But actually the kw.-m. to be transmitted is 5355, therefore the voltage loss = (5355 ÷ 6470) 10 per cent = 8.3 per cent.

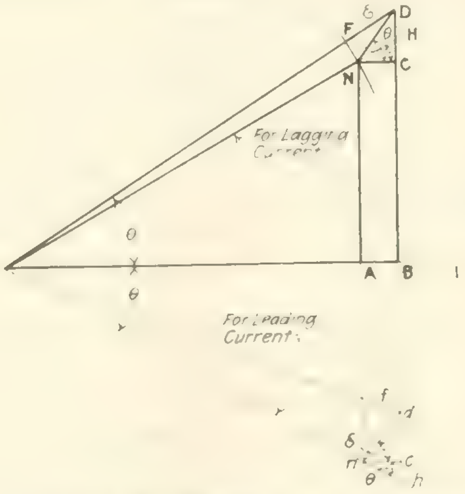


FIG. 1—SIMPLE TRANSMISSION-LINE VECTOR DIAGRAM

An inspection of formula (8) will show that for voltages other than those given it is only necessary to multiply the value of kilowatt-miles as given in the table by the square of the ratio of the voltages. For a given load, under similar conditions as to voltage, wire size, spacing, etc., the drop for single-phase is just twice that for three-phase. Table II can therefore be used for single-phase by taking one half the values given for kilowatt-miles.

It will be seen from formula (8) that the kilowatt-miles value is not directly proportional to the power factor or to the per cent voltage loss (*A*). The error of assuming kilowatt-miles directly proportional to (*A*) is, however, very small. In order to determine within what range of power factor Table II can be applied by direct exterpolation without serious error it is necessary to study the relation existing between kilowatt-miles and power factor under conditions likely to be met with in practice. The curves in Fig. 2 show this relation at 13,200 volts, 55-in. (140-cm.) mean spacing and 10 per cent voltage loss for the wire sizes listed in the table. It is interesting to note the rapid increase in kilowatt-miles (or load for a given distance) as the power factor is raised above 90 per cent especially for the larger wire sizes. The fact will also be evident that it is not safe to assume that the value of kilowatt-miles is directly proportional to power factor above or to the right of the dotted line TU. In using the table it is therefore important to remember that the error for the larger wires at power factors above 90 per cent is quite appreciable if the extrapolation method is used. It is recommended that formula (5) or formula (8) be used under these conditions. It is not probable that many such cases will be met with in practice.

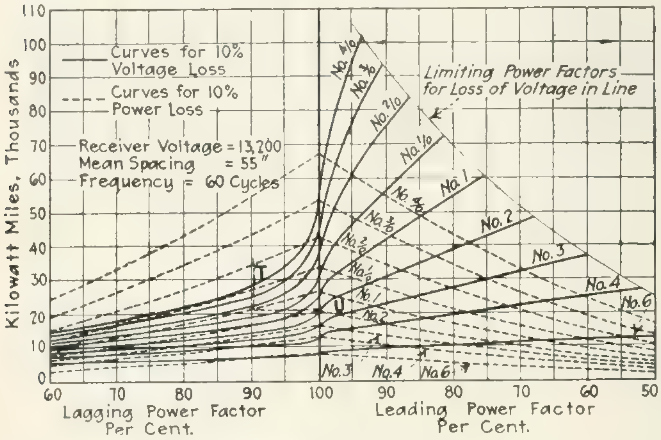


FIG. 2—RELATION BETWEEN KILOWATT-MILES AND POWER FACTOR ON BASIS OF (1) VOLTAGE DROP (2) POWER LOSS

The rapid increase in the kilowatt-mile capacity of the larger conductors as unity power factor is approached suggests the desirability of using condensive reactances to raise the power factor up to or beyond unity. In this connection it must be remembered that operation at high power factors would probably result in unstable voltage regulation if large conductors were used. The rate of change of voltage with power factor is not so great as that for kilowatt-miles. Nevertheless, it would be necessary to keep close watch of the voltage, or to install an automatic regulator, where the load is likely to fluctuate appreciably.

Where the separation between the three conductors of a three-phase circuit is not equal, the geometrical mean spacing should be used. This is obtained by taking the cube root of the product of the three conductor spacings. Sketches of a few types of construction in which the spacings are unsymmetrical are given in Fig. 4. The geometrical mean spacing for each of these types is given at the foot of the sketch.

In the construction of transmission lines on which the load is light it is important to see that the generating equipment is of sufficient size to handle the charging current. The effect of charging current on voltage loss is negligible on short lines but should be taken account of on lines 50 miles (80 km.) or more in length. A practical method by which this effect can be quickly determined is described below.

Let I_c = Charging current in amperes per mile of line.
X_m = Inductive reactance in ohms per mile of wire.
V = Voltage to neutral at receiver.
m = Length of line in miles.
f = Frequency in cycles per second.
C_m = Capacity in microfarads between wire and neutral.
L_m = Coefficient of self-induction in henrys.
S = Per cent rise in voltage at no load (or reduction of voltage loss under load) due to charging current.

The increase in voltage to neutral at the receiver over that at the generator due to the charging current flowing through the line inductance is, by the split condenser method, for three-phase, in per cent:

$$S = \frac{I_c X_m \mathrm{m}^2 . 100}{2V} \qquad (9)$$

But $I_c = 4\pi f C_m V 10^{-6}$ and $X_m = 2\pi f L_m$

$$\text{Hence m} = \sqrt{\frac{2S10^{-6}}{L_m C_m (2\pi f)^2 100}} \qquad (10)$$

$$\text{Since } L_m = 0.000742 \log \frac{\textit{dist. to neut.}}{\textit{wire radius}} \text{ and } C_m = \frac{0.0388}{\log \frac{\textit{dist. to neut.}}{\textit{wire radius}}}$$

$$L_m C_m = \frac{1}{34700}. \qquad (11)$$

$$\text{Then m} = \frac{4119.8}{f} \sqrt{S} \qquad (12)$$

For a frequency of 60 cycles per second, $\mathrm{m} = 68.66 \sqrt{S}$.

$$\text{or } S = \frac{\mathrm{m}^2}{4714}. \qquad (13)$$

Since only a slight irregularity in the wave form is sufficient to increase the charging current by 30 or even 40 per cent, it is safe to assume that it is at least 25 per cent greater under practical conditions than that obtained by calculations based on a sinusoidal wave form. Applying this correction in formula (13), we have $S = \mathrm{m}^2/3770$. (14)

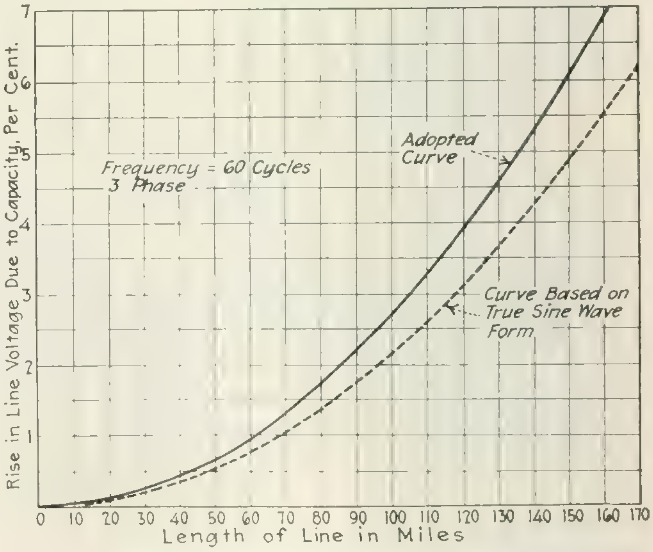


FIG. 3—RISE OF LOAD VOLTAGE DUE TO LINE CAPACITY

From the above formula we observe the very interesting result that the effect of line capacity on the per centage voltage loss for a given frequency is a function only of distance, regardless of the size of the conductor, spacing, line voltage or load. While the formula gives the per cent rise of voltage at no load, it may also be used for determining the reduction of voltage loss under load conditions with lagging power factor. While this assumption is not theoretically correct, it is sufficiently accurate for practical line calculations. The error due to the wave form not being sinusoidal is probably of greater magnitude than that resulting from the above assumption. Fig. 3 gives the values of S for various lengths of line, plotted in the form of a curve. The full-line curve is based on equation (14) and the dotted curve on equation (13).

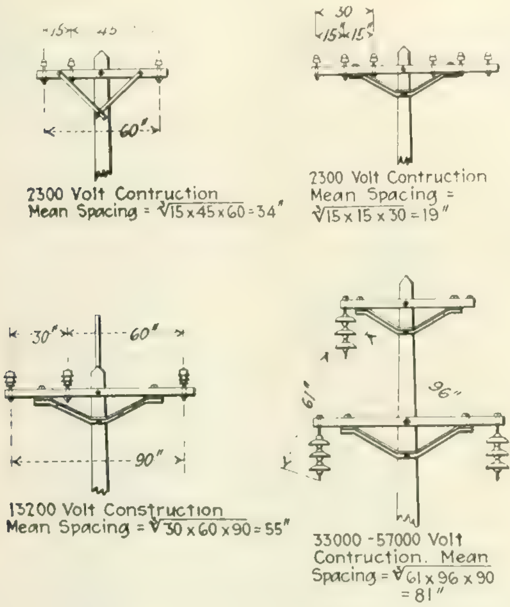


FIG. 4—MEAN SPACING OF CONDUCTORS FOR UNSYMMETRICAL CONSTRUCTION

For a single-phase line one-half the values of S obtained should be used.

Similar tables to those given above for transmission lines can be prepared for local distribution lines, underground cables and for interior wiring from equations (2) and (8). For these tables the term kilowatt-feet should be used instead of kilowatt-miles.

In order to show how these tables may be used for the solution of transmission-line problems in the various forms in which they occur, Problems 2 and 3 are worked out.

Problem 2.—Length of line, 16 miles; power factor, 90 per cent lagging; load, 400 kw.; voltage, 6600 at receiver; No. 2/0 wire, 55-in. spacing. Find per cent power loss for (a) three-phase and (b) single-phase. Find per cent voltage loss for (c) three-phase and (d) single-phase.

Solution.—

$$400 \times 16 = 6400 \text{ kw-m.}$$

From Table I for No. 2/0 wire, 6600 volts, kw-m = 6786.

Per cent power loss, three-phase $= \frac{6400}{6786} \times \left(\frac{8}{9}\right)^2 \times$ 10 per cent = 7.4 per cent. (a)

Per cent, power, loss, single-phase = 7.4 per cent × 2 = 14.8 per cent. (b)

From Table II for No. 2/0 wire, 6600 volts, kw-m. = 4540.

Per cent voltage loss, three-phase $= \frac{6400}{4540} \cdot \frac{8}{9} \cdot 10$ per cent = 12.5 per cent. (c)

Per cent voltage loss, single-phase = 12.5 per cent × 2 = 25.0 per cent. (d)

Problem 3.—Length of line, 98 miles, three-phase; load, 18,000 kw.; power factor of load, 75 per cent lagging. What size of wire should be used for approximately 10 per cent power loss and what will be the line voltage loss for a 120-in. spacing at 110,000 volts?

Solution.—

$$18{,}000 \times 98 = 1{,}764{,}000 \text{ kw-m.}$$

From Table I it is seen that No. 2/0 is the wire to be used; stranded wire is considered preferable.

Power loss $= \frac{1{,}764{,}000}{1{,}885{,}000} \cdot \left(\frac{80}{75}\right)^2 \times 10$ per cent = 10.6 per cent.

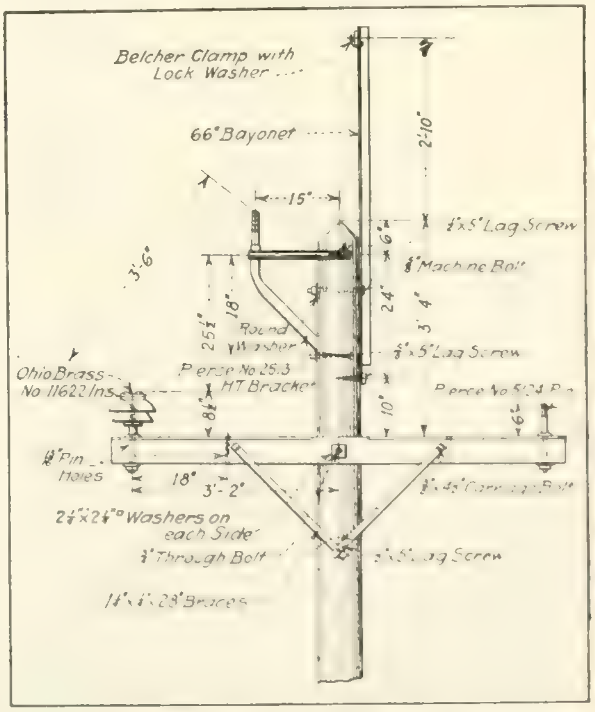
Voltage loss $= \frac{1{,}764{,}000}{1{,}169{,}200} \cdot \frac{80}{75} \times 10$ per cent = 16.1 per cent.

The line being over 50 miles in length, the effect of line capacity should be considered. From the curve in Fig. 4. we find the correction for 98 miles to be 2.6 per cent.

Corrected voltage loss = 16.1 — 2.6 = 13.5 per cent.

Pole-Top Construction Used by Mining Company

TO OBTAIN a triangular spacing of conductors, provide for a ground wire and still avoid using too long poles, the pole-top construction shown is being used on 33,000-volt lines interconnecting iron-mine power plants in northern Michigan. As may be seen, the cross arm is attached to the pole only 3 ft. 4 in. (1.2 m.) from its top and the upper power conductor supported on a Pierce No. 2513 bracket just above but at one side of the pole top. The ground wire is carried in a Belcher clamp at the top of a 66-in. (168-cm.) bayonet about 3 ft. (0.9 m.) above the upper power conductor. This construction was devised by F. C. Stanford, electrical engineer of the Cleveland Cliffs Iron Company, Ishpeming, Michigan.



POLE-TOP CONSTRUCTION FOR 33,000-VOLT LINES INTERCONNECTING IRON-MINE PLANTS IN MICHIGAN

Relative Temperatures of Square and Round Conductors

Why for the Same Current and Cross-Section Circular Cables Reach a Higher Temperature than Square Ones

BY T. S. TAYLOR
Research Laboratory, Westinghouse Electric & Manufacturing Company

IT HAS been observed by different persons that an insulated cable of square cross-section has in general a much lower conductor temperature than a circular one having equal cross-section of conductor and insulation. Although the explanation is quite simple, no discussion in regard to its cause seems to have been given in literature. To explain this phenomenon the following article is written. It is rather singular that previous observers of the fact have not presented the explanation.

In the first place, consider the temperature of the conductor of a circular insulated cable having such length that all the heat generated per unit length must pass through the insulation symmetrically and at right angles to the conductor.

Let H = Number of units of heat generated per unit length of the conductor.
a = radius of the conductor,
b = radius of cable over the insulation, and
k = thermal conductivity of the insulation.

The surface of the conductor and the outside surface of the cable are equi-temperature surfaces having temperatures t_2 and t_1 respectively. Now for a radial flow of heat in a cylinder we have

$$dH = -k\ (Adt/dr) = -k\ (2\pi rdt/dr)$$

Then
$$H = 2\pi k \frac{\int_{t_1}^{t_2} dt}{\int_a^b \frac{dr}{r}}$$

or
$$H = \frac{2\pi k\ (t_2 - t_1)}{\log b/a}$$

Solving this for t_2, we get:

$$t_2 = t_1 + \frac{H \log b/a}{2\pi k}$$
$$= t_1 + 0.159\ H/k \log \frac{b}{a}.$$

For a cable having square cross-sections of conductor and insulation of the same total areas respectively of both conductor and insulation as the above circular cable we have the following relation,

$$dH = -kAdt/dr$$
$$= -k8xdt/dx$$

$$H = 8k \frac{\int_{t'_1}^{t'_2} dt}{\int_c^d \frac{dx}{x}}$$

$$= 8k\ (t'_2 - t'_1)/\log d/c.$$

But $d = b/2 \sqrt{\pi}$ and $c = a/2 \sqrt{\pi}$

Hence we have $H = \dfrac{8k\ (t_2' - t_1')}{\log b/a}$

From which we obtain for t'_2:

$$t'_2 = t'_1 + 0.125\ (H/k) \log b/a,$$

an approximate solution.

Now, if the temperatures of the outside are maintained the same for both cables, that is t_1 equal to t'_1, and the energy consumed per unit length of the cable is the same in both cases, we find that the temperature of the circular cable exceeds that of the square cable by an amount given by the expression

$$t_2 - t'_2 = 0.034\ (H/k) \log b/a.$$

Another factor which enters here is that due to the fact that the cable of square cross-sections will have a greater surface area than the circular one and hence will have a lower outside temperature than the circular one. This will tend to lower the temperature of the conductor of the square cable still further. Then, since the conductor temperature is lower for the square cable, its resistance will be lower, which will make the heat generated per unit length less also. This in turn will cause a still greater difference to exist and give a further advantage to the square cable.

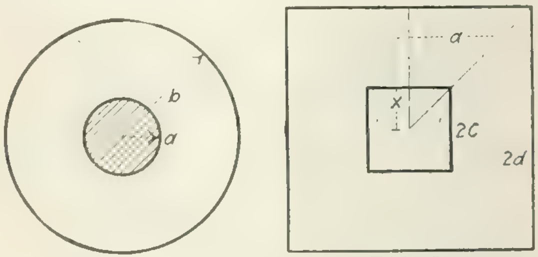


FIG. 1 FIG. 2

PRINCIPAL DIMENSIONS FOR SQUARE AND CIRCULAR CABLES

It is noteworthy also in connection with the above to observe that for a given form of cable, say circular, having a given insulation, so long as the ratio of the outer to the inner dimensions of the insulation remains the same, the difference between the conductor and the surface temperatures will be the same for all cables of this form, provided that the heat generated per unit length is the same.

To illustrate the difference that we might expect to exist, consider a rubber-insulated cable, having k = 0.0080 watts/in/deg. C./sec., and a ratio of b to a of 4, a being 0.1 in. For simplicity it is assumed that the outside temperatures of the cables for both cables, circular and square cross-section, are maintained the same. Thus for each watt generated per unit length of cable we have a difference between t_2 and t'_2 of (0.034/0.008) × 1.386, or 6 deg. C. approximately. Hence for cables having ratios of b/a or d/c of 4, where the circular copper conductor has a equal 0.1 in. and a resistance of approximately 2×10^{-5} ohms per inch length, we would have as much as 2.7 deg. difference in conductor temperatures for a current of 150 amp. Experiment has shown that the temperature of the conductor of a cable of the above dimensions and under the conditions specified will be about 25 deg. C. above room temperature. Hence the difference as calculated would be about 10 per cent. This shows that if cables of square cross-section were used, it would be quite possible to increase their carrying capacity considerably and still not exceed the temperature guarantees of the cable insulation.

The approximate calculation of the shape factor $S = \dfrac{8k}{\log {}^{b}/_{a}}$ for the square cross-section gives the maximum value for this quanity, and hence this makes $(t'_2 - t'_1)$ a minimum value. Another solution for this quanity involving another assumption will render $(t'_2 - t'_1)$ a maximum value which is still sufficient to give 5 per cent difference in favor of the square cable.

Experience with Transformer Cooling Methods

Methods of Preventing or Removing Scale Deposits Where Water Available Is Not Suitable for Transformer Cooling—General Comparison of Cooling Methods in Common Use

By G. E. ARMSTRONG
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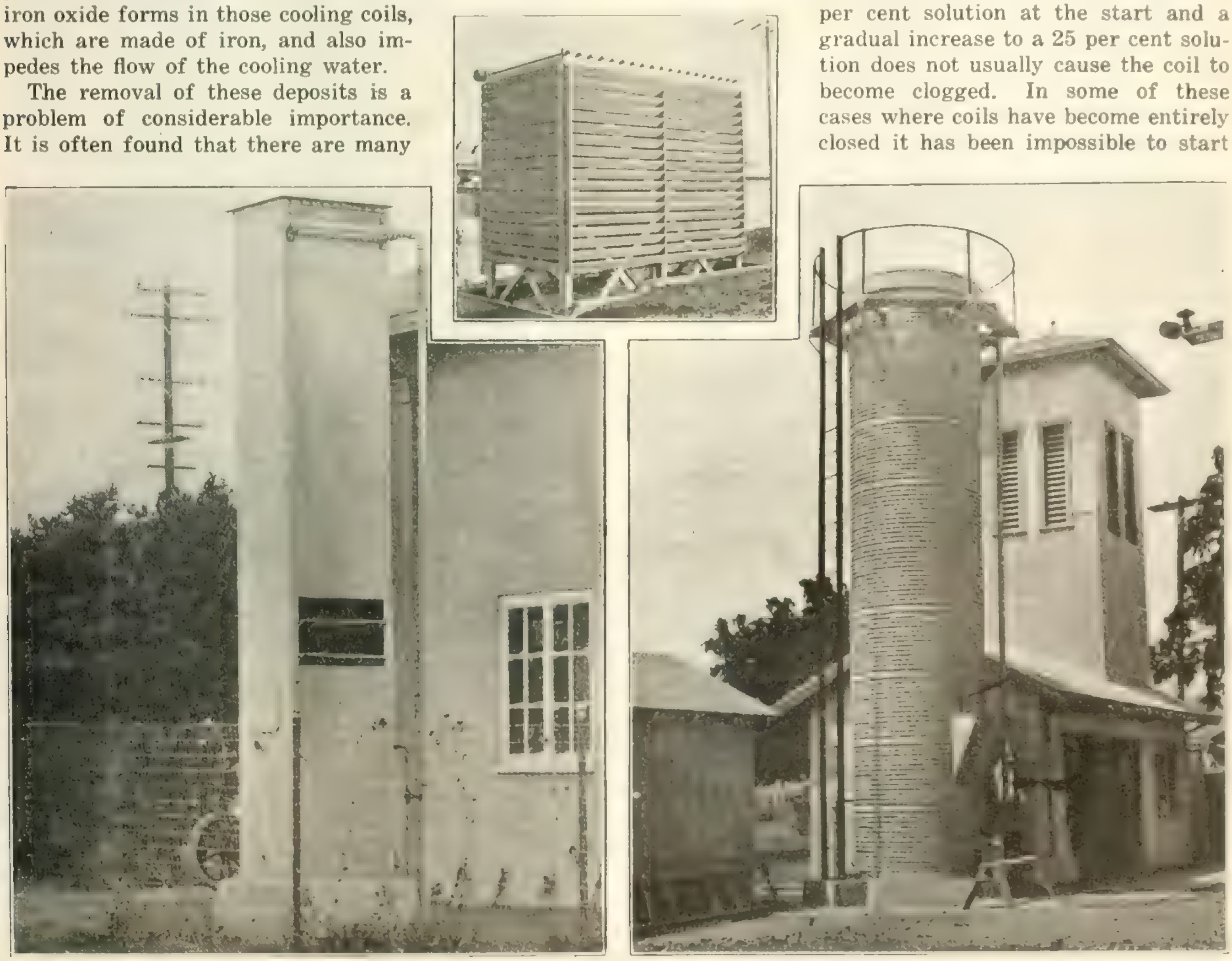
AT THE recent Pacific Coast convention of the American Institute of Electrical Engineers a great deal of interest was manifested in a paper having reference to difficulties in the operation of water-cooled transformers caused by clogged cooling coils.

The experience of operating engineers in the West has been that trouble nearly always accompanies the use of water-cooled transformers, particularly in southern California, and such trouble is due to the fact that water as obtained from the usual sources contains a considerable amount of solids in solution which generally consist of varying proportions of calcium and magnesium carbonates and magnesium sulphate. In addition to these the water may contain vegetable or earthy matter. These substances are deposited in the interior of the cooling coils and may ultimately result in a stoppage of the water flow. In addition, iron oxide forms in those cooling coils, which are made of iron, and also impedes the flow of the cooling water.

The removal of these deposits is a problem of considerable importance. It is often found that there are many difficulties in the way of thoroughly cleaning the interior of the coils, in some cases being so great as to render the use of water-cooled transformers inadvisable. Methods which have been used with considerable success in preventing or removing such deposits are outlined below.

A common method of cleaning such coils is to circulate a solution of muriatic acid through them. This circulation is accomplished in various ways, either by the use of a centrifugal pump constructed entirely of brass or bronze, by a reciprocating pump, or by forcing the solution from a reservoir by the introduction of compressed air into the reservoir. During the first part of the treatment it is absolutely necessary to use a very much diluted solution of acid, as a higher concentration would cause the formation of gas pockets or would loosen such large particles of scale as to cause the coil to plug up. A 3 per cent or 5 per cent solution at the start and a gradual increase to a 25 per cent solution does not usually cause the coil to become clogged. In some of these cases where coils have become entirely closed it has been impossible to start



TOWERS USED IN CALIFORNIA FOR COOLING TRANSFORMER WATER the flow again, even though the pressure were increased to several hundred pounds.

This method of cleaning is satisfactory where the scale consists largely of carbonates, as the acid reacts readily on the carbonate. If the carbonates and sulphates are intimately mixed, the carbonates are dissolved and the sulphates crumble and are washed out. However, in those localities where the scale has more sulphates than carbonates the acid treatment has little effect and it becomes almost impossible to remove the scale. In such cases it has been found necessary to install new cooling coils.

REMOVING SCALE BY SAND AND WATER BLAST

A new method of cleaning coils which has been used with some success has been to force sand and water through the coils at a very high velocity by means of compressed air. This method of cleaning is particularly dependable in those cases where the deposit consists of earthy or vegetable matter.

In using the acid treatment a great deal of caution must be exercised when cleaning a brass or copper coil. It has been found that dezincification has resulted and allowed the water to enter the transformer oil. This occurs in the case of the copper coils, where sections are brazed together.

There are several alternatives possible when considering the best method of cooling transformers: (1) Water-cooled transformers, (a) iron coils, (b) copper coils; (2) naturally cooled transformers; (3) oil circulation; (4) air blast.

METHODS OF COOLING TRANSFORMERS ARE COMPARED

As between the use of copper and iron coils there is considerable diversity of opinion as to which is preferable. The iron coils are somewhat stronger mechanically than the copper coils but are subject to the formation of iron oxide by the passage through them of air entrained or dissolved in the water. This latter feature is particularly noticeable when the water is cooled by a spray cooling pond or some form of cooling tower. The thermal conductivity of the iron being somewhat less than that of copper requires a larger area of coil than in the case of copper. The copper coils are somewhat more expensive. At the present time the increased cost of transformers is from $0.032 to $0.134 per kilovolt-ampere if copper is used in place of iron.

A further consideration in the use of water-cooled transformers is the cooling of the water used. The necessity of circulating the water involves the fact that re-use of the water causes a concentration of the solids in solution and so may necessitate a treatment of the water to precipitate the solids in order to prevent them from being deposited in the form of scale in the interior of the cooling coils. Tri-sodium phosphate has been quite successfully used for treating cooling water. The Southern California Edison Company has recently installed a bank of 5,000-kva. transformers having the inside surfaces of the cooling coils treated to retard, or prevent if possible, the formation of scale. This treatment is different in the three transformers of the bank, being varnish of different kinds in two and hydrolene thinned with benzine in the third.

The photographs show several typical installations made by the Southern California Edison Company for the purpose of cooling transformer cooling water.

A small cooling tower which handles the water for a 1,200-kva. transformer is shown in the figure (left).

At the right is a cooling tower devised by the Southern California Edison Company, which has been used to handle cooling water of transformers of a total capacity of 12,000 kva. In this type of cooling tower a fan is placed near the bottom of the tower and the air forced upward through the tower. The water from the transformer is pumped to the top of the tower where a distributer is placed which consists of a number of 1 in. (2.6-cm.) pipes having ⅛ in. (3 mm.) slots cut lengthwise. These pipes are connected to a cross-box. From the pipes are suspended ¼-in. (6-mm.) mesh galvanized-iron screens, which extend down to the point where the air enters. The lower part of the cooling tower forms a reservoir in which the water level is maintained by a float valve. Centrifugal pumps take the water from this reservoir and force it through the transformer cooling coils.

At the top is seen a typical cooling tower which has been adopted as the standard. Cooling towers following this design are built in various sizes dependent upon requirements. The one illustrated is for transformers of a total capacity of 4,800 kva.

Naturally cooled transformers in sizes up to 1,000 kva. are coming more into favor, especially in those localities where there is not constant attendance or where the water available for circulating through the transformer is of such a character as to make the cost of maintenance very high. Entirely satisfactory results have been obtained in Southern California from the use of naturally cooled transformers installed outdoors where the cases of the transformers have been painted light gray or white.

OIL CIRCULATION HAS PROVED AN EXCELLENT METHOD OF COOLING

For large installations and installations of considerable importance from other reasons the circulation of transformer oil through exterior cooling coils offers, in the opinion, of the writer the very best solution for the the cooling problem. Such installations involve somewhat greater expense if properly made. The most acceptable method of installing an oil circulation system is to keep the oil from each bank of transformers separate from that of the other banks. In case of units of sizes such as 10,000 kva. it is advisable to keep the oil of each individual unit separate from the others. This necessitates the use of a large amount of piping and the operation of a considerable number of pumps, but has the advantage of great reliability and safety as the introduction of moisture into the oil of any one transformer would not be conveyod to the others.

A further advantage of this form of transformer cooling is that the scale forms on the outside of the cooling coils and can be readily removed by mechanical means. The danger of contaminating the oil by water is small, provided that the cooling coils are on the pressure side of the circulating pump.

The air-blast type of transformers is applicable to those places where cooling water is not obtainable or where space is not available for the construction of cooling towers—such as in downtown substations. Air-blast transformers carry a fire risk which require special care in design and operation. Owing to insulation requirements air-blast transformers are of use only at the lower voltages.

Analysis of Insulator Practice

Policies of More than Forty Transmission Companies in Insulating Their Lines—Nature of Tests Made Before Installing the Insulators—Costs—Causes of Failures and Methods of Preventing

TO GIVE transmission companies some basis on which to compare their insulator practice with that of other companies, the ELECTRICAL WORLD has made an extensive study of the practices of more than forty companies operating lines rated at 11,000 volts to 150,000 volts. Information was requested regarding (1) the types and ratings of insulators used on different lines, with the reasons; (2) nature of tests made before and after the insulators are put in service; (3) frequency, method and effectiveness of inspections; (4) relation between years of service and rate of depreciation; (5) cost of testing and inspecting insulators; (6) causes of insulator failures; (7) ratio of number of failures at dead-ends and at tangent points with causes and methods of reducing; (8) relative vulnerability of different positions in suspension strings; (9) effect of alternate heat and cold, dust, ocean fogs, etc., with methods of prevention; (10) methods of preventing injury from flashovers. The companies from which replies were received are listed with notes regarding peculiar conditions under which they may operate. Replies regarding insulator ratings are tabulated in Table II, classified according to the operating voltages of the lines on which they are used. The companies can be identified by comparing the key numbers in the last column with those in Table I. An analysis of these replies and preliminary tests made on insulators is presented in this issue. Information on the other subjects investigated will be given in a later issue of the ELECTRICAL WORLD.

While the operating voltages in existence may be no indication of those which will be in favor ten years from now, it is interesting to note that of those reported, 13,200, 22,000, 33,000, 66,000 and 110,000 volts seem to be preferred to other voltages, such as 11,000, 26,400, 38,000, 44,000, 50,000, 55,000, 60,000, 70,000 and 100,000, although every one of the last group is in use too. With the exception of the first preferred voltage (13,200) all of the other preferred voltages are even multiples of 11,000, which is very advantageous when it comes to transforming from one voltage to another since it permits standard even-ratio transformers. Of course, slight departures from even multiples of 11,000 volts can be easily permitted by the taps on the transformers. It is significant that 44,000 volts and pressures between 66,000 and 110,000 do not appear to be popular. The next higher voltages coming into use for long-distance bulk transmission are 150,000 volts and 220,000 volts, three examples of the former being in operation. Transmission at the latter voltage is still in the development stage, although there are very positive signs of its being used on the Pacific Coast shortly.

RELATION OF INSULATOR RATING TO LINE VOLTAGE

The rating given an insulator by a manufacturer must necessarily be based upon a certain assumed set of conditions. These conditions may or may not be the same as those which will obtain at the place of service. Hence it is necessary in selecting insulators for a particular location to give proper consideration to the maximum working voltage, all the climatic conditions, the amount of power to be transmitted and the reliability of service required. The consideration of these factors will lead to the selection of a much larger insulator in some places than in others operating at the same voltage.

On the average, the insulator ratings employed seem to be the next multiple of 11,000 volts above the operating voltage. For example, the average insulator rating used for 13,200-volt lines is about 26 kv., that for 22,000-volt lines 35 kv., that for 33,000-volt lines 45 kv., for 66,000 volts 75 kv., etc. Of course, the actual ratings arrange themselves each side of this average, the limits for the 11,000-13,200-volt class being 15 kv.

TABLE I—COMPANIES FROM WHICH REPORTS WERE RECEIVED

With Brief Outline of Climatic, Geographic or Operating Conditions Which Affect Insulator Performance and Practice

NORTHERN UNITED STATES

(1) NEW ENGLAND POWER COMPANY, WORCESTER, MASS.
Lines located inland at moderate altitude and in dry, temperate climate so that service is probably less severe than on some other systems.

(2) CENTRAL MAINE POWER COMPANY, AUGUSTA, ME.
At northern end (Greenville) the transmission line is 1,000 ft. (305 m.) above sea level; the southern extremity (Bath) is at sea level. When storms originate at the north and travel south via the Kennebec Valley, conditions are ideal for lightning trouble. There are about 400 miles (120 km.) of high-tension transmission line interconnected in this system. By opening sectionalizing switches at the power stations, dividing the system into three sections, before thunderstorms reach this locality, it has been found possible to minimize line surges and thus reduce insulator failures and damage to station and switch bushings, aluminum-cell arresters, etc., almost 100 per cent.

(3) EASTERN MASSACHUSETTS ELECTRIC COMPANY, SALEM, MASS.
Ocean fogs and lightning storms experienced somewhat; numerous birds and hunters.

(4) ROCKINGHAM COUNTY LIGHT & POWER COMPANY, PORTSMOUTH, N. H.
Ocean fogs experienced. Three times during the last six years there have been occasions during heavy northeast storms when insulators would "spill" over as fast as moisture would accumulate. However, this would only be a flash which would dry off the insulator without interrupting service.

(5) NARRAGANSETT ELECTRIC LIGHTING COMPANY, PROVIDENCE, R. I.

(6) CUMBERLAND COUNTY POWER & LIGHT COMPANY, PORTLAND, ME.

(7) CONNECTICUT LIGHT & POWER COMPANY, WATERBURY, CONN.

(8) TURNERS FALLS POWER & ELECTRIC COMPANY, GREENFIELD, MASS.
Some heavy sea fogs followed by rain.

(9) HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, TORONTO.
Extensive system operating at voltages up to and including 110,000.

(10) ADIRONDACKS ELECTRIC POWER CORPORATION, GLENS FALLS, N. Y.

EASTERN ATLANTIC SECTION

(See Southern section also.)

(11) PENNSYLVANIA WATER & POWER COMPANY, BALTIMORE, MD.
Considerable lightning.

(11A) APPALACHIAN POWER COMPANY, BLUEFIELD, W. VA.

(12) PHILADELPHIA ELECTRIC COMPANY, PHILADELPHIA, PA.

(13) CONSOLIDATED GAS, ELECTRIC LIGHT & POWER COMPANY, BALTIMORE, MD.

(*Table I continued on page 544*)

TABLE I—(*Continued from page* 543)

MIDDLE WEST

(14) UNION ELECTRIC LIGHT & POWER COMPANY, ST. LOUIS, MO.

U. S. Weather Bureau classes its territory as storm zone. Has unusually severe lightning disturbances, considerable windstorms and wind of high velocity. Moisture from Mississippi River Valley. Very hot in summer.

(15) MISSISSIPPI RIVER POWER COMPANY, KEOKUK, IOWA.

Extremely hot summer months and subjected to moisture from Mississippi River Valley. See also (14).

(16) TERRE HAUTE, INDIANAPOLIS & EASTERN TRACTION COMPANY, TERRE HAUTE, IND.

Severe electrical storms.

(17) PUBLIC SERVICE COMPANY OF NORTHERN ILLINOIS, CHICAGO, ILL.

(18) ILLINOIS TRACTION SYSTEM, PEORIA, ILL.

(19) SOUTHERN ILLINOIS LIGHT & POWER COMPANY, ST. LOUIS, MO.

(20) NORTHERN STATES POWER COMPANY, MINNEAPOLIS, MINN.

(21) PENINSULAR POWER COMPANY, MADISON, WIS.

Electric storms exceptionally severe and numerous during summer months.

(22) FORT WAYNE & NORTHERN INDIANA TRACTION COMPANY, FORT WAYNE, IND.

Lines follow river bank where they are exposed to severe lightning and wind.

(23) CENTRAL ILLINOIS LIGHT COMPANY, PEORIA, ILL

(24) IOWA RAILWAY & LIGHT COMPANY, CEDAR RAPIDS, IOWA.

Lightning extremely severe. Owls, squirrels, etc., interfere with operation.

(25) NORTHERN INDIANA GAS & ELECTRIC COMPANY, HAMMOND, IND.

(26) INDIANA RAILWAYS & LIGHT COMPANY, KOKOMO, IND.

(27) INDIANA GENERAL SERVICE COMPANY, MUNCIE, IND.

(28) HAWKS ELECTRIC COMPANY, GOSHEN, IND.

SOUTHERN SECTION

(29) SOUTHERN POWER COMPANY, CHARLOTTE, N. C.

Has 400,000 insulators in service. Average conditions for this latitude and for a system with transmission network.

(30) ALABAMA POWER COMPANY, BIRMINGHAM, ALA

Severe lightning storms are practically a daily occurrence four or five months of year. Extremely hot and humid in summer.

(31) GEORGIA RAILWAY & POWER COMPANY, ATLANTA, GA.

Although in the South, the system is relatively high above sea level, and hence temperature is not so high as might be expected.

(32) VIRGINIA RAILWAY & POWER COMPANY, RICHMOND, VA.

(33) TEXAS POWER & LIGHT COMPANY, DALLAS, TEX.

Dry and hot months. Nights are cool.

FAR WEST

(34) GREAT WESTERN POWER COMPANY, SAN FRANCISCO, CAL.

Considerable lightning, great differences in elevation, ocean fogs, rainy winters, etc.

(35) SAN DIEGO CONSOLIDATED GAS & ELECTRIC COMPANY, SAN DIEGO, CAL.

Lines located close to coast, where they are subjected to ocean spray occasionally. Ocean fogs are frequent. Inland it is very dry and dusty in summer. Winters are rainy.

(36) SOUTHERN SIERRAS POWER COMPANY, RIVERSIDE, CAL.

Ocean fogs; sometimes very dusty; rough country traversed; rainy winters.

(37) WASHINGTON WATER POWER COMPANY, SPOKANE, WASH.

Lightning storms are quite severe but infrequent and of short duration. Sleet and high winds are practically unknown. Precipitation and humidity are very slow. Temperature varies from 100 deg. Fahr. to about 20 deg. Fahr.

(38) SOUTHERN CALIFORNIA EDISON COMPANY, LOS ANGELES, CAL.

The system extends through territory having a great variety of climatic conditions, so the insulation of lines of the same voltage has been varied accordingly. (See 60,000-volt line insulation Table II.)

(39) PUGET SOUND TRACTION, LIGHT & POWER COMPANY, SEATTLE, WASH.

Very few lightning storms.

(40) PACIFIC GAS & ELECTRIC COMPANY, SAN FRANCISCO, CAL.

Operates two systems interconnected through auto-transformers. The first system contains approximately 300 miles (480 km.) of 125-kv. tower line and the second about 1,800 miles (2,900 km.) of 60-kv. line mostly on wood poles. The elevation above sea level is 5,000 ft. (1,525 m.). The temperature range is about 20 deg. Fahr. to 110 deg. Fahr. Very bad service conditions exist near the coast whereas very favorable conditions are encountered in the mountains. Lines exposed to the ocean fogs require considerably more care to keep the insulator surfaces clean than do those inland. Lightning is comparatively absent. The use of steel towers or other grounded structures undoubtedly requires a higher degree of insulation than wooden construction, where metal pins may be tied together but not grounded.

to 45 kv., for 22,000 volts 27 kv. to 35 kv., for 33,000 volts 35 kv. to 45 kv., for 66,000 volts four to eight disks in suspension and five to nine in strain, and for 110,000 volts six to nine disks in suspension and nine to ten in strain.

The wide divergence from average insulator ratings which has been pointed out is not so illogical, however, when it is considered that average conditions do not exist everywhere. Where the climate is favorable and the service not particularly important, where wood arms and non-grounded pins are used and the neutral grounded, it can be easily imagined that a lower factor of safety can be provided. On the other hand, where the climate or geographical location is unfavorable and the service extremely important, where steel arms and grounded pins are used and a delta system is employed, where the load is likely to warrant increasing the voltage shortly and switching surges are experienced, a higher insulator rating will have to be used. These facts should be borne in mind when comparing the ratings employed. To explain the differences in insulator ratings for the same line voltage, remarks are made opposite each case where the company furnished an explanation, and some of the peculiar conditions under which the companies operate are explained briefly in Table I.

It may be noted in several cases that very low insulator ratings are employed where the air is dry and other climatic conditions are particularly favorable. On the other hand, even on the same system and at the same voltage the opposite extreme will be observed owing to the fact that the lines may run where operating conditions are not so favorable, as, for instance, near the coast where salt spray blows on to them and is deposited to the detriment of the surface resistance.

As might be expected after some consideration, the largest divergence in insulator ratings exists on the lowest voltage lines listed, namely 11,000, because these lines are not only liable to be subjected to all the climatic and geographical conditions of higher voltage lines but they are physically at variance among themselves. For instance, some are on wood cross-arms, others on steel; some on wood pins, others on grounded metal pins. Some serve important loads; others may be temporary in character or serve loads to which interruption of service is not so serious. Again, it is with this class of lines that loads are likely to grow beyond the range of the initial voltage so that it is cheaper to insulate for a higher voltage in the beginning than to change insulators when an increase in voltage is demanded.

The use of both delta and grounded neutral systems also accounts for differences in insulator rating for the same phase voltage. For instance, on one line the rating is less than phase voltage because a grounded neutral is employed, whereas another line with the same phase voltage but delta connection would require a higher insulation rating.

Several companies are making a distinction between insulation on steel arms and that on wood, feeling that the opportunity for an insulator to flash over is increased with steel arms. To determine the truth of the matter some companies are using different rated insulators of the same make on steel arms and comparing their performance. There has been some dependence placed on the insulation afforded by wood construction, but surface leakage and fires show that too much

TABLE II. TYPES AND RATINGS OF INSULATORS REPORTED USED BY COMPANIES

Where abbreviations are used, O.B. indicates Ohio Brass; J.D., Jeffrey Dewitt; C.P., Canadian Porcelain; G.E., General Electric; L., Locke; T., Thomas, and W., Westinghouse.

Line Voltage	Type of Insulator or Rating (in Parentheses)		Remarks	Key Number of Company (See Table I)
	Straight-line	Dead-End		
11,000	(23,000)	Cemented insulators may be replaced with non-cemented	Replaced single-piece 33,000-volt	(10)
	(35,000) Pin	Various makes		(31)
	(27,000) O.B. 12546	O.B. 11940		(32)
	(27,000) Locke 408A	Two Ohio brass 11535		(34)
	(15,000) Pin (27,000) Pin (45,000 Pin)	Two Locke 3039 Two Locke 3039 Two Locke 3039	Used in dry places inland, but 18-22 kv is preferable Under ordinary conditions Near coast	(35)
	(11,000) One-piece pin (23,000) One-piece pin		Regular Coast	(38)
	(22,000) O. B. 11535	O. B. 11535		X
13,000	(22,000) Pin			(29)
13,200	(22,000) Pin	Locke & Ohio brass, 10 in.		(1)
	(26,000) Locke 2117	Locke 2335A	Insulation rating 100 per cent above line voltage	(4)
	(22,000) Pin	Two Hewlett	Next higher voltage	(8)
	Canadian Porcelain No. 793 (105,000) D.F.O. (55,000) W.F.O.	(Same type)		(9)
	(20,000)	2-J.D.		(11A)
	(27,000) O.B. 12546	(Same as suspension)		(12)
	(35,000) O.B. 11622	O.B. 10566 or 10567 Jeffrey Dewitt		(14)
	(27,000) J.D., O.B	Jeffrey Dewitt		(20)
	(25,000) O.B. 10637		1000 in service	(21)
	(15,000) One-piece pin (20,000) Locke 5875 (33,000) Three-piece pin	G.E. 61912	Used for a time Rating now in use Formerly used with idea of raising voltage.	(23)*
	(27,000) Locke 5155	Locke 2335 A		(24)
	(27,000) O.B. 12546	O.B. 12464		(32)
	(13,000) O.B. 10044	7-in. O.B	Ungrounded neutral	(37)
13,800	(20,000)	G.E. 61916		(39)
15,000	(23,000) One-piece porcelain (27,000) Two-piece porcelain	Locke 2335, 2335A, 2565 6000 and 5996	Regular Near coast	(38)
22,000	(33,000) Pin	Locke 10 in., Ohio brass		(1)
	(35,000) O.B. 11622	Two O.B. 11535	13,200 volts to ground	(3)
	(33,000) Pin	Three Thomas 1142		(5)
	(35,000) Pin		Use next higher voltage than line pressure for insulator rating	(8)
	Two O.B. 11622 (130,000 D.F.O.) (70,000 W.F.O.)			(9)
	(35,000)			(31)
	(35,000) Thomas pin		17 miles of 22,000-volt line	(32)
	(27,000) Locke 408 A	O.B. 11623, 2 O.B. 11535		(34)
26,400	Two O.B. 11622 (130,000 D.F.O.) (70,000 W.F.O.)			(9)
	(35,000) O.B. 11622	O.B. 10566 or 10567 Jeffrey Dewitt		(14)
	(27,000) J.D., O.B	Jeffrey Dewitt		(20)
33,000	(45,000) Thomas 3055		Planning to use Hewlett for strain and suspension; on river crossing will use two sets of three each, with yokes	(2)
	(35,000)	Three Thomas 1142		(5)
	(45,000) Pin			(7)
	(45,000)		Delta system	(10)
	(45,000) Three-piece porcelain		Avoid dead-ending by turning corners on two poles	(16)
	(45,000) Locke 5233	Two Locke 3266	Delta system	(17)
	(45,000) O.B. 11623		50 per cent above operating voltage ordinarily	(18)
	(35,000) Locke 5339	Locke 2335 A		(19)
	(40,000) Locke 3998, Locke 5233, also O.B	Locke 5800, also O.B. and Jeffrey Dewitt	Voltage probably as high as 35,000	(22)
	(45,000) Locke 5233	Five Locke 2335 A		(24)
	(35,000) Locke 311 and 5166 O.B. 9416	3 Locke 10 in		(36)
	(35,000) Two-piece porcelain	Locke 2335, 2335A, 2565, 6000 and 5996	Ordinary service	(38)
	(35,000) Pin	O.B. 11535		X
38,000	(40,000) Thomas 3056			(6)
	(45,000) Pin			(31)
44,000	(Three-suspension) (225,000 D.F.O.) (130,000 W.F.O.)			(9)
	C.P. 1159, etc. (165,000 D.F.O.) (120,000 W.F.O.)			[illegible]
	(60,000 Pin, all makes			(29)
	(55,000) Pin	O.B., Thomas & Locke	Strain points [illegible]	(30)
	(45,000) O.B. 11623	Four O.B. 11535	Exceptionally favorable conditions	(34)
50,000	(45,000) J.D. and O.B.	Jeffrey Dewitt	Grounded neutral	(20)
55,000	Locke 341, 351			(36)
	(60,000)	Three—G.E. 47048 Hewlett, also Westinghouse 27219 and Jeffrey Dewitt		(39)
60,000	(60,000) (80,000)		On wood cross-arms On steel cross-arms	(10)
	(66,000) Pin, (60,000) Disk	90,000 disk		(20)
	(70,000) O.B. 10,748	10-in. O.B	Grounded neutral, 650 miles in multiple	(37)
	Three Locke 2335, 2335A, 2565, 5996 and 6000 (new type) Four Locke Five Locke Eight Locke	Four Locke, same types Five Locke, same types Six Locke, same types	Hot dry districts Normal conditions Near coast where fog is common One place on beach	(38)

TABLE II—(*Continued on page 546*)

TABLE II—*Continued from page 545.* TYPES AND RATINGS OF INSULATORS REPORTED USED BY COMPANIES

Line Voltage	Type of Insulator or Rating (in Parentheses)		Remarks	Key Number of Company) (See Table I
	Straight line	Dead-End		
66,000	(80,000) Disk	Locke Ohio brass, 10 in.		(1)
	Five Thomas 1142	Six Thomas 1142 Nine Thomas 1142	On main line At river crossings	(5)
	Five Jeffrey Dewitt	Two parallel strings of seven, Jeffrey Dewitt		(7)
	Four Hewlett (25,000 volts per disk)	Five Hewlett		(8)
	Eight O.B. 12464	Nine O.B. 12464	Importance of continuous service determining factor	(12)
	Four Locke 2335	Five Locke 2335	12,000 in service	(21)
	Four O.B. 11936	Five O.B. 11936	4,000 in service	
	Four Locke 5996	Five Locke 5996	Manufacturer's recommendation	(35)†
	Six Locke 5996	Seven Locke 5996	Near coast	
	Five Locke 5996	Six Locke 5996	Favored for interior	
	(66,000) three part 13-in. pin, Locke	Five 10-in. O.B.		(40)
	Six O.B. 11535			X
70,000	Seven O.B. (10-in. type B) 375,000 D.F.O	Eight O.B.	Several thousand Jeffrey Dewitt are being installed	(11)‡
88,000	Five J.D., O.B. or Thomas	Six or seven J.D., O.B. or Thomas		(11A)
100,000	(320,000)			(29)
	Seven Locke 2335A, 4976, 5257 or 5996 Seven Ohio Brass 10567	Eight Locke or O.B		(36)
	Six Jeffrey Dewitt	Seven Jeffrey Dewitt		
110,000	Eight CP 1725 or 2133 Eight O.B. 12464 Eight (475,000 D.F.O.) Eight (335,000 W.F.O.)	Ten units	Used on steel arms	(9)
	Seven C.P. 1725 or 2133 Seven O.B. 12464 Seven (425,000 D.F.O.) Seven (310,000 W.F.O.)	Nine units	Used on wood arms and in few cases on steel for experimentation	
	(150,000) J.D. and O.B	J.D.		(20)
	Nine O.B. 12464			(32)
	Six 10-in. disks	Nine 10-in. disks		(34)
125,000	Seven 10-in. O.B.	10-in. O.B.	Climatic conditions not severe	(40)
150,000	Ten 10-in. disks	Double strings of twelve 10-in. disks		(34)
	Locke 2565	Locke 2565		(38)

* Three-phase delta system.

† Were using 88-kv. pin-type insulators, but inadequate.

‡ Originally the line was insulated with five or six units per string, but frequent flashovers during lightning storms caused the insulation to be increased to seven and eight units.

reliance should not be placed on this insulation, which changes in character with the weather anyway. On the other hand, it should not be forgotten that this insulation is no longer present as a margin of safety when insulators are supported directly on steel crossarms or structures, so the rating should be more liberal.

Higher than normal insulation is also generally employed at dead-ends because there the insulators are not in the best position (vertical) to display their normal electrical characteristics. While no company has admitted the belief, it is likely that some are still influenced by the old theory, not yet disproved, that a dead-end point is subjected to unusual electrical stresses. Replies which may give some light on this point, form the basis of an analysis appearing in this article.

One company has an interesting practice of over-insulating at points inaccessible and remote from substations. By so doing it has been able to secure better results from those insulators which cannot be inspected regularly and still without raising the average insulation rating considerably.

It is unnecessary to comment on the use of parallel strings of insulators at dead-ends since the purpose is obvious and the number of parallel strings depends on the mechanical strength required. It must be pointed out, however, that the number of strings in parallel is limited by physical reasons so some companies are using link-type insulators or putting parallel strings of built-up insulators in compression since in this way fewer parallel strings are required for the same mechanical strength.

In most of the cases listed pin insulators are used for straight-away lines up to 66,000 volts, whereas for dead-ends and pressures of 66,000 volts and higher disk-type insulators are in favor. Several companies that have apparently overinsulated have reported that the increased surety of continuous service afforded by this practice on their important lines fully justifies the added expense of insulation. Then, too, when the insulation rating is raised above a certain point, the insulation becomes more immune to damage from lightning.

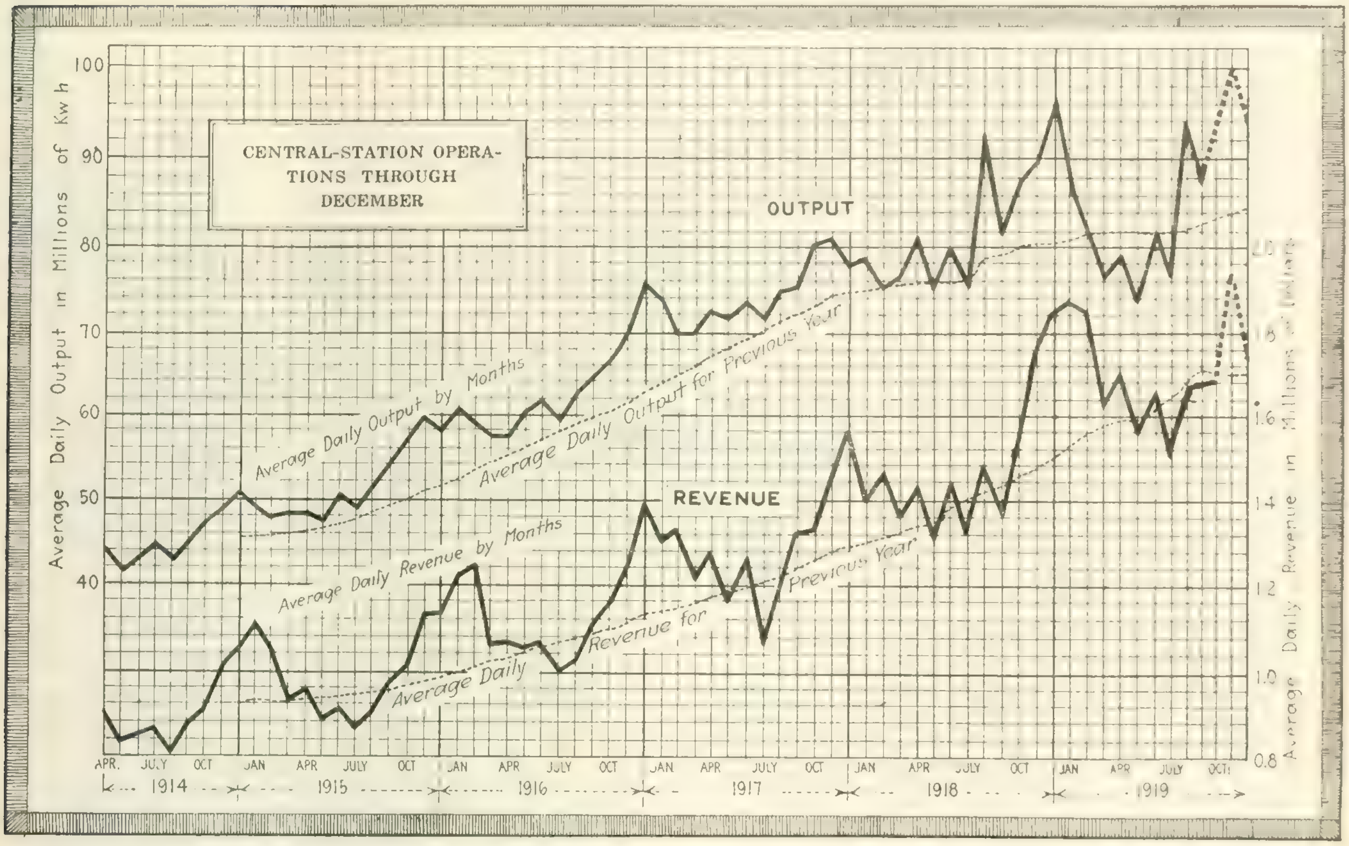
The remainder of this analysis will be presented in subsequent issues.

Diesel-Electric Equipment for Yacht Elfay

OIL-ELECTRIC drive, which appears to have many advantages for propulsion of ships not requiring more than 6,000 hp., has been applied to the yacht Elfay, a schooner measuring 152 ft. (46 m.) over all and having a displacement of 313 gross tons. The drive includes a six-cylinder Model 54 Winton full-Diesel oil engine rated at 115 hp. and 425 r.p.m. and driving a 75-kw., 125-volt Westinghouse generator and exciter. The generator in turn is connected with a 90-hp. Westinghouse motor, which drives the propeller directly through a clutch that permits disconnecting the motor when the yacht is sailing. After the turbo-generator is once started there is nothing to do except to keep the machinery running, since the control is situated on deck just forward of the steering gear, where it is under supervision of the navigator. Only the intensity and direction of the generator field is adjusted in controlling the ship. Russell A. Alger is the owner of the yacht.

Effect of Coal Curtailment Small

All Sections of the Country Except the Far West Exhibit Unusual Gains in Central-Station Output for December, but Western Loss Prevented Another National Record



LARGELY increased central-station operations in December are shown by the returns received by the ELECTRICAL WORLD for the Central and Eastern States. **The Western States, however,** showed a large loss compared with December, 1918, this loss being sufficient to absorb the gains of the Eastern plants and thereby eliminate the possibility of another national record. As was anticipated, the returns for December were delayed by reason of the excessive amount of statistical work necessary in connection with the regular company reports made at the close of the fiscal year, and consequently sufficient returns have not been received to warrant making an estimate of the total output and revenue for the year 1919. These figures, however, will appear in the April 3 issue of the ELECTRICAL WORLD.

Although the fuel shortage and the cumulative effect of the entire labor situation both tended to slow up production, remarkably heavy calls for energy were exhibited in all sections of the country with the exception of the Mountain and Pacific States. Active cotton spindles in the country totaled 34,594,214, a gain of 3 per cent over December, 1918. This gain in active spindles was about the same in the cotton-growing states as in the textile-manufacturing centers of the New England section of the country.

The curtailed steel production in the Middle Atlantic and North Central States during the first part of December caused by the coal strike was more than overcome by improved conditions during the latter half of the month, resulting for the month in an increased call for energy in this section. The steel industry as a whole was operating at about 81 per cent capacity on Dec. 31, which was slightly better than immediately preceding the coal strike. The coal strike ended on Dec. 10, at which time the bituminous coal production was only about 20 per cent of normal. Within one week production had reached 94 per cent of normal.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Industry Represented	Revenue from the Sale of Energy			Percentage of Industry Represented	Kw.-Hr. Output		
		1919 Thousands	1918 Thousands	Per Cent Increase		1919 Thousands	1918 Thousands	Per Cent Increase
Jan	57	$33,294	$27,589	18.1	57	1,522,669	1,357,275	12.1
Feb.	54	28,139	23,162	21.4	54	1,249,806	1,147,275	7.9
Mar	57	8,569	24,420	16.8	57	1,357,981	1,341,574	1.2
Apr.	54	27,629	23,814	15.9	54	1,278,273	1,240,842	2.9
May	55	6,389	23,023	14.6	55	1,255,598	1,267,878	- 1.0
June	57	28,129	24,676	13.8	57	1,397,213	1,367,018	2.2
July	55	25,716	22,523	12.5	55	1,306,883	1,281,120	2.1
Aug.	58	29,864	26,590	12.7	58	1,658,755	1,672,000	— 0.8
Sept.	60	29,044	25,539	13.7	60	1,579,512	1,526,372	3.4
Oct.	62	32,375	27,512	17.2	67	1,928,565	1,767,648	8.8
Nov.	63	37,449	31,953	14.0	68	2,054,977	1,897,811	8.1
Dec.	49	26,578	23,218	14.6	49	1,392,607	1,299,549	7.2

The automobile industry of the central lake states had almost recovered from the labor troubles of the past four months and was working at about 90 per cent capacity, with a tremendous demand for cars of all descriptions. The Texas oil fields showed a material decrease in activity, and the production of these fields in December fell below that of Oklahoma. The Kansas

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	New England States				Atlantic States				Central States				Pacific and Mountain States			
		Percentage of Industry Represented	1919	1918	Per Cent Increase	Percentage of Industry Represented	1919	1918	Per Cent Increase	Percentage of Industry Represented	1919	1918	Per Cent Increase	Percentage of Industry Represented	1919	1918	Per Cent Increase
REVENUE	Jan.......	63	4,253,000	3,443,000	23.5	60	13,444,000	11,168,000	20.3	47	10,410,000	8,484,000	22.7	77	5,187,000	4,494,000	15.4
	Feb	63	3,895,000	3,048,000	27.7	53	10,894,000	8,943,000	21.8	45	9,305,000	7,484,000	24.3	73	4,036,000	3,618,000	11.5
	March....	64	3,608,000	3,044,000	18.4	58	11,731,000	10,244,000	14.5	47	9,012,000	7,447,000	21.0	81	4,218,000	3,685,000	14.4
	April.....	64	3,473,000	2,964,000	17.2	51	11,408,000	10,114,000	12.7	47	8,420,000	6,981,000	20.5	76	4,328,000	3,755,000	15.3
	May......	62	3,194,000	2,800,000	14.0	51	9,430,000	8,571,000	10.0	47	8,297,000	6,888,000	20.4	77	5,468,000	4,764,000	14.7
	June......	64	3,321,000	2,925,000	13.3	55	10,535,000	9,478,000	11.2	50	8,757,000	7,504,000	16.7	78	5,516,000	4,767,000	15.8
	July......	61	3,329,000	2,949,000	13.0	50	9,319,000	8,375,000	11.8	50	8,854,000	7,442,000	18.0	79	4,214,000	3,756,000	12.3
	Aug.......	64	3,579,000	3,192,000	12.2	59	11,401,000	10,490,000	8.3	49	9,469,000	8,260,000	14.5	79	5,415,000	4,930,000	10.0
	Sept......	64	3,707,000	3,276,000	13.2	58	10,711,000	9,383,000	14.2	51	9,125,000	7,915,000	15.3	83	5,501,000	4,965,000	10.8
	Oct.......	64	4,029,000	3,384,000	19.0	59	12,009,000	10,248,000	17.2	55	10,875,000	9,074,000	19.8	81	5,462,000	4,806,000	13.6
	Nov......	64	4,442,000	3,826,000	16.1	67	14,738,000	12,761,000	15.4	55	12,604,000	10,383,000	21.3	80	5,665,000	4,983,000	13.7
	Dec......	66	4,785,000	4,172,000	14.7	55	12,925,000	11,329,000	14.2	40	7,173,000	5,975,000	20.0	67	2,944,000	2,775,000	6.0
KW.-HR. OUTPUT	Jan.......	63	143,254,000	124,632,000	14.9	60	525,322,000	458,545,000	14.5	47	463,394,000	403,127,000	14.9	77	390,690,000	371,156,000	5.2
	Feb......	63	128,660,000	109,993,000	17.0	53	406,702,000	374,958,000	8.4	45	426,965,000	378,992,000	12.6	73	287,479,000	293,492,000	−2.0
	March....	64	125,510,000	124,707,000	0.7	58	459,166,000	461,096,000	−0.4	47	442,591,000	423,802,000	4.4	81	330,714,000	331,769,000	−3.0
	April	64	123,211,000	118,322,000	4.1	51	382,282,000	369,701,000	3.4	47	373,116,000	345,213,000	8.1	76	328,925,000	333,405,000	−1.0
	May......	62	120,949,000	122,531,000	−1.3	51	362,207,000	383,860,000	−5.6	47	389,805,000	375,944,000	3.6	77	382,637,000	385,543,000	−0.7
	June......	64	127,355,000	119,946,000	6.3	55	406,102,000	417,441,000	−2.7	50	417,942,000	386,422,000	8.4	78	445,814,000	443,209,000	0.6
	July......	61	139,133,000	129,639,000	7.4	50	373,105,000	378,053,000	−1.5	50	428,370,000	408,165,000	5.0	79	366,275,000	365,263,000	0.3
	Aug......	64	148,442,000	143,100,000	3.4	59	595,812,000	625,000,000	−4.8	49	470,475,000	445,000,000	6.0	79	444,026,000	465,518,000	−4.8
	Sept......	64	141,743,000	137,452,000	3.1	58	569,894,000	570,187,000	−0.1	51	444,219,000	398,026,000	11.5	83	423,656,000	420,707,000	0.7
	Oct......	64	159,084,000	141,353,000	10.4	59	595,931,000	567,807,000	4.9	70	738,984,000	641,296,000	14.4	81	434,566,000	417,192,000	4.1
	Nov......	64	153,326,000	142,253,000	7.8	67	724,001,000	707,347,000	2 6	69	754,838,000	657,467,000	14.2	80	422,812,000	390,744,000	8.2
	Dec......	66	175,408,000	149,571,000	17.2	55	660,670,000	616,762,000	7.2	40	369,712,000	310,916,000	18 8	67	238,514,000	266,473,000	10.4

and Oklahoma oil fields showed increased activity despite two severe blizzards during the month.

The Mountain and Pacific States as a whole showed a decided slump in production for December. However, a study of the various districts indicates that the slump was not general but was confined mostly to the copper and tungsten mining regions, where a decreased call for energy of about 35 per cent was exhibited. Operations in these districts were materially reduced over 1918, owing probably to the insufficient metal market and severe weather conditions throughout the Mountain States. Continued prosperity was reported in the Northwestern States, one company reporting an increase in production over December, 1918, of 100 per cent.

Data on the Cost of Constructing Transmission Lines

Cost of Important Canadian Lines Constructed During Recent Years Are Compared with Typical Costs at This Time

IN ORDER to show the great-increased cost of transmission lines compared with pre-war conditions, a table has been prepared showing cost of Canadian transmission lines built from 1897 to 1917.

Concerning recently constructed lines the following typical examples are given in the *Electrical News*, (Toronto) of recent date:

A main-line "heavy-duty" steel-tower transmission line, carrying two lines at 110,000 volts, such as the latest type of line used by the Hydro-Electric Power Commission of Ontario between Niagara Falls and Toronto, with 66-ft. (20-m.) right-of-way, the equivalent of No. 4/0 copper conductors, telephone service and all items of expense, would be about $17,000 per mile.

A 110,000-volt line, single-circuit, supported by wood poles, with 66-ft. right-of-way and the equivalent of No. 1/0 copper conductors and with telephone line, would cost about $8,500 per mile. If pole rights alone are obtainable, the cost might be reduced to about $5,500 per mile.

A 44,000-volt wood-pole line, with steel conductor and telephone line on same poles, could be erected for about $3,000 per mile, but if there were considerable rock excavation for poles, this cost might easily be doubled.

A 22,000-volt line, carrying one circuit of approximately the equivalent of No. 1 copper conductor and with telephone line, would cost about $3,500 per mile.

Smaller lines of about 4,000 volts, with equivalent of No. 4 copper conductors, have under present conditions been built for about $2,000 per mile.

COST DATA OF TRANSMISSION LINES

Line	Year Built	Lgth. Miles	Voltage	Cost per Mile	Remarks
Canadian Light & Power Company, Montreal.	1911	27	44,000	$11,000	Two circuits of No 2 0 copper, steel towers.
Laurentian Power Company, Quebec.	1916	24	50,000	6,875	Two circuits of No. 1/0 copper, steel towers
Shawinigan Water & Power Company	1902-10	550	50,000	1,500	Single circuit of aluminum, wooden poles.
				3,500	Two circuits of aluminum, steel towers.
Shawinigan Water & Power Company.	1910	94	100,000	7,500	Two circuits of aluminum, steel towers.
Sherbrooke municipal	1917	30	45,000	2,334	Single circuit of No. 4 copper, wooden poles.
Hydro-Electric Power Commission. Niagara system.	1907 13	325	110,000	14,000	Two circuits of Nos. 4/0 and 3/0 copper and equivalent aluminum, steel towers.
Hydro-Electric Power Commission Niagara system.	1907 13	765	26,400 and under	2,200	Single circuit of aluminum and copper, wooden poles.
				3,000	Two circuits of aluminum and copper, wooden poles.
Muskoka system. . .	1915	26	22,000	2,025	Single circuit of No. 2 aluminum, wooden poles.
St. Lawrence system.	1913–15	60	26,400	2,458	Single circuit of No. 3/0 aluminum, wooden poles.
Kamloops municipal. .	1916	42	44,000	1,667	Single circuit of No. 2, aluminum, wooden poles.
West Kootenay Power & Light Company, Rossland.	1897–1905	170	60,000	4,000	Single circuit of 92,000-circ. mil. copper, wooden poles.
West Kootenay Power & Light Company, Rossland.		32	20,000	2,000	Two circuits of No. 2 copper, wooden poles.

Readers' Views and Comments

Modern Motorized Machinery

To the Editor of the ELECTRICAL WORLD:

SIR: In respect to the development of the electrical industry, the idea seems to prevail generally that the art of illumination in this field is pretty well developed, in a comparative sense at least, and the developments in motor power are not far behind, but that the sphere of applied industrial heating is comparatively untouched. Conceding these assumptions to be well founded, it is nevertheless true that there are still innumerable opportunities for great and beneficial improvements in the vast field of applied motive power. In the days ahead this power will play an important part in creating more business and new wealth, besides cheapening the various processes of creating wealth and helping to conserve that which we now have in the form of natural resources.

In most instances and by most people a motor is considered as a unit machine that will change electrical energy into mechanical power. In the case of a dynamo the reverse is true, mechanical power being transformed into electrical energy to rotate the motor. From the beginning of the electrical industry the motor was developed with no thought in mind of the possibilities of building it into a machine at some strategic point, so to speak. Thereby the design was quickly simplified by the elimination of difficult transmission movements or perhaps of a number of otherwise necessary gears or belts. In fact, it is sometimes even possible by building more than one motor into a machine to construct a piece of mechanism that would be impracticable otherwise.

If the motor builders and the manufacturers of industrial machinery could realize the possibilities before them in making motors an integral part of machines it would result in great benefit all around, because it would create new business for the motor builders in dealing with the machinery manufacturers, and they in turn would have new selling arguments founded upon facts to present to the industries that use their machines. The manufacturers would be able to say to the industrial plants truthfully: "Here is a machine to replace the old worn-out one, and it costs you less to buy because it costs us less to build. It will cost you less to maintain because it has fewer parts to wear out, and it consumes less power as the power is more directly applied. Besides all this, it can be installed at any convenient point in your factory. Furthermore, there are no expensive belts and countershafts to consider, and therefore a source of initial expense and another maintenance item are eliminated."

There has been considerable discussion among engineers as to whether it is the best policy to apply individual motors to each machine or to belt from a motor to a group of machines through a countershaft. The cycle of operations sometimes determines the answer to this problem, but by the adoption of the idea of building the motor into the machine it seems probable that eventually the individual machine connected to an electric circuit will become universal practice.

The answer of the motor builders to this argument may be that there are now many machinery builders using motors of both constant and variable speed in conjunction with their machines, but they must realize that as against the comparatively few machine-tool manufacturers who use motors with variable-speed characteristics to obtain certain results, or possibly to eliminate some otherwise necessary gearing, there are a vast host of other builders of machinery for the non-metallic industries who have not seriously considered motors at all in connection with their products. As regards the adoption of motors as here outlined, neither the motor builders themselves nor the machinery manufacturers have begun to realize or capitalize the possibilities. This is especially true of constant-speed machinery.

There will probably be two main objections raised against this practice. One will come from the motor manufacturers, to the effect that it would entail deviation from standard stock production; but they should bear in mind that gradually standards will be developed and should be willing to help. The other objection will come from machinery builders for certain industries, notably those in which chemical processes are involved, to the effect that machines so constructed would not long withstand the chemical reactions; but the motor builders can and must meet this objection by showing them that this is not necessarily so. On the other hand, the machinery builders should not be too skeptical, lest competitors develop right under their eyes a whole new line of machinery embodying this advanced method.

The gradual adoption of this plan of building machinery will hasten the time in the not far distant future when a factory will not contain a single belt. This will not only conserve power and leather needed elsewhere but will also tend to make conditions more pleasant for the industrial worker, resulting in greater production.

JOHN J. BROPHY.

Salem, Mass.

High Vacuums in Steam-Turbine Operation

To the Editor of the ELECTRICAL WORLD:

SIR: In your issue of Feb. 7, 1920, page 344, I have noticed a reference to the high vacuum obtained by the United Light & Power Company at its 201st Street station in New York City. A vacuum of 30.35 in. is no doubt unusual, but, taking into consideration that the barometer at that time was 30.9 in., it is not so extraordinary as might be supposed.

We claim for the station of the Long Island Lighting Company the highest vacuum ever recorded and believe we can maintain this claim. For example, on Feb. 4, 1920, we had a vacuum of 30.4 in. with a barometer reading 30.7 in. This, we believe, is as nearly a perfect vacuum as can be obtained by any commercial apparatus. The particular unit involved is a 2,500-kw., Curtis turbine connected to a Worthington surface condenser fitted with a Worthington hydraulic air pump.

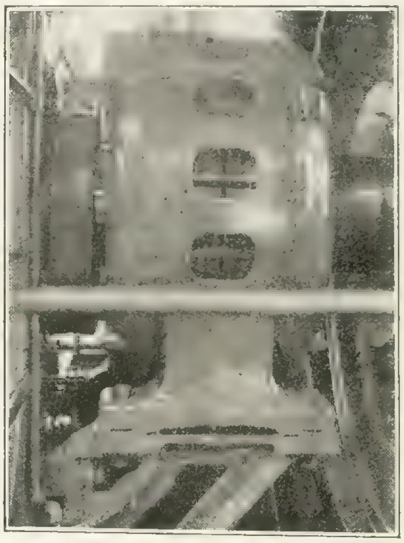
N. L. PIDGEON,
Chief Engineer.
Long Island Lighting Company,
Northport, N. Y.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Inexpensive Method of Power-Factor Correction

IN THE Lake Linden power station of the Calumet & Hecla Mining Company, Lake Linden, Mich., a condenser has been made available for power-factor correction by the conversion of an old discarded engine-driven generator. The generator is a 440-volt machine rated at 1,204 amp. and 150 r.p.m. and has been driven by a rope-drive drum. The space made available by the removal of this drum was used for mounting the 440-volt, 158-amp., 150-r.p.m. starting motor. The motor has a special squirrel-cage rotor keyed onto the 16-in. (41-cm.) shaft of the generator.



STARTING MOTOR MOUNTING WITH CONDENSER AT LEFT

The condenser is operated with a turbo-generator which carries a connected mine and mill load of 10,500 hp., of which 3,800 hp. is synchronous load and the remainder is induction-motor load. The following figures indicate that with a load of 6,300 kw. and the condenser running idle the power factor of the system was 0.84, while with an excitation of 160 amp. and 1,250 amp. on the condenser the power factor was raised to 0.91. Losses amount of approximately 64 kw. The total cost of making the change was only $2,500.

	Condenser			Exciter		Turbine Load		
	Amp.	Volts	P. F.	Amp.	Volts	Kw.	Volts	P. F.
No load........	0	464	0.95 lag	104	115	6,300	4,000	0.84
Full load......	1,250	480	0.93 lead	160	120	6,300	4,000	0.91

Asst. Electrical Engineer. CARL FICHTEL.

Warm Air Counteracts Dampness of Transformer Room

IN ORDER to prevent the 13,200-volt current transformers in a Michigan power house from breaking down on account of the dampness in the basement bus room where they are installed, a blower was arranged to supply warm air from the engine room. This proved effective in keeping the bus room dry, and no further faults developed on the instrument transformers. Since the blower was already on hand, the cost of this installation was very low.

The dimensions of the bus room are 114 ft. long by 16 ft. wide by 11 ft. high (34.5 m. by 4.8 m. by 3.3 m.), and the blower delivers 3,500 cu.ft. of air per minute (1.7 cu.m. per second) at a pressure of 0.5 oz. per sq.in. (2.2 gr. per sq.cm.). The blower is driven by a 7.5-hp., 440-volt, three-phase, 25-cycle, 500-r.p.m. induction motor which is directly connected to the fan. No special provision was made for circulating the air. It is simply forced into the bus room and allowed to leak out as best it can.

X-Ray Transformers Require Liberal Service Rating

Secondary Voltage Drop Should Not Exceed 2 per Cent with 200 per Cent Load, As X-Ray Effect Varies with Square of Voltage

BECAUSE the kilovolt-ampere requirements are rarely stamped on X-ray apparatus, central-station engineers are often at a loss to know what size of transformer to install. If the apparatus is to give good service, the service transformer and connections should be too large rather than too small. This is essential because the X-ray effect varies with the square of the voltage. One manufacturer says that the voltage drop between the transformer and the apparatus should not exceed 2 per cent, with a load 100 per cent in excess of the normal transformer rating.

RATING OF SERVICE TRANSFORMERS REQUIRED BY X-RAY TUBES

Tube	Milli-amperes	Back-up Spark, In.	Equivalent Voltage	Service Transformers Required, Kva.
Universal Coolidge............	60	10	104,000	10
Radiator-type Coolidge......	30	5	62,000	5
Radiator-type Coolidge......	10	5	62,000	2
Radiator Dental Coolidge....	10	3	40,000	1½
Victor Hydrogen............	60	8½	92,000	10
Macalaster-Wiggin (Tungsten target, gas-type).	60	8½	92,000	10
Macalaster-Wiggin (Water-cooled tungsten target, gas-type)..........	5	8½	92,000	1½

However, the secondary line drop is not the only thing to be considered. The drop across the transformer secondary must also be allowed for. Where this figure is high, a larger transformer should be used than might otherwise be specified, based solely on the kilovolt-ampere demand. A variation of a few per cent in line voltage over long periods of time is not objectionable, since it can be compensated for by the regulator in the apparatus, but a drop in the voltage while the apparatus is in use cannot be tolerated.

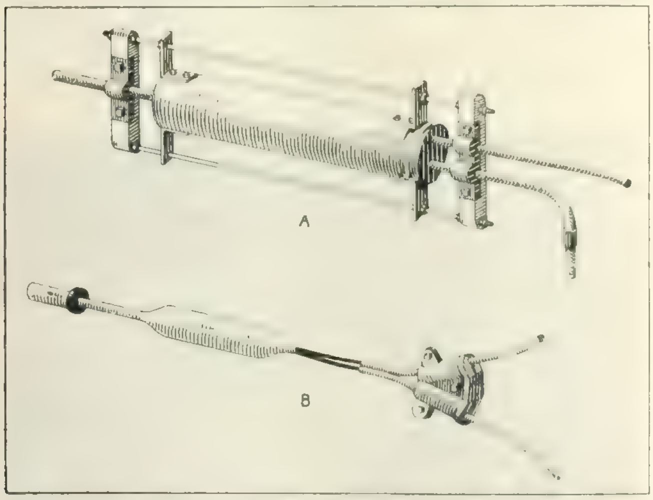
There are two general types of X-ray tubes in use, and they can be used with any X-ray apparatus of sufficient capacity to supply their requirements. The two kinds of tubes are known as the gas type and the Coolidge or electron type. The former is the older tube and the one in most general use, but there are more of the Coolidge type being sold today. X-ray tubes are rated in milliamperes at so many inches (25 mm.) back-up (shunt) spark. The equivalent voltage for different spark lengths may be obtained from the A. I. E. E. rules. Some of the more efficient X-ray machines on the market equipped with auto-transformer regulation only require transformer rating equivalent to twice the product of the milliamperes and the equivalent voltage of the back-up spark. With less efficient apparatus, and especially when rheostatic control is used, the transformers may have to be four times the kilovolt-ampere rating of the tubes. The service requirements of some of the X-ray tubes on the market when operated at full capacity under average conditions with efficient apparatus are given in the table on page 550.

Montford Morrison,
Chief Engineer.
Victor Electric Corporation,
Chicago.

Protecting Cable Splices in Soft Ground

In the installation of the lighting system of Terwilliger Boulevard, Portland, Ore., special problems were encountered which called for the devising of a new type of splice connection. The boulevard lighting is part of the regular standardized system which has been adopted by Portland for its parks and drives. A constant-current series-lighting system is used. Transformers step up the 2,300-volt city service to 2,600-volts, single-phase energy.

The wiring arrangement provides for eight 2,075-ft. (635-m.) lengths of double steel-taped No. 8 stranded cable, used without splices, all connections being made in the terminals within the standards into which the main cable itself is looped. The steel cable was placed in a trench. With this type of construction it was found that different types of ground encountered called for special treatment. In some places rubber-covered wire had to be spliced to steel-taped cable so a special clamp was devised for a "Y" connection which is strong enough to take the strain off the splice. Another connection was used for joints in soft ground. The sketch shows the details of these devices and the splice necessary to be made at the base of a standard, the conduit running from here to the standard. Comfort stations are used to house the tub transformers and other substation apparatus. One hundred standards are served by each transformer set.



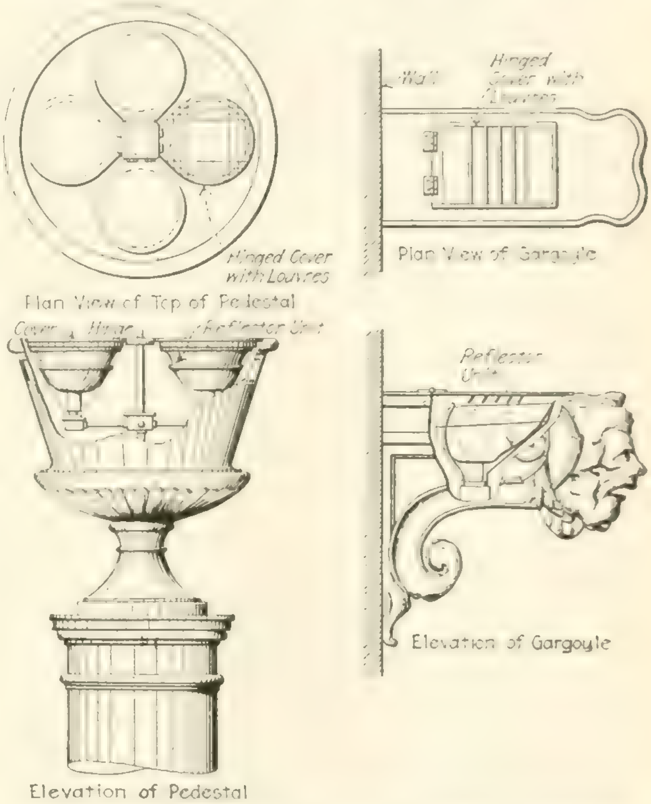
CABLE SPLICES USED IN LIGHTING SYSTEM

The lower sketch shows a splice of rubber-covered wire and steel cable, with a "Y" clamp for protection against strain; the upper one shows the method of keeping the strain off the joints in soft ground.

F. D. Weber,
Electrical Engineer.
Oregon Fire Insurance Rating Bureau,
Portland, Ore.

Interiors Illuminated Without Ceiling Fixtures

When it is undersirable to suspend lighting fixtures from the ceiling and when it is impracticable to construct a continuous cover, pocket or compartment for the concealment of the lighting units, specially shaped reflectors may be advantageously employed in brackets placed directly against the walls or on columns. This method of lighting is especially suitable for rooms with low ceilings, and it has been used to advantage in the dining room of the National Bank of Commerce in New York City. For the latter installation the following data has been compiled:



FIXTURES USED IN LIGHTING LOBBY OF HOTEL COMMODORE, NEW YORK

The hinged covers used on both types of fixtures are equipped with louvres which are set to make the lamp invisible from the balcony overhead. In the gargoyle fixtures the louvres also prevent a background of light on the columns.

Size of room	30 ft. x 80 ft.
Floor area	2,400 sq.ft.
Ceiling height	11 ft.
Number of fixtures	Forty-eight wall urns
Lamps per fixture	One 75-watt Mazda C
Type of reflector	One X-Ray E-65
Energy consumed	1.5 watts per square foot
Position of fixtures	On pillars 8 ft. apart and 48 in. from ceiling

Concealed lighting was also installed in the lobby of the Commodore Hotel in New York. This lobby was designed to represent an Italian garden or courtyard with an overhead skylight, through which, however, no daylight enters. The lighting units were placed in ten pedestals and twenty-two gargoyle-shaped wall brackets, but one gets the impression on entering the room that it is lighted by units placed above the glass ceiling The record of the mechanical equipment used to produce the lighting effect is given below:

Size of room	48 ft. x 140 ft.
Ceiling height	26 ft. 6 in.
Square feet area	6,720
Total watts	11,700
Watts per square foot	1.74
Equipment employed	Six center pedestals each containing four 300-watt type C lamps and EC-345 reflectors; twenty-two No. E-65 gargoyle brackets, each with a 150-watt type C lamp; four end pedestals, each with one 300-type C lamp and EC-345 reflector. All reflectors are X-ray

The ballroom of the Commodore Hotel also called for special lighting arrangements, and the cove or cornice method was adopted with reflector units running along two sides of the room. No reflectors are employed within 6 ft. (1.8 m.) of the corners of the room; otherwise the lighting units are symmetrically spaced about 15 in. (280 mm.) apart. The units are divided so that every alternate reflector is on the same circuit. An amber film was placed over the mouth of the reflectors on one of the circuits to allow for tinting the light. Data on this installation follow:

Size of ballroom proper	52 ft. x 162 ft.
Ceiling height	28 ft.
Area	8,424 sq.ft.
Total watts	23,200
Watts per square foot	2.75
Equipment	232 No. 610 X-ray reflectors with one 100-watt Mazda C lamp in each

In presenting these facts before the thirteenth annual convention of the Illinois Illuminating Engineering Society, Augustus D. Curtis and J. L. Stair pointed out that careful planning and co-operation between the lighting man, the architect and the contractor was essential if lighting systems of this description are to be successfully installed.

Small Home-Made Induction Regulator Gives Zero to 160 Volts

TO PROVIDE voltages and currents ranging gradually from zero to very high values, a 1.5-hp. squirrel-cage motor was rewound by the Merchants' Heat & Light Company, Indianapolis, Ind., to serve as an induction regulator in combination with auto-transformers. The squirrel-cage winding of the motor was replaced by 0.1-in. (2.5-mm.) square double-cotton-covered copper wire. Four coils of ten turns each were put on, each coil spanning seven of the forty-one slots, and all coils were connected in series. The machine has four poles, and the rotor winding covers about one pole. When 110 volts alternating current is impressed on the stator winding a voltage is induced in this new winding.

For varying this voltage the rotor is turned by a handle fastened to the end of the shaft. The motor bearing was made tight enough to hold the rotor firmly after its position is adjusted. Voltages from zero to 160 and current from zero to 100 amp. can be obtained. For higher values two auto-transformers are employed. One of these has a two to one ratio and the other a ratio of about 155 to 180. These may be used for voltage or current adjustment and may be connected to step up or down. When still higher values are required instrument transformers are used reversed.

Effective Method of Testing Disconnecting Switches

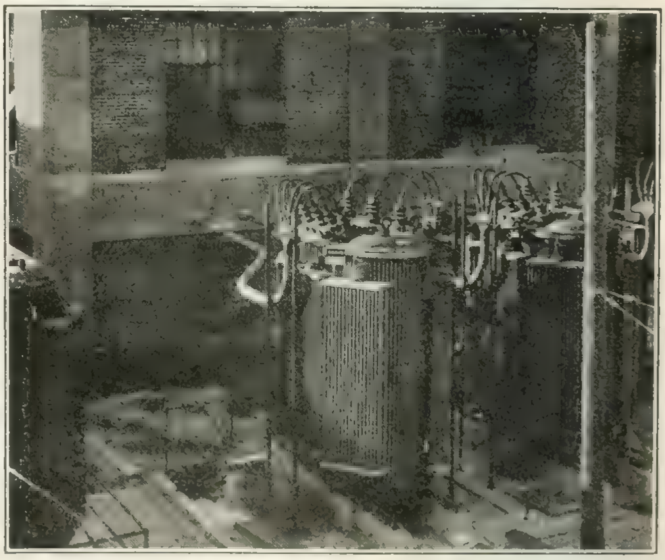
FOR testing disconnecting switches which have been suspected of heating under load, a common tallow candle has been used successfully by several operating companies. To test the switches the operator mounts the candle on an insulated stick and brings it in contact with the switch blades. If the candle melts, it is of course evident that the switch under test is operating at a temperature too high for safety, but if the tallow remains hard under contact with the switch blade this is taken as an indication that the temperature has not reached the danger point. Although this is an unusual test, and is not quantitative, it has proved to be thoroughly satisfactory.

On the disconnecting switches which "run hot" the trouble is usually found to be misalignment. There are cases, however, where disconnecting switches heating under load were properly aligned and still gave trouble. In such instances it is said to be good practice to examine the blade for blowholes in the copper, which would reduce the cross-section of the conductor. If the clips of the switch are opened too wide the pressure will not be sufficient to make a good contact and the switch will heat. After tightening these loose clips or aligning the switch the blade should be operated a number of times in order to fit the contact surfaces to each other.

Chicago, Ill. C. S. LLOYD.

Cables from Transformers to Substation Run Above Ground

INSTEAD of installing the cables connecting the outdoor transformers at substation "E" of the Kansas City (Mo.) Light & Power Company in underground ducts, it was decided to carry them directly to the building through the air 10 ft. (3 m.) from the ground.



CABLES CONNECTED DIRECTLY FROM TRANSFORMERS TO SUBSTATION

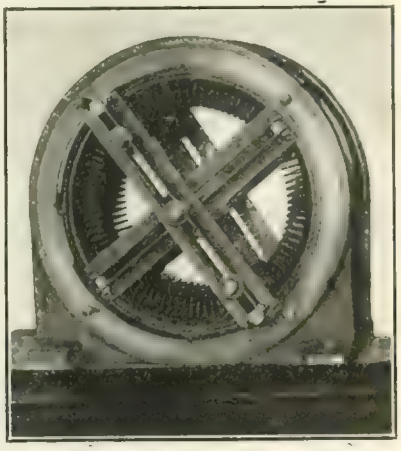
This decision was made in contemplation of future extensions to the building, which in themselves would have necessitated the rearranging of the underground ducts. In addition to eliminating the cost of underground construction, considerable cable was saved by making the short-line connection.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Clamp Made of Angle Iron for Restacking Stator Lamination

RESTACKING the laminations of motors which have been damaged is facilitated in an English industrial plant by the use of a clamp made of angle irons. This clamp consists of two halves which press at four points on each side of the stator laminations when the tie bolts are tightened. Each half of the clamp is made of two crossed members, each consisting of two anglebars bolted together as shown. The clamp is adjusted against the lock rings at each side of the lamination, the latter being carefully aligned by the aid of a steel gage the size and shape of a slot before the bolts are tightened. When a solid sound is produced by tapping the laminations with a hammer they are sufficiently compressed. After the keys which hold the lock rings are fitted in place the clamp is released.



CLAMP COMPRESSES LAMINATIONS WHILE REBUILDING STATOR

L. E. WOOD.

Four Methods of Locating Proper Brush Position

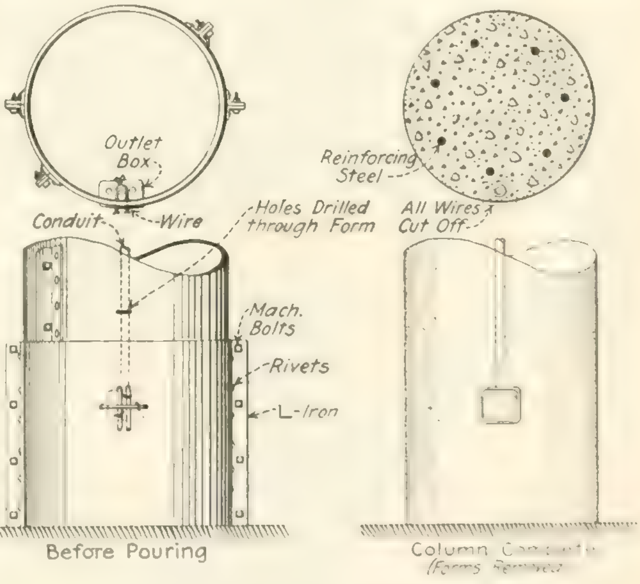
TO DETERMINE the neutral point on the commutator of a direct-current motor or generator without interpoles the writer commonly uses four methods: (1) Inspection; (2) the "kick" method with pointed brushes; (3) this method without special brushes; (4) the voltmeter method. By the first method the neutral point may be roughly located at the commutator bar whose coil spans the space between poles. In the "kick" method pointed brushes touching only one bar replace the regular brushes. To find the neutral by this method, after attaching the leads of a low-reading voltmeter to the brushholder buses, the field circuit is separately excited and quickly opened by a circuit breaker or quick-opening switch. The brushes are shifted until no reading is indicated on the meter upon opening the circuit. The brushes are then at the no-load neutral. A variation of this method for use when no pointed brushes are available consists of quickly opening the circuit and noting the "kick" between adjacent bars with a voltmeter. In this case the point of maximum "kick" is the no-load neutral.

These methods all give the neutral point for no load, but the brushes must be shifted to the best position after the machine is loaded. However, the fourth method gives the proper neutral for any load; for this method the machine is operated at normal speed and load. When the voltmeter reading taken by leads spaced one bar apart is at minimum, the leads are at the neutral point for the existing load.

Washington, D. C. R. L. HERVEY.

Setting Outlet Boxes in Concrete Columns

ONE of the common methods of supporting conduit outlet boxes in the steel forms for concrete columns is to set the outlet boxes in the required locations against the side of the form after the steel forms have been erected but before the reinforcing steel has been placed in them. Then the box and the conduit are wired to the form in such a manner that neither can be displaced by the concrete when it is being poured. It is necessary to drill small holes through the metal forms with a small-diameter drill to permit the tie wire being placed. A $\frac{1}{8}$-in. (3.2-mm.) diameter hole is ample. Each outlet box should be stuffed tightly full of paper before it is placed in the form, to prevent the entrance of the concrete while it is being poured. After the forms have been removed, the tie wires which extend from the concrete column should be snipped off close to the surface of the column. Care should be exercised to insure that the conduits to the boxes are fastened firmly in the form, so that there can be no shifting while the concrete is being poured.



OUTLET BOX ON COLUMN BEFORE AND AFTER CONCRETE IS POURED

T. F. DICKMAN.

Dallas, Tex.

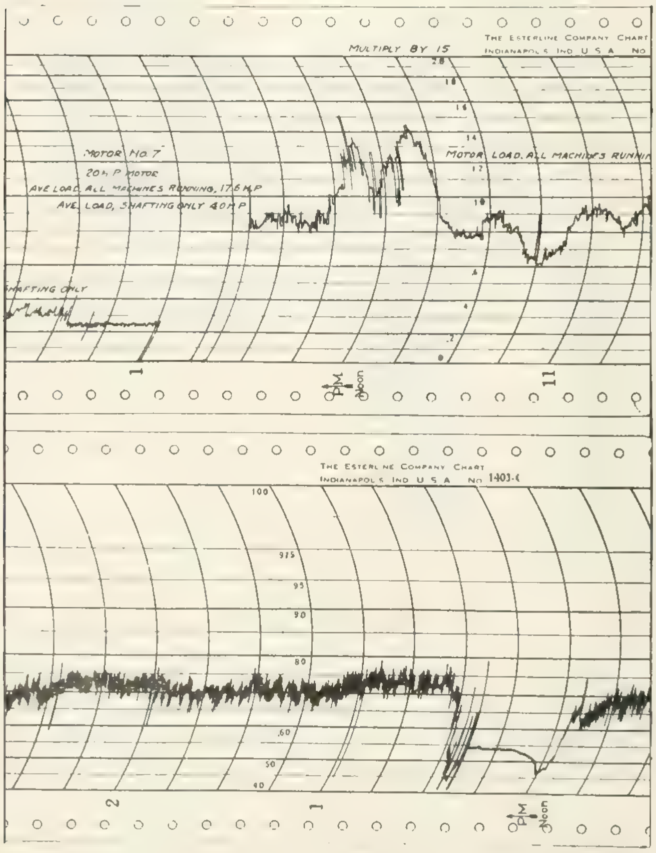
Blown Fuses and Hot Motors Caused by Overmotoring

IN AN automobile-part machine shop, where it was known that the fuses and motors were adequate for their work, considerable trouble was experienced from the constant blowing of fuses and by motors running hot. After an investigation was made with the aid of Esterline graphic recording meters, it was discovered that the chief cause of the troubles was overmotoring. The load curve of a typical 20-hp. motor in the plant shown at the top of the accompanying illustration indicates that 17.6 hp. was the average load, while the short peaks were not greatly over 20 hp. Evidently, therefore, a smaller motor could be used for this particular work. In addition, the power factor of the motor is consequently low which causes further trouble.

LOSSES RESULTING FROM OVERMOTORING MACHINE SHOP

Total motor horsepower installed	397½
Actual total horsepower load on motors	237¾
Total idle motor horsepower	159¾
Average per cent load on motors	60%
Investment in idle motor horsepower, including controlling and protective apparatus	$3,375.00
Annual interest and depreciation charge on idle investment	$542.00
Average efficiency of all motors if loaded between three-quarters and full load, per cent	88.4
Actual average operating efficiency of motors, per cent	83
Percentage of total power wasted due to lightly loaded motors	5.4
Cost of power wasted per year	$1,152.00
Cost of power wasted would pay 6 per cent on an investment of	$18,200.00
Average three-quarters load to full-load power factor of motors	0.86
Actual average operating power factor	0.71

The power factor of the entire plant (shown by the curve at the bottom of the illustration) is only 71 per cent. This means that the current required by the plant is abnormally high, which in turn causes an excessive voltage drop in the supply feeders. Blown and overheated motors are the consequences. The accompanying table shows these losses. As a result of the investigations the motors are being shifted so that each motor will operate at or near full load, and the extra motors released will be used for driving new machinery which is now being installed.

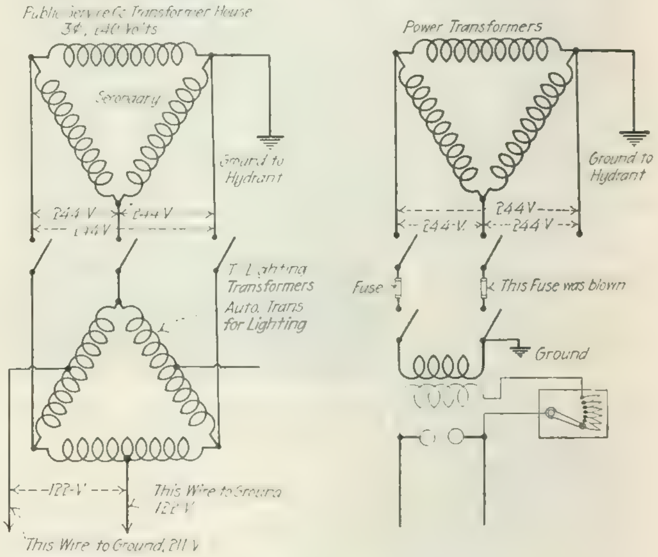


CURVES OBTAINED FROM AN INVESTIGATION IN AN INDUSTRIAL PLANT WHERE FUSES BLEW FREQUENTLY

The upper chart indicates that the load is too small for a 20-hp. motor and the one below shows the power factor of plant with underloaded motors.

Tapping Power Lines Causes High Voltage to Ground

AT A LARGE manufacturing plant where energy for power was received from the public service company and energy for lighting was supposed to be furnished from an isolated plant a fatality occurred recently, the investigation of which indicated an unusual condition. The accident happened after the engine ordinarily driving the lighting generator had broken down, when a workman, in trying to adjust a portable extension lamp, received a fatal shock. An investigation showed that the key on the socket was damaged so as to expose the metal that was cast into the hard rubber, and as this metal constituted one side of the line, it was alive. On testing the circuit it was found that from one lighting wire to the engine (or ground) there was a voltage of 122 and from the other wire or metal key to ground there was a voltage of 211. Across the lamps the voltage was 122.



METHOD OF CONNECTING AUTO-TRANSFORMERS TO POWER CIRCUIT

Further investigation showed that in order to obtain lighting energy without operating its prime mover the industrial plant had connected three auto-transformers to the power circuit as shown in the accompanying diagram. On test the auto-transformer circuit showed that 211 volts existed between one side of the secondary and ground.

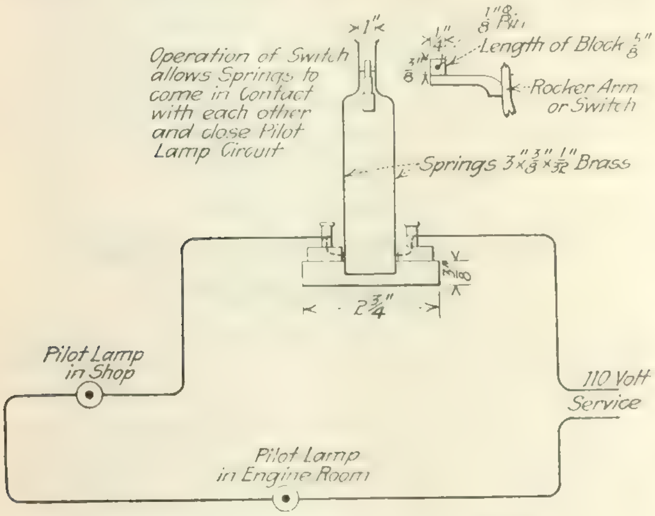
On disconnecting power transformer ground it was found that there was 244 volts potential difference between the line and the ground. From this it was assumed that one of the other circuits was grounded, and so all of the distribution switches in the factory were opened and then closed in succession to determine where the trouble existed. The circuit which apparently caused the trouble led to the testing room, where a 50-kva. testing transformer was installed. While this testing transformer was operating, the power-transformer ground was again disconnected, causing quite a flash and cutting off the energy supply to the testing transformer.

Upon making an examination of the testing outfit, it was found that it had been installed with one side of the primary, or 240-volt side, grounded. When this phase was connected to the power phase that had no ground, a short circuit resulted which caused one of the testing transformer fuses to blow. Failure of this fuse had passed unnoticed, however, because the set continued to receive current through the ground wire on the hydrant. It developed that these conditions had been in existence for more than three years without being detected. C. A. AUBREY.

Bridgeport, Conn.

Remote Control of Transformers Aids the Watchman

IN A CAMBRIDGE (Mass.) factory two transformer banks of 225-kva. rating each are used for lighting and power service during productive hours, and a bank of 30-kva. transformers is employed for night, Sunday and holiday service. The change from the former to the latter is made by the watchman and to save trips to and from the switchhouse it is installed on the roof of the establishment. The switch rods from the oil circuit breakers controlling the supply of energy to the transformer banks are run downward into the shop proper to an operating center.


1''
1/8'' Pin
1/4''
Length of Block 5/8''
3/8''
Operation of Switch allows Springs to come in Contact with each other and close Pilot Lamp Circuit
Rocker Arm or Switch
Springs 3''×3/8''×1/32'' Brass
3/100
2 3/4''
Pilot Lamp in Shop
110 Volt Service
Pilot Lamp in Engine Room

CONTACT-MAKING DEVICE FOR OIL-SWITCH PILOT LAMPS

Pilot lights above the switches indicate when transformer switches are open and closed. One switch prevents the larger transformer-bank secondaries from supplying the 550-volt, three-phase shop network, leaving the latter to be energized from the secondaries of the small bank only. The pilot lamps are each wired in series with another similar lamp in the factory engine room (part of the energy being locally generated), so that the operating engineer is at once informed in case the outside supply is cut off. A sketch of the contact-making device which controls the pilot-lamp service is shown.

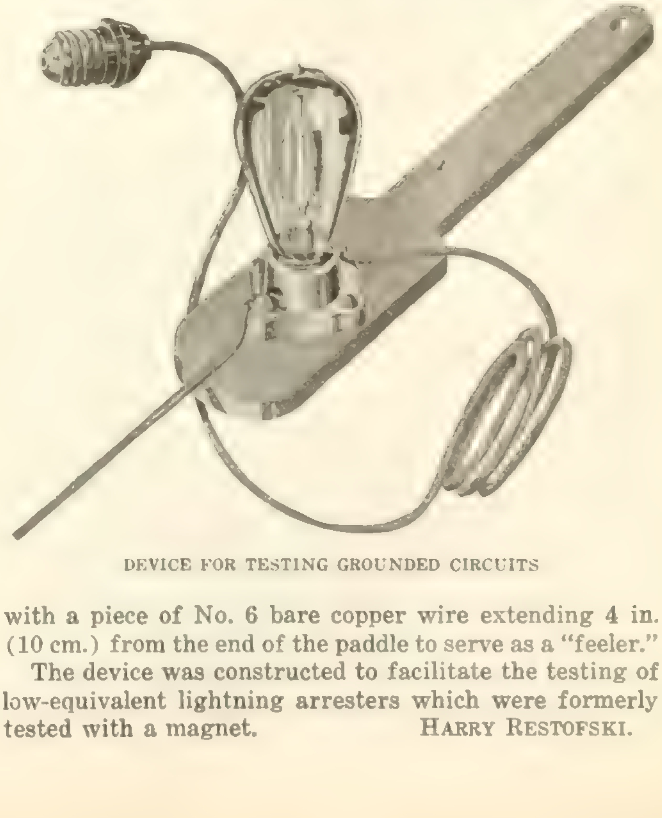
How to Reduce Furnace Electrode Breakage

WHEN an electrode in an electric furnace breaks the trouble is seldom investigated and the blame is usually placed on the electrode, whether it belongs there on not. There may, however, be several causes for these breaks. The Acheson Graphite Company of Niagara Falls, N. Y., points out remedies as follows:

> Probably the greatest breakage occurs during the melting-down period from faulty regulation of the electrodes. The automatic regulators are controlled by the length of the arc and are so constructed that any lengthening or loss of this arc will cause the electrodes to be fed down into the furnace. If contact is lost and there is no stop or brake on the regulator, the electrode will be forced into the scrap until the strain breaks it, usually at the joint just below the holder. This can be remedied by raising the voltage so that the arc will be longer and will melt the scrap beneath it before the electrode can be forced into the scrap. Then when contact is lost the operator will notice it in time to regulate the electrode by hand or to put some material under the electrode to remake the contact.
>
> Another great cause of breakage is careless charging. When charging scrap the electrodes should be raised so high that there is no danger of throwing heavy pieces of scrap against them. Striking the electrodes with this large scrap may not break them at once, but it may so weaken and damage the joint that when operation is resumed a break occurs, which of course means trouble and loss of time before the furnace can be started again.

Convenient Device for Testing Grounded Circuits

BY MEANS of a wooden paddle on which is mounted an incandescent lamp bulb a central-station company in Pennsylvania has been able easily to test low-tension circuits one side of which is normally grounded. A porcelain receptacle attached to the paddle holds the lamp in place. One side of the receptacle is attached to the live side of the circuit through 25 ft. (7.5 m.) of cord and a Benjamin plug. The other side is connected with a piece of No. 6 bare copper wire extending 4 in. (10 cm.) from the end of the paddle to serve as a "feeler."



DEVICE FOR TESTING GROUNDED CIRCUITS

The device was constructed to facilitate the testing of low-equivalent lightning arresters which were formerly tested with a magnet. HARRY RESTOFSKI.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Charge Made for Delivering Small Appliances

MERCHANDISE customers of the Union Electric Light & Power Company, St. Louis, Mo., have for about two years paid an extra charge for the delivery of every electrical appliance purchase which they did not carry away with them. An item of unnecessary expense has in this way been passed on to those calling for the special service.

A charge of 10 cents is collected for delivery in the regular course of business on all electrical appliances except articles like the following: Portable lamps, washing machines, vacuum cleaners, three-light radiators, fans, junior ranges, tailor irons, commercial water heaters, sewing machines (not motors only). Customers who require a special delivery are charged 25 cents for any appliance. A delivery is construed as a single call at a customer's premises for the purpose of delivering or collecting one or more packages. No charge is made for collecting or delivering articles which are to be or have been repaired by the company.

Optional Flat Rate for Household Service

BY J. F. FARQUHAR

WHEN the shortage of meter readers and bookkeepers during the war brought about a careful revision of billing methods to reduce costs and labor requirements to a minimum, the Washington Water Power Company, Spokane, Wash., adopted a flat-rate schedule for use in suburban and rural districts which not only has reduced billing costs but has resulted in an increased consumption and revenue in rural districts. So successful has the method proved that it is being carried over with satisfactory results into the present period.

The schedule filed provided for giving the customer unlimited hours' use of electricity for all household purposes with the exception of water heating and room and air heating for a minimum of at least 25 per cent increase over his previous year's ledger record. The success of the rate, of course, is dependent upon the judgment of the man in the field. As a matter of fact, the average increase of the flat rates signed up over the metered rates of the previous year has been 42.8 per cent rather than the 25 per cent minimum, and the schedule is constantly being boosted. If the man on the ground knows the conditions surrounding the consumer, it is always possible to obtain an equitable flat rate from the standpoint of the company.

During the first eight months this rate was in operation 812 consumers were signed up, with revenues involved amounting to about $48,000. This represents a $15,000 increase over the old ledger record. In two towns where meters were left in to check up on the advantage which this flat rate would mean to the consumer statistics are at hand to show that from two to ten times as much electricity was being used as on a meter basis. Even with this record, however, the company received an average return of 6 cents per kilowatt-hour on all energy consumed.

The entire costs of billing are done away with under this system. No monthly statements are rendered. The customer is signed up on the flat rate with an agreement to pay in monthly installments in advance, and the response to date has been quite satisfactory. Eight per cent discount is allowed for paying in advance.

The rate has proved very popular with consumers—to such an extent that one whole town on the Washington Water Power Company's lines is now on a flat rate. Thus the meter reader is entirely done away with in this district. This excepts, of course, power installations. The flat rate has been extended to cover purely commercial lighting with incidental small power which would ordinarily come on the lighting meter. A large number of ranges have been signed up on the same rate. Consumers seem willing to pay anywhere from 25 to 250 per cent increase over their former bills without question.

The only difficulty foreseen has been the increase in demand beyond the capacity of the station, but so far there has been no trouble in that regard.

Collecting the Bill at the Time of Reading Meters

IN SPARSELY settled rural districts the separate reading of meters and billing often involves an expense disproportionate to the return to the power company. In order to lessen this expense the British Columbia Electric Railway Company, Vancouver, B. C., has arranged on one of its rural lines to have all operations handled at one visit, a proceeding which has proved most satisfactory. A suburban line 60 miles (96 km.) in length is thus handled by three representatives in various communities along the line, who keep ledgers, read, bill and collect in these various areas. One of the chief advantages of this system is the personal contact thus maintained between the customer and the company. It is made easy for the householder to pay the monthly account either in the main office or at the branch office, which keeps in close touch with the city headquarters. In case of any question in regard to an account a telephone question addressed to the main office sets a clerk to looking up the form, and the answer is ready within two minutes from the time that the company receives the original request.

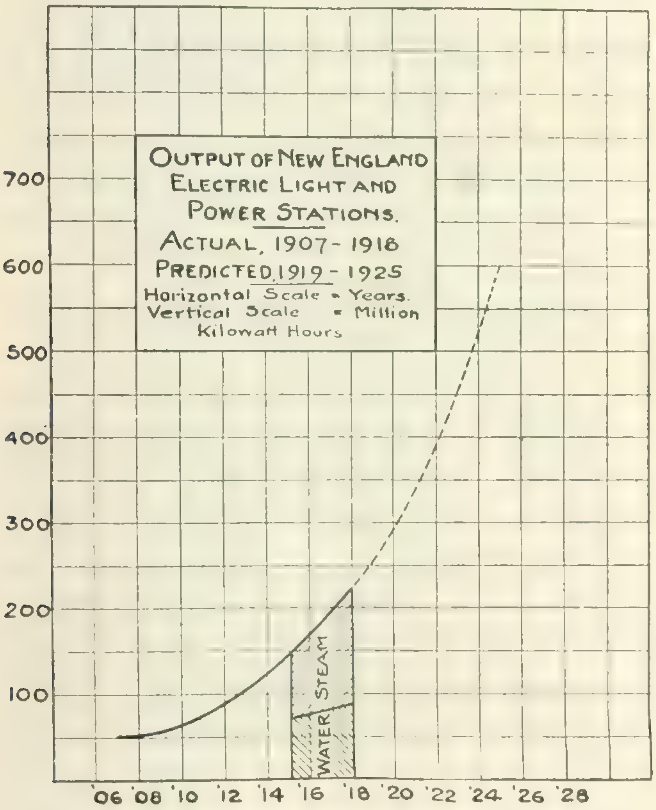
A similar system has been tried in the vicinity of Spokane, where it was arranged to have the meter reader read and collect at the same time. The results were entirely favorable, and although the system has not yet been permanently adopted, it is probable that it will be.

Planning for Power in New England

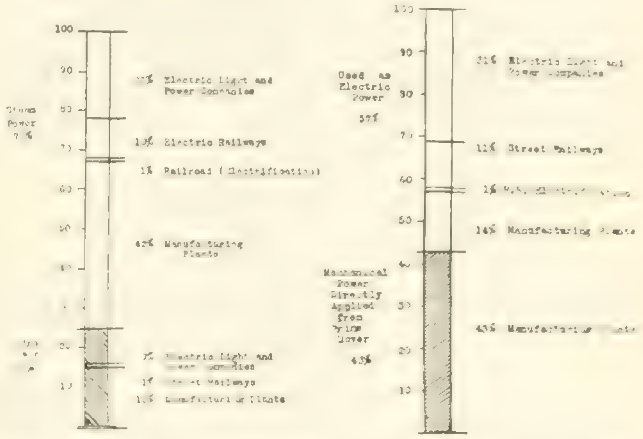
Development of Large Stations and Extension of Interconnection Program Necessary to Meet Demands of Future

If THE installed capacity of New England central stations, now 1,500,000 kw., continues approximately to double in five-year periods, said Prof. Charles F. Scott of Yale University at the New London (Conn.) convention of the New England Section, National Electric Light Association, then more than 1,000,000 additional kilowatts will be installed in the next five years, and at the end of ten years there will be 4,000,000 kw. in excess of the present capacity. Preliminary estimates indicate that by the adoption of a general power system savings of the order of $100,000,000 can be realized in investment with an annual reduction in coal consumption of 10,000,000 tons.

New England is peculiarly dependent upon power, being a manufacturing community without raw materials or coal. With 2 per cent of the area and 4 per cent of the population of the United States in 1914, New England had 16 per cent of the wage earners, used 14 per cent of the industrial power and made 12 per cent of the products. In 1869 two-thirds of the industrial power of New England was hydraulic. Since then the hydraulic power has doubled, while the steam power has increased fifteen-fold. The diagrams illustrate the subdivision of hydro-electric and steam power in New England, the relation between mechanical and electric power applications and the growth of central station outputs. Nearly half the power driving the industries is obtained from steam engines with purely mechanical service. In Connecticut alone it was found in the war-time fuel investigations that among 1,250 industrial plants not more than 50 had good economy. There were 1,200 plants ranging from 4 lb. to 8 lb. of coal per horsepower-hour.



PREDICTED OUTPUT 1919-1925 FOR CENTRAL STATIONS OF NEW ENGLAND



SUBDIVISION OF HYDRO-ELECTRIC AND STEAM POWER (AT LEFT) AND RELATIONSHIP BETWEEN MECHANICAL AND ELECTRIC APPLICATION (AT RIGHT) IN NEW ENGLAND

It is computed that in 1918 New England had 900,000 kw. in developed water power, 320,000 kw. in central stations and 580,000 kw. in manufacturing plants. The total hydro-electric energy produced was about 2,400,000,000 kw.-hr., which is about half the energy produced by steam and equivalent in coal to 2,400,000 tons (based on 2 lb. per kilowatt-hour). The estimated undeveloped water power is 750,000 kw., and the estimated undeveloped water power susceptible to economical exploitation is 375,000 kw.

It is clear that even with complete hydraulic development the present needs of New England could not be met by water power alone. Professor Scott set forth in his address the importance to future supply of large interconnected steam generating plants, commenting upon the superior economy and reduced unit investment cost of the larger stations.

Farm Electric Service Rates Increased in Ohio

The Greenville (Ohio) Electric Light & Power Company has filed a new schedule with the Public Service Commission carrying increased charges for farm electric service. The monthly lighting rates to be charged outside of the built-up limits of the city of Greenville and outside of the unincorporated towns which the company serves consist of a fixed charge per lighting customer of $1 per month plus an energy charge of 11 cents per kilowatt-hour for all energy used. This charge is subject to a discount of 1 cent per kilowatt-hour if the bill is paid before the tenth of the month. For farm-power service a monthly fixed charge of $1 per month per kilowatt of transformer capacity connected, plus an energy charge of 7 cents per kilowatt-hour for the first 200 kw.-hr. and 5 cents per kilowatt-hour for all energy used over this amount, is made. This billing is also subject to 1 cent per kilowatt-hour discount for prompt payment.

Heating and cooking requiring over 750 watts connected load take the farm power rate. The regulations under which this service is furnished are that the customer must supply all lines, transformers and appliances excepting the meter for his service. Where transmission lines have been built by consumers and turned over to the company, subsequent customers along the line shall, when first coming on, pay their pro rata cost of the line, and this is distributed in such a manner that all customers will ultimately contribute equally to the cost of the line. While these rates for farm-lighting and power service appear low at first glance, it must be taken into consideration that they are based on service in which the company has no investment charge in equipment beyond the city limits.

The Public Relations of Public Utilities*

Every Available Means of Getting Evidence of the Companies' Useful Service Before the Public Should Be Employed

IT HAS developed that the problems of peace following war are no less difficult than the problems of war. The most effective weapons of defense against the elements of disturbance are intelligence and publicity. If there is any class of business which is at all times before the great court of public opinion, it is that which comprises the public utility corporations. It therefore behooves the utility to see that its character is such that it cannot be impeached before the court, that its testimony before the court is infallible and invulnerable, for the court of public opinion is the court of last resort; from it there is no appeal.

Let it be understood that a public utility is not some sort of monster designed to rob and bleed the public. There may be dark pages in the history of utilities covering their early development, as there is in the history of mining and other enterprises. But wise legislation has, through regulatory powers conferred upon various state and federal commissions, done away with the possibility of extortion and dishonest methods on the part of utilities.

A public utility stands for permanence. It has an advantage over private enterprise in its ability to draw capital from a thousand towns and cities and center it in places where it will do the most good. The war has proved the necessity of great aggregations of capital in order to accomplish great things. While the tendency toward what are known as monopolies or trusts was once viewed with genuine alarm, governmental regulation and supervision has operated to allay this general apprehension, and the spirit of the times is toward cordial public relations for large corporations that are supplying recognized needs.

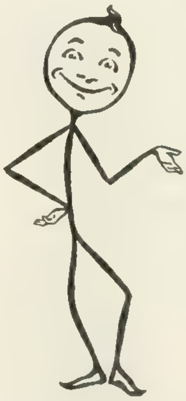
Plans are being made for the formation of the most gigantic pool of power interests ever conceived. If these plans are consummated, it will mean the forming of great rivers of electricity flowing over the mountains and down the valleys of the entire East, giving a new impetus to industry.

Big corporations are insisting that their employees must be competent. They must have more than hand skill. They must be neat in appearance, they must be mannerly, they must be courteous, and they must have character. Big business is also recognizing that the man who works must have something more than a bare living wage in order that he may have opportunity to develop the sort of character which is required of him.

Now, proper relations between the public and public utilities depend upon the utilities recognizing the public needs and sufficiently and effectually supplying such needs, and upon the public having a sympathetic understanding of what is involved in the task of supplying such service. All this must come about through proper publicity. Are we employing every available means of getting our best evidence before the tribunal of public opinion? For instance, would it not be fine if we could inspire our stockholders to take as much interest in protecting the good name of our particular utility as the management is expected to show; if we could bring them to a lively realization that they are the owners of the business which we are operating for them and that they ought at all times to defend and protect and advance their own business?

The advertising of public utilities is written with the thought in mind of accomplishing a dual purpose. It is calculated to build up a favorable opinion of the goods or service offered to the public, and it has in mind the creation of a favorable sentiment with respect to the reputation of the firm or company offering the goods or service. Character is something that is built up within the corporation. Reputation is something that is built up outside the corporation. If its character is such that it will bear the searchlight of open, candid and even intimate publicity, its reputation will be a true reflex of its character, and the corporation will stand well in the public mind.

Trademark Adopted by Brooklyn Company



THE ingenious cartoon trademark shown in the accompanying illustration has been adopted by the Brooklyn Edison Company for use in the advertising of electrical appliances. This little figure and the words "With Little Effort" lend themselves to many catch phrases, such as "With little effort finish your work by 10 a.m."; "With little effort cook right on the dining-room table," etc. This figure with the wording "With Little Effort" has been copyrighted by the company.

REPRESENTATIVES *of the corporation will sometimes state in its defense that it is only an aggregation of individuals and the corporation should not be blamed for individual transgressions. What is the public but an aggregation of individuals who like their individuality recognized? The corporation whose employees consistently practice the art of conciliation when coming in contact with its patrons will realize some day that, having pleased the individuals, it has finally won the much desired confidence of the public.*—S. M. KENNEDY.

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*Abstracted from a paper presented by J. F. Greenawalt, publicity manager of the Mountain States Telephone & Telegraph Company, before the sixth annual convention of the New Mexico Electrical Association.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Failures of Turbo-Generators and Suggestions for Improvements.—J. SHEPHERD.—In the opinion of the writer general types of failures may be roughly classified under (1) mechanical weakness, (2) electrical weakness, (3) heating and fire risk, (4) ventilation difficulties. Under mechanical weakness the writer points out the tremendous forces that are brought into play when a large number of conductors are embedded in a slot and rotated at high speed. He states that one of the most serious electrical weaknesses is the inability of the generators to withstand short-circuit stresses. In discussing the use of insulations that withstand high temperature the author gives curves showing the useful life of insulation and temperature for fibrous and mica insulations. He states that the ideal machine should embrace the following features: (a) Coils to be continuously held against movement under mechanical forces, but free to expand with heat; (b) working temperature and output independent of air conditions; (c) capability of working at a much reduced temperature and to be practically fireproof.—London *Electrician,* Jan. 16 and 23, 1920.

The Theory of Constant-Power Generators.—F. K. D'ALTON.—Machines having approximately constant power characteristics are essential for arc welding where it is necessary to keep the temperature constant. The author considers these machines under this classification: (a) The separately-excited, differentially compound-wound generator, (b) the self-excited generator with differential series winding, (c) the separately-excited, self-excited differentially compound-wound generator, and (d) special constant-power generator having two opposite poles which are separately excited. A pair of poles at right angles to these have only the series coil. This is said to have approximately constant-power characteristics.—Toronto *Electrical News,* Jan. 15, 1920.

Lamps and Lighting

Multiple Systems of Distribution for Street Lighting.—WARD HARRISON.—The wider use of multiple lamps supplied from standard secondary distribution systems is considered as a step in simplifying operating problems and reducing the disproportionate cost which goes to cover fixed charges on special equipment and additional lines for street lighting only. The advantages in simplicity and flexibility of multiple-connected lamps is pointed out, and the more general adoption of multiple street lighting is stated to be contingent upon the standardization of suitable methods of control applicable generally to existing electrical power distribution systems. Different devices in use or proposed for control of multiple street lamps are briefly described, and the characteristics desirable in such apparatus are outlined. It is said that only a small difference in the efficiency of present multiple and series incandescent lamp systems exists.—*Journal of the American Institute of Electrical Engineers,* January, 1920.

Japanese Specifications for Tungsten Incandescent Electric Lamps.—These specifications as formulated by the Japanese Illuminating Engineering Society cover the vacuum tungsten incandescent lamps. It is said that the specification for gas-filled lamps is in course of preparation.—London *Illuminating Engineer,* October, 1919.

Generation, Transmission and Distribution

Cooling of Transformer Windings After Shut-Down.—V. M. MONTSINGER.—When taking temperature measurements of alternating-current apparatus by the measurement of resistance by direct current after the alternating current has been shut off errors occur due to the cooling of the windings before the readings can be taken. The author considers several methods to correct this error and concludes: (1) That the cooling-curve method of correcting back to the instant of shut-down is the most accurate when used with laboratory care, but it is not practical commercially because it is laborious and expensive; (2) that a partly theoretical and partly empirical method is applicable and can be used with results accurate enough for practical purposes for all types of oil-immersed transformer windings. However, for distribution transformers of 100 kva. and less, where the copper density is fairly uniform for the different sizes, an arbitrary rate of 1 deg. C. per minute, provided the time does not exceed three minutes, can be used. For air-blast transformers an arbitrary rate of 1 deg. per minute may be used, provided the time does not exceed four minutes.—*General Electric Review,* December, 1919.

Traction

The Axle-Generator Regenerating System.—R. E. FERRIS.—The considerations which led up to the use of this system on the Chicago, Milwaukee & St. Paul passenger locomotives are as follows: (1) Safety for vehicle (locomotive or car); (2) protection to electrical apparatus, such as motors, auxiliary rotating apparatus, switches, etc., from voltage surges and current overloads; (3) efficiency; (4) simplicity. In the axle-generator regenerating system the main motors are separately excited from an axle-generator, whose fields are separately excited in turn from a storage battery or some other constant-voltage source. The axle-generator is connected across the main motor fields with a balancing resistance in series, as shown in the diagram. The

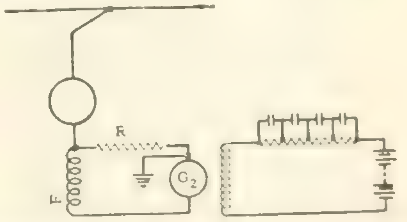


DIAGRAM OF AXLE REGENERATING SYSTEM

main motor armature current is carried through the balancing resistance R, thus giving a differential effect on the main motor fields when the regenerated current increases owing to a drop in line voltage. This differential effect is essential to stable operation of the main motors. The characteristics of the system are given in a series of diagrams.—*Electrical Journal,* February, 1920.

The Electric Power Supply for the Chicago, Milwaukee & St. Paul Railroad.—A. W. COPLEY.—A general description of the power-supply system for this railroad, consisting of a large hydro-electric generating plant near each end of the Puget Sound division, one near Seattle and one near Spokane with a 100,000-volt transmission line between and substations at seven points along the line.—*Electric Journal,* January, 1920.

Electric Traction in Silesia.—E. C. ZEHME.—A total of 274 km. (170 miles) of the Prussian railroads in the rocky parts of Silesia have been electrified. Alternating current of 16⅔ cycles and at 15,000 volts is employed. The total power consumption is about 12,000 kw. The author gives a thorough description of power stations, locomotives, arrangement of trolley wires and a great number of details of construction.—*Elektrotechnische Zeitschrift,* July 17, 24 and 31, 1919.

Installations, Systems and Appliances

Simple Electric Water Heater for the Utilization of Surplus Hydro-Electric Power.—H. A. WINNE.—A simple and substantial electric water heater, described in this article, has been developed to take the place of fuel-fired water heaters in those industrial plants that are operated by isolated hydro-electric stations. As surplus electric power is ordinarily available under such conditions, the use of the electric heater will save the cost of the equivalent fuel minus the capital and depreciation charges of the heater—*General Electric Review,* December, 1919.

Electrical Propelling Machinery for U.S.S. Tennessee.—WILFRED SYKES.—A brief description of the generating and driving equipment of the U.S.S. Tennessee, which is now nearing completion. It is said that full advantage has been taken in this case of the possibilities of electric drive.—*Journal A. I. E. E.,* January, 1920.

Audible Electric Signals in Industrial Plants and Acoustical Engineering.—V. KARAPETOFF.—The paper is a plea for a wider use of acoustic signals in industrial plants. It is shown that much time is wasted by the officials, experts and important employees in trying to find each other. With loud acoustic signals installed throughout a plant, in the shops, yards and offices, it becomes possible to locate any of a considerable number of men instantly, using a simple code call for each. Such calls could be given only imperfectly by pushing a button, and for this reason a special code calling instrument has been developed which closes electric contacts automatically after having been set for a desired combination. The actual conditions and the needs for acoustic signals are discussed in application to steel mills, shipyards, textile mills, printing establishments, coal mines, construction jobs, etc. The problem of measurement of sound intensity is then taken up and the available means and devices are described. It is also shown that sound waves may be directly photographed under proper conditions and the laws of their propagation studied. Attention is called to the importance of experimental and theoretical study of the modes of vibration of diaphragms used in acoustic devices.—*Journal A. I. E. E.,* January 1920.

Protective Resistances for High-Tension Apparatus.—H. GEWECKE.—The undesirable characteristic of carborundum resistances of the usual type in giving a resistance which greatly decreases with voltage makes their protective value less, particularly when used as series resistances for high-tension potential transformers. It has been found that copper oxide forms a better material for such resistances, units made of fused copper oxide (probably containing some copper suboxide, which has a higher conductivity) giving remarkably constant resistance values even when tested with sudden high-voltage surges. The resistance measurements were made in the following way: Switching surges were sent from a 15-kv. transformer along a 150-m. (500-ft.) aërial transmission line, and the resistance to be tested was connected across the line at the far end. The voltage at this end was measured by means of a sphere gap. From the voltage values with and without the resistance unit the "surge resistance" of the unit could be calculated according to the wave reflection formulas. Thus tested, a copper-oxide unit retained between 50 and 70 per cent of its Wheatstone-bridge resistance, while the resistance of a carborundum unit dropped to about one-fiftieth of its normal value. —*Elektrotechnische Zeitschrift,* July 31, 1919.

Electrophysics and Magnetism

On the Radiation of Antenna Systems.—MAX ABRAHAM.—The electromagnetic radiation field surrounding two radio-telegraphic antennas will cause a certain electromagnetic coupling between the antennas, just as the magnetic field surrounding two coils will cause a magnetic coupling between the coils. In considering the effect of coupling upon the oscillation characteristics of antennas, however, it is necessary to take into consideration the finite velocity of propagation of the electromagnetic disturbances through the ether. In the present paper some problems of antenna coupling are analyzed by means of general field equations and retarded potentials. Expressions are derived for the mutual energy of two oscillating antennas and for the apparent change in radiation resistance due to the coupling. It is also shown that the interaction between two tuned antennas will affect the period of free oscillations, there being two free periods, one higher and one lower than the natural. A discussion of the electromagnetic shadow cast by an antenna into the field of another radiating antenna leads to some interesting conclusions of high practical value. When certain conditions are fulfilled an auxiliary antenna will cast an absolute shadow; in other words, it may be used to screen out all radiation in the direction of a certain receiver station, while the radiation in the opposite direction may be quite considerably increased by the mirror-action of the auxiliary antenna. At 1,000 m. wave length an absolute shadow will be cast by a 30-m. high auxiliary antenna with a total resistance of 2 ohms, placed at a distance of 165 m. and tuned to the transmitted wave length. The radiation in the opposite direction from the auxiliary antenna will in this case be 2.83 times normal, but this large increase is partly accounted for by an increase in transmitter power. Conversely, the electromagnetic shadow of an auxiliary antenna erected in the neighborhood of a receiving station may be used to screen out the radiation from a certain interfering transmitting station.—*Archiv für Elektrotechnik,* July 24, 1919.

Units, Measurements and Instruments

Method and Instrument for the Measurement of the Visibility of Objects.—LLOYD A. JONES.—The writer describes an instrument developed during the war for the initial purpose of determining the visibility of camouflaged objects.—London *Philosophical Magazine,* January 1920.

Distance Indicator for Large Direct-Current Values. —ERNEST BESAG.—In parallel operation of direct-current generating or converting stations it is often of great convenience to be able to measure from one station the total current output of another. A practical load-dispatching problem which arose some years ago in Frankfort led to the development of an instrument for indicating currents of up to 5,000 amp. at one station (I), the instrument being placed on the switchboard of a station (II) at 2.5 km. (1.5 miles) distance. Around the direct-current buses in station I are placed iron cores, with secondary windings, similar to alternating-current transformers. These windings are connected by means of a 2.5-km. cable of No. 15 copper wire with station II. At the latter station an alternating voltage of 120 volts and 45.3 cycles is impressed upon the cable, the entering current being measured by an ordinary alternating-current ammeter. The flux in the iron-cored choke coils will vary with the direct-current strength to be measured, and the effective impedance of the secondaries thus will vary, enabling the alternating-current ammeter in station II to be a calibrated in terms of direct-current strength at station I. Similar methods may be employed in high tension direct-current stations to insulate the switchboard instruments from the mains and also, in plants with extremely heavy currents, to reduce losses due to instrument shunts.—*Elektrotechnische Zeitschrift,* Sept. 4, 1919.

Telegraphy, Telephony and Signals

Wireless Telephony.—N. H. SLAUGHTER.—The writer states that the three important elements of radio transmitting and receiving sets are a radio-frequency generator, a modulator for controlling the radio-frequency current and an antenna for radiating the electromagnetic waves produced by the radio-frequency current. He shows that the vacuum tube when used as an oscillator, or radio-frequency generator, associated with properly designed circuits, will meet all of these requirements, excepting that its power output is limited to a few hundred watts. As to the modulation of the radio-frequency current the requirements are fulfilled in a remarkable degree by the vacuum tubes used in properly designed circuits. The writer then takes up the detail problems of the application of radio-telephony for aëroplane use.—*Journal of the Franklin Institute,* January, 1920.

High-Power Vacuum-Tube Transmitters.—In a lecture on the use of vacuum tubes in radio engineering, Count Arco recently discussed the future of vacuum-tube transmitters. He stated that the Telefunken company is making tubes which deliver 1.5 kw. high-frequency output. A particular type of 800-watt tube is employed in a standard transmitting set, and by parallel connection of several tubes it has been possible to build a vacuum-tube transmitter giving 10 kw. of high-frequency energy.—*Elektrotechnische Zeitschrift,* July 3, 1919.

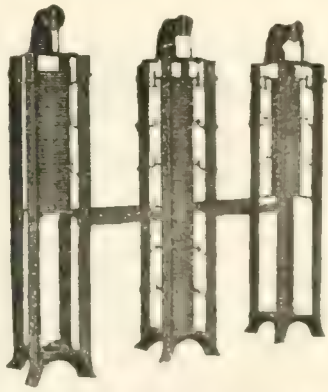
Theory of the Audion as a Detector.—F. CARBENAY. Semi-empirical equations for the three-electrode vacuum tube are obtained by developing the "characteristic surface" in a power series of the plate and grid voltages as independent variables, adding terms proportional to the time derivatives to take into account the effect of capacity currents between electrodes and lead-ins. The rectifying action of a bulb with grid condenser and leakage resistance is then considered, expressions for the available audio-frequency power are derived, and it is shown that the fulfillment of certain optimum conditions is essential for good detecting efficiency.—*Revue Générale d'Electricité,* Nov. 1, 1919.

Miscellaneous

Thermal Conductivity of Insulating Material.—T. S. TAYLOR.—The author gives data for the thermal conductivity of such materials as fish paper, fullerboard, cambric, mica tape and various kinds of wood, asbestos, plate glass, sheet steel, wool, felt, etc.—*Mechanical Engineering,* January, 1920.

Electric Water Heaters.—H. OSTEN.—The author urges a more general use of electric heating in hot-water plants. In a large creamery in Germany a 3-kw. electric water heater was installed in 1913 to replace an out-of-date steam-heating plant. The heater has been in continuous use since then, without any disturbances, and has shown good economy. Since the hot-water tank acts as a heat reservoir it is easy to avoid energy consumption during peak-load hours, and power may therefore be obtained at a low rate.—*Elektrotechnische Zeitschrift,* June 12, 1919.

Some Developments in the Electrical Industry During 1919.—JOHN LISTON.—This review covers the progress that has been made by electricity in railroad electrification and automatic substations. A brief description is given of the remote-control and full automatic generating stations, some of them very recently designed. The author also outlines the system of radio transmission for transoceanic commercial service as proposed by E. F. W. Alexanderson. The present status of the oxide-film lightning arrester is shown and information regarding static condenser equipment is set down. Outdoor substation equipment of many kinds is described and considerable information regarding relay equipment is given.—*General Electric Review,* January 1920.



OXIDE FILM ARRESTER FOR THREE-PHASE 15,000-25,000 VOLTS

News in Brief

Summary

of Important Happenings in the Industry During the Week

The lifting of freight embargoes from the steel regions and from part of New England gives promise of relief on shipments from those points. Much steel material tied up between the mills and the East is badly needed to replenish stocks.

Northern New England is badly tied up, and New York is just extricating itself from its transportation difficulties. The South and Middle West have been free of traffic troubles in their districts but have suffered from lack of shipments from the affected regions. Their volume of business has been good to the extent that their stocks would permit.

Mills have booked their entire capacities of electrical sheets for the first half year, and it is expected that it will be about May before books will be opened for future buying. Line-hardware orders are coming through in good volume and prices have just advanced 10 per cent. Yellow pine cross-arms are up 30 per cent and Northern cedar poles 25 per cent.

In pursuance of the reorganization plans under way at N. E. L. A. headquarters in New York, Fred W. Herbert has been appointed superintendent of the service department and George F. Oxley director of the publicity department.

American members of the advisory committee of the International Electrotechnical Commission are about to sail for Europe to attend meetings in Brussels called to promote the work of the commission. Dr. C. O. Mailloux, the new president of the commission, who is also chairman of the American delegation, will furnish a cabled report of the proceedings to the Electrical World.

A "National Lighting Week" is being planned by the Illuminating Engineering Society to intensify public interest in good illumination.

Plans for increasing the activities of the Electrical Manufacturers' Council are being perfected with the object of still further co-ordinating the work of the three constituent bodies—the Electric Power Club, the Associated Manufacturers of Electrical Supplies and the Electrical Manufacturers' Club.

Progress in eliminating the inductive interference of power circuits with telephone lines and in long-distance transmission and economy in cables is noted in the annual report of the American Telephone & Telegraph Company.

Electric power figures for October last, issued by the Geological Survey, show a total of kilowatt-hours produced by public utility plants in the United States of nearly 3,500,000,000, about one-third being generated by water-power.

The power plant forming part of a war factory for making picric acid built near Little Rock, Ark., has been sold by the United States government to the Arkansas Power & Light Company for $235,000. It will be used to furnish energy in pumping for irrigation.

Congressional conferees on the water-power bill met in Washington this week and will reconvene next Monday. Opposition to selecting the executive secretary of the Federal Power Commission from the Engineers' Corps of the army has developed.

Approval of the acquisition of the Connecticut Power Company by the Hartford Electric Light Company will be granted by the Connecticut Public Utilities Commission.

To improve co-operation between various branches of the electrical trade the New England Electrical Supply Jobbers' Club has been formed at Boston, Mass.

The first of two 20,000-kva. steam-turbine units to be installed by the Hartford (Conn.) Electric Light Company in the new station that it will build on the Meadows site is due in January, 1921. The building will afford room for a third unit of this size without enlargement.

The lines of the Central Maine Power Company will soon be interconnected with the Franklin Light & Power Company.

A petition of the Grosvenordale Company, an industrial concern, for authority to build a transmission line to the Massachusetts border for the importation of energy to its factory has been denied by the Connecticut Public Utilities Commission.

Kansas has established a Court of Industrial Relations, in which are vested all the powers of the superseded commission and in addition, control over labor conditions in public utilities, mining and the manufacture of food products and clothing.

Electric traction will be the subject of the meeting of the A. I. E. E. to be held in Pittsburgh next Friday.

A proposed civilian National Board of Public Works to co-ordinate all government engineering work under the headship of a Cabinet officer has been indorsed by sixty-seven engineering societies, and the plan is now embodied in a measure before Congress known as the Jones-Reaves bill.

Appropriations for foreign trade promotion under the Department of Commerce which had been cut into by the appropriations committee of the House were restored as the result of vigorous commercial protests.

Only five public utilities throughout the country offered bond or stock issues in February, the total sum represented being $10,950,000 and the prevailing rate of interest 7 per cent.

In a decision of the District of Columbia Supreme Court the valuation of the property of the Potomac Electric Power Company made by the Public Utilities Commission has been sustained. Enforcement of the order of the commission reducing the rate from 10 cents to 8 cents a kilowatt-hour still awaits court proceedings.

Direct commercial communication by wireless between the United States and England has been established for the first time by the Radio Corporation of America, which plans service to all parts of the world.

Regulation of radio communication by the Department of Commerce rather than by the Navy Department is recommended by John V. L. Hogan, president of the Institute of Radio Engineers.

A standards committee has been formed by the Associated Manufacturers of Electrical Supplies, consisting of one representative from each of the twenty-two sections.

Factories may possibly be established in Japan and China as the result of an investigation being made by the Westinghouse company.

Operation of the Pacific Coast division of the Chicago, Milwaukee & St. Paul Railway by electric motive power was scheduled to start on March 5.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

Object to Military Control in Water Power Commission

CONFEREES from the House and the Senate on the water-power bill met in Washington on Monday, and the next day the conference was suspended because of the death of Senator Bankhead of Alabama. The conferees will meet again on Monday, March 8.

Numerous protests have been addressed to the conferees against selecting the executive secretary of the Federal Power Commission from the Engineer Corps of the army. The objections are based on the grounds that it would increase military control, not only of rivers and harbors but of power, which enters into all industries, public utilities and domestic establishments. It also is held that the executive secretary, who will be the mainspring of the commission, should be a man of long experience in water-power matters. It is claimed that the Engineer Corps cannot provide such a man. The point also is made that the securing of control of public works is a long step toward militarizing the government.

California Hydro-Electric Shortage Relieved

THE water shortage from which hydro-electric companies in California have suffered recently has been relieved by a snowfall of sixty-four inches in the mountains and three inches of rainfall in the drainage area of the Crane Valley dam.

A statewide appeal of the California State Railroad Commission to conserve water has brought about a Water Conservation Congress in Sacramento to urge a special session of the Legislature to meet the crisis. Seventeen utility companies supplying California with electrical energy have pledged themselves to carry into effect to the limit of their ability all orders and regulations of the Railroad Commission concerning diminution of service, taking on of new business and interchange or delivery of power among the companies.

Larger Activities for the Electrical Manufacturers' Council

PLANS are being perfected for increasing the activities of the Electrical Manufacturers' Council. A permanent secretary has been appointed with headquarters in New York. The council, which is made up of four representatives each from the Electric Power Club, the Associated Manufacturers of Electrical Supplies and the Electrical Manufacturers' Club, purposes to develop extensively the work for which it was formed, namely, that of co-ordinating the work of the three member associations.

The Electrical Manufacturers' Council has been in existence now just four years. Among the important matters taken up by it is the uniform cost accounting system which it developed for electrical manufacturers. The council played, through its war service committee, an important part in helping the government to procure the maximum of service from the electrical manufacturers.

The council meets six times a year. Its next meeting is scheduled for the latter part of April.

Frederic Nicholas, formerly contributing editor of the ELECTRICAL WORLD, has just entered upon his duties as permanent secretary of the council. Mr. Nicholas was engaged in editorial work on the ELECTRICAL WORLD twelve years, resigning Feb. 1 of this year.

Appropriation for Work of Department of Commerce Is Not Cut

BY A VOTE of 210 to 30, the House of Representatives has refused its sanction to the partial abandonment or drastic reduction of the Department of Commerce agencies for the development of foreign trade. This proposed retrenchment, which was recommended by the House appropriations committee, had been vigorously criticised by export and manufacturing interests.

After two hours' debate an appropriation of $165,000 for the continuance during the fiscal year ending June 30, 1921, of commercial attachés of the department at the principal business centers of the world was reinstated in the bill. The appropriation for foreign trade investigations was increased from $175,000 to $325,000, the amount originally asked by the department. The House then approved an appropriation of $100,000 for promoting trade with South and Central American countries.

There is every indication that the amendments will be approved by the Senate.

Associated Manufacturers Form Standards Committee

TO TAKE care of the adoption and publication of all standards of the Associated Manufacturers of Electrical Supplies, there has been formed a general standards committee composed of one representative from each of the twenty-two sections of the association. This committee will also work with outside standardization bodies along co-operative lines. LeRoy Clark, Safety Insulated Wire & Cable Company, has been chosen chairman, and C. A. Bates, Bryant Electric Company, secretary.

Under the new plan proposed standards will originate in the sections and be submitted to the general standards committee for adoption. They are then referred back to the sections interested for final ratification and then to the board of directors for approval, after which they will be published by the committee.

Representatives of the sections on the committee are as follows:

Air circuit breaker, H. L. Smith, General Electric Company; armored conductor and metallic flexible conduit, C. E. Corrigan, National Metal Molding Company; attachment plug, C. A. Bates, Bryant Electric Company; carbon, J. F. Kerlin, Corliss Carbon Company; electrical porcelain, H. R. Holmes, R. Thomas & Sons Company; fan motor, C. E. Remsen, Diehl Manufacturing Company; fuse, R. C. Cole, Johns-Pratt Company; heating appliance, H. S. Mirrieless, Manning, Bowman & Company; insulating materials, F. Y. Stewart, United States Rubber Company; industrial lighting, W. D. Steele, Benjamin Electric Manufacturing Company; knife switch, F. T. Wheeler, Trumbull Electric Manufacturing Company; lamp receptacle and socket, H. R. Sargent, General Electric Company; line material, L. McCarthy, Macallen Company; molded or formed insulation, E. B. Hatch, Johns-Pratt Company; metal molding, C. W. Abbott, American Wiremold Company; non-metallic conduit, Russel Dart, Alphaduct Company; outlet box, H. G. Knoderer, Sprague Electric Works; panelboard and switchboard, L. H. Frank, Mutual Electric & Machine Company; rigid conduit, Oscar Hoppe, American Circular Loom Company; signaling apparatus, Vernon Durbin, Holtzer-Cabot Electric Company; snap switch, Shiras Morris, Hart & Hegeman Manufacturing Company; wire and cable, LeRoy Clark, Safety Insulated Wire & Cable Company.

Electric Traction Subject of Pittsburgh A. I. E. E. Meeting

ELECTRIC traction will be the subject of the 358th meeting of the American Institute of Electrical Engineers to be held in Pittsburgh next Friday, March 12, under the auspices of the Pittsburgh Section of the Institute and the traction and transportation committee. All of the meetings and the dinner will be held at the William Penn Hotel.

The morning will be devoted to an inspection trip through the East Pittsburgh plant of the Westinghouse Electric & Manufacturing Company, where the visitors will have an opportunity to inspect the electric passenger locomotives being built for the Chicago, Milwaukee & St. Paul Railway. Immediately afterward luncheon will be served at the new lunch club of the Westinghouse Company.

At the afternoon session the following papers will be presented: "Short-Circuit Protection for Direct-Current Substations," by J. J. Limebaugh, General Electric Company; "Flashing of 60-Cycle Synchronous Converters and Some Suggested Remedies," by Marvin W. Smith, Westinghouse Electric & Manufacturing Company; "Automatic Railway Substations," by Frank W. Peters, General Electric Company; "Automatic Substations for Heavy City Service," by R. J. Wensley, Westinghouse Electric & Manufacturing Company.

At the subscription dinner in the evening members and delegates will be welcomed by H. D. Shute, vice-president of the Westinghouse company, and some prominent officials of one of the operating companies in the Pittsburgh district. At the evening meeting the design of the new type of electric locomotive now being furnished to the Chicago, Milwaukee & St. Paul Railway will be described by representatives of both of the manufacturers, N. W. Storer presenting the Westinghouse design and O. W. Batchelder presenting the General Electric design.

At the recent meeting of the board of directors of the Institute it was decided, in accordance with the recommendation of Vice-president Fisken and the Portland Section, to hold the 1920 Pacific Coast convention at Portland, Ore., July 21-23.

Capitalization of Free Franchises Not Allowed in Rate Case

IN DISMISSING the appeal of the Potomac Electric Power Company on March 2 from the valuation findings of the Public Utilities Commission of the District of Columbia, Justice Gould of the District Supreme Court sustained the commission, holding that the procedure was logical and without prejudice. The court had the case under consideration for more than a year. The fair value of the company's property as of Dec. 31, 1916, was found by the commission to be $11,231,170. On the basis of a fixed return the commission directed a reduction on rates of from 10 cents to 8 cents per kilowatt-hour. Pending the court's decision the company is impounding the 2 cent difference. It is expected that an appeal will be taken.

In his decision Justice Gould was emphatic in denying any capitalization allowance for franchises or easements for which the company had paid nothing.

"To claim that these so-called easements" the court said, "which cost the power company nothing, without which it could not perform its public duty and which it is allowed to exercise to enable it to do so, can be capitalized against the consumer of its product in any sum whatsoever is to make the public use destructive of the public right and effect a result which should not be tolerated by any judicial tribunal."

Utility Information Bureau Plan Spreading Rapidly

Bureaus of public utility information similar in plan and scope to the one which has been operating in Illinois for some time are now established in Indiana, Kentucky, Michigan and Minnesota. Utility associations in Iowa and a number of other states are considering plans for similar state bureaus to handle publicity for their utility members.

Co-ordination of Government Construction Demands Attention

THE organized movement, backed by sixty-seven engineering societies, to establish a National Board of Public Works composed of civilians to handle government construction work deserves the serious attention of every engineer, said Marshall O. Leighton before the American Society of Civil Engineers in New York on Feb. 19. At present the army and about twenty-nine other Government bodies endeavor to function independently of each other. Instead there is proposed a civilian organization with co-ordinated branches, each member of which will hold his position or attain a higher one by reason of his ability and not because of military rank or years of service. At present every existing department has an interest only in its own work, and there is duplication of effort, with the resulting waste of energy and money, to say nothing of the competition for appropriations. Moreover, some public works is now under the control of departments which have no apparent claim to supervise it.

With the proposed National Board of Public Works, which would be under the Secretary of the Interior, who would be called the Secretary of Public Works, there would be the co-ordination desired, the possibility of eliminating duplication of work, and the machinery by which appropriations could be intelligently secured and equitably distributed. It was estimated by Mr. Leighton, who has been elected leader of this movement, that $12,000,000 can easily be saved in one year by such co-ordination. Administration and legislation would be simplified.

Two identical bills, known as the Jones-Reaves bill, are now before the Senate and the House of Representatives, respectively, which provide for the establishment of such a board and outline its organization and activities. A special committee is to be appointed by the Republican steering committee of the House of Representatives to consider the bill. A hearing will be conducted as soon as the personnel of this committee is agreed upon. In the Senate the bill has already reached a committee stage. Hearings have been conducted during which prominent advocates of the Public Works Department appeared. Written opinions as to the desirability of the changes are being requested by the Senate committee on public lands. Further hearings are to be had at which those opposed to the proposal will be heard.

Few Public Utility Issues Offered During February

DURING the month of February only five public utilities throughout the country offered bond or stock issues, the total sum of money represented being $10,950,000. The prevailing rate of interest is 7 per cent with but one exception, a comparatively small bond issue of $550,000 offered by the New England Power Company at par, which bears only 5 per cent interest. Two bond issues of the Consumers' Power Company—one for $5,000,000 offered at 98, the other a $3,000,000 issue of gold debenture bonds—and a $2,000,000 issue of preferred stock offered at par by the Louisville Gas & Electric Company are the only issues of any size. The balance is made up of $250,000 in three-year notes of the Twin State Gas & Electric Company, at 98¾, and $150,000 in preferred stock offered at par by the Port Henry (N. Y.) Light, Heat & Power Company.

Direct Commercial Wireless with England Established

THE first wireless messages since war control, which began April 30, 1917, was lifted were sent through the New Brunswick (N. J.) station last Monday morning. Those messages marked an epoch in wireless history. Never before has there been established direct commercial communication between the United States and England. Before the war the United States communicated with England by way of Canada. During the war the only wireless communication with England was under government control. On the first day of the return of the wireless stations communication was between New York and England. In the near future it will develop the service with Norway.

From San Francisco service is provided with Honolulu and Japan. Later on wireless communication will be developed with China, South America and the West Indies. Work is already being done in connection with a super high power station in South America.

A joint resolution, favored by the Secretary of the Navy, has been introduced into the House of Representatives by Mr. Greene of Massachusetts authorizing the commercial use of certain naval radio stations until an American radio company is prepared to take over this work and establish adequate communication between the points in question. The resolution has been referred to the committee on the Merchant Marine and fisheries, and hearings have begun.

Regulation of Radio by Department of Commerce Favored

JOHN V. L. HOGAN, president of the Institute of Radio Engineers, in addressing the institute in New York last Wednesday night said that he considered some form of federal regulation of radio communication both desirable and necessary. This he declared, should be accomplished by some modification of the radio law of 1912, placing control and supervision under the Department of Commerce rather than the Navy Department. Several bills are under consideration at Washington to put control of radio matters in the hands of the navy.

Mr. Hogan made the following suggestions for future consideration: (1) Amend the present law to meet the rapid advances made in the art. (2) Standardize wave lengths for distress, commercial, military and amateur operations. (3) Let future laws be flexible enough to encourage improvement of new types of apparatus, particularly through the development of continuous-wave transmitters. (4) Acknowledgment was made of the debt of both the government and the radio profession in general to the amateur radio worker, for to the experimental and research work of these radio enthusiasts is due in no small part the marvelous record made by wireless telegraphy during the War.

During discussion of the paper a resolution was adopted calling attention to the very inadequate appropriations for the radio service of the Department of Commerce, and the board of directors of the institute was authorized to call this matter to the attention of the authorities in Washington with recommendations for adequate support of the supervisory work. Admiral Bullard said he thought the Navy Department had been put in a false position and that it had been guided only by a desire to serve the best interests of the public. Several members expressed the feeling that while the control of radio matters would be safe in the hands of men like Admiral Bullard, those in high authority did not take the same attitude as he, but, their aim rather, was to establish complete government control of radio work by operation or ownership.

Among those participating in the discussion were L. L. Israel, President Hogan, Dr. A. N. Goldsmith, Admiral Bullard and E. J. Simon.

Hines to Continue to Regulate Domestic Coal Distribution

Executive orders have been issued by President Wilson providing for the continuation of the powers of the Fuel Administration, with domestic distribution under the jurisdiction of Director-General of Railroads Hines and bunker and export supplies in the hands of a commission of four. Mr. Hines' authority is thus extended by the President beyond the date of the return of the roads, which took place a week ago.

To Discuss Proposed International Electrical Standards

FIVE of the advisory committees of the International Electrotechnical Commission will meet in Brussels on March 27 to discuss proposals from the various countries for new international standards. The United States will be represented by Dr. C. O. Mailloux, recently elected president of the commission, and chairman of the delegation; C. E. Skinner, L. W. Chubb, H. M. Hobart, A. H. Moore, Dr. P. G. Agnew and possibly James Burke.

At the recent plenary meeting of the I. E. C. in London eight advisory committees were appointed, instead of three or four as in former years, to carry on the work of the commission. Each country brings up proposals and plans for the extension of international standards before these committees, which hold one or two meetings a year for the purpose of harmonizing the various proposals and formulating them for action at the next plenary meeting. Of the eight advisory committees five will hold sessions at the Brussels meeting. Committees 1 and 3, on nomenclature and symbols, will meet together, while committee 2, on rating of electrical machinery, committee 4, on prime movers, and committee 8, on high-tension voltages, will hold separate meetings. It is expected that the session will be completed about April 3.

Dr. Mailloux has kindly consented to cable a report especially for ELECTRICAL WORLD at the conclusion of the meeting. Part of the American delegation were scheduled to leave on the Imperator today, and the rest will follow on the Baltic in a week or so.

Standard for Automotive Storage Batteries Discussed

SPECIFICATIONS for storage batteries for starting and lighting systems for military trucks were discussed at an important conference at the Bureau of Standards in Washington, on Feb. 25. These specifications cover all the important elements of standards for batteries in this service, and it is anticipated that large use of the specifications will be made in commercial work as well as by the government departments for which they are being drafted.

The conference was called at the request of the Motor Transport Corps in co-operation with the Society of Automotive Engineers. Members of the electrical equipment committee of that society, representatives of the manufacturers, members of the American Institute of Electrical Engineers' committee on storage batteries, representatives of the Navy Department, the Bureau of Standards and the Motor Transport Corps were invited to attend.

The matters discussed included the capacity and arrangement of the batteries and the method of rating them, with specifications for proper construction, the quality of materials and the electrolyte. Tests of the battery were outlined to include the measurement of the capacity, the retention of charge, the purity of the electrolyte, life tests and vibration tests. While the general form of the specifications was agreed on, together with a satisfactory system of ratings, some details as to dimensions and performances were left for further consideration of sub-committees.

One of the important items discussed at the conference was the basis upon which batteries should be rated. The proposal was tentatively adopted to base battery ratings upon the ampere-hours available during five hours' continuous discharge for lighting services and upon the current produced during a twenty-minute period in the case of starting batteries. A standard temperature for these tests of 25 deg. C. was also tentatively adopted.

Co-operation of Telephone and Transmission Engineers Lessens Interference

IN THE annual report of the directors of the American Telephone & Telegraph Company, signed by President H. B. Thayer, an optimistic note is struck in the subject of the inductive interference of electric light and power circuits with telephone lines. The increasing complexity of this problem has brought about extensive investigation and has led to closer co-operation between the engineers of the telephone company on the one hand and the engineers of electric companies on the other. Frequently, the report says, the interferences produced on the telephone lines are not caused by currents actually needed for the operation of the power and electric light circuits, but are caused by currents which are incidentally produced by the generators and are not essential. By co-operation with manufacturers and users of power apparatus it is expected that improvements in the design of such machinery will be brought about that will greatly reduce the interruptions to telephone service.

While for a number of years it has been practicable to talk by long-distance telephone between all of the principal centers of the United States, the improved means of voice transmission that have now been perfected will make it possible to include satisfactorily many small points tributary to those centers, as well as to render conversation between New York and San Francisco, for instance, as easy and as distinct as that now carried on between New York and Boston.

Intensive development work has been applied to the problem of economy in cables. Those placed as late as 1916 for long-distance circuits contained 320 lb. of copper per mile. Today better transmission can be given over circuits containing only 80 lb. of copper per mile.

The report declares that the actions of the rate controlling bodies have with few exceptions been acceptable to the company, and that it is becoming more clearly understood that the best of rates for a utility which in order to give service must extend with the growth of the community is the return which will attract capital, economy and efficiency being assumed.

The period of federal control is said to have made no change in the organization, the methods or the personnel of the company, nor did the return of the lines involve any such change. The greatest loss from war conditions was the disappearance of margins for plant growth and reserves of men and women in training. Unavoidably the service, particularly in congested centers, has been impaired.

The total income of the Bell telephone system in the United States for 1919, including government compensation, was $79,650,186, leaving, after the deduction of interest and dividends, undivided profits of $12,117,638. The department of development and research during the year prosecuted work upon more than 500 improvements in the act.

The sales of the Western Electric Company aggregated $135,000,000, of which $70,000,000 were to the associated Bell companies and $65,000,000 to other customers, the decrease of $10,000,000 as compared with 1918 being entirely attributable to the cessation of government requirements.

Heads for New N. E. L. A. Departments Appointed

REORGANIZATION plans at the National Electric Light Association headquarters, intended to increase and better the service rendered member companies, have been furthered by the addition to the staff of Fred W. Herbert as superintendent of the service department and George F. Oxley as director of the publicity department. Both are from the West, where Mr. Herbert was chief statistician for the Colorado Public Utilities Commission, and Mr. Oxley manager of the Mountain Division of the American Red Cross.

FRED W. HERBERT

GEORGE F. OXLEY

Mr. Herbert, who is a trained accountant with practical rate experience, has been closely associated with state regulation, accounting and statistical work. Prior to his association with the Colorado commission five years ago he was connected with Western utilities for many years as secretary and auditor. While with the commission Mr. Herbert drafted the uniform classification of accounts for public utilities in Colorado, which has been extensively copied, by other utility commissions. Among other matters he will assist in promulgating and interpreting the uniform classification of accounts established by the association and have charge of rate research and general statistical service for member companies.

Mr. Oxley's work, as director of publicity, will supplement that of the committee on public information and the advertising and publicity service bureau, and will comprise supervision of the association's monthly *Bulletin*, the promulgation of a plan of national publicity in the interests of the electrical industry and the organization of public information work throughout the country. Mr. Oxley, who has had a wide newspaper experience in many parts of the country, was for two years secretary of a Western utilities commission, resigning just prior to the entrance of the United States into the war to become a national organizer for the American Red Cross, and subsequently becoming associate manager and then manager of the Mountain Division.

National Popularization of Lighting Proposed

METHODS for increasing the membership of the Illuminating Engineering Society are being discussed, and as a part of this effort it was proposed this week to popularize good lighting through the establishment of a "National Lighting Week." A committee is being brought together to consider this proposal and make recommendations.

The society now has twelve hundred members, and President Doane, who sees a long way ahead for the society, feels that a membership far in excess of that now on the books should be attained.

Among the plans for increased membership is a provision for affiliated members with a small enrollment fee. "Affiliates" may participate in meetings and present papers but will not have any of the voting privileges of members or be eligible for office.

Utility Buys War Plant at 40 Per Cent of Cost of Material

THAT plans can be devised for utilizing most of the industrial plants built by the government during the war is strikingly illustrated by the sale of the power plant of the picric-acid factory built near Little Rock, Ark. The power plant has been purchased by the Arkansas Power & Light Company to make possible the operation of large pumping operations to be used in connection with rice irrigation.

The contract contains a clause which requires the purchaser of the power plant to furnish power to the other units of the establishment, which are to be sold separately. Assured of power and water supply, negotiations which promise to terminate favorably already are under way.

The power plant was sold for $235,000. It is rated at 1,000 kw. and was constructed with a view of permitting its capacity to be tripled. The selling price represents 40 per cent of the cost of the material to the government. Owing to the speed with which it was necessary to assemble this material its cost was particularly high. The total cost of the plant to the government was $6,700,000. The highest bid for the whole plant was $500,000. made by the Everly M. Davis Chemical Corporation, which had in mind the establishment of a large fertilizer activity.

The sale of this plant has also demonstrated that the Director of Sales is not so bound around with red tape as to prevent prompt negotiation. H. C. Couch, the president of the Arkansas Power & Light Company, arrived in Washington on a Friday with the proposition to lease the power plant. As the Director of Sales could not entertain a leasing proposal an outright sale was negotiated, and on the following Tuesday Mr. Couch was on his way back to Arkansas with the signed contract in his pocket.

Incidentally the plant is to play a part in the remarkable development of the rice industry in the Little Rock area. It will furnish the power needs for 1,000 square miles of rice land.

Major William L. Browning, chief of the plant facilities section, represented the Director of Sales in conducting the details of the negotiation.

New England Jobbers Organize to Better Trade Conditions

AN IMPORTANT step forward in co-operation with other branches of the industry has been taken in the formation of the New England Electrical Supply Jobbers' Club, of which W. F. Abely, assistant manager Western Electric Company, New England branch, has been elected chaiman, and Almon Foster, of the Foster-McDonald Company, Boston, secretary. Through conferences looking toward a betterment of conditions among jobbers, contractor-dealers and central stations in New England it is planned to secure harmonious and constructive working on the part of these interests in the electrical field. The following committee has been appointed to confer with contractor-dealers: W. F. Abely, Frank S. Price, F. S. Hardy, E. C. Lewis and H. M. Savage. On behalf of the Boston district of the Massachusetts State Association of Electrical Contractors and Dealers, F. A. Foresman, Newton Center, Mass.; George B. Quinby, state chairman, and James S. Safford, Boston, have been named a committee to confer with the jobbers' representatives, and in the near future a committee from the New England Section of the National Electric Light Association will be named.

Unauthorized Importation of Energy by Industrial Company Forbidden

AN INDUSTRIAL company without specific legal authority cannot, in the opinion of the Connecticut Public Utilities Commission, construct a transmission line for the importation of energy from another state over and across public highways, semi-public rights-of-way and along an acquired right-of-way. The commission recently reached this conclusion in the petition of the Grosvenordale Company, which desired to erect a 66,000-volt transmission about 3 miles long from the company's plant in the town of Thompson to the Massachusetts state line, to take energy from the New England Power Company's system. The Putnam Light & Power Company, which serves the territory through which the proposed line would pass, opposed the petition. The commission pointed out in its decision that its general jurisdiction over electric service companies includes jurisdiction over the method of construction of every system used for the transmission of electricity, whether owned by a public service corporation or otherwise. The method of construction, however, was not called in question, the main issue being the right of the petitioner to build and operate such a line.

It was suggested at the hearing but not pressed by the petitioner that the jurisdiction of the commission in this case was confined solely to the method of construction and that as an administrative tribunal it had no jurisdiction to determine the charter or legal rights of a non-utility company making application under the statute for an approval or designation of the method of construction. The commission maintains that it has authority to pass upon these rights, especially in view of the claims presented by the Putnam company; it points out that the petitioner offered no proof of its authority to build the line in question, and holds that the location, construction and utilization of the proposed line by the petitioner, in the absence of specific legal authority so to act, would constitute a violation of the state laws. The petition was therefore denied. This assertion of the broad powers of the commission is regarded as highly significant and gratifying by the public utility interests of Connecticut, in view of the protection it establishes.

Electrical Appliances to Be Featured in Commodity Advertising

THE general commodity advertisers, division of the N. E. L. A., which was recently organized to present to advertisers of general commodities the advantages of featuring electrical appliances in the background of their advertising displays when featuring household equipment, has presented a report outlining the work that the committee has done to date. The report reads in part as follows:

> For the purpose of interesting, influencing and assisting the advertising agencies, we have proceeded to prepare a portfolio of illustrations of electrical appliances, to be furnished on request to any advertising agency—that is, providing copy for a general commodity advertiser whose product might be shown in combination with an electrical appliance. Also for the purpose of securing the attention of the manufacturers of general commodities themselves, so that they will give thought to the featuring of more modern background pictures in their popular display advertising, the membership of the division has been organized to maintain a personal contact direct with manufacturers whose advertisements seem to offer opportunities to effectively introduce pictures of electrical appliances and with their advertising agents. A list of 56 of the most widely read and influential popular and general magazines has been prepared, and apportioned among the members of the division.

The committee having this work in charge is made up as follows: Howard Angus, California Electric Co-operation Campaign, San Francisco, Cal.; W. S. Byrne, Nebraska Power Company, Omaha, Neb.; Brinton Carrigan, assistant to vice-president, Brokaw-Eden Company, New York City; T. J. McManis, Edison Lamp Works, Harrison, N. J.; J. P. MacSweeney, Rochester (N. Y.) Railway & Light Company; W. H. Wells, Brooklyn (N. Y.) Edison Company; L. S. Gillham, Utah Power & Light Company, Salt Lake City, Utah; A. H. Orr, Southern Public Utilities Company, Anderson, S. C.; Dorsey Smith, Consolidated Gas, Electric Light & Power Company, Baltimore, Md.; C. E. Smock, Eureka Vacuum Cleaner Company, Detroit, Mich.; F. Neumuller, United Electric Light & Power Company, New York; and Earl E. Whitehorne, chairman, representing McGraw-Hill Company, New York.

Million and a half Dollar Municipal Plant for Lansing, Mich.

A RESOLUTION has been unanimously adopted by the city council of Lansing, Mich., providing for the expenditure of $140,000 for extensions to and maintenance of the city's two power plants, and for the expenditure of $1,500,000 for a new station near the city limits. It is believed that an expenditure of $140,000 must be made on the existing plant to carry the city's electrical load through the year 1920, while the new station will carry the load beyond that period. The present two stations are meeting a daily maximum demand of about 9,500 kw., and while the stations have a total generator rating of 14,500 kw., the condition of the boilers in the two plants is said to be such that the two plants are turning out virtually all they can under the present conditions.

Safety in Disposing of Surplus Power

THE acquisition of the Connecticut Power Company by the Hartford Electric Light Company will be approved by the Public Utilities Commission of Connecticut, Chairman Higgins of that board announced at the close of a hearing upon the matter on Feb. 25 in Hartford. There was no opposition. Samuel Ferguson, vice-president of the Hartford company, and M. L. Sperry, manager of the Connecticut Power Company, New London, appeared before the commission. Mr. Ferguson touched briefly upon the benefits of interconnection in addressing the board, speaking in part as follows:

"The fundamental reason which makes this a desirable transaction is the need of Connecticut industries to be in a position to compete with the Middle West, which is nearer the coal fields. For Hartford industries that means building as large and efficient a plant as possible to get maximum economy—a plant larger than Hartford alone can supply with sufficient load. Maximum plant efficiency means selling the capacity that Hartford cannot use, selling it wholesale to other communities in the state, and the most convenient vehicle is the Connecticut Power Company, with which the Hartford company has in the past had a contract for the sale of power. Business could be more advantageously developed through direct ownership than through contractual relations because the Hartford company feels it unsafe financially to build a large station and to depend on a contract as the method of distributing power outside Hartford."

During the hearing it was brought out that the Falls Village hydro-electric plant of the Connecticut Power Company yields from 2000 kw. during the three low-water months of the summer to 9000 kw. in spring. About 90 miles of 66,000-volt transmission line fall under the Hartford company's control, and reference has previously been made in the ELECTRICAL WORLD to the company's intention to build a new 66,000-volt trunk line fom the Hartford district to connect with the Eastern Connecticut Power Company's system at New London. Without hydro-electric and interconnected energy supply, it was stated at the hearing, the city of Bristol, Conn., would now be hard hit.

Brooklyn Edison Ten-Year Issues

THE Brooklyn Edison Company, Inc., is issuing $3,000,000 general mortgage 6 per cent gold bonds due Jan. 1, 1930. These bonds, which are being placed on the market at 92¾ and interest, yielding over 7 per cent, are secured by a mortgage on all of the company's real and personal property.

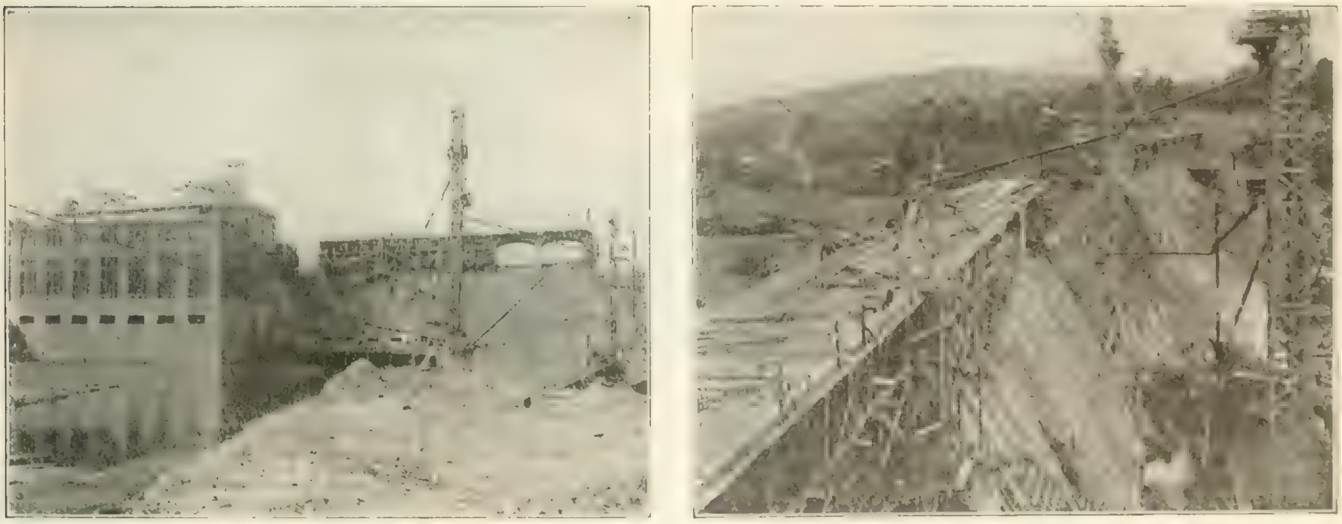
The proceeds of this issue will be used to reimburse the company in part for expenditures which have been made for the acquisition of property and for extensions and improvements to its plant and facilities. As a result of this financing, the company, President M. S. Sloane states, will be provided with adequate working capital, and with funds for expansion and development.

To Study Interior Lighting Effects

WHILE the work of the Illuminating Engineering Society has up to the present been of an engineering nature, its efforts being devoted to increasing the efficiency of lighting, either as regards the illuminant or the illumination, the necessity for directing thought in the field of artistic lighting, where the effect is the main thing to be considered, is now recognized.

To undertake this work the society has instituted a new committee in artistic treatment of interior lighting. Samuel G. Hibben, Westinghouse Lamp Company, has been appointed chairman, with authority to select the other members.

Dam and Hydro-Electric Plant of Connecticut Light & Power Company



The dam of the Connecticut Light & Power Company at Stevenson, Conn., has raised the normal water level of the river from a stage of about 35 ft. (10 m.) to 100.25 ft. (32 m.) and will back up the water for 10 miles. The reservoir lake behind the dam has a capacity of 1,500,000 cu.ft. (42,000 cu.m.). The height from foundation to crest is 125 ft. (40 m.), and the length is 1,200 ft. (384 m.).

The hydro-electric plant under construction at Stevenson, which is on the Housatonic River, between Oxford and Monroe, will have an ultimate installation of 10,000 hp. in generating units. The voltage will be 6,600 stepped up to 66,000 for transmission to Waterbury, 20 miles (32 km.) distant, from which point further distribution will take place. The plant will also supply New Britain, Naugatuck, Beacon Falls, Seymour, Cheshire and Southington, and a transmission line to Danbury is being erected.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Twenty-four Thousand Miles of Copper Wire Strung in Six Months.—Since August, 1919, the Mackay Companies have strung almost 24,000 miles, or 5,000,000 pounds, of new copper wire between the commercial centers of the United States. Though this has been brought about by expansion in telegraph business, the wires are available for long-distance telephone service as well

Large New Unit for Springfield, Mass.—The United Electric Light Company of Springfield, Mass., will seek permission to issue $800,000 additional capital stock for the purchase of a 25,000-kva. steam-turbine unit, the erection of a 10,000-kva. substation in the northern portion of the city and other improvements. It is proposed to issue 8,000 shares, increasing the total capital stock from $2,400,000 to $3,200,000.

New York Electrical Show.—George F. Parker, general manager of the New York Electrical Show, announces that the 1920 exposition will be held at the Grand Central Palace from Oct. 6 to Oct. 16. Already virtually all the main floor space has been reserved, and reservations are being made on the second and third floors, where an industrial display will be made which will include electric spot welders at work and electric trucks in operation. Electric appliances for the home and the office will also, as usual, be a feature.

Capital for Cleveland Company.—The Cleveland (Ohio) Electric Illuminating Company has been authorized to increase its capitalization from $18,000,000 to $50,000,000. At present the company has outstanding $9,763,500 of common stock and $800,000 of 6 per cent preferred stock, not having issued all the $18,000,000 authorized. The officers of the company state that only $3,000,000 of the increased stock will be offered for sale at this time. This will be 7 per cent preferred stock, the proceeds from which will be used in the company's regular expansion program.

Reorganization of California-Oregon Power Company.—The California-Oregon Power Company is to be reorganized by a stockholders' committee of eleven. Since July, 1915, when lack of earnings made necessary the suspension of coupon payments, the efforts of the management have been devoted to improving the property and increasing the earnings. Savings on interest account, together with assessments amounting to $6.30 per share of common stock, have made this possible. It is pointed out that any plan of reorganization must contemplate a reduction of the bonded indebtedness.

Hydro-Electric Power in California.—The State Water Commission of California announces that in the last six months of 1919 applications were received for permits to divert water to generate 2,103,000 theoretical horsepower, largely on streams tributary to the San Joaquin Valley. This is estimated to be 26 per cent of the maximum ultimate hydro-electric power development of the state.

Another Unusual Application.—The electric mangle was, of course, devised for use in laundries, but the California Walnut Growers' Association has found that it can be used successfully to rid walnut sacks of the codling moths which infest them. The mangle has a twofold action on the moth cocoons and larvæ. The mangle roll exerts a pressure of 200 lb. on the sacks, and in addition they are pressed against the hot shoe, which is maintained at a temperature of 700 deg. Thus the larvæ are both crushed and cooked.

Military Engineers to Have Society.—A national association of present and former officers of engineers and civilian engineers who have served in any branch of the United States Army, to be called the Society of American Military Engineers, is being organized in Washington with the approval of the Chief of Staff and under the direction of a committee appointed by the Chief of Engineers. The society's objects are to promote the science of military engineering and to foster the co-operation of all arms and branches of the service and of civilian engineers in that science. Dues are not to exceed $5 a year.

Portable Generating Plant in Turpentine Fields.—One of the great variety of uses for electric plants of the portable type is illustrated here. The outfit shown is rated at 4 kw., 60-110 volts, and is used to operate large drills for boring tree stumps for dynamite charges in cut-over lands that are being worked by the Yaryan Rosin & Turpentine Company of Brunswick, Ga. The plant was manufactured by the Universal Motor Company of Oshkosh, Wis.

Wireless in China and Japan.—*Ohm*, a Japanese electrical paper published at Tokio, complains that the Japanese wireless system is inadequate and costly and asserts that they do those things better in China, where, it says, business men can communicate with Europe and America with the utmost promptness.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Illuminating Engineering Society, New York Section.—"The Electric Lighting of Railroad Signals" will be discussed by F S. Stallknecht and L. C. Porter and "The Development of Electric Sign Lighting" by E. A. Mills at the March meeting of this section next Thursday evening in the Engineering Society Building.

A. I. and S. E. E., Philadelphia Section.—As previously announced, Walter C. Kennedy, operating engineer of the Worth Steel Company, Claymore, Del., will discuss the control of blooming-mill tables and screw-downs before this section of the Iron and Steel Association tonight.

A. I. and S. E. E., Pittsburgh Section.—On March 20 T. D. Lynch, research engineer with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., will present a paper on "Babbitt and Babbitting" at the meeting of this section of the Association of Iron and Steel Electrical Engineers.

Pennsylvania State Association of Electrical Contractors and Dealers.—The annual meeting of this association is now definitely scheduled to be held in Erie, Wednesday, March 10, with headquarters at the Hotel Lawrence. A meeting of the executive committee is called for 10 a. m., followed by a "noonday acquaintanceship luncheon," a trip through the plant of the General Electric Company and a business session in the afternoon. There will be a dinner at 7 p. m., all branches of the electrical industry being invited.

Wisconsin Electrical Association.—The Wisconsin Electrical Association will meet at Milwaukee on March 23, 24 and 25. The following program has been arranged: "The Relations of the Central Station to the Public," by M. H. Aylesworth, executive assistant to the president of the National Electric Light Association; "Cost Reproduction Less Depreciation," by Paul Stark, district auditor of the Eastern Wisconsin Electric Company, Sheboygan; "Possibilities of City Street-Car Operation," by E. M. Walker, general manager Terre Haute, Indianapolis & Eastern Traction Company, Terre Haute, Ind.; "Development of Small Water Powers in Wisconsin," by E. L. Hinchcliff, district superintendent Ashland Light, Power & Street Railway Company; "Development of Automatic Substation Equipment," by a representative of the Westinghouse Electric & Manufacturing Company; report of committee on extension of rural lines. E. J. Pulliam, Milwaukee, is secretary-treasurer.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Right to File New Rate Schedule.—In the matter of a complaint by the city of New Castle against the Mahoning & Shenango Railway & Light Company, the Pennsylvania Public Service Commission has determined that a public utility whose rates have been declared to be just and reasonable by the commission cannot thereafter within a period of three years file a schedule of increased rates without the consent of the commission.

Validity of Security Issues.—Complaint of false and misleading statements regarding the issuance of certain public utility securities having been made to the Pennsylvania Public Service Commission, that body found: (1) that it was improper to state that the securities had been approved by the commission when under the statute no such approval was required or could be granted; (2) that there is not such a variance between the statement in an advertisement as to securities that the proceeds would be used to increase the capacity of the plant and the statement in the certificate of notification that the issue was to provide funds to pay accounts and bills and for improvements, betterments, additions and extensions and the acquisition of property, and for working capital and other capital expenditures, as to invalidate the issue.

Free Utility Service Illegal.—In case brought by municipalities in [illegible] northwestern part of the state ag[illegible] the United Natural Gas Compa[illegible] cause of its refusal to render fre[illegible] ice or reduce the charges below [illegible] lished rates, the Public Service [illegible] mission of Pennsylvania has [illegible] down a broad decision applica[illegible] electric, gas and other utilities thr[illegible] out the state. The company is up[illegible] in its refusal to furnish service un[illegible] the conditions noted, free service to [illegible] municipality by a public utility being [illegible] declared to bring about an unjust discrimination against other patrons and to be prohibited by the public utility act of 1913. The decision sets forth that "many practices which were permitted prior to Jan. 1, 1914, are no longer permissible. The property of every public utility in the state must be considered from the viewpoint that it has been removed from the domain of private property and set aside for public service; that it has been impressed with a trust character and no longer has the right to make speculative profits. It must be content with earnings as restricted by law. Its property is set aside for public service. All service rendered must be paid for according to the law; if service is furnished to a municipality free of cost or at a reduced rate, it necessarily must be paid for by some one, and the burden of its cost is imposed upon other shoulders and is therefore violative of the public service law."

Charging for Expenses Incurred in Disconnecting Delinquent Customer.—The Public Service Commission of the State of New York, Second District, has refused to approve a charge of $25 made by a gas company for restoring service to a delinquent customer who declined to permit the removal of his meter. The charge was made to cover the expense involved in digging up the street to disconnect the service and then to restore it again. The commission held that the company could have forced entrance to the customer's premises through an order from the courts and therefore cannot, under the statute, force him to pay the expense incurred by following a course of its own.

Fixing the Basis for Rates.—In permitting a rate of $2 per 1,000 cu.ft. for gas to the Bath Electric & Gas Light Company, which was deprived of its market for electrical energy by the establishment of a municipal plant, the New York Public Service Commission, Second District, said: "While this company is entitled to a reasonable return on the value of its property used in the public service, the public is entitled to have the company keep the property up to date and to expend a reasonable amount for renewals and replacements. A fair amount to set aside annually for this purpose for this company would be 2½ per cent on its fixed capital." The rates fixed by the commission are declared to be not "over-compensatory," although "they are so high as to restrict what should be the full normal use of such a utility to the public it serves, and show that the high-water mark, from a practical standpoint, has been reached if not already passed."

Practice on Temporary Rates.—The practice of one public utilities commission in regard to temporary war rates is as follows: At the hearings on the applications to continue certain of these temporary rates it develops that the rates are in some cases not bringing a return so great as the commission has fixed in certain instances and that there is no return to the utility for certain isolated towns. In those cases it is the policy to allow the rates to continue in effect pending objection from consumers, when the burden of proof as to their reasonableness is placed on the company. In some other cases where the record is not entirely satisfactory it has been the commission's policy to make the rates effective for a definite period, the idea being that at the expiration of this period facts absent from the original record may be brought out. There are also other cases in which it appears that the rate of return to the company is at least as high as the commission has authorized in previous cases, and these rates are continued.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Condemnation Proceedings Before Jury.—In Dallas Power & Light Company vs. Edwards, the Court of Civil Appeals of Texas held that incorrect charges as to the measure of damages in proceedings to condemn ground for a transmission-line tower, improper testimony, or other irregularities such as an authorized statement of a juror as to value, when such matters affect only the amount of the verdict, are not ground for reversal in the absence of any claim that the verdict is excessive. (216 S. W. 910.)

Utility Control Over Municipal Lighting Plants.—In the case of the Springfield Gas & Electric Company vs. the city of Springfield, the Illinois Supreme Court has handed down a decision to the general effect that the Public Utilities Commission of the state has no control over municipal lighting plants. The decision, which affects about fifty cities of the State, sustains a decision of the Sangamon County Court which refused an injunction to compel the Springfield plant to operate under the orders of the commission.

Responsibility for Strength of Poles.—The death of one riding in an automobile from collision with a rotten pole belonging to a power company which broke and caused his electrocution was not ascribable to the company's negligence if the pole was in a condition to withstand ordinary strain and safe from ordinary danger of collision and if its failure was caused by unusual circumstances which the company was not called on to anticipate and could not control. (186 P. 160.)

Two Principles Established by United States Supreme Court in Case Affecting Commissions' Powers.—In the case of Napa Valley Electric Company vs. the Board of Railroad Commissioners of the State of California, the Supreme Court of the United States ruled that the clauses of the federal Constitution which forbid state legislation affecting the validity of contracts cannot be invoked to prevent a commission from establishing wholesale rates other than those named in a contract with an electrical corporation inherited from a predecessor by a distributing company. The point raised by the attorneys for the appellant that in denying the company's petition for a preliminary writ the district court did not adjudicate the controversy as required by law was also declared without merit by the Supreme Court, which sustained the authority of a court to determine on the face of a pleading what action should be taken. (40 S. C. R. 174.)

Robert N. Hodgson has recently resigned as general manager of the Binghamton (N. Y.) Light, Heat & Power Company and as general sales manager of the W. S. Barstow Management Association, which controls the former company, to devote his entire time to private business interests.

R. L. Peterman, heretofore superintendent of the Pennsylvania Utility Company at Easton, Pa., has been appointed general manager of the Binghamton (N. Y.) Light, Heat & Power Company to succeed Robert N. Hodgson, who has resigned to devote his entire time to private business interests.

Charles R. Wright, formerly with the Knoxville (Tenn.) Railway & Light Company, has purchased an interest in the Acme Electric Company, which does electrical contracting work and renders expert advice in electrical engineering. Mr. Wright has been connected with the Knoxville Railway & Light Company for the past thirteen years and for the latter part of this period has held the position of engineer in charge of the meter and arc light department. He will supervise the construction work of the Acme Electric Company.

Frank R. Fowles, who has been general manager of the York County Power & Light Company at Biddeford, Me., for several years, has been promoted to the position of assistant general manager of the Cumberland County Power & Light Company and will maintain headquarters at Portland, Me.

William E. Shaw, local manager of the York County Power & Light Company at Biddeford, Me., has been appointed superintendent of the electrical division, to take the place of Frank R. Fowles, who has been made assistant general manager of the Cumberland County Power & Light Company at Portland, Me.

Ralph E. Hawkes succeeds William W. Shaw as local manager of the York County Power & Light Company at Biddeford, Me. Mr. Shaw has been promoted to be superintendent of the electrical division.

L. L. Ferree, formerly general superintendent of the Harrisburg (Pa.) Light, Heat & Power Company, has been made general superintendent of the Salem (Pa.) Lighting Company.

John G. Felton, formerly connected with the gas and electric property at Charleston, S. C., has succeeded C. B. Yonts as manager for the Wisconsin-Minnesota Light & Power Company at La Crosse, Wis.

George Van Namee, secretary to Governor Smith of New York, has been named by the Governor to be Public Service Commissioner, Second District, for a term of five years to succeed Thomas F. Fennell, whose term expired on Feb. 1. Mr. Van Namee has been secretary to the Governor since the latter's inauguration a year ago. He was assistant clerk and clerk of the State Assembly in 1911 and clerk in 1913 and was later a member of the bill-drafting commission of the Legislature.

Men of the Industry

Changes in Personnel
and Position—
Biographical Notes

William J. Hammer, who has recently left the government service, in which he held the rank of major in the inventions section of the operations division, General Staff, and is about to resume practice in New York City as a consulting electrical engineer, has been elected president of the Edison Pioneers. Mr. Hammer was born in Pennsylvania in 1858 and in 1879 entered the employ of Thomas A. Edison at Menlo Park, devoting especial attention to the incandescent electric lamp. In 1881 he was sent abroad by Mr. Edison and became chief engineer of the En lish Edison Electric Light Company. association with E. H. Johnson, constructed the Holburn Viaduct ce tral electric light station in Lond Subsequently he was chief engineer the German Edison company. In 188 Mr. Hammer returned to America an was associated with Mr. Johns and Frank J. Sprague in the incorpor tion of the Sprague Electric Railway & Motor Company, of which he became secretary. Later he was general manager and chief engineer of the Edison Electric Illuminating Company of Boston and was instrumental in the notable growth of its plant and the rapid financial success of the company. Mr. Hammer was connected with many other important developments of early electrical days and was in charge of the extensive Edison exhibit at the Paris Exposition of 1889. His scientific activities have been extremely varied, and he has been an influential member of the chief electrical associations and numerous other technical bodies. In 1890 he opened an office in New York City as consulting electrical engineer, which he relinquished in June, 1918, to undertake for the government the important war duties to which allusion has already been made.

W. J. HAMMER

Herbert Laws Webb, a well-known Anglo-American telephone expert, has recently been in this country making a study of telephony here under post-war conditions, technical, political, financial and industrial, and some interesting articles may be expected from his pen in the English newspapers. During the war Mr. Webb was an officer in the aviation service in London, and just prior to the war he was actively connected with the installation of a great telephone system in Constantinople. Mr. Webb, who has just sailed for Europe, speaks highly of American telephony even in its early stages of recovery from governmental management.

Gerard Swope, president of the International General Electric Company, New York City, has been awarded the distinguished service medal for exceptionally meritorious service during the war. As one of the principal advisers and assistants to the Director of Purchase, Storage and Traffic, Mr. Swope accomplished the task of working out the detailed plan for bringing under one head the direction and supervision of procurement, storage and issue of all commodities and articles of equipment and supply needed for the army. It was due to his foresight and loyal co-operation that the procurement program for the great army of 1918 was successfully planned, and he assisted materially in carrying it into effect, thereby contributing directly to the success of the military program.

Obituary

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the aft**rge B. Fessenden**, an inventor of at 7 p. ical clocks and equipment, died industr17 at Allston, Mass.

Wis**C. Johnson**, who has recently died The Wa, was employed by the Common-will nth Edison Company, Chicago., as 24 asistant electrician at its Fiske and beeuarry Street stations from 1906 to Ce912. Upon leaving the Commonwealth A Edison Company he joined the sales forces of the Westinghouse Electric & Manufacturing Company. He was later general manager of the Southern Iowa Utilities Company.

Harold McGill Davis, who had held the position of advertising manager of the Sprague Electric Works of the General Electric Company since December, 1899, died at his home in Brooklyn, N. Y., on Feb. 9. Mr. Davis was born in Jerseyville, Ill., on Aug. 26, 1860, and entered the advertising profession in 1893 as a writer and designer. For four years he was advertising manager of a trade paper in New York. Afterward he became connected with an advertising agency, thus broadening his experience and fitting him for the position he held at the time of his death.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Manufacturers Believe Fixture Supply Will Be Worse

DEMAND exceeds supply in practically all lines of lighting fixtures. The greatest shortage, however, is in those lines which are used for home lighting as against lines which are more applicable for public buildings and industrial plants. The shortage is in general laid to the smaller amount of work per man-hour and to a shortage in the labor market. Many concerns are doubling the size of their factories, but this does not mean that they will double the output of their former plants because it seems unlikely that they will be able to secure enough labor to man the new additions completely.

During the past few months the influenza epidemic and a number of small strikes, such as the one which has affected the wood-working industry in New York, have made the situation more acute. It is the firm belief of manufacturers and distributers of fixtures that this situation will become worse before it becomes better because building will undoubtedly be more active in the spring than it has been during the winter. Deliveries of three months are being quoted on fixtures other than those of standard commercial designs, on which better deliveries prevail in most instances.

The price tendency is upward. This is easily understood when it is considered that fixture manufacturers must buy their glassware from four to six months ahead at prices which are uncertain. The delivery of chain is slow, and the price tendency is still upward in this material. Sheet steel and sheet brass are becoming so scarce that some manufacturers are paying bonuses for delivery of the stock they require.

Jobbers Still Dissatisfied with Government Payments

ELECTRICAL supply jobbers who have been accepting orders from the government are still very much dissatisfied with the methods of receiving, checking and payment which are being practiced. The government's agents, especially at the ports, are just as lax, or more so, in their system of handling this business as they were while the war was at its height. At that time the jobbers felt that by stretching several points they could endure under the stress of war necessity. But now, after more than a year of peace, they feel that it is an imposition to be called upon to make partial shipments, because it is virtually impossible to fill orders completely under present factory conditions, and wait for payment until the order is completed.

Not only this, but also they are required to go to the government's agents, check delivery receipts and frequently to open cases, in order to prove that the stated shipment was received intact. These receipts were frequently signed months ago, by watchmen who have since been discharged, and to all intents and purposes the goods had not been received.

The whole matter has and still is costing jobbers in New York much time, energy and money in thus checking up receipts and endeavoring to collect on back orders which have been shipped in full. The business is on a highly competitive basis and is not too profitable in any circumstances. Some long overdue accounts run as high as $50,000, and at least two jobbers have recently signified their intention of refusing further supply business from the government under existing methods of payment.

Appliance Demand Large Enough to Permit Separate Jobbing

WITHIN the past year or two the socket-device trade has grown to such an extent that an opportunity has presented itself for the development of an entirely new business in that line. The wholesale distributer of socket devices only has been the logical outgrowth of the extreme demand. There is apparently enough money in this wholesale distribution to cause two large electrical contractors in New York City to form entirely separate organizations to handle this class of business, and in Buffalo one electric company distributes only electrical household appliances. Anticipated business for 1920 is running to half millions and one millions in dollars.

As the industry has developed the distribution of specialized lines of electrical material has been found necessary, and it would not be surprising to find in a relatively short time that the distribution of this last line of socket devices had been broken up into still more specialized lines.

Electric Sheet Mill Capacity Booked Through June

STEEL mills are entirely booked upon electric sheets through the first half of the year. Where books were opened in November for the first half, the mills concerned had no difficulty in taking care of their capacity in a very short time. Where booking by the quarter is practiced, second-quarter capacity was contracted for in almost no time a few weeks ago, and in some districts a good part of it was done over the telephone.

Realizing that the demand was far ahead of the supply, the mills and their agents writing up second-quarter business first took care of their regular trade of long standing; and even these customers were not always able to secure sufficient sheets to supply their needs. District agents had only their allotment of mill capacity, and this in turn had to be allotted further. New customers and new manufacturers in the field were hard put to it to obtain material, but apparently jobbers held sufficient of the electric sheets to supply part of their needs anyway.

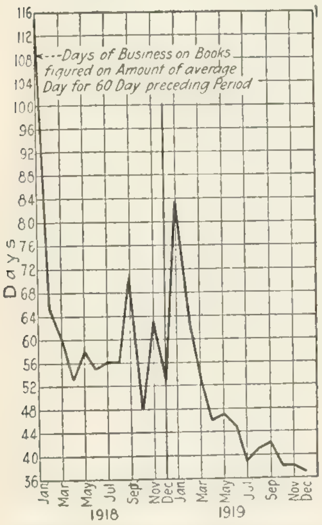
During the first quarter some customers bought heavily, really more than they would consume in that period, but they were a little ahead of the game when second quarter was allotted. Consequently some mills had small amounts extra that they could hand out, and these were eagerly snapped up by other than regular customers. In one case in point, where the mill agent offered one of these small lots to a rather new customer, the latter was in no hurry to take it. Two weeks later, when he wrote in for it he was much upset to learn that it had been gobbled up by another firm. That is merely one instance in which the nature of the market is shown. Electric sheets are not now being sold over the counter at the buyer's will.

Books for the second half year or for the third quarter are not yet open. Mills expect just as large a demand as that experienced over the first half year. Slightly better capacity will be available, it is reported. A loosening up of the labor market would place the industry on a still better basis. It is expected that orders may be placed along toward the end of April or early in May when the books will be open. Prices for the second half year will probably be higher than those quoted for the first half, while those for the third quarter are hardly expected to show much advance over those of the second quarter.

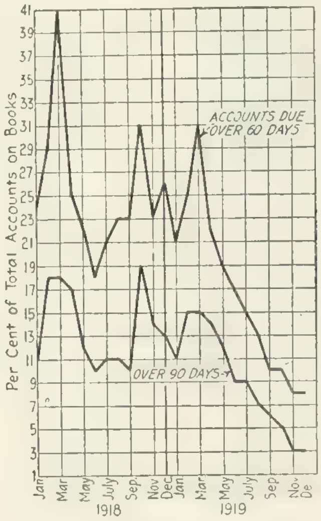
The foreign demand for sheets is heavy, but there is extremely little capacity set aside to serve it. In some cases there has been no allotment whatever set aside for this market. Actual orders are on hand for a considerable tonnage from European countries, but the mills have been unable to fill them and care for their regular domestic trade too. In some quarters this policy has been questioned because the good will which might be built up at this time might be very acceptable when the demand for sheets shall have decreased in the domestic market and a foreign outlet for an excess mill capacity be sought. It has been contended that small tonnages would materially help the foreign situation now and undoubtedly help the domestic mill in the future.

Collections Show Steady Improvement During Past Two Years

INVESTMENTS in receivables have shown a steady decrease during the years 1918 and 1919. The first curve shows the investment in receivables for one large Middle Western electrical supply house. It will be noted that in January, 1918, there was 115 days' business on the books, figured on the basis of the average daily business of the preceding sixty-day period. In January 1919 the outstanding accounts figured eighty-three days. This peak is accounted for by the increased billing in December of each year, so that the business may be included in that year. As a result the January accounts show up as a peak in the curve.



INVESTMENT IN RECEIVABLES



COLLECTIONS OVER TWO YEARS

Collections for these two years for this company are plotted in the second set of curves, where a continuous improvement is shown in the percentage of long period accounts. In December, 1918, 26 per cent of the total account had been due over sixty days and 13 per cent due over ninety days. By December of 1919 such a decided improvement was shown that only 8 per cent of the accounts had been due over sixty days and 3 per cent over ninety days.

The collections of this house are typical of other houses in the Middle West and are illustrative of business conditions at this time. The improvement shown is said to be due to several factors. Money has been very free during the past year, and there is a tendency to meet obligations promptly. In the second place, the present market favors the seller, who is able to choose his customers with more freedom. In other words, a credit man is more apt to turn down a dubious account when the volume of business is greater than his company can handle. A third reason is the increased efficiency of credit departments as well as sales departments. During the war period there was more or less disorganization of these departments, and the result was reflected in higher outstanding accounts and deferred payments.

Spring Buying of Line Hardware Opening Up Well

TO ALL appearances utilities are quite active in their preparations for line work this spring as orders for line hardware have been coming in in large amounts. Here and there, however, spots are found in the ordering where there is little or no work in course of preparation at this time. Throughout the South, West, and Middle West the buying has been more marked than in the East, although there has been considerable movement there too.

Shipments are of varying length of time, according to the class of material required. In the East, flats may be ordered from stocks acquired before the embargoes shut down shipments from the steel regions, and deliveries are being made in two to three weeks. Many brackets are coming through in three to four weeks, while some cannot be shipped for four to six weeks.

It seems that the rolling mills are devoting much of their effort on heavy sections, and this is given as a reason for a rather limited quantity of the light sections such as angles, channels, ovals and flats.

The latter part of last week some manufacturers advanced their prices of line hardware 10 per cent, and it is expected that those who have not already done so will follow suit any day. The tendency of steel products is upward, and mills are booked to the limit for months to come. One of the main causes for the shortage is given as the insufficient number of cars to carry coal to be coked, to carry raw materials to the mills and to remove finished products from the mill warehouses. Then, too, there is a shortage of labor not only in the steel mills but also at the coke ovens, so that it is improbable just now that a considerably greater amount of coal could be coked were there sufficient cars available to bring the coal in.

Canadian Jobbers Up Against Supply Shortage

CANADIAN jobbers are up against virtually the same situation as jobbers on this side of the boundary. The demand for electrical supplies is heavy in Canada, but the amount of material available is too low to satisfy it. Prices ruling in that country are slightly higher than those in the States, and jobbers are at times able to purchase certain materials from the States at a price lower than they can purchase them in Canada and sell at the latter's list price. An instance of this was in the wiring porcelain line where a jobber made more than 100 per cent on an item bought in the States where he would have made about 20 per cent on the Canadian product. This price included duty and the exchange rate, which at present is rather unfavorable to imports. It is true, however, that in this case Canadian factories are producing up to their capacity in porcelain and imports are merely helping to relieve the shortage in that line.

The rigid-conduit situation presents different aspects in different localities. In general, however, a shortage exists. In the Province of Quebec, for instance, there are fair amounts of ½-in. black conduit, and shipments into that territory are reported to be in good condition. The demand is holding strong. On the other hand, in Ontario the ruling of the Hydro-Electric Power Commission requiring residence feeders to be of No. 10 wire or larger, because of labor-saving devices and for mechanical reasons, precludes the use of conduit less than ¾ in. on the service side of the meter, because these wires cannot be pulled through ½-in. pipe. Consequently the call in this province is for ¾-in., 1-in. and 1½-in. pipe. This releases much ½-in. pipe to other fields but is keeping the supply of these larger sizes very low in Ontario. Shipments of 2-in. and larger are good. Four-inch round outlet boxes are also short in the market. Wire is plentiful. Lamp stocks are good in the regular tungsten and gas-filled types, but there is considerable demand for Moguls, and it is in this type that stocks are poor. A recent order for 200 300-watt Moguls could not be filled. The jobber supplied 100 adapters, all he had, and fitted these with Edison base lamps. But he feels that he will have to replace these adapters and lamps as soon as Moguls are available. It means double handling and used materials.

Jobbers are ordering for shorter periods ahead than they are doing in the States. They are booking their requirements of outlet boxes, locknuts and bushings, flexible armored conductor, conduit, heating devices and labor-saving devices only through the first half year, and sometimes July, and figure on being able to use every bit of material they can secure by that time.

Glassware Producers Expanding Their Foreign Trade

WHILE the illuminating glassware manufacturers of the United States are tremendously busy with orders at home, and while deliveries of illuminating glassware at present range from four months to six months, some of the shrewd business men in this industry are looking ahead to the time when glassware orders will not be so plentiful, and they are expanding their businesses into foreign cities. To spend money in developing new territory while profits from existing business are adequate is the theory on which they are operating. One concern is laying the foundation for an export trade in South and Central America, China, England and France. This concern, however, shows small disposition to sell in Japan.

At the same time importers are finding interesting situations in dealing with concerns abroad. Those who are buying German goods are having trouble with getting shipping space to carry their wares to the United States. This includes importation of fabrics and composition fixtures. On the other hand, importers who are buying the small artistic portable lamps from England are in some cases finding that the delivery on our eastern seaboard is more prompt from England than it is from factories within the United States.

Metal Market Situation

COPPER sales, which a week ago were rather encouraging, have decreased a bit. Producers are showing no anxiety over the situation because they know the big consumers, for the most part, are covered only through March and April, and they feel that the market must open again shortly. They are holding in general for 19 cents for March and April, but it is believed that this figure could be shaded on the approach of some large orders. Producers are not pressing the market.

The outside market, on the other hand, is looking for March shipments, and much copper is offered as low as 18.50 cents. Little domestic buying has resulted at this figure, however. On a large order it is doubtful if this market would sell under 18.75 cents. There is little buying in either market for deliveries after May. Large selling agencies say that copper production is more than cared for by sales already booked even if no more is sold between now and the first of May.

NEW YORK METAL MARKET PRICES

	— Feb. 24 —	— March 2 —
Copper	£ s d	£ s d
London, standard spot	121 0 0	119 7 6
	Cents per Pound	Cents per Pound
Prime Lake	19.25	19.00
Electrolytic	18.75 to 19.00	18.50
Casting	18.62½	18.37½
Wire base	22.25	22.25
Lead, trust price	9.00	9.00
Antimony	11.62½	11.62½
Nickel, ingot	43.00	43.00
Sheet zinc, f. o. b. smelter	12.50	12.50
Spelter, spot	9.35	9.10
Tin	64.25	63.50
Aluminum, 98 to 99 per cent	31.50 to 32.00	31.00 to 32.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.50 to 17.25	17.00 to 17.50
Brass, heavy	9.50 to 10.00	9.50 to 10.25
Brass, light	8.75 to 9.00	9.00 to 9.25
Lead, heavy	7.25 to 7.50	7.50 to 7.75
Zinc, old scrap	5.00 to 5.12½	5.00 to 5.25

THE WEEK

IN TRADE

FEBRUARY was an active or a quiet month for supply jobbers, depending on the locality affected. In New England and New York territories business has dropped off appreciably and is not likely to reach normal again until rail transportation is greatly improved. With demand off, because of cold weather, there is not so much drain on stocks, but stocks are hardly being replenished in quantities sufficient to satisfy the every-day run of present business. In the South and Midwest business has kept on in good volume, although stock are with difficulty maintained.

Embargoes have been lifted from the steel regions and from part of New England, and much steel material should soon be released from the former districts. Schedule material is already coming through in better shape from New England. Men in the steel industry are warning Middle Western customers to expect shortages more severe than those which now exist in steel sheets and wire. In addition to shortages formerly reported, there is a dearth of lighting fixtures, and contractors are experiencing especial difficulty in getting motors.

Price advances are reported in yellow-pine cross-arms, line hardware and Northern cedar poles. Building plans continue in a very satisfactory condition.

NEW YORK

Embargoes have been lifted from the steel regions and from New England, so it is probable that some relief is about due on supplies from those districts. Considerable steel is held up in transit, and stocks of outlet boxes and pipe are still extremely low. Car shortage is causing shipments to lengthen on such materials as line hardware and other steel products and is also holding down delivery of building supplies. Already better stocks of sockets and other brassware are reported, but the demand for these is increasing from fixture manufacturers.

Industrial installations of motors are off just a bit, but there is a good demand from that direction for lighting units. The motor market is badly depleted in stocks, and deliveries are not very encouraging. Ship repair work is active. The turbine demand is good and industrials are placing orders for units up to 5,000 kva. Line hardware sales are not quite up to snuff, and deliveries are about six to eight weeks.

The Building Trades Council called a walkout of union structural-steel workers employed on steel construction operations in New York City.

Flexible Armored Conductor.—The two-wire conductor situation is unchanged. There is some three-wire No. 14 available in fair amounts at $110 to $117.30 per 1,000 feet.

Rigid Conduit.—With the lifting of embargoes from steel districts the conduit situation will probably loosen up a bit. Around $80 is being quoted for ½-in. black and about $5 more for galvanized, although from some quarters the black can be secured for $75. Stocks are poor. Some quotations on 2½-in. galvanized range from $500 to $585 per 1,000 feet.

Lamps.—Stocks are spotty, shortages this week being reported in 25, 40, 60 and 100-watt sizes.

Reflectors.—Demand is getting better for steel R. L. M. reflectors, the favorite size being the 200-watt. Stocks are fair. Installations are running up into 800 units.

Flexible Non-Metallic Conduit.—There is much loom held up in transit while the amount available for the consumer, especially of ½-in., is small. Demand is off a bit because cold weather has put a brake on suburban building.

Schedule Material.—The New England territory has opened up for the movement of materials, and shipments of wiring materials are coming through in better shape. Socket stocks are better and demand for them for fixture work is especially active.

Lighting Fixtures.—Stocks of unit lighting fixtures are depleted. Emeralite fixtures, prices of which advanced in a range from five per cent to 30 per cent on Feb. 1, are especially low. Brascolites, which advanced about 10 per cent in February, are also short. Demand on these units is heavy.

Turbines.—Shipments are running along at about eight months under a demand which is keeping producing capacity at about full rate. Industrial units in capacities up to 5,000 kva. are in good demand. Price advances are expected from companies which have not recently made them.

Cross-Arms.—One company operating in the South raised prices 30 per cent last week on yellow pine arms. In this case shipments are virtually from stock.

Motors.—Local stocks of industrial sizes up to say 25 hp. are in extremely bad shape, and contractors are kept hustling to pick up sufficient for jobs coming through.

Line Hardware.—Prices went up Feb. 28 about 10 per cent. Shipments are about three to eight weeks under a demand which is somewhat below expectations at this time.

CHICAGO

February business showed a substantial increase over January due mainly to recovery from the usual decrease that follows the holidays. As compared with February, 1919, this year's business showed increases of from 50 to 100 per cent in the case of most jobbers. Shortage of conduit is very acute, especially in the smaller sizes. One jobber reported that he was unable to locate 1,000 ft. of ½-in. conduit in Chicago last week. Carload shipments that contain only 20,000 ft. of ½-in. conduit do not relieve the situation. Pole-line hardware, which jumped 10 per cent on Feb. 26, is very uncertain as to deliveries. Vacuum cleaners and washing machines are moving in excellent volume. Salesmen are reported to be bringing in orders by the hundreds for vacuum cleaners, and a carload of washing machines is apt to be sold out in a day. A loss of 12,000 wringers and 600 washing machines is reported in the destruction of a manufacturing plant by fire. The large stock of washers on hand was due to freight embargoes in that particular district. The loss of the wringers is a serious blow as there is an acute shortage of these. A considerable export business is reported in Brascolites. Wire prices have been holding stationary for some time. Building permits in Chicago for the week ending Feb. 28 amounted to $2,100,000.

Wire.—Stocks are in fair shape in both rubber-covered and weatherproof, and prices remain unchanged. A good demand is reported, and while no large quantities are on hand jobbers are able to keep up with the orders.

Conduit.—Deliveries are very uncertain in all sizes and stocks are extremely low, particularly in ½-in. Quotations range around $85.50 per 1,000 ft. for ½-in. black, $113.30 for ¾-in., and $167.50 for 1-inch.

Lamp Cord.—Prices on silk cords have been withdrawn, and there are practically no stocks on hand. Cotton-covered cords are also hard to obtain.

Poles.—Prices advanced on Northern cedar poles approximately 25 per cent this week. Stocks are fair, but the demand is growing heavier each week and shortages will soon be evident.

Cross-Arms.—New prices in effect after the advance of last week on Washington fir 3¼-in. x 4¼-in. arms are as follows: 3-ft. two-pin, $69.69; 4-ft. four-pin, $92.93; 6-ft. four and six pin, $139.39; 8-ft. six and eight-pin. $185.85, all in quantities of less than 1,000 linear feet. In lots of from 1,000 linear feet to carload lots the 3-ft. arm is quoted at $61.95, the 4-ft. at $81.60, the 6-ft. at $123.90 and the 8-ft. at $165.20.

Pole-Line Hardware.—An advance of 10 per cent, effective Feb. 26, has been announced. Deliveries are uncertain in all items.

Washing Machines.—The demand is very brisk, and jobbers are sold out in a number of cases. Prices have shown no change since early in January.

Vacuum Cleaners.—A large volume of business is reported with manufacturers far behind the demand. Delivery promises of six months to a year are becoming more frequent.

Lighting Fixtures.—There is a growing demand by farmers for industrial lighting fixtures for lighting farm buildings of all kinds.

Electric Signs.—Deliveries are on a basis of three months with a large volume of business on hand. Enameled-steel and raised-letter glass signs are at present undergoing a strong demand.

BOSTON

Railroad tie-ups and embargoes dominate the entire trade situation and the volume of business shows a decided falling off for the time being. Northern New England is practically snowbound as regards freight movement, and employees of industrial plants, students and volunteers are trying to dig out the railroads. It is likely to be two months before the efforts of present delivery stoppages are overcome in the electrical trade of the interior. Building contracts continue to increase. To Feb. 19 these totaled $50,671,000 for New England, against $8,901,000 for the same period last year. Stocks are being pulled down despite strenuous efforts to obtain shipments by water, parcel post, and express. Four thousand stalled cars were reported Sunday on the New Haven system alone. Collections are somewhat slow. Prices show stiffer tendencies in lead batteries, cross-arms, tape and rigid conduit. The influenza situation is greatly improved. An eight-hundred-thousand-dollar war memorial building is to be erected at Lowell, Mass., and an electrically driven textile mill to cost $4,500,000 is to be built at Somersworth, N. H., by the Great Falls Manufacturing Company.

Wire.—Stocks are fair, with steady demand. Rubber-covered, No. 14, sells for $16 per 1,000 ft. in less-than-coil lots and $13 in coil to 6,000-ft. lots. Weatherproof, triple-braid, No. 10, brings 57 cents per pound, and bare is quoted at 22¼ cents base f.o.b. factory, on No. 4/0 to No. 8.

Storage Batteries.—Stocks are being well maintained despite traffic delays. Lead batteries are stiffer in price. Garage activities have slowed down on account of the weather. Battery makers are overwhelmed with orders at the factories.

Fractional Motors.—The demand is tremendous. One New England factory which started to produce about 8,000 motors per month a year ago is now planning to turn out 60,000 per month as soon as possible. Washing-machine and vacuum-cleaner trade is buying heavily for many months in advance.

Flexible Armored Conductor.—Prices are steady at $98.50 per 1,000 ft. for No. 14 single-strip and $10 more for double-strip. Stocks are very low.

Non-Metallic Flexible Conduit.—Stocks are cleaned out in many cases. In coil to 1,000-ft. lots, 7/32 in. brings $37 per 1,000 ft., and ¼-in., $40. Such stocks as exist are being held for old customers.

Metallic Flexible Conduit.—Jobbers are asking list less 17 per cent, but stocks are practically wiped out.

Lamp Cord.—Silk cord is not available and cotton cord is running low. The latter is quoted, for No. 18, $26 per 1,000, in 500-ft. lots.

Fiber Conduit.—Stocks are in good shape. No. 3 socket joint brings about 12 cents per pound list with 17 per cent off at the factory. No sign of shortage in this material can be seen. Present demand is low.

Tape.—The ¾-in. black brings around 50 to 55 cents per pound with fair stocks. Firm prices are anticipated.

Cross-Arms.—Fir arms are up about 10 per cent.

Motors.—The supply seems to be going from bad to worse. Manufacturing facilities are taxed to the utmost. Prices are steady.

Metal Molding.—Prices on "Wiremold" are up 15 per cent to the jobber. Business is very active, and raw material is difficult to obtain.

ATLANTA

Reports indicate that business continues unabated despite poor weather conditions and considerable illness throughout the section. Jobbers express a feeling of optimism that while no immediate relief of the general material shortage is in sight there is little probability of its becoming more acute because factories have been reporting increases in production during the last sixty days. The shortage of stamped steel boxes has become acute, and contractors are salvaging all boxes that are usable, drawing on old stocks and having numerous boxes made by hand at the local metal-manufacturing plants. The demand for labor-saving devices continues brisk, running ahead of the supply.

The report of the Sixth Federal Reserve District for January shows that in twenty-four Southern cities there were 1,821 building permits issued valued at $5,380,000, while the statement for Atlanta for February shows building permits of approximately $1,000,000 value. The banks report deposits holding up well, in some cases increasing, and collections are good.

Conduit.—There has been no change in the conduit situation in the last thirty days. Jobbers will not attempt to predict when the present shortage will be relieved.

Armored Conductor.—Very poor stocks are reported throughout the territory, and of the small shipments received the quantities are not sufficient to meet the demands.

Flexible Metallic Conduit.—There has been a slight increase in the demand which has been promptly met as local stocks are in fair condition. Shipments are reported fair.

Wire.—Stocks of wire in the territory continue to hold up well in the face of fair shipments, although some shortage is felt in No. 6, No. 8 and No. 10. Jobbers are expecting a price advance on wire in the near future.

Lamp Cord.—An increase of 12 per cent in lamp cord has been registered. Stocks in the territory are very small and shipments are reported poor. Prices, $23 to $24 per 1,000 feet.

Porcelain.—Stocks are in miserable conditions, one of the largest jobbers reporting absolutely no tubes or knobs on hand. Poor shipments with no prospects of their being bettered seem to indicate a very acute condition in the near future.

Industrial Reflectors.—Industrial plant construction throughout the Southeast has caused the demand for steel reflectors to hold up well, as manufacturers had accumulated stocks of raw material. Shipments are reported to be in good condition.

Metal Molding.—The demand for this specialty is on the increase, owing to the substitution of metal molding for conduit in a number of places. As the adaptability of this article is more generally realized, jobbers predict an even greater activity. Shipments are reported fair with stocks in good condition.

Flashlights.—The popularity of flashlights continues, and jobbers report brisk movements in this line. Stocks are reported in good shape, with shipments holding up well.

SEATTLE—PORTLAND

Seattle jobbers and dealers as a whole are agreed that the month of February recorded a creditable gain in volume of sales of house-wiring devices, domestic appliances and small electrical equipment. Over the same month in 1919 an increase was noted in the sale of house-wiring devices, because of the daily increasing amount of new building occasioned by the exceptionally warm spring weather.

Millions of dollars' worth of construction work is on the boards of local architects, much of which has not been given publicity. Lumber interests recently announced a considerable cut in export prices, to remain in effect during spring and summer months, and lumbermen hope for an improvement in car conditions now that railroads are in the hands of their owners.

Schedule Materials.—The demand for house wiring and appurtenances, including bells, buzzers, switches, etc., is increasing daily, owing to the approach of spring and unexcelled weather. However, shipments from Eastern factories are not improving, and, generally speaking, stocks are not being replenished fast enough to avert a shortage in case the demand of the last two weeks continues. Prices are fluctuating somewhat, but no decided increase or decrease has been noted.

Ranges.—Demand from apartment-house owners and builders is showing continued increases. All types, as near as can be learned, are enjoying about equal popularity. However, demand from home owners has not yet been built up to what it was before recent price advances. Still, back orders are awaiting shipments from Eastern factories. The majority of local dealers predict a record year in range sales.

Washers.—Demand is increasing daily, and jobbers and dealers are having a hard time trying to maintain stocks. Prices show no particular change.

Lamps.—Trade in all types is still brisk, although a considerable decrease in sales of industrial types is noted. Part of this decrease is being absorbed in the Puget Sound district proper by increasing sales for new residence purposes. Demand from rural communities is considerably heavier than usual. Stocks are in good shape.

Motors.—Sales in fractional-horsepower motors are showing a slight increase, most of the demand coming from fruit, fish and vegetable canneries. Demand from lumber mills and larger industrial plants is showing satisfactory increase. Shipments are coming though very slowly and stocks are in an unsatisfactory condition.

SAN FRANCISCO

Generous rains have relieved the drought and have slowed up building to a certain extent. The previous drought coupled with the post-Christmas lull has made counter and store business rather dull, a condition which will probably prevail until April. It is reported as an evidence of building activity that 1,600 buildings, principally dwellings, are under construction in Fresno alone.

Lamps.—Lamp deliveries and agents' stocks are good. In some cases they have required vigorous pruning. The white Mazdas are selling a bit more slowly than previously, and now that deliveries have caught up with orders, further missionary work will be required. Exceedingly vigorous competition exists for contracts nearing their completion.

Porcelain.—There is a big demand, probably 30 per cent greater than last year, for standard knobs and tubes, and this call is generally distributed in the city and country. Cleats are slower. Prices are steady and stocks are fair. The former government demand for split insulators has practically ceased, because of the completion of certain lines, together with the adoption of new apparatus, the possible use of wireless equipment in the forests and the auxiliary aëroplane patrol.

Electric Signs.—The recently renewed activity in electric sign business, with its accessories, such as lamps and sockets, will probably be hurt by the low rainfall, which will necessitate a decrease in all lighting that is not absolutely necessary. The rains of the past week, however, have improved the situation.

Washing Machines.—Electric washing machines are now selling for $160 in the swinging-wringer style and $150 in the stationary-wringer style in the majority of standard makes. Various manufacturers in regular rotation have been short of stock, but delivery conditions are now better.

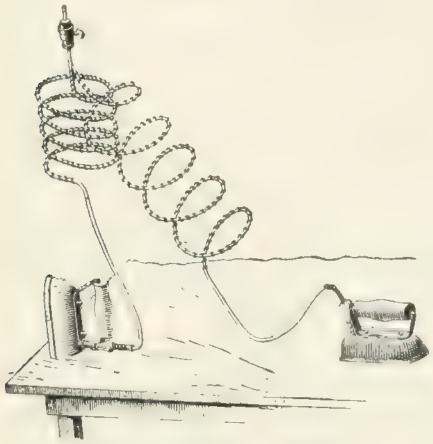
Ranges and Water Heaters.—The Great Western Power Company is staging a campaign over its system embracing lines through the north central portion of the state to San Francisco. The Hughes ranges will be standardized, and a 3-cent rate for ranges and a $2.50 flat rate for water heaters will be given. The Standard Oil Company intends to equip its new tankers with large ranges with a maximum demand of 22 kw.-hr. bake ovens, griddles and other large equipment.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Electric Cord Coiler

A piece of spring wire so fabricated that it will hold electric iron or telephone cord up and out of the way of the user is being marketed by D. C. Hughes & Company, Chicago, under the name of the "Elektro" electric cord coiler. The illustration shows how the spring holds the cord and prevents it from becoming twisted or interfering with the operation of the device.


KEEPS CORD OUT OF THE WAY

Precision Portable Potentiometer

A portable precision potentiometer to permit the measurement of all electromotive forces met with in pyrometry has been developed by the Brown Instrument Company, Philadelphia, Pa.

This instrument is also adapted for checking millivolt meters and potentiometers and measuring the voltage of thermocouples. A cadmium-sulphate cell having an unsaturated solution, a negligible temperature coefficient, and conforming with the recommendations and specifications of the Bureau of Standards, is supplied. These cells are aged by the makers before being sent out. The current for the main circuit is supplied by a dry battery. This potentiometer has a drum wire of 150 ohms resistance, and the total instrument's resistance for 50 millivolts is approximately 4,000 ohms. This is gradually reduced to a minimum of about 3,400 ohms when the dry cell is exhausted. A double-pivoted galvanometer is used with a guaranteed sensitivity of 2.8 megohms. The standard types are made for 25, 50, 75 and 100 millivolts full scale. Special ranges can be supplied up to 1 volt. The instrument weighs 14 lb. and measures 10¾ in. x 9 in. x 6½ in.

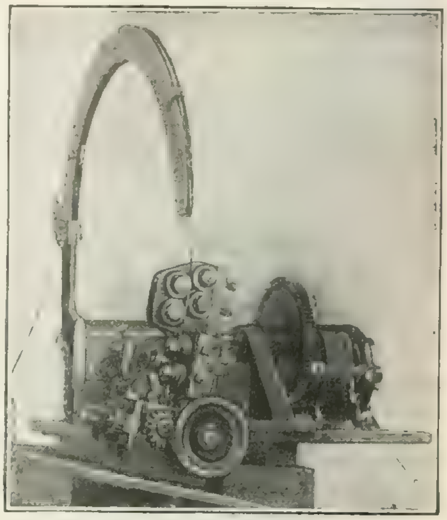
FOR USE IN PYROMETRY

Fan Constructed to Lessen Blade Humming

A new style of blade designed to eliminate as far as possible the metallic humming of fan motors is being furnished on the 16-in. fans, both alternating and direct current, of the Eck Dynamo Motor Company, Belleville, N. J. These blades have two pairs of symmetrical leaves which from the front look exactly like ordinary fans. They are mounted, however, on a spider or fan hub with a distance piece between the two pairs of leaves, so that when rotating they travel in two different planes. The effect, it is said, is to reduce considerably the blade humming. This innovation is confined to the 16-in. fans, because, the maker says, it is in that size that the humming is most objectionable.

Automatic Metal Feed for Arc Welding

A device for automatic arc welding designed to secure a more steady arc is soon to be put on the market by the General Electric Company, Schenectady, N. Y., for use with a regular welding set and to take the place of the hand-controlled electrode. It consists of a pair of rollers, called feed rolls, driven by a small direct-current motor, which deliver to the arc a steady supply of wire and automatically maintain a fixed working distance. The whole is controlled from a small panel. The welding head is held by a suitable support with a certain amount of hand-regulated adjustment and consists of a steel body carrying feed rolls and straightening rolls, both adjustable for various sizes of wire. Three gear ratios are obtainable. The control panel carries an ammeter and voltmeter for the welding circuit, as well as rheostats, a control relay and the contactors and switches for the feed motor. It is possible to start and stop by a pendant push button, but adjustment of the feed conditions must be made from the panel. The adjustment for arc conditions by regulation of the speed of the feed motor as the arc voltage varies is taken care of by the panel equipment. The whole apparatus is mounted on a base designed to be bolted to a support.


FEEDS WELDING METAL AT DIFFERENT SPEEDS

Washer with Centrifugal Wringer

A washing machine in which the clothes are dried by centrifugal force has been developed by the Home Utilities Company, 17 North State Street, Chicago. The washing is done by three suction cups which rise and fall, compressing and releasing the clothes. A gas heater keeps the water warm while washing. When washing is completed the water is drained and the clothes are dried by centrifugal action without removing from the machine. The capacity of the machine, which is known as the "Klymax vacuum washer," is eight sheets. It is equipped with a belt-connected ¼-hp. motor.

CENTRIFUGAL WRINGING UTILIZED

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE SUNBEAM ELECTRIC MANUFACTURING COMPANY, Evansville, Ind., has increased its capital stock from $250,000 to $275,000.

THE FLEXIBLE STEEL LACING COMPANY, Chicago, has announced plans for the building of a one story factory building, 200 ft. x 200 ft., on Polk Street, to cost $200,000. The greater part of the space will be used in the manufacture of the "Flexco-lox" lamp guard.

THE AUTOMATIC ELECTRIC FAUCET COMPANY, INC., has moved from San Francisco to 2927 Newbury Street, Berkeley, Cal.

H. E. STOCKER, who, for a number of years was production manager of the Fort Wayne Works of the General Electric Company, has become general manager of Roth Brothers & Company, motor manufacturers, 1400 West Adams Street, Chicago. For the twenty-three years preceding June, 1918, Mr. Stocker was connected with the General Electric Company. Starting with a grammar-school education, he entered the Lynn plant of the General Electric Company as an office boy and rose to positions of increasing responsibility until in 1916 he became production manager of the Fort Wayne plant. In June, 1918, he became general manager of the International Clay Machinery Company, Dayton, Ohio. Recently Roth Brothers & Company have developed their business into a wider field of motor application, and the addition of Mr. Stocker's abilities to this long-established organization will greatly supplement its strength. New facilities are being provided for the manufacture of a greater output.

H. E. STOCKER

THE MATERIAL HANDLING MACHINERY MANUFACTURERS ASSOCIATION at its annual meeting and convention in New York City on Feb. 26 and 27, elected to its board of governors for the coming year H. M. Standart of the Northern Engineering Works, D. V. Jenkins of the Watson Elevator Company, Roy Owens of the Lakewood Engineering Company, C. W. Miller of the Jeffrey Mfg. Company, W. H. Merrill of the Lamson Company, G. O. Helmstaedter of the Hyatt Roller Bearing Company and T. Robins of the Robins Belt Conveyor Company. The officers of the association will be elected by the board of governors at a later date.

WILLIAM M. ANDREW has resigned as general secretary of the Canadian Associated Manufacturers of Electrical Supplies and the Canadian Electrical Supply Jobbers' Association, and from the Ontario Association of Electrical Contractors and Dealers, in order to take up commercial and engineering work with a prominent American company. The two former associations were organized in March, 1919, and Mr. Andrew took up the work of general secretary in June. Since that time these two associations have made considerable progress and are accomplishing good results for co-operation and standardization. The best results obtained have been the better relations which exist between these two branches of the industry since their organization and also among the various individual firms inside both associations. Mr. Andrew is a native of Cincinnati, Ohio, and, after being graduated from the Massachusetts Institute of Technology, became associated with the General Electric Company, where his activities were directed chiefly in the electrification of railways. After a few years he left the General Electric Company to do electric railway development work with the Canadian Westinghouse Company, Ltd., of Hamilton, Canada, and for the past two years he has represented the Westinghouse interests in connection with great development of the Hydro-Electric Power Commission of Ontario, Canada.

FRANK BECKER of the department of standardizing and testing, Edison Electric Illuminating Company of Boston, Mass., has resigned to join the engineering staff of the Hygrade Lamp Company, Salem, Mass.

THE YARNALL-WARING COMPANY, Philadelphia, has opened a branch office in the Builders and Traders Exchange, Penobscot Building, Detroit, in charge of Walter G. Heacock, branch manager.

THE WOODFIELD-THOMPSON COMPANY has been formed for the purpose of engaging in electrical construction work, with offices at 801-03 Otis Building, Philadelphia.

THE WHEELER CONDENSER & ENGINEERING COMPANY, Carteret, N. J., has recently designed a vertically split casing of the tail pump for vertical jet and rectangular type counter-current condensers. The feature permits quick removal or inspection of the pump rotor or other internal part.

THE HURLEY MACHINE COMPANY, Chicago, has issued the first number of the *Hurley Message*, a house organ devoted to the sale of Hurley products.

CHARLES EISLER, has become consulting engineer and vice-president of the Newark Engineering & Tool Company, Newark, N. J., specializing on lamp machinery. Mr. Eisler for many years was connected with the Westinghouse Lamp Company.

THE ELECTRIC FURNACE COMPANY, Alliance, Ohio, has issued Vol. 1, No. 1, of the *Electric Furnace*, dated Jan. 1920. The journal is devoted to the development of the electric furnace industry. T. F. Baily is president, F. T. Cope is vice-president and R. F. Fletcher editor and advertising manager.

THE R. B. COREY COMPANY, INC., announces the removal of its office to 1170 Broadway, New York City. The warehouse will remain at 207 Fulton Street.

J. P. LAFFERTY has left the Chicago office of the Robbins & Myers Company to take charge of the St. Louis office of the same company succeeding J. F. Galvin, who has resigned to enter the motor-manufacturing business.

THE GREEN FUEL ECONOMIZER COMPANY, Beacon, N. Y., announces the opening of an office at 1006 Finance Building, Philadelphia. The office will be in charge of W. F. Wurster, assisted by G. E. Kille. The company was formerly represented in this territory by the Baker-Dunbar-Allen Company. Mr. Wurster has been doing engineering and sales department work with the Green Fuel Economizer Company for the last six years

THE EDISON ELECTRIC APPLIANCE COMPANY, Chicago, expects to have a downtown location on Lake Street by March 1. The additional quarters will provide 4,700 sq.ft. of floor space for a service station for dealers. The sales force will be moved to this location. Walter M. Fagan is district sales manager.

THE CONNECTICUT ELECTRIC MANUFACTURING COMPANY, Bridgeport, Conn., has opened a Chicago office at 431 South Dearborn Street, in charge of L. G. Cushing. A stock will be carried for the convenience of Middle Western dealers.

THE MAHER ENGINEERING COMPANY, 30 North Michigan Avenue, Chicago, announces the opening of a branch office at 708 Schofield Building, Cleveland, Ohio, to handle the distribution of Erie Engine Works engines, Dayton-Dowd Company, centrifugal pumps and Galland-Henning hydraulic presses. The office will be under the management of Lincoln E. Maher.

THE REFLECTOR & ILLUMINATING COMPANY, 565 West Washington Street, Chicago, James C. Herron, president, and Robert H. Davidson, secretary and treasurer, has purchased and taken over from Frederick A. Watkins, manufacturers sales agent, that portion of his business pertaining to the sales agency for reflectors manufactured by the Pittsburgh Reflector & Illuminating Company of Pittsburgh, Pa., and also the fixture equipment therefor made by him. Said purchase includes the account now standing in Mr. Watkins' name, and arrangements have been made so that it will be taken care of in due course of business by the purchasers named above.

CHANGES IN PERSONNEL AT SQUARE D COMPANY.—Several additions and changes in the sales and advertising departments of the Square D Company, Detroit, Mich., became effective Feb. 1. E. A. Printz, formerly district sales manager of the Chicago territory, was made sales manager, A. MacLachlan continuing as secretary and director of distribution. D. M. Stone, formerly district sales manager of the Pittsburgh territory, was made district sales manager of the Detroit territory. J. A. Jaques, formerly in charge of the New York territory as district sales manager, was given the district salesmanagership of the Pittsburgh territory, and H. W. Spahn, district sales manager of the Buffalo territory, was placed in charge of New York. D. H. Colcord, formerly of the department of publicity of the Westinghouse Air Brake Company of Pittsburgh, was appointed director of research engineering.

E. A. PRINTZ

THE COMBUSTION ENGINEERING CORPORATION, New York City, has enlarged its facilities for handling business in the Philadelphia territory. The office of the company in this territory is in the Lincoln Building, and W. C. Stripe, formerly of the Pittsburgh office and previously of the Westinghouse company, becomes manager of the Philadelphia district. Associated with him in that territory on the active selling force are C. L. Bachman, manager of the company's Chicago office before the war, and E. F. Kuehnle, formerly of the main office in New York.

THE DIXIE ELECTRICAL EQUIPMENT COMPANY has been organized in Atlanta, Ga., and announcement is made that it will handle exclusively the installation, construction, maintenance and repair work on telephone intercommunicating systems, automatic fire alarms, watchman's time detectors, and automatic code-calling devices. A special service department on a contract basis is one of the company's features.

CHICAGO FUSE MANUFACTURING COMPANY EXPANDS.—Arthur D. Dana.

president of the Chicago Fuse Manufacturing Company, announces the purchase from the Otis Elevator Company of the property at Fifteenth and Laflin Streets, Chicago, Ill. A two-story factory building, 140 ft. x 360 ft., with four-story office section, covers the entire property. William W. Merrill, vice-president and treasurer of the company, states that the business has entirely outgrown the present quarters on Congress and Morgan Streets, and that the facilities afforded at the new location will furnish an extremely well equipped plant. The building will be remodeled to meet the purchaser's needs, and the layout will be such, when completed, as to represent an investment of substantially $500,000. It is expected that the company's two plants on West Congress Street and South Troop Street will be transferred to the new location and be in operation by May 1.

THE BLACK & DECKER MANUFACTURING COMPANY, Baltimore, Md., announces that it has sold its South Calvert Street plant in Baltimore to the Dieffenbach-Westendorff Manufacturing Company, manufacturer of high-class special machinery, and will discontinue making special machinery in an endeavor to keep up with the demand for electro-flaters, portable electric drills and electric valve grinders.

THE PLANT ENGINEERING & EQUIPMENT COMPANY, INC., New York City, manufacturer of the Corliss Valve steam trap, Mason condensation meter and other power and heating specialties, announces the opening of its twenty-sixth office to care for the increasing demands for its products. M. W. Ehrlich, experienced in consulting and contracting engineering, will be the New Jersey manager in charge, with headquarters at Newark and a sub-office at Lyndhurst.

LOUIS BARNETT has become sales engineer with the Multiple Electric Products Company, Inc., New York City. He is a graduate of the Massachusetts Institute of Technology, '09, and for the last ten years has been associated with the American Sugar Refinery of Brooklyn as departmental engineer, where he has had varied experience with electrical apparatus.

Supply Jobbers' Notes

WALKER & BORDMAN, formerly with the Frank H. Stewart Electric Company, Philadelphia, have started a jobbing business at 15 South Seventh Street, Philadelphia.

ELECTRICAL CLUB MEETING.—The annual meeting of the Electrical Club of New York was held Feb. 3 at the Hotel Breslin, and the following officers were elected to carry on the administration work of the club during 1920: president,, J. L. Owen; vice-president, H. H. Kabat. The executive committee consists of the following: W. J. Drury, J. E. McClernon, Samuel Frost, J. D. Sweeney, P. J. McSweeney and W. A. Kennedy. The secretary-treasurer is W. J. Kreger, with offices in the Marbridge Building, 47 West Thirty-fourth Street.

Foreign Trade Notes

ELECTRICAL PORCELAIN PRODUCTION DEVELOPING IN JAPAN.—One of the newer developments in the pottery industry is the manufacture of electrical accessories in connection with the rapidly expanding electrical industry in Japan. The large high-tension insulators demanded by hydro-electric development are made both in large factories, such as the great Morimura plant at Nagoya, and also by small individual workshops (on sub-contracts) in villages. Smaller white porcelain goods, insulators, cleats, rosettes, etc., are for the most part manufactured in Japan in the households alongside of dolls and teapots. They are molded in plaster of paris molds, with a lavish expenditure of time and energy, from clay purchased ready for working, and are then fired in community kilns. With practically no overhead, such small manufacturers are able to compete successfully with modern factories. In fact, one large establishment which put in an insulator factory has been undercut in price by the small independent potters to such an extent that it has almost ceased to do business.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A dyeing establishment in France (No. 31,807) desires to secure a special electrical apparatus which verifies and controls during the night the colors dyed with aniline products, producing the same results obtained by sunlight.

An American firm (No. 31,814) having branches in Egypt and Greece desires to secure agencies for the sale in the Levant of electrical supplies.

A firm in Spain (No. 31,817) desires to secure agencies on commission for the sale of electrical materials.

A company in England (No. 31,859) desires to purchase motors for use in the construction of electric vehicles, in quantities of from five to twenty per week, sizes 4, 6 and 8 hp., and with voltage of 88 for lead batteries and 60 for Edison batteries; the motors to be in every way suitable for traction purposes and to be capable of giving three times the normal torque at one-half speed for ten minutes, to have the highest possible efficiency from half load to 200 per cent overload, and to be fitted with ball bearings and totally inclosed.

A commercial agent from Italy (No. 31,863) is in the United States for a short time and desires to secure an agency for the sale of electrical goods and supplies.

The electrical department of a machinery and supply company in Mexico (No. 31,864) desires to receive information as to base prices of wire and cable, with discount, and the added amounts for size, stranding, insulation, reels, etc.

A company in India (No. 31,891) desires to purchase and secure an agency for electrical novelties.

A commercial agent in Morocco (No. 31,894) desires to secure the representation of manufacturers and exporters for the sale of telegraph and telephone poles.

A commercial agent in the Levant (No. 31,926) desires to enter into communication with American firms for the importation of materials and furnishings for electric light installations, and street railways.

A merchant in France (No. 31,931) desires to purchase electric appliances.

Trade Publications

CIRCUIT BREAKERS.—Bulletin No. 47,444, superseding bulletin No. 47,405, has been issued by the General Electric Company of Schenectady, N. Y., descriptive of its type FK-5 oil circuit breaker up to 7,500 volts.

FARM EQUIPMENT.—In bulletin No. 35 the Delta Star Electric Company of Chicago .describes the high-tension outdoor-unit type of farm power and lighting equipment, together with some larger outdoor substations.

STOKERS.—In circular 1615, which is a seventy-six-page booklet, the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., describes its underfeed stokers.

BRAKES.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has revised and reprinted booklet A, descriptive of its motor-operated brakes for alternating-current service.

MAGNETIC SEPARATOR.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has revised and reprinted booklet F, descriptive of its magnetic separator.

UNDERGROUND CONDUIT.—The Chicago Stone Conduit Company, Chicago, in a small folder describes its different types of stone duct.

WASHING MACHINES.—The "Modern Home" Washer, designed to fit into any washtub, is described in a folder issued by the Home Devices Company, New York City.

WASHING MACHINES.—The "Gold Seal" Washer is described in a recent folder put out by the Philip Smith Manufacturing Company, Sidney, Ohio.

TRANSFORMERS.—Bulletin No. 200, recently issued by the Packard Electric Company, Warren, Ohio, describes its line of distribution transformers.

TRANSFORMERS.—The Packard Electric Company, Warren, Ohio, describes in bulletin No. 202 its series regulating transformers for series street lighting.

MOTORS.—In bulletin No. 200 the Electro Dynamic Company, Bayonne, N. J., describes type A, form K, polyphase induction motors.

APPLIANCES.—In a recent bulletin the Pelouze Manufacturing Company, Chicago, describes its line of electric heating appliances in addition to its line of scales.

FIXTURES.—The Reflectolyte Company is describing in a recent folder its new lighting unit, known as the "Supreme Reflectolyte."

LAMP GUARDS.—In a recent folder Harvey Hubbell, Inc., Bridgeport, Conn., describes its line of lamp guards.

FANS.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has just released its 1920 fan sales promotion catalog, in which are included dealer helps.

CONDENSITE.—The Condensite Company of America, Bloomfield, N. J., has recently put out a booklet relative to plastic molding of "condensite."

ELEVATORS.—The Link-Belt Company of Chicago has issued books Nos. 380 and 375 relative to its line of electric hoists, overhead cranes and conveyors.

HOODS.—Bulletin No. 37, superseding bulletin No. 22, has been issued by the Reynolds Electric Company of Chicago relative to its line of color hoods for electric sign lamps.

New Incorporations

THE M. W. KELLOGG COMPANY, 117 Westside Avenue, Jersey City, N. J., manufacturer of general power plant equipment, piping, etc., has filed articles of incorporation under Delaware laws with a capital of $15,770,000.

THE DUPLEX ROTOR ENGINE COMPANY, Newark, N. J., has been incorporated by R. F. Anthony, Hugh C. Barrett and Michael Sugrue, Jr. The company is capitalized at $125,000 and plans to manufacture and deal in engines, etc.

THE CONSUMERS' ICE & LIGHT COMPANY, Magnolia, Ark., has filed articles of incorporation with a capital of $75,000 to operate a local electric light and ice-manufacturing plant. W. W. Sorrels is president and W. R. Gantt, secretary-treasurer.

THE P. T. HENRY COMPANY, Philadelphia, Pa., has been incorporated under Delaware laws with a capital of $100,000 to manufacture electric lamps, etc. P. T. and E. R. Henry and Thomas J. Leslie, Philadelphia, are the incorporators.

THE SNYDER UTILITIES COMPANY has been incorporated with a capital of $50,000. Its purpose is to construct and operate public utility plants at Snyder. The incorporators are D. P. Yonker, W. B. McCormick and E. P. Johnson.

THE CONSUMERS' LIGHT & FUEL COMPANY has been incorporated here with a capital of $50,000. The incorporators are L. S. Johnson, H. M. Handsby and P. T. Crypsup.

THE PARR ELECTRIC COMPANY, 77 Warren Street, New York, N. Y., jobbers, have been incoporated with 2,000 share of common stock and an active capital of $10,000. The incorporators are J. E. Tracy, R. F. Shephard and I. M. Payne.

THE KAYENN MANUFAFCTURING COMPANY of New York, N. Y., has been incorporated with a capitalization of $30,000 to manufacture electrical equipment. The incorporators are E. R. Greenstein, E. Spector and C. H. Levitt.

THE WINDALL-WAGNER MANUFACTURING COMPANY, of Shelbyville, Ind., has been incorporated with capital of $150,000 to manufacture furniture. The incorporators are Carl W. Tindall, Paul S. Ragan and Arthur Wagner.

THE ELWELL-PARKER ELECTRIC COMPANY, of Cleveland, Ohio, has been chartered with a capital of $700,000 to manufacture many kinds of electrical supplies. The incorporators are C. F. Beavis, J. M. Garfield, J. P. Wood, W. B. Coakley and R. C. Hyatt.

THE MIAMI ELECTRIC COMPANY, of Troy, Ohio, has been chartered with a capital of $10,000 to deal in electrical supplies of all kinds. The incorporators are Herzstam, H. W. Shelby, Earl Wiley, R. A. Myers and R. E. Shelby.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

MOUNT DESERT ISLAND, ME.—A new electric transmission station (Specification 4133) will be erected by the Bureau of Yards & Docks, Navy Department, Washington, D. C., at the local yard. The cost is estimated at about $20,000. C. W. Parks is chief of the bureau.

BRADFORD, N. H.—The Bradford Light & Power Company contemplates the installation of new meters. C. E. Hadley is the general manager.

FALL RIVER, MASS.—Ground has been broken for the proposed addition to the power plant of the King Philip Mills, 372 Milburn Street. The cost is estimated at $50,000. The McNally Construction Company, 86 Main Street, is contractor.

HARTFORD, CONN.—Plans are under consideration by the Board of Fire Commissioners for the erection of a new machine shop for municipal service, to cost about $125,000.

Middle Atlantic States

BELFAST, N. Y.—The Town Board has adopted the petition of the taxpayers for establishing a lighting district within the village. It is proposed to enter into a contract with the Genesee Valley Power Company to furnish electric lighting service.

BUFFALO, N. Y.—Large quantities of electrical and mechanical equipment will be required by the Philadelphia Rubber Works, Akron, Ohio, in connection with the proposed new plant at Buffalo. The works will comprise a group of factory buildings, including main manufacturing plant, power plant for works operation, administration building and auxiliary structures. The cost including machinery and equipment, is estimated at about $1,000,000. The Austin Company, Euclid Avenue, Cleveland, Ohio, is engineer.

CLARENDON, N. Y.—The Public Service Commission has granted the Western Utilities Company of Medina permission to construct and operate an electric lighting plant in the town of Clarendon under a franchise granted by the local authorities.

HADLEY, N. Y.—The Public Service Commission has granted the Hadley Light & Power Company authority to operate an electric light plant in Hadley. The company was also given permission to take over the local electric plant owned by Joseph Gatti. Extensions and improvements, it is understood, are contemplated to the system.

JAMESTOWN, N. Y. — Bonds to the amount of $250,000 have been voted for extensions and improvements to the municipal electric light plant.

MARCY, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, N. Y., until March 17 for construction, heating, sanitary and electrical work of mortuary and laboratory, and accommodations for tubercular patients, Utica State Hospital (Marcy Division). Drawings and specifications may be obtained at the Department of Architecture, Capitol, Albany. L. F. Pilcher, Capitol, Albany, is state architect.

NEW YORK, N. Y.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 18 for furnishing and installing lighting fixtures in the United States Assay Office in New York.

NEW YORK, N. Y.—Ground has been broken by the Knickerbocker Ice Company 1480 Broadway, for the construction of its proposed new ice-manufacturing plant on Willis Avenue, near Old Counter Road, Mineola, L. I. Considerable refrigerating apparatus and electrical machinery will be required.

NIAGARA FALLS, N.Y. — Plans have been prepared by the United States Light & Heat Corporation, 3215 Highland Avenue, manufacturer of electric batteries, etc., for a new addition to its plant, about 80 ft. x 100 ft. Mills, Rhines, Bellman & Nordoff, Ohio Building, Toledo, Ohio, are engineers for the company.

POTSDAM, N. Y.—The construction of a hydro-electric plant in Potsdam is under consideration. A. Kuyle of Monticello is reported interested.

SODUS, N. Y.—Plans have been prepared by the Wayne Power Company for extensions and improvements to its system, including the erection of 1½ miles of transmission lines and the installation of new equipment at its plant, to cost about $91,500. The company has applied to the Public Service Commission for permission to to issue bonds for this amount to cover cost of the proposed improvement.

SYRACUSE, N. Y.—The Dyneto Electric Company, 301 Wolf Street, is contemplating the construction of a new factory and office building at Park and Wolf Streets. The company manufactures electric starting and lighting systems for automobile service. Ford, Bacon & Davis, 115 Broadway, New York, are engineers.

WATERTOWN, N. Y.—The H. H. Babcock Company, Factory Square, contemplates the construction of a power house and tailrace, and installation of a new generator. The cost is estimated at about $100,000.

BAYONNE, N. J.—Foundations have been completed in connection with the construction of a new power plant and laundry building at the Bayonne Hospital, East Thirtieth Street, near City Hall. In connection with other work at the institution the project is estimated to cost $250,000. The Franklin-Rocks Company, 354 West Twenty-fourth Stret, New York, is the contractor.

ELIZABETH, N. J.—Contract has been awarded to H. Wilhelms & Son, 803 East Jersey Street, by the Consumers' Ice & Cold Storage Company, 1079 East Grand Street, for the construction of the new addition to its ice manufacturing plant. Refrigerating apparatus and electrical machinery will be installed. The cost is estimated at $46,000.

KEYPORT, N. J.—Plans are under contemplation by the Monmouth Lighting Company for improvements in its power station at Keyport, including the installation of turbine unit and improvements in condenser equipment and auxiliary apparatus.

NEWARK, N. J.—Considerable electrical and mechanical equipment will be required in connection with the proposed new local plant of the Murray Motor Car Company, 19 West Forty-fourth Street, New York, to be located at Frelinghuysen Avenue and McClellan Street. Plans for the works have been completed, and these will comprise four factory buildings for general manufacturing operations. The cost of the plant is estimated at $400,000. Henry Y. Rosensohn, 800 Broad Street, Newark, is architect.

BATH, PA.—The power plant at the works of the Penn Allen Cement Company near Bath was wrecked on Feb. 5, severely damaging machinery and equipment. The loss is estimated at about $100,000.

BETHLEHEM, PA.—The Fritch Coal Company is contemplating the installation of new electrically operated loading machinery at its Stahr yards, to have a capacity of about 20,000 tons.

HERSHEY, PA.—Foundation work has been completed in connection with the construction of the proposed addition to the Hershey Chocolate Company. The buildings will include a main manufacturing plant, 100 ft. by 400 ft., five stories, and a power plant, 130 ft. by 140 ft., one story. The cost, including machinery and equipment, is estimated at about $500,000. A. C. Wood, 1411 Walnut Street, Philadelphia, Pa., is contractor.

PHILADELPHIA, PA.—The Department of Public Works, John C. Winstead, director, has had plans prepared for the erection of a new ash-handling plant at the municipal pumping station at Torresdale, Pa., to cost about $20,000.

BALTIMORE, MD.—The New Annex Advisory Commission has submitted a report calling for an appropriation of $1,000,000 for improvements in the lighting system and underground conduit systems, covering approximately 230,000 lineal ft. of trunk conduits and 200,000 lineal ft. of lateral conduits.

BALTIMORE, MD.—Considerable electrical and mechanical equipment will be required in connection with the proposed additions and improvements at the Sparrows Point (Baltimore) plant of the Bethlehem Steel Corporation, plans for which are now under way. The work will include the erection of sheet-metal shop, joiner shop, pipe shop and auxiliary structures, as well as a large power plant.

BLUEFIELD, W. VA.—The capital stock of the Appalachian Power Company has been increased from $8,050,000 to $12,000,000.

ELKINS, W. VA.—Plans are being prepared for the installation of a new electric light plant and waterworks system. The Roberts Engineering Company of Charleston is consulting engineer.

NORFOLK, VA.—Preparations are being made by the Norfolk Shipyards Corporation for shipbuilding plant in Norfolk. The plans provide for twenty shops and construction buildings, including machine shop, foundry, woodworking and power plant and two drydocks. A marine railway will also be built. Benjamin Lowenberg is president.

PETERSBURG, VA.—Electric equipment, including motors for individual drive, will be installed in the proposed new plant of the Petersburg Silk Hosiery Corporation, recently incorporated with a capital of $500,000. The proposed plant will have a capacity of about 1,800 dozen pairs of hose daily. Edwin S. Bayer is president and Arthur G. King treasurer.

PORTSMOUTH, VA.—The City Council has instructed W. B. Bates, manager, to prepare estimates of the cost of the proposed extension to the ornamental lighting system on High Street from Chestnut Street to the Belt Line, and also extension to the system for two blocks on Crawford Street.

North Central States

DETROIT, MICH.—Plans have been prepared by the American Electrical Heater Company, 1351 Woodward Avenue, for the erection of a two-story and basement plant, 30 ft. by 130 ft., on Conner Avenue, Hamtramck, Mich. The company manufactures electric heating and cooking appliances.

STURGIS, MICH.—At an election to be held March 18 the proposal to issue $100,000 in bonds for extensions to the municipal electric light plant will be submitted to the voters.

CINCINNATI, OHIO — The Cincinnati Steel Castings Company, it is reported, is contemplating the installation of an electric furnace.

HAMILTON, OHIO—Plans, it is understood, are being prepared for a new municipal electric light plant, for which $650,000 in bonds have been voted.

SHELBY, OHIO — The Huron Valley Light & Power Company is contemplating the erection of a high-tension transmission line from Shelby to Plymouth. The proposed line will supply electricity in Plymouth, Greenwich, Willard, Shiloh and other villages.

GUTHRIE, KY.—The South Kentucky Power Company contemplates construction of transmission line from Lebanon, Tenn. to Watertown. Wire and transformers have already been purchased. A. F. Trimble is the manager.

HAZARD, KY.—The Kentucky and West Virginia Power Company, Hazard, contemplates the erection of a transmission line to Rockhouse Creek. W. F. Ficklen, Jr., is manager.

STANFORD, KY.—The Stanford Water, Light & Ice Company contemplates construction of 20 miles of transmission line to serve two towns. B. T. Penny is secretary-treasurer.

ANDERSON, IND.—Preliminary plans are being prepared by the city for the erection of a new municipal electric power plant. Joseph Essington is city clerk; Charles Brossman, 1503 Merchants Bank Building, Indianapolis, is engineer.

DECATUR, IND.—The city of Decatur has taken bids for the erection of a new one-story brick and concrete power plant, about 82 ft. by 92 ft., to be used for municipal service. The cost, including machinery and equipment, is estimated at about $150,000. D. McNaughton, Lincoln Life Building, Fort Wayne, is consulting engineer.

INDIANAPOLIS, IND.—Plans have been completed by the Indianapolis Power & Light Company for an addition to its power plant, to cost about $75,000.

CARROLLTON, ILL.—The construction of a municipal electric light plant in Carrollton is under consideration.

QUINCY, ILL.—Extensions to the ornamental lighting system are under consideration by the City Council.

KOHLER, WIS.—Extensions to the electric lighting system are under consideration by the village officials.

MIDDLETOWN, WIS.—The installation of a municipal electric light plant in Middletown is under consideration.

MILWAUKEE, WIS.—H. C. Schrank, 501 Water Street, has had plans prepared for alterations and improvements in the lighting plant on East Water Street, including the erection of an extension to the present building.

MILWAUKEE, WIS.—Geuder, Paeschke & Frey, Fifteenth and St. Paul Streets, have had plans prepared for the construction of a new power plant at their works, about 75 ft. by 100 ft. The cost including equipment is estimated at about $150,000. Cahill & Douglas, 217 West Water Street, are engineers.

MILWAUKEE, WIS.—Bids are being received by the Milwaukee Electric Railway & Lighting Company for construction of five one-story power plant buildings, to be erected at St. Francis, to cost about $500,000, R. S. Pinkley is engineer of way and structures.

SHAWANO, WIS.—Plans are under consideration to purchase energy to operate the municipal electric light plant from the Central Wisconsin Power Company. Paul E. Capraro is manager of the municipal plant.

SHEBOYGAN, WIS.—The Northern Furniture Company has decided to equip its entire plant, including the additions now under construction, for electrical operation. A new Ames uniflow engine directly connected to a General Electric generator will be installed. Otto Knabe is chief electrical engineer.

ASBY, MINN.—Bonds to the amount of $20,000 have been voted for the installation of an electric lighting system in Asby.

AURORA, MINN.—The Water and Light Commission contemplates the installation of two boilers and one 312-kva. generating unit. C. Juhlin is the engineer in charge of the power station.

FAIRMONT, MINN.—The Council has engaged Silas Jacobson, architect, Endicott Building, St. Paul, to prepare plans for a new power plant.

GOOD THUNDER, MINN.—The Good Thunder Electric Company contemplates the erection of 2½ miles of transmission lines from its substation to the hydro-electric plant. F. H. Griffin is secretary.

HEIBERG, MINN.—The J. F. Heiberg Electric Light & Power Company will install a 125-kw. umbrella-type generator with waterwheel and erect a three-phase transmission line to Ulin, Minn., a distance of 15 miles. J. F. Heiberg is manager.

MILROY, MINN.—The Milroy Electric Light & Power Company contemplates the construction of a transmission line into the country districts. C. F. Boyer is manager.

WAUBUN, MINN.—The Waubun Electric Light Company contemplates changing its system from direct to alternating current. L. A. Fancher is president.

BUNCETON, MO.—The Bunceton Ice, Light & Fuel Company contemplates the construction of additional transmission lines. W. K. Simmons is manager.

LINCOLN, MO.—The Lincoln Light Company contemplates the installation of a 10-hp. engine, and a 5-kw. generator. I. T. Sterrett is superintendent.

LEADVILLE, MO.—The St. Joseph (Mo.) Lead Company contemplates the construction of a new 5000-kw. steam-driven electric power plant in Leadville. The cost is estimated at more than $500,000.

NOVINGER, MO.—The Merchants' Light & Power Company contemplates the installation of a new 150-kva. generating unit. C. H. Charlton is secretary and treasurer.

ST. LOUIS, MO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., unitl March 16 for remodeling the United States Appraisers Stores, including plumbing, electrical work, etc., in St. Louis. Former bids rejected.

GRAND FORKS, N. D.—Bids will be received by the Industrial Commission of North Dakota, Bismarck, until March 15 for construction of flour mill of from 2,000 to 3,000 barrel capacity; elevator of 1,500,000 bushels capacity and office building, 40 ft. by 160 ft., eight stories. The cost of the project is estimated at about $1,500,000. The Pillsbury Company, Metropolitan Life Building, Minneapolis, Minn., is engineer.

AVOCA, NEB.—The installation of an additional engine and generator in the municipal electric light plant is under consideration. L. W. Fahnestock is manager.

BARTLEY, NEB.—The Municipal Electric Light Department is considering the erection of 27 miles of transmission line. J. A. Finnegan is manager.

CHAPPELL, NEB.—Plans are under way for the installation of a new 200 to 250-hp. oil engine in the municipal electric light and water plant this spring. C. P. Tschabrun is manager.

CROFTON, NEB.—C. G. Lamson has been awarded contract for construction of the municipal electric light plant.

KIMBALL, NEB.—The city contemplates the installation of a 200-hp. type "Y" engine directly connected to the generator in the municipal electric plant. F. C. Overton is city clerk.

MILLARD, NEB.—The Millard Light & Power Company contemplates the construction of a transmission line to Chalco, Neb. C. W. Peters is owner.

NEBRASKA CITY, NEB.—The Nebraska City Utilities Company, it is reported, contemplates the erection of a transmission line to furnish electricity in the towns of Dunbar, Syracuse, Unadilla, Palmyra and Julian from the local central station.

OAKLEY, NEB.—Improvements are contemplated to the municipal electric light and power plant, including the installation of a complete steam or oil plant of 150 hp. capacity. W. E. Day is superintendent.

RUSHVILLE, NEB.—The Sheridan Electric Service Company is to add approximately 25 kw. extra capacity to its generating capacity. The street lighting and residential commercial circuits are also to be extended. T. C. Shipley is manager.

SCOTTSBLUFF, NEB.—The Intermountain Railway Light & Power Company, Scottsbluff, contemplates the installation of a 750-hp. boiler and doubling the ice-plant equipment. J. R. Murphy is superintendent.

SIDNEY, NEB.—The Sidney Municipal Service contemplates the installation of a new boiler and generating unit. J. E. Poquette is manager.

SUPERIOR, NEB.—The Southern Nebraska Power Company contemplates the installation of one new 650-hp. waterwheel and the erection of 45 miles of transmission lines. D. Guthrie is president.

ELK CITY, KAN.—The C. R. Long Light & Power Company, box 117, contemplates installing a 100-hp. oil engine and a 75-kva. generator and the construction of 8 miles of transmission line. J. A. Logan is superintendent.

EMPORIA, KAN.—Bids will be received by the State Board Administration, Topeka, until March 11, for construction of power house, one story, 82 ft. x 110 ft., and brick smokestack, 35 ft. x 40 ft. The cost is estimated at about $70,000. R. L. Gamble, 1415 Fillmore Street, Topeka, is architect; J. A. Kimball is manager.

HIAWATHA, KAN.—Extensions and improvements are contemplated by the Hiawatha Light, Power & Ice Company, including the construction of an ice-storage building, etc. The cost is estimated at about $50,000.

KANSAS CITY, KAN.—The Water & Light Department, City Hall, contemplates installing a 6,000-kw. generator and erecting a 6600/13,200-volt transmission line. J. D. Donovan is superintendent.

LEAVENWORTH, KAN.—The Leavenworth Light, Heat & Power Company, 515 Delaware Street, contemplates the installation of a switchboard and other improvements. W. A. Schwerin is superintendent.

PHILLIPSBURG, KAN. — The Phillips County Light & Power Company contemplates the installation of a 200-hp. boiler and a 250-hp. steam-engine generating unit and the construction of 10 miles of 13,200-volt transmission line to Almena, Kan. F. J. Supuhler is manager.

TIPTON, KAN.—The Tipton Light Company contemplates the installation of extension to its transmission lines and the erection of a larger plant. L. E. Hohl is manager.

Southern States

ATKINSON, N. C. — Arrangements are being made by the Atkinson Power & Light Company, recently organized, for the installation of a local distributing system, to cost about $10,000. L. M. Thompson of Montgomery, N. C., is secretary and general manager.

KINSTON, N. C.—It is reported that a power house and pipe tunnels will be constructed by the Caswell Training School. J. A. Salter of Raleigh, N. C., is the architect; R. L. Blalock, Kinston, is contractor.

WILSON, N. C.—Plans are under consideration by the Town Commissioners for the construction of a new municipal hydroelectric power plant. The project will include the construction of a new dam, power plant, outdoor transformer station, headworks and a 13,000-volt transmission line, about 4 miles long. Lee, MacEwan & Turnbull, Realty Building, Charlotte, are architects and engineers.

PROSPERITY, S. C.—The city is to vote on a bond issue of $35,000, the proceeds to be used for construction of an electric power line and installing electric lighting system in the city.

WALTERBORO, S. C.—Plans are under consideration for improvements to the municipal electric light plant, including the installation of electric generating unit, to cost about $12,000.

REYNOLDS, GA.—At an election to be held March 22 the proposal to issue $15,000 in bonds for the construction of a municipal electric light plant will be submitted to the voters.

TALLAHASSEE, FLA.—Bids will be received by the Board of Commissioners of the city of Tallahassee, City Hall, until March 10, for furnishing and erecting steam and gas plant apparatus. Equipment for steam plant is to include one 500-kw. steam turbine, two condensers, two 225-hp. water-tube boilers, superheaters, feed pumps, feed-water purifying system, spray cooling system and motor-generator set. Equipment for gas plant to include one generator, carburetor, superheater, boiler, scrubber, hydraulic seal, purifier, blower, gas-storage tanks, oil-storage tanks, pumps, piping, gages, etc. Specifications may be obtained from Mees & Mees, consulting engineers, Trust Building, Charlotte, N. C., upon deposit of $20. A. H. Williams is city clerk.

BROOKSVILLE, MISS.—A bond issue of $10,000 has been voted by the city for improvements to the light and water systems. J. N. McMorries is town clerk.

CRYSTAL SPRINGS, MISS.—Bonds to the amount of $15,000 have been voted for improvements to the municipal electric light system.

DURANT, MISS.—The installation of a new 100-kw. generating unit in the municipal electric light plant is under consideration. J. D. Alsbury is superintendent.

OXFORD, MISS.—The Electric Light and Water Commissioners contemplate the installation of a new electric generating unit in the municipal electric plant and remodeling the street-lighting system. D. H. Hull is manager.

SHELBY, MISS.—The Shelby Light & Power Company contemplates the installation of a 170-kva. alternator directly connected to a 200-hp. oil engine. Daniel Bradera is manager.

SHAW, MISS.—Extensions and improvements are contemplated to the municipal electric light plant and water works system, to cost about $30,000.

STARKVILLE, MISS. — Extensive improvements are being considered by the City Council to the light and water plants, including boiler equipment and superheater, stack, economizer, stoker, boiler-feed pump, a 160-hp. "Unaflow" engine, two 100-kw. generators, switchboard and air compressor. Williams & Lebby of Yazoo City, Miss., are engineers.

MAGNOLIA, ARK.—The Consumers' Ice & Light Company contemplates the purchase of a 250-hp. to 450-hp. engine directly connected to generator.

TILLAR, ARK.—Plans are being considered by the Tillar Light & Power Company, for the construction of an electric light plant.

BOYCE, LA.—Extensions and improvements are contemplated to the municipal electric light plant and water works system for which $30,000 in bonds have been voted. Xavier A. Kramer of Magnolia, Miss., is consulting engineer.

VINTON, LA.—At an election to be held on March 16 the proposal to issue $90,000 in bonds for the purchase of the property of the Vinton Water, Light & Power Company will be submitted to the voters.

ADMIRAL, TEX.—The McEwen Manufacturing Company contemplates the erection of a power house to cost approximately $18,000.

LA PORTE, TEX.—The La Porte Water, Light & Ice Company, recently organized with a capital of $13,000, is planning the construction of a power house, 46 ft. x 20 ft. The building will cost about $33,000. The company also expects to construct a 9-mile transmission line. J. Pfeiffer is engineer.

Pacific and Mountain States

CENTRALIA, WASH.—Plans are under consideration by the Kine Pneumatic Shock Absorber Company for the construction of a new 500-kw. power plant at Fords Prairie, near Centralia.

TURLOCK, CAL.—Bonds to the amount of $1,280,000 have been voted for improvements to the municipal electric lighting system.

VALLEJO, CAL.—Plans have been completed by the Vallejo Electric Light & Power Company for the construction of an addition to its power plant, to cost about $70,000.

WILMINGTON, CAL.—Arrangements are being made by the Pacific Electric Railway Company for rebuilding its local substation, recently destroyed by fire. The loss is estimated at about $10,000.

Canada

CALGARY, ALTA.—J. F. McCall, superintendent of the municipal electric plant, has recommended the installation of a new motor-generator, to cost about $30,000.

WINNIPEG, MAN.—The erection of a power transmission line to Morden this spring is under consideration by the Provincial Power Commission.

KINCARDINE, ONT.—The by-law authorizing $40,000 for the installation of hydro-electric power has been approved by the ratepayers.

RIPLEY, ONT.—The ratepayers have approved the by-law authorizing $15,000 for the installation of hydro-electric power.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer of the Panama Canal, Washington, D. C., until March 11, for duplex pumps, water pumps, oil-drying and purifying outfit, oil-testing outfit, steel cable, ring bolts, etc. Blanks and general information relating to this circular (1348) may be obtained at the above office.

Record of Electrical Patents

Notes on United States Patents

(Issued Feb. 17, 1920)

1,330,787. INKING MECHANISM; George S. Conger, New York, N. Y. App. filed Feb. 19, 1919. For printing telegraphs.

1,330,790. DRIVING MECHANISM FOR VALVES AND OTHER DEVICES; Peter P. Dean, New York, N. Y. App. filed Oct. 1, 1917. Alternative mechanical and electrical control.

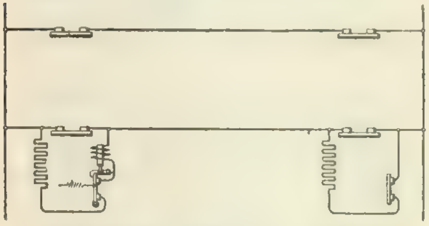
1,330,800. METHOD OF SECURING PLATES; James H. Gravell, Brooklyn, N. Y. App. filed July 26, 1918. Short electrical circuit for welding ship plates.

1,330,811. IGNITION MANIFOLD; Otto Konigslow, Sr., Cleveland, Ohio. App. filed June 12, 1918. Co-operating members form conduit through which electrical conductors pass.

1,330,858. PROTECTIVE MEANS AGAINST LIGHTNING; Frank A. Ford, Glenpool, Okla. App. filed Dec. 19, 1918. Grounded network around and above tank.

1,330,867. REFRIGERATING APPARATUS; Charles C. Hansen, Forest Park, Ill. App. filed Feb. 23, 1916. Thermostatic controlling mechanism for motor driving compressor.

1,330,877. ELECTRIC COOKER; Frank Kuhn and Jay A. Hand, Detroit, Mich. App. filed Feb. 21, 1918. Compact heater for toasting, broiling, etc.



No. 1,331,050—System of Electrical Switching

1,330,887. INDICATOR FOR TRAMCARS AND THE LIKE FOR INDICATING STATIONS OR STOPPING PLACES; Charles W. Mallins, Blundellsands, near Liverpool, Eng. App. filed March 26, 1917. Contact completes circuit with trolley pole.

1,330,904. ELECTRIC RADIATOR; Will R. Savage, Omaha, Neb. App. filed April 10, 1915. Double-threaded winding resistance, multiple series or three-heat combination.

1,330,935. MEANS FOR SUPPORTING ELECTRODES IN IONIC TUBES; Frederick P. Driver, London, Eng. App. filed June 29, 1918. Used in wireless telegraphy.

1,330,941. CIGAR LIGHTER; Nellie N. Hill, Moultrie, Ga. App. filed Aug. 28, 1917. Electric spark ignites waste.

1,330,944. PROGRAM CLOCK; Edwin E. Jacobs, Ashland, Ohio. App. filed April 29, 1919. For schools with daily schedule.

1,330,952. IGNITION APPARATUS; Auguste V. Pellet, Chicago, Ill. App. filed June 20, 1919. Spark electrodes are opened electromagnetically.

1,330,961. SPEED-CONTROLLING APPARATUS; Simon Sparrow, St. Louis, Mo. App. filed Feb. 27, 1919. Regulated and connected to storage battery.

1,330,999. NON-GROUNDED OR METALLIC LINE-CIRCUIT SYSTEM; Raymond H. Burfeind, Chicago, Ill. App. filed April 18, 1917. Common battery for talking circuit in automatic exchange.

1,331,018. SEPARATOR FOR SECONDARY BATTERIES; Joseph O. Luthy, San Antonio, Tex. App. filed Sept. 29, 1919. Celluloid strips for spacing plates.

1,331,050. SYSTEM OF ELECTRICAL SWITCHING; Elmer E. F. Creighton, Schenectady, N. Y. App. filed Dec. 31, 1917. For disconnecting feeders.

1,331,053. INSTRUMENT FOR USE OF MUSIC TEACHERS, ETC.; Bertrand de Bernyz, New York, N. Y. App. filed Jan. 3, 1919. Circuit enables comparison of pitch, volume and tone.

1,331,055. STARTING SYNCHRONOUS MOTORS; Robert E. Doherty, Schenectady, N. Y. App. filed Aug. 12, 1916. Started under load with good torque and brought into synchronism smoothly.

1,331,059. DEMAND INDICATOR; Chester I. Hall, Fort Wayne, Ind. App. filed Sept. 5, 1916. Without electrical contacts or gear openings.

1,331,061. HEATING DEVICE; John Harding, Detroit, Mich. App. filed Nov. 17, 1917. Attached to air intake of carburetor.

1,331,065. RELAY MECHANISM FOR FLOW METERS AND OTHER USES; Alfred Herz, Chicago, Ill. App. filed Dec. 20, 1917. Pitot tubes face in opposite directions in line of fluid flow.

1,331,068. TRANSFORMER; Svend E. Johannesen, Pittsfield, Mass. App. filed March 6, 1917. Interposes radially a primary winding between an outer and an inner secondary winding.

1,331,077. REINFORCEMENT FOR ELECTRICAL WINDINGS; Walter S. Moody, Pittsfield, Mass. App. filed Feb. 27, 1915. Transformer windings protected against shearing.

1,331,085. LEADING-IN CONDUCTOR; John H. Anderson, Cleveland, Ohio. App. filed Aug. 28, 1915. For incandescent lamps in which metals having different coefficients of expansion from that of glass may be used.

1,331,089. OIL-COOLED TRANSFORMER; Arthur F. Berry, Ealing, Eng. App. filed Feb. 16, 1917. Provided with cover that will move with expansion and contraction of oil.

1,331,090. DYNAMO-ELECTRIC APPARATUS FOR INTERNAL-COMBUSTION ENGINES; Joseph Bijur, New York, N. Y. App. filed Feb. 10, 1915. Power transmission between gas engines and motor-generators.

1,331,107. SELF-PROPELLED SADIRON; Abraham M. Holtzman, Brooklyn, N. Y. App. filed Nov. 22, 1918. Heavy motor-driven iron.

1,331,154. RECORDING SYSTEM AND APPARATUS; Richard M. Hopkins, New York, York, N. Y. App. filed Jan. 27, 1917. Separate groups of watchmen's records made automatically.

1,331,168. STARTING APPLIANCE; Francois Richard, Cleveland, Ohio. App. filed Feb. 3, 1917. Supplies an intermittent power impulse to starting pinion.

1,331,180. ANNUNCIATOR; Charles A. Bindhammer, Chicago, Ill. App. filed Jan. 2, 1918. Displaying advertising cards.

1,331,213. METHOD OF MAKING PRIMARY BATTERIES; Otto E. Ruhoff, Madison, Wis. App. filed June 9, 1917. Substitute for carbonaceous material used in depolarizing mixture.

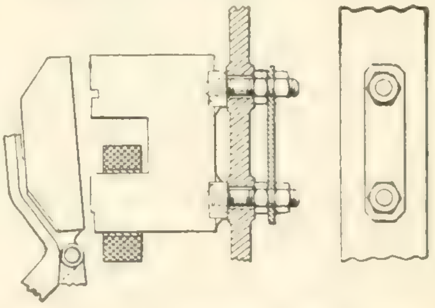
1,331,223. REGULATOR FOR ELECTRIC GENERATORS; William A. Turbayne, Niagara Falls, N. Y. App. filed April 22, 1914. Maximum current output at relatively low speeds.

1,331,234. SYSTEM OF ELECTRICAL REGULATION; William L. Bliss, Niagara Falls, N. Y. App. filed April 17, 1914. Predetermined battery voltage attained, after which generator is held above battery voltage.

1,331,287. ELECTRIC LAMP SOCKET; Arthur L. Smith, Ashtabula, Ohio. App. filed Dec. 11, 1918. Free from vibrations of support.

1,331,290. ALTERNATING-CURRENT MAGNET; Harry F. Stratton, Cleveland, Ohio. App. filed Oct. 14, 1918. Prevent chattering of armatures of magnets on pole faces.

1,331,301. INCANDESCENT LAMP; William White, Rossville, Ga. App. filed Oct. 8, 1918. Varied mounting and arrangement of filament.



No. 1,331,290—Alternating-Current Magnet

1,331,316. AUTOMATIC CONTROLLING DEVICE FOR ELECTRIC CIRCUITS; Clarence E. Brown, Clarksburg, W. Va. App. filed March 8, 1918. Automatic control of motor circuit used for turning the flattening stones in window-glass manufacture.

1,331,320. MINER'S LAMP; Louis Chomier, St. Etienne, France. App. filed Nov. 7, 1918. Lamp and battery separated by special locking device.

1,331,345. SANITARY DEVICE FOR TELEPHONES; Dalmacio P. Lopez, San Nicolas, Cuba. App. filed May 15, 1919. Sanitary pad attached to receiver.

1,331,355. ELECTRIC LAMP LOCK; Frederick J. O'Neill, Dunedin, New Zealand. App. filed Aug. 12, 1918. Prevents unlawful removal of lamp from bayonet joint fitting.

1,331,400. STAND FOR ELECTRIC IRONS; Emil Stranszky, Canal Dover, Ohio. App. filed March 18, 1919. Stand keeps iron at constant temperature.

1,331,435. MANUFACTURE OF SILICON CARBIDE; Otis Hutchins, Niagara Falls, N. Y. App. filed July 15, 1919. Uniform product obtained.

1,331,456. BATTERY AND DUPLEX ELEMENT THEREFOR; Carleton Ellis, Montclair, N. J. App. filed Sept. 29, 1917. Composite element formed.

1,331,468. STERILIZER; Albert H. Jessup, Erie, Pa. App. filed July 5, 1917. Sterilizing medium electrically heated.

1,331,469. TELEPHONE RECEIVER; Carl Kraft, New York, N. Y. App. filed June 25, 1919. Watchcase for aircraft, tanks and headsets.

Directory of Electrical Associations

Printed in the First Issue of Each Month

Alabama Light and Traction Association. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

American Association of Engineers. Secretary, C. E. Drayer, Nepecnauk Bldg., 63 East Adams St., Chicago, Ill.

American Electric Railway Association. Secretary, E. B. Burritt, 8 West 40th St., New York City.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, Bethlehem, Pa.

American Institute of Consulting Engineers, Inc. Secretary, F. A. Molitor, 35 Nassau St., New York City.

American Institute of Electrical Engineers. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country. Annual convention, White Sulphur Springs, Va., June 29-July 2.

American Physical Society. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

American Society for Testing Materials. Secretary-treasurer, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society. Secretary, H. C. Forbes, 29 W. 39th St., New York City.

Arkansas Utilities Association. Secretary, W. J. Tharp, Little Rock, Ark.

Associated Manufacturers of Electrical Supplies. General secretary, C. E. Dustin, 30 East 42d St., New York City. Annual meeting, New York, March 18.

Association of Edison Illuminating Companies. Secretary, Preston S. Millar, Electrical Testing Laboratories, New York City.

Association of Iron and Steel Electrical Engineers. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

Association of Municipal Electrical Utilities of Ontario. Secretary, S. R. A. Clement, 190 University Ave., Toronto.

Association of Railway Electrical Engineers. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern, Railway, Chicago, Ill. Annual meeting, Chicago, Ill., Oct. 28-31.

British Columbia Association of Electrical Contractors and Dealers. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C. Annual meeting, Vancouver, B. C., Oct. 19.

Canadian Electrical Association, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St., East, Toronto, Ont.

Colorado Electric Light, Power and Railway Association. Secretary-treasurer, F. O. Safford, Denver Gas & Electric Co., Denver, Col. Annual convention, Glenwood Springs, Col., September.

Conference Club. Secretary, Sullivan W. Jones, 19 West 44th St., New York City.

Commercial Section, N. E. L. A. Secretary, R. H. Tillman, Baltimore, Md.

Eastern New York Section, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

Electric Hoist Manufacturers' Association. Secretary-treasurer, W. C. Briggs, Shepard Electric Crane & Hoist Co., New York City.

Electric Furnace Association. Secretary, Dr. C. G. Schluederberg, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Electrical Manufacturers' Club. Secretary, F. L. Bishop, Hartford Faience Co.

Electrical Supply Jobbers' Association. General secretary, Franklin Overbaugh, 411 South Clinton St., Chicago, Ill., Annual meeting, Del Monte, Cal., May 12-14.

Electrical Manufacturers' Club. Secretary, F. L. Bishop, Hartford Faience Co.

Electrical Supply Jobbers' Association, Atlantic Division. Secretary, E. Donald Tolles, 52 Broadway, New York City.

Electrical Supply Jobbers' Association, Pacific Coast Division. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

Electrical Trade Association of Canada. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

Electric Power Club. Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

Electric Vehicle Section, N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York City.

Empire State Gas and Electrical Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York City.

Florida Engineering Society. Secretary, J. R. Benton, Gainesville, Fla.

Illinois State Electric Association. Secretary-treasurer, R. V. Prather, Springfield, Ill.

Illuminating Engineering Society. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

Indiana Electric Light Association. Secretary, Thomas Donohue, Lafayette, Ind.

Industrial Electric Heating Association. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

Institute of Radio Engineers. Secretary, Alfred N. Goldsmith, College City of New York, New York.

International Association of Municipal Electricians. Secretary, C. R. George, Houston, Tex.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria Street, Westminster, London, S. W., England.

Iowa Section, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

Jovian Order. Jupiter (president), Arthur J. Binz, Houston, Tex.

Kansas Public Service Association. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

Michigan Section, N. E. L. A. Secretary, Herbert Silvester, Ann Arbor, Mich.

Minnesota Electrical Association. Secretary and treasurer, Meyer Barnert, St. Paul, Minn.

Mississippi Electric Association, affiliated with the N. E. L. A. Secretary, E. S. Myers, Vicksburg, Miss.

Missouri Association of Public Utilities. Secretary-treasurer, F. D. Beardslee, 315 N. 12th St., St. Louis, Mo.

National Association of Electrical Contractors and Dealers. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin. Annual convention, Baltimore, Md., Oct. 6.

National Association of Electrical Inspectors. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

National Electric Light Association. Executive assistant to president, M. H. Aylesworth, 29 West 39th St., New York City. Annual convention, Pasadena, Cal., May 18-21.

National Electrical Credit Association. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

National Fire Protection Association. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

Nebraska Section, N. E. L. A. Secretary-treasurer, B. H. Conlee, Nebraska Gas & Electric Co., Beatrice, Neb.

New England Electrical Credit Association. Secretary, Alton F. Tupper, 15 State St., Boston, Mass.

New England Section, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

New Mexico Electrical Association. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

New York Electrical Credit Association. Secretary, Franz Neilson, 120 Broadway, New York City.

New York Electrical Society. Secretary, George H. Guy, 29 West 39th St., New York City.

Northwest Electric Light and Power Association, affiliated with N. E. L. A. Secretary, W. E. Herring, 860 Stuart Bldg., Seattle, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 13-16.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

Oklahoma Utilities Association. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City.

Pacific Coast Section, N. E. L. A. Secretary, A. H. Halloran, Rialto Bldg., San Francisco, Cal. Annual meeting. Hotel Del Monte, April 7-9.

Pennsylvania Electric Association, State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg Pa.

Public Service Association of Virginia. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

Public Utilities Association of West Virginia. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

Radio Club of America. Secretary, T. J. Styles, 1112 S. Curtis Ave., Richmond Hill, Queens Borough, N. Y.

Rocky Mountain Association of Municipal Electricians. President, Lawrence Stone, Denver, Col.

Society for Electrical Development, Inc. General manager, J. M. Wakeman, 29 West 39th St., New York City.

Society for the Promotion of Engineering Education. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

South Dakota Electrical Power Association. Secretary-treasurer, L. V. Schneider, Salem, S. D.

Southeastern Section, N. E. L. A. Secretary-treasurer, Charles A. Collier, Georgia Railway & Power Co., Atlanta, Ga.

Southern California Electrical Contractors and Dealers' Association. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

Southwestern Electrical and Gas Association. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex. Annual convention, Galveston, Tex., May 13, 14 and 15.

Southwestern Society of Engineers. Secretary, C. E. Barglebaugh, 721 First National Bank Building, El Paso, Tex.

Technical and Hydroelectric Section, N. E. L. A. Secretary, W. C. Anderson, 29 West 39th St., New York City.

Toronto Electrical Contractors' Association. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

Tri-State Water and Light Association. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual convention, Atlanta, Ga., May 19-21.

Vermont Electrical Association. Secretary-treasurer, A. B. Marsden, Rutland, Vermont.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

Western Society of Engineers, Electrical Section. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

Wisconsin Electrical Association. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis. Annual meeting, Milwaukee, Wis., March 24 and 25.

Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 75 New York, Saturday, March 13, 1920 *Number* 11

Research a Vital Necessity

FEW greater mistakes can be made than to put industrial research into the luxury class. The poorer concern needs it even more than its prosperous competitor. Shortages and wastes of materials are reduced by adequate investigation, labor productivity is enhanced and community wealth is enlarged.

Foreign Trade Appropriation

IT WAS gratifying to be able to report last week that the House of Representatives was decidedly opposed to the cut in appropriations for foreign trade made in committee. Just when the foreign trade of the world is beginning to feel the old competitive influences surely should be the time for increasing rather than reducing the helpful support given by the government through the Bureau of Foreign and Domestic Commerce. We are glad that the House has set itself against the penny-wise and pound-foolish viewpoint of the bill as reported by its appropriations committee.

Importing Electrical Energy

REFUSAL by the Connecticut Public Utilities Commission to permit an industrial company to build a transmission line to the Massachusetts border for the purpose of importing electricity is further recognition of the monopolistic rights of a public utility in the territory it serves. Such a decision by a utilities commission is not only to be expected by a distributing company but it is essential to the future development of networks built in the expectation of a return on the investment through obtaining the business which will arise from the increase in the demands of the district and the loads of new industries as they are established.

Service or Failure?

THERE is a lesson for electrical jobbers in the recent action of a Cincinnati soap concern which has announced that it will sell direct to dealers in New England. When asked for the reason the answer of an official was: "We are merely trying to attend to our own competition rather than trust it to the jobbers." The wholesale grocers, it seemed, were not fully co-operating with their natural allies, the manufacturers. Not only did many wholesale grocers have their own private brands, but they were in the market constantly as buyers of job lots of merchandise which they sold in competition with the goods of manufacturers for whom they acted as distributing agents. The complaint was made that the majority of jobbers' salesmen were merely order takers and that manufacturers' salesmen and not the jobbers sell the bulk of their output. Regardless of the right or wrong of this particular case, it deserves the attention of every jobber who is honestly trying to give manufacturers service—which in this case means better distribution than the manufacturer could give himself.

Standardization in Electrical Supplies

WITH the formation by the Associated Manufacturers of Electrical Supplies of a standards committee another strong factor will enter into the effort to eliminate those freaks in design whose chief merit lies in being different. Already, through the committee work of the American Institute of Electrical Engineers and through the American Engineering Standards Committee, much has been done in standardization along strictly scientific and engineering lines. The committees of the International Electrotechnical Commission which meet in Brussels the latter part of this month are working in the same direction with representatives of all countries. It thus remains for the Electric Power Club and the Associated Manufacturers of Electrical Supplies to translate standard recommendations into actual design specifications. This, it is hoped, will be one function, if not indeed the main one, of the new standards committee that will deal with electrical supplies. Otherwise there is danger that it may become a debating society, with postponement of standards ratification as its main accomplishment.

Purchasing Power of the Farmer

THE agricultural department of the University of California has estimated that the average gross income of the farmers of the United States is $6,000. It is customary to estimate about half the gross income as necessary to cover expenses, including labor, whose compensation might usually be said to bear a fixed ratio to the income of the farmer. This leaves only $3,000 as an average profit, which, when considered as representing interest on an investment averaging about $30,000 as well as the labor return to the farmer himself, is not large. Nevertheless, the increase in income has more than kept pace with increased living costs, and the effect is felt in purchasing power. The standard of comfort has always been high in Western agricultural districts, where more electricity is used than in any other farming district in the country, and the increased prosperity of the present year is shown in even larger demands for energy and larger sales of electric appliances. Figures recently published by the Bureau of the Census indicate that the central stations of California during the year 1917 generated 2,746,000,000 kw.-hr. of electrical energy as against 661,000,000 kw.-hr. in 1907, an increase of 315 per cent. Figures for last year are not yet available, but informal reports indicate a largely increased rural load.

Public Service Securities and the Consumer

THERE is food for thought in testimony recently given before the California Railroad Commission by a prominent savings bank official of the Pacific Coast. Savings banks, said this authority, alluding especially to conditions in California, are in the field for investments of a conservative kind yielding a growing rate of interest, a large portion of their investments in real estate mortgages having been paid off or amortized. The securities of public utilities have not in the past been in high favor, despite their natural attractiveness, owing probably to the deterrent influence of a few historical examples on the wrong side particularly among street railways—for investors do not always discriminate. Regulation by the public service commissions, however, is doing much to deprive such traditions of any force, and capital should flow to the utilities provided that they are not outbidden by other enterprises offering an equal degree of security and a higher rate of interest.

The consumer is more vitally interested in this aspect of public service than the investor. The latter can find other outlets for his money, but unless the public utility can attract to itself enough capital to stabilize its business and provide funds for extensions and improvements, the consumer cannot get the service he desires.

How closely public prosperity is bound up with that of the utilities was brought out in another statement of the witness, to the effect that the banks in the southern part of California are loaning heavily in the agricultural communities of the northern part. The development of farm lands in that section depends largely upon hydro-electric power for irrigation. If there shall be assurance that the supply of energy will be sufficient to meet the demand, the banks will not only lend on the land but will purchase the securities of the utilities and advise their clients to do likewise. This again is an indication that additional generating capacity where needed will help all along the line.

A Solution in the Three-Phase, Four-Wire System

THE inherent characteristics of the three-phase, four-wire system of distribution have compelled many central-station engineers to give serious consideration of its advantages in replacing systems that have been outgrown by the demands of their territory. The economy effected in the use of copper and the ability to regulate satisfactorily both single-phase and three-phase loads are advantages that in themselves recommend the adoption of the three-phase, four-wire system for new installations. When it becomes necessary to make some changes to accommodate the increase of load beyond the capacity of an existing system, the three-phase, four-wire system offers usually other advantages. A sufficient number of these point to its adoption as the best means of rehabilitating a system.

Some of these advantages are: The use of the same substation transformers as in the old system by reconnection of their terminals; the possibility of regulating twice the amount of power with the same regulators by connecting the regulator coils in parallel instead of in series; the use of the same switches and other equipment in the substation; a gain in total kilowatt capacity of the duct line by carrying more load in each duct; the use of the same cable if of sufficient insulation; the use of the same spacing of the wires on the poles and a saving in the number of wires necessary on account of the increased voltage, and the use of the same distribution transformers for the single-phase load. That some or all of these advantages are usually realized is shown by the fact that the three-phase, four-wire system of distribution has stood the test of the scrutinizing analysis of central-station engineers and has been adopted in many places with success. Moreover, this system offers a method of obtaining greatly increased line capacities without large outlays of capital. Under present conditions this is an important consideration.

How Manufacturing Companies Can Teach the Teacher

MANUFACTURING companies which have tried through permitted addresses made by their representatives at educational institutions to impress upon students the merits of particular wares have met little success. This has been due partly to the inability of commercial representatives or even of designing engineers to present their subjects impartially, clearly and interestingly and partly to the fact that a detached lecture, not connected with the rest of the course, does not leave much impression. Would it not be better if an organized effort were made by the leading electrical manufacturers and the principal operating companies to teach the teacher rather than to try to reach the student directly? This teaching of teachers is already being attempted in a sporadic and unsystematic way through brief summer courses offered by some large companies and through the promiscuous distribution of commercial literature most of which goes into the wastebasket without being read. We venture to suggest two other means that ought to prove much more effective.

One suggestion is that periodic trips to prominent colleges of engineering be made by broadly educated and competent engineers connected with the leading manufacturing and operating concerns. These men should not address the students but should have conferences with teachers only. A prominent designer of transformers may prove to be an ineffective speaker before a class of students, but a group of professors and instructors sitting with him around a table could elicit from him a large amount of valuable and inspiring information. What is particularly important, they would get the correct point of view as to the relative importance of the various subjects that they teach.

The other suggestion would be for the preparation of literature to go to the teachers—special information, blueprints, diagrams, operating and testing instructions, reports on difficulties in operation, interesting phenomena, etc. Such literature is ordinarily sent to the company's engineers only. The information usually conveyed in the bulletins and catalogs so generously sent to teachers is of little use to them, because the machinery is always shown covered and no real hint is given as to the principle on which it operates.

The problem of closely connecting colleges of engineering with industry has many sides. Teaching the teacher is only one of these. It is one, however, which has been neglected. This is the time of organized efforts, and the electrical industry should without further loss of time provide regular channels through which teachers of engineering could get practical, reliable and up-to-date information concerning their specialty.

Electric Ranges and Distribution

THE effect of electric ranges on the laying out of distribution systems is taken up elsewhere in this issue in a short article by H. P. Seelye. The author gives suggestions for coping with the new situation brought about by the large number of range installations being made everywhere and makes the best use possible of the available information on the load characteristics of these ranges. This information is still quite incomplete and will remain so until additional data are collected.

Mr. Seelye points out the way in which all distribution problems should be attacked. He dismisses the old-fashioned haphazard design with no definite thought of the future development of the region to be served and no appreciation of the economic laws governing such undertakings. He begins by clearly stating his problem—the actual conditions and the necessary assumptions. This is the first requisite of an engineering problem and an essential step toward a correct solution. He then eliminates the factors that do not affect his analysis, such as right-of-way, poles, cross-arms, etc. Finally he devotes his attention to wire and transformers, finding the combination of these that will give the smallest annual charges under satisfactory service conditions. The analysis is based on a theoretical determination of the economical wire size, transformer spacing and transformer size for the load densities expected as limited by an assumed maximum allowable voltage drop. Then these theoretical findings are translated into practical entities under modification by the physical conditions of the problem at hand. Finally, having reduced to known quantities all the factors that could be so treated, the author applies his best judgment to the treatment of those factors that do not lend themselves to exact analysis and gives us the final solution of his problem.

It is to be hoped that the engineers who deal with these problems will soon be in a position to give us more definite information on the load factor and diversity factor of electric ranges. This information is essential to produce correct design of the distribution system that is to handle that load.

Paralleling Synchronous Frequency Changers

WHEN an alternating-current distribution network operating at one frequency, such as 25 cycles, is associated with a similar neighboring network operating at another frequency, such as 60 cycles, the two cannot be directly connected. Such a connection would produce a combination network operating at both frequencies and give rise to various difficulties, especially in the operation of motors. In order to bring the two networks into co-operative relation they are coupled through one or more frequency changers. The ordinary frequency changer consists of a pair of synchronous machines, one for 25 cycles and the other for 60 cycles per second, when running at the same speed, clamped rigidly together on the same shaft. Power then tends to be absorbed by one of the machines as a synchronous motor and delivered to the other as a synchronous generator through the common shaft. Frequency-changing sets require to be synchronized both on the motor and generator sides. Once set in action, however, they may continue to run for long periods continuously, with little superintendence.

The operation of a plurality of frequency-changer sets in parallel sometimes reveals curious actions. It may happen that two sets operating in parallel may apparently refuse to divide the load evenly between them. One of them may insist upon carrying an unduly large share. This peculiarity may usually be traced to some mechanical or electrical dissymmetry between the sets. A surprisingly small amount of mechanical dissymmetry in construction may involve a very noticeable amount of electrical dissymmetry in action.

The subject of controlling the division of load between parallel frequency-changer sets is discussed this week by Errol B. Shand. Five different methods of control are described. These different methods are by no means equally convenient or effective, but their relative merits are considered. The methods numbered three and five will probably be regarded as the most easily effected in an ordinary case.

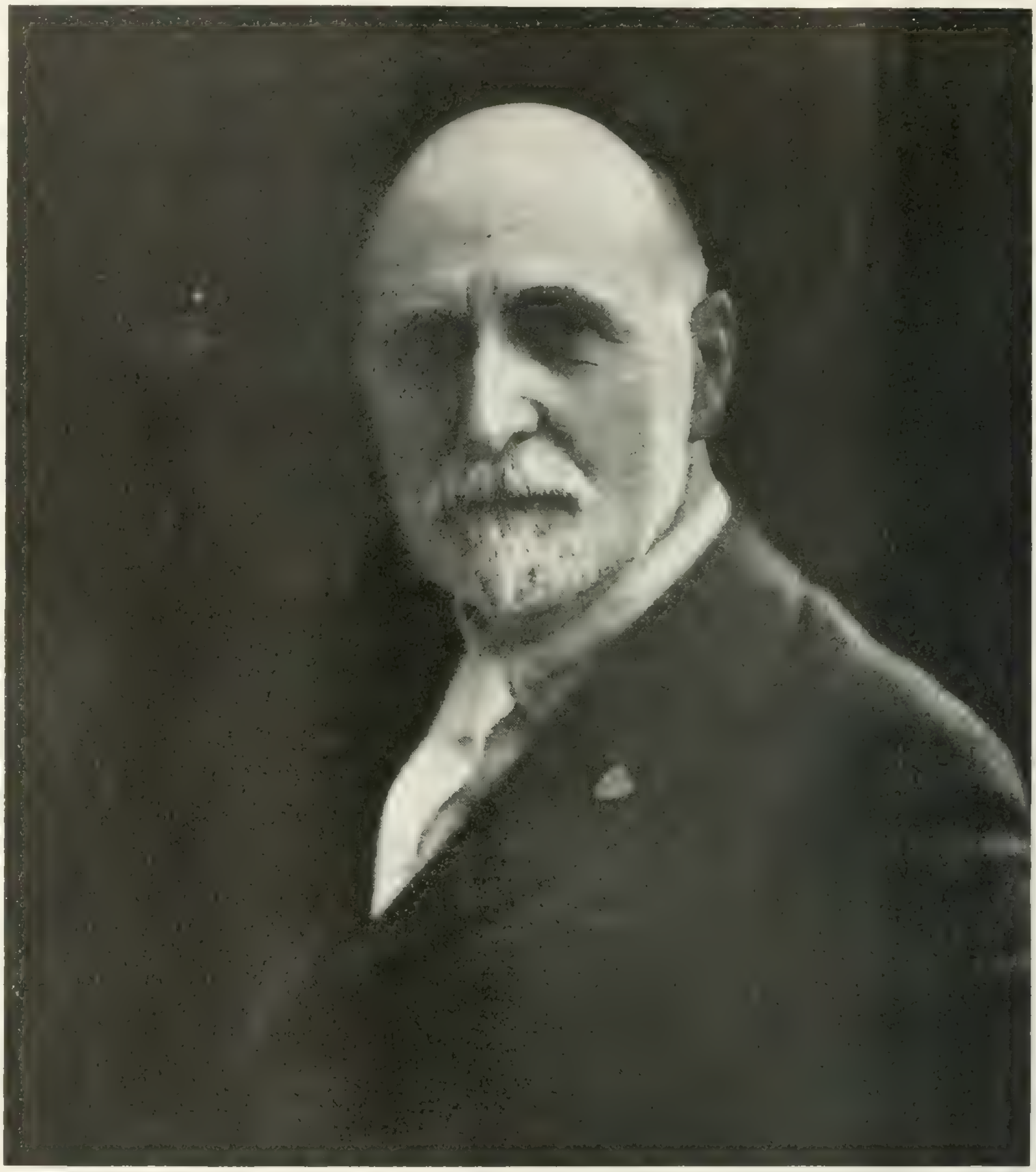
Meter Installation Tests

METERS installed on customers' premises require to be checked or tested at certain intervals in order to make sure that they are in proper working order. The expense of these routine tests is, in the aggregate, considerable and constitutes a very appreciable fraction of the total cost of metering to the central station. Moreover, state utility commissions frequently require such tests to be made within a short time after an installation is complete.

From the central-station standpoint, meters are much more likely to under-record than to over-record when they go wrong; so that errors, in the long run, tend to work against the company. The magnitude of the loss sustained increases with the size of the installation and the meter recording on it. Consequently it is most economical to test large meters at frequent intervals and to test small meters at long intervals. From the point of view of the customer, it is desirable, for his satisfaction, that the meters should be tested at regular and fairly frequent intervals.

The article of R. A. Keller which we print this week, and which is an abstract of a paper on the subject recently read before the Illinois State Electric Association, makes a plea for less frequent tests of the smaller induction meters and for the abolition of the first installation tests of such meters. The paper gives statistical tables of installation tests and of regular routine tests of meters of a number of types and sizes taken collectively. The results conform fairly well to the laws of accidental errors in free distribution. The data reported on the 2,473 installation tests indicate an average rate of nearly 100 per cent, with a probable error of about 1 per cent. The data reported on the 4,614 routine tests indicate an average rate of about 99.1 per cent, with a probable error of about 2 per cent. The data tend to show that the general run of the meters covered by the routine tests was slow nearly 1 per cent and had nearly double the probable error of the newer meters in the tests.

It is clearly to the advantage of the utility companies, the consumers and the state commissions that systematic records should be maintained of all meter tests made. From careful study of such records much can be learned for the benefit of all interested.



Alex Dow

A pioneer in the operation of large generating stations, an authority on rates and an advocate of the Golden Rule policy in dealing with the public

"I BELIEVE that the proper policy of electric light management under the conditions of the present is to sell electrical energy to every accessible user in any shape that the user requires and at the lowest price which will pay a reasonable profit on the capital invested." This statement was made by Alex Dow in a paper bearing the title "Electric Lighting for Profit" which he read at a meeting of the Northwestern Electrical Association at Milwaukee, Wis., on Jan. 19, 1898. He was then manager of the Edison Illuminating Company of Detroit, furnishing direct-current service through Edison tubes. When that company and the Peninsular Electric Light Company were consolidated to form the Detroit Edison Company, in 1903, this policy of providing electrical energy for any use and in any quantity was adopted by constructing the famous Delray power house. It has since been maintained, and the system output has increased from 14,600,000 kw.-hr. in 1904 to 872,500,000 kw.-hr. at the end of 1919. During that period Mr. Dow, as president and general manager of the Detroit Edison Company, has made detailed studies of possible economies in central generating stations and of rate schedules. He has also shown a marked leadership in perfecting relations with the public. The results of his own experience and details of his policies Mr. Dow has given liberally through the N. E. L. A. He has served twice as vice-president, in 1906 and in 1916, and as member of the public policy and executive committees. He also served as president of the Association of Edison Illuminating Companies from 1906 to 1908. Mr. Dow is one of a small group of men now living and in control of metropolitan public utilities on whose sound judgment, practical experience and operating and management ideals it may be said that the present high quality of central station service in this country has been built.

Pulverized Coal in Central Stations

Tests of Its Uses in Furnaces Showed 80 Per Cent Efficiency—No Clinkering of Coal, No Cleaning of Fires, No Smoke—Load Fluctuations Easily Handled

By JOHN ANDERSON

Chief Engineer of Power Plants, Milwaukee Electric Railway & Light Company

EARLY in 1918 the Milwaukee Electric Railway & Light Company decided to determine the feasibility of burning pulverized coal and made a trial installation on one of the 468-hp. boilers in its Oneida Street power plant. After certain changes were made the installation proved so successful that four more boilers of the same size were similarly equipped. The powdered coal fuel installation constitutes practically one-half the boiler capacity of the plant and is sufficiently large to compare directly with the other boilers in this station having underfeed stokers. The latter are subjected to practically the same operating conditions as the boilers under which the pulverized fuel is burned.

With the Lopulco system applied to the five boilers, the gross efficiency of the boiler and furnace burning dry pulverized 12,810-B.t.u. (1,460 cal. per kg.) coal was 80.67 per cent over a test period of four days compared with 76.8 per cent efficiency for the stoker section of the plant. The boilers were subjected to regular normal operation except that the rating was held at practically a constant figure of 120 per cent and no special effort was made to obtain an efficiency which would not be obtained under normal plant operation.

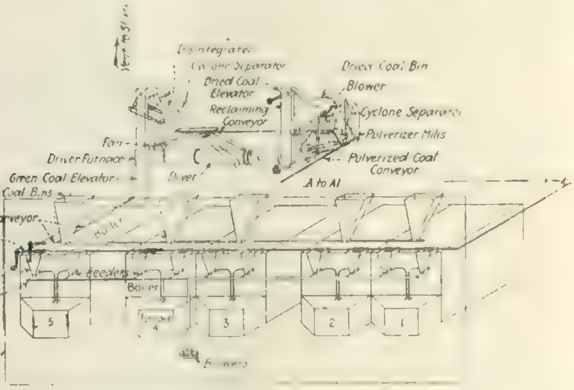


FIG. 1—ISOMETRIC LAYOUT OF PULVERIZED FUEL INSTALLATION IN MILWAUKEE

Screenings are delivered to the station by barge, run over an automatic scale, discharged onto a short-belt conveyor equipped with magnetic-separator pulley for removal of tramp iron and then into a Peck carrier which conveys them to the green-coal storage bunkers. From this point the green coal is conveyed and elevated to a Jeffrey disintegrator, where it is prepared for drying by being crushed, discharged into a small storage bin and fed to the dryer. The dryer is of a double-shell type and is so arranged that the gases exhausted from it are discharged through a cyclone separator where coal dust carried from the shell is reclaimed and conveyed to the pulverizers. The gases discharged from the separator are vented into the smokestack. The dried coal is carried from the dryer discharge by a bucket elevator to the dry-coal storage bins, to which are connected the pulverizer feeders. The pulverizers are of the five-roll Raymond type. Pulverized coal from the mill outlets is carried by screw conveyors to the pulverized-fuel storage bins. Screw feeders take the fuel to the air-mixing chamber, from which it is blown in to the furnaces.

After observing the tests Paul W. Thompson, technical engineer of power plants for the Detroit Edison Company, said: "The boiler-room operation was indeed much simpler than is obtained with a stoker installation. The rate of steaming of the boiler is controlled by varying the speed of the feeder motor and adjusting the damper to take care of the different quantity of flue gas. It is unnecessary to look into the furnace at frequent intervals, as is the case when firing with stokers and where holes in the fire or heavy spots must be corrected. Variations in the kind and quality of fuel burned seemed to have no effect on the operation except that when feeding at a constant quantity the rating of the boiler varied with the heating value of the coal.

Many inconveniences experienced with stokers are eliminated. They include break-downs in the stoker itself, breaking up of clinkers, loosening clinkers, con-

TABLE I—TEST OF FIVE 468-HP. BOILERS USING PULVERIZED COAL

Oneida Street power plant of the Milwaukee Electric Railway & Light Company, Nov. 11-15, 1919

DIMENSIONS	
Number and kind of boilers	Five Edge Moor water-tube boilers
Kind of furnaces	Lopulco pulverized fuel burning furnaces
Volume of combustion space, per boiler, cu ft	1,678
Water heating surface, sq ft, per boiler	4,680
Superheating surface, sq ft per boiler (approximate)	594
Kind and size of coal	Mixture of 50 per cent Youghiogheny screenings and 50 per cent Eastern Kentucky screenings
AVERAGE PRESSURE, TEMPERATURES, ETC.	
Steam pressure by gage, lb. per sq in	167.8
Temperature of steam leaving superheaters, deg Fahr	441.9
Temperature of feed water entering boiler, deg. Fahr	156.6
Temperature of escaping gases, deg. Fahr	496.6
(a) Temperature of flame above hearth, deg. Fahr	2,767
(b) Temperature of furnace bottoms, deg Fahr	2,180
Draft under damper, inches of water	0.173
Draft in furnaces, inches of water	0.031
Air pressure at blower, inches of water	6.36
(a) Pressure of air mixing with coal at screw feeder, inches of water	6.00
(b) Pressure of air and coal mixture above burner outlet, in. of water	1.00
HOURLY QUANTITIES AND RATES	
Slag, ash and refuse (dry, laboratory basis) per cent	11.90
(a) Withdrawn from furnace bottom, pounds per hour per boiler	19.8
(b) Withdrawn from tubes, flues and combustion chamber, pounds per hour per boiler	20.0
(c) Blown away with gases, pounds per hour per boiler	176.8
Percentage of total lost with gases	82.8
Percentage of combustible in slag from furnace and ash recovered from combustion chamber, per cent (combined analysis)	6.9
Factor of evaporation	1.1473
Dry coal per hour per boiler, lb.	1,796
Water evaporated per hour per boiler, lb. actual	16,666
Equivalent evaporation per hour from and at 212 deg Fahr per sq ft of water heating surface, lb.	4.09
CAPACITY	
Percentage of rated capacity developed	18.4
ECONOMY	
Equivalent evaporation from and at 212 deg. Fahr. per pound of coal, as received, lb.	9.879
Equivalent evaporation from and at 212 deg Fahr per pound of coal, dry, lb.	10.649
GROSS EFFICIENCIES	
Gross efficiency of boiler and furnace, per cent	80.67
Efficiency of furnace, per cent	99.79
ANALYSES OF FLUE GASES	
Carbon dioxide, per cent	12.26
Oxygen, per cent	6.82
Carbon monoxide, per cent	0.00

ANALYSES OF COAL

	As Received	As Fired	Dry
Calorific value of 1 lb. of dry coal by calorimeter, B.t.u.			12,810
(a) Moisture	7.23	0.67	.....
(b) Volatile	32.13	34.40	34.63
(c) Fixed Carbon	49.60	53.11	53.47
(d) Ash	11.04	11.82	11.90
(e) Sulphur separately determined referred to dry coal			1.62

Analyses of	Slag	Combustion Ash Retained	Combustion Ash Lost
(a) Moisture	0.00	13.00	
(b) Combustible	0.59	13.76	Unknown
(c) Earthly matter	99.41	86.24	

FEATURES OF HEAT BALANCE CALCULATED BY A.S.M.E. METHOD

Loss due to evaporation of moisture in coal, per cent	0.06
Loss due to combustible in ash, per cent	0.18
Loss due to combustible carried away with flue gases, unconsumed hydrogen, hydrocarbons, radiation and unaccounted for, per cent	3.07

tinually watching the fire to maintain correct and uniform thickness, dumping and watching the gas passes of the boiler to prevent large sparks which indicate a carrying away of combustible. From the standpoint of reliability of operation the odds are in favor of the pulverized fuel. This is an item for serious consideration in plants where the losing of a boiler due to stoker trouble at the time of maximum load might make it necessary to drop a portion of the load.

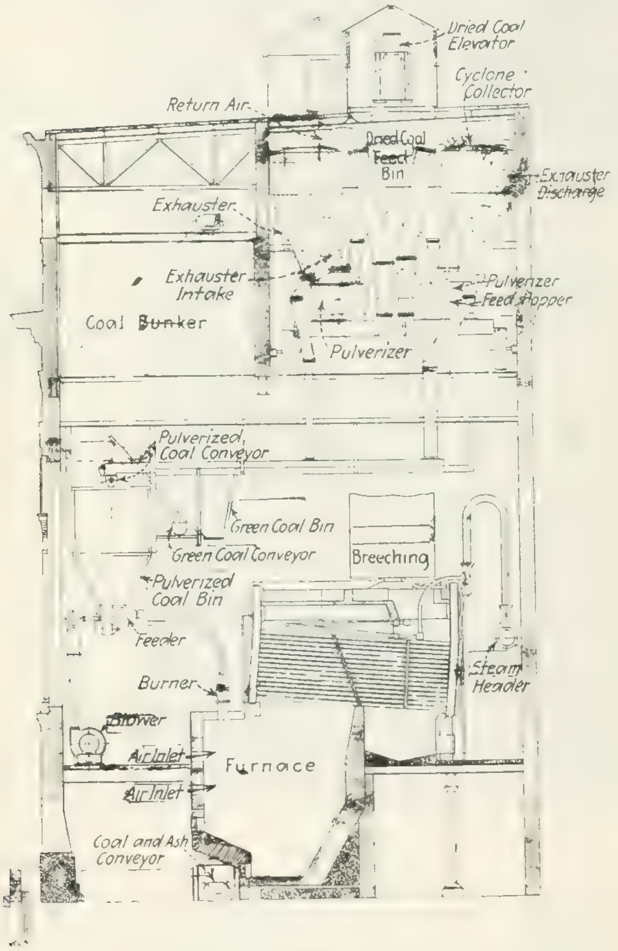


FIG. 2—CROSS-SECTION THROUGH BOILER PLANT USING PULVERIZED COAL

TABLE II—TEST ON FUEL-PULVERIZING EQUIPMENT
November 11-15, 1919

GENERAL CONDITIONS—AVERAGE TEMPERATURES, ETC.	
Vacuum in pulverizers, inches of water, average	5.08
Temperature of coal entering dryer, deg. Fahr	88.2
Temperature of coal leaving dryer, deg. Fahr	137.9
Temperature of coal leaving pulverizers, deg. Fahr	169.7
Moisture of coal entering dryer, per cent	5.59
Moisture of coal leaving dryer, per cent	1.61
Moisture of coal leaving pulverizers, per cent	1.03
Fineness of pulverized coal, 200 mesh, per cent	81.30
100 mesh, per cent	18.20
60 and 80 mesh, per cent	0.5
TOTAL AND HOURLY QUANTITIES	
Coal crushed per hour, as received, tons	17.5
Total coal dried per hour of dryer operation, as received, tons	6.7
Coal pulverized per hour, dry, tons, total	7.90
Grease consumed on all equipment per ton of coal, as received, lb	0.040
Oil consumed per ton of coal as received, qt	0.036
ELECTRIC ENERGY AND COAL CONSUMPTION	
Energy consumed by crusher and green coal elevator per ton of coal, as received, kw.-hr	0.47
Energy per ton of coal, as received, consumed by dryer	1.53
Energy consumed by pulverizer per ton of coal, as pulverized, kw.-hr	17.90
Total energy consumed by pulverized coal conveyors, feeder blowers and feeders per ton of coal as fired	4.00
Energy consumed by all equipment on preparation and firing of pulverized fuel per ton of coal, as received, kw.-hr	22.45
Coal used in dryer furnace per ton of fuel dried, lb. (based on coal as received)	25.66
Total coal and equivalent consumed in preparation and firing of one ton of pulverized fuel, lb	59.34

"On several occasions during the first and second day of the test, slagging occurred in the furnace due to not admitting a sufficient quantity of air. The direct cause of this was the over-anxiety on the part of the men conducting the test to obtain a higher percentage of CO_2 in the flue gas. The reduction in the excess air permitted the furnace temperature to rise to a point where slagging occurred. The removing of this slag from the bottom or floor of the furnace twice every twenty-four hours presented more difficulty than is usually experienced in removing the refuse from the ash hopper of a stoker-fired boiler. The slag had to be broken up and pulled out before it fused to the brick lining of the furnace. It appeared, however, that this formation of slag could have been almost entirely eliminated by a more frequent inspection of the floor of the furnace and the admitting of more air through the openings in the front of the furnace when it was found that slag was beginning to form. Even at times of removing this slag it was possible to maintain the rating on the boiler by increasing the coal feed. This practice resulted, however, in a decreased efficiency during the cleaning period, which lasts about forty-five minutes every twenty-four hours for each boiler.

"A large portion of the ash resulting from combustion is carried through the passes of the boiler and out of the stack. Owing to the fineness of this ash it is apparently carried a considerable distance even in a moderate wind. Throughout the test there was a moderate wind blowing probably between 4 and 8 miles (6 km. to 13 km.) per hour, and there was no noticeable deposit in the streets even during the periods of blowing the deposit of ash from the boiler tubes, which was done three tmes a day, requiring about twenty minutes per boiler for each blow. At no time during the test was there any tendency for slag to form on the tubes of the boiler. The flues were blown down once every eight hours during the test. Back-chamber ash was removed once every two days."

Mr. Thompson did not believe that the efficiency obtained with the use of pulverized fuel exceeded that which had been obtained from the best stoker practice under constant boiler rating. However, he said: "Under normal operation the elimination of the many variable conditions entering into stoker operation should result

TABLE III—COST COMPARISONS BETWEEN PULVERIZED FUEL AND MECHANICAL STOKERS

	Pulv.-Fuel System	Modern Stoker
ELECTRIC ENERGY AND FUEL CONSUMPTION PER TON OF COAL BURNED		
Energy consumed by conveyors, crusher, elevators, dryers, fans and feeders, kw.-hr	5.73	*10.94
Energy consumed by pulverizer, kw.-hr	16.72	......
Total energy, kw.-hr	22.45	10.94
Coal equivalent at 1.5 lb. per kw.-hr., lb	33.68	16.41
Coal consumed in dryer furnace, lb	25.66	......
Total coal and equivalent, lb	59.34	16.41
COST OF FUEL PREPARATION, FIRING AND ASH DISPOSAL		
Labor†—coal preparation	$0.143	$0.000
Labor—firing	.112	.140
Labor—ash removal (in plant)	.025	.064
Dryer fuel—coal at $4 per ton	.051	.000
Electric energy—coal per kw.-hr. at 1.5 lb	.068	.033
Maintenance:		
Labor at 3.6 cents, material at 2 cents (manufacturer's estimate), lubricants at 0.7 cents	.063	......
Labor at 4.6 cents, material at 4.9 cents, lubricants at 0.2 cent	......	.097
Total cost of fuel preparation, firing, ash disposal and maintenance	.462	.334
Price of coal as purchased, per ton	4.000	4.000
Total cost, per ton	4.462	4.334
Cost per ton of coal in pulverized fuel system over modern stoker	.128	......

*Stokers and blowers.

†Based on the labor required to pulverize coal sufficient for five boilers through a twenty-four-hour run per day.

in higher all-day efficiency for the pulverized-fuel installation. Over-all efficiencies of boiler, furnace and grate as high as 82 or 83 per cent have been obtained on test with stoker-fired boilers, but normal operation day in and day out seldom exceeds 76 per cent in the very best practice where highly skilled help is employed in supervising the boiler-room operation. The gross over-all efficiency of boiler and furnace of 80.67 per cent as obtained from the results of this test, would unquestionably have been higher had the boilers been cleaned prior to the test. Each boiler had been in operation prior to the test approximately 600 hours after being entirely cleaned, and three of the boilers had been in operation approximately 300 hours since cleaning the first four rows. As the boiler-feed water consists of approximately 90 per cent untreated water, the scale formation in the tubes tended to give a lower efficiency than would have been obtained if the boilers had been clean."

The results obtained in this pulverized fuel-burning plant, where the equipment was installed and made to fit into an old plant originally equipped with stokers, are so gratifying that the Milwaukee Company has decided to use this kind of fuel in a 200,000-kw. station now being built. There are many improvements which can be made in the new plant, especially in the design of furnace, location of drying and coal-pulverizing equipment, method of coal handling, drying and pulverizing, method of ash handling, slag prevention and possibly of using waste gases for the drying of fuel, all of which will have an effect on the efficiency.

The tests which are given here were conducted by engineers of the Milwaukee (Wis.) Electric Railway & Light Company under the direct supervision of Fred Dornbrook, of the engineering department assisted by Messrs. Schubert and Mistele.

Head of Philadelphia Utility Champions Aggressive Policy

IN SUBMITTING to the stockholders of the United Gas Improvement Company a plan to authorize $15,000,000 of cumulative preferred stock at 7 per cent, of which more than $6,000,000 would be at once offered to the present stockholders at par, constituting a 10 per cent allotment, President Samuel T. Bodine expresses his belief in the wisdom of public utilities in growing communities adopting a vigorous policy of improvement as the proper way to meet present financial conditions, despite the stringent nature of the present money market. He says:

"It is the policy of the state utility commissions and municipal authorities to discourage establishment of competing companies where the existing company gives good service and extends its plant to care for new business offered at remunerative rates. War conditions have narrowed the market for securities of gas and electric companies, largely because the increased cost of labor and materials entering into the production of gas and generation of electric energy have not been fully offset by increases in the rates that have been allowed by public authorities.

"Your directors believe it is wise now to make provision against a possible continuance of these conditions for two or three years by creating a security so attractive to our stockholders and others that it will find a ready market."

Alex Dow, On the Business Outlook

Sees a Busy Year Ahead with Need for Higher Rates if Operating Conditions Are Not More Favorable

ALEX DOW, president of the Detroit Edison Company, foresees a busy year in 1920 and justification for pushing the constitution program.

"All the indications which guide us in making estimates for the future lead to the belief that 1920 will be a busy year, and they amply warrant us in pushing our construction program," says Mr. Dow in his report to stockholders for 1919. "We have more new business under contract and more inquiries and prospects than at the end of any year in our history. The generating plants are more than fully loaded. The new turbogenerator now being erected and its companion, which should be in service in May, will be needed before they are ready."

Among other subjects which Mr. Dow discusses are the rate situation and the elements entering into the high level of the operating ratio. He says:

> No changes in our rates were made in 1919. Our attitude as to possible increases of rates has remained as expressed by us in our report a year ago, namely, that while our rates are apparently too low, we deem it better to let their readjustment lag somewhat and be based on proved conditions than to risk error in making premature changes. The margin between income and outgo is certainly inadequate at the present time. If the new year shall not bring more favorable operating conditions, a substantial increase in rates will be in order.
>
> The operating ratio remains very high, being 68.9 per cent. Last year the ratio was 67.2; in 1917, 63.8, and in 1916, 54.5. That this figure should have continued to increase is a disappointment. We did not deceive ourselves into expecting in 1919 any fall in prices of fuel and other supplies, or in the wage rate, but we did expect an opportunity to redress certain inefficiencies of production which developed during the two war years. That opportunity did not come. There was no lessening of the demand upon our power houses, not even during the period while local industries were changing from war work to their ordinary work; and after that period there was a continuous increase in the demand, with the result that the steam plants (including reserve machines) have been running fully loaded and, latterly, overloaded. The arrival of new equipment which would have given a much needed relief was postponed by strikes in factories producing such equipment and by delayed release of manufacturing facilities and raw material which had been held for war uses. The first of two 30,000-kw. turbines, contracted for three years ago, arrived in Detroit in Christmas week of 1919.
>
> In 1916 our plants attained their highest mechanical efficiency, and our operating organization was at its best both as to method and as to personnel. We have every expectation of restoring during 1920 the good mechanical conditions of 1916, and we have already, under difficult conditions, made a good start toward re-establishment of the efficiency of organization which was impaired during the war by the absence of so many good men and is still disturbed by the readjustments sequent upon their return.
>
> This company at the present time is paying the highest wage rates it has ever paid. The Detroit scale has always been above that of similar industrial districts and considerably above the average for the country; and this company's scale has been a little above the local scale. The quick resumption of all industrial activities after the war, and continued increase thereof, and the release of many building and public works projects which had been deferred for two years or more, have served to maintain and to raise these wage differences.

Paralleling Synchronous Frequency Changers

Five Methods Are Outlined for the Control of Load Division Between Synchronous Frequency-Changer Sets—Some Schemes Give Good Approximate Results, While the Effect of Others Depends Upon the Load

By **ERROL B. SHAND**
Wilkinsburgh, Pa.

THE growth of systems operating at both 25 cycles and 60 cycles has brought about the considerable use of synchronous frequency-changer sets. With the present tendency toward interconnection of electrical systems, moreover, the application of such motor-generator sets should be increased. In this article the general principles upon which load division of alternating-current machines depends are first outlined and these principles are then applied to the consideration of five specific means of controlling load division between frequency-changer sets operating in parallel. While some of the methods are not in practical use, it is worth while to consider their characteristics.

PHASE DISPLACEMENT AND LOAD DIVISION

When two alternators driven by prime movers are operated in parallel, the portion of the kilowatt load taken by each machine is dependent upon, generally speaking, the governor settings of the two prime movers, any deficiency of magnetization in either machine to carry this portion of the load being supplied by magnetizing currents from the other alternator.

In the case of two synchronous frequency-changer sets operating in parallel on both the incoming and outgoing lines it is somewhat different, for the speed of the generator of each set is controlled from the same source, namely, the frequency of the incoming line. However, it should be realized that it is not as if both generators were coupled rigidly together, but rather they might be considered as driven from a common source each through a slender shaft admitting considerable torsional strains or angles of twist, these strains being proportional to the torques developed in the respective shafts. Such an arrangement is shown in Fig. 1. When the two generators *A* and *B* are operated thus in parallel the distortion of the shaft is one of the factors producing stable operation.

One of the principles governing the parallel operation of synchronous machines is that if there tends to be difference of phase angle between the terminal emfs. of two machines in parallel, a power component of current will circulate between them, increasing the load on that machine whose phase angle tends to advance, and decreasing the load on the other. Applying this principle to the case in question, if one machine tends to advance in phase position, the increased load will produce a corresponding increased torsional strain in its shaft, causing the poles to drop back until the terminal voltage coincides with that of the other machine, which will have advanced in phase position by the reverse process.

This torsional effect just mentioned in connection with the motors is also found in the generators. It will be referred to as "phase displacement of voltage with load," or simply "phase displacement," and its causes are armature reaction and inductance.

Fig. 2 (a) is the ordinary vector diagram for an alternator where:

E_{ta} = terminal voltage.
I_a = line current, which is assumed to be in phase with E_{ta}.
Ix_a = reactive drop in the armature due to reaction and self-inductance.
E_{oa} = the voltage which would be generated with the same field excitation on open circuit and corresponds in phase to the position of the poles.

If the terminal voltage on open circuit be assumed to be in phase with the pole position, under the load assumed it will have a lagging phase displacement behind the pole by the angle α_a. Ix_a and α_a will increase roughly as the load for a given power factor. It follows from this that in both generator and motor there are phase displacements with load which cause the terminal voltage to lag behind its relative open-circuit position for the generator and vice versa for the motor, and that this angle per unit load depends upon the inherent characteristics of the machines.

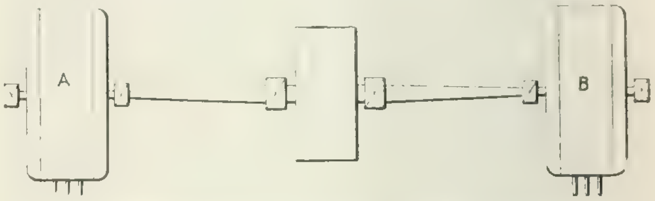


FIG. 1—MECHANICAL EQUIVALENT OF TWO ALTERNATORS IN PARALLEL

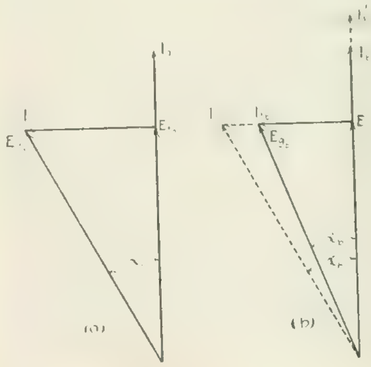


Fig. 2

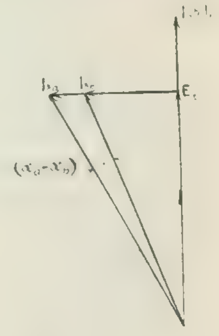


Fig. 3

FIG. 2—LOAD DIVISION DEPENDS UPON INTERNAL VOLTAGE DROP.
FIG. 3—ANGLE OF STATOR SHIFT FOR LOAD DIVISION

To show how these characteristics control the division of the load, compare diagrams (a) and (b) of Fig. 2. Equal loads are represented in the two cases. but the reactive effect and angle of displacement are considerably greater in (a) than in (b). Assuming that these diagrams represent the total effective characteristics[1] for both motor and generator of each of two frequency-changer sets, *A* and *B*; when these are paralleled α_a must equal α_b, therefore the load on *B* must increase at a corresponding faster rate than that on *A* by the ratio of I_b/I_a. In other words, the load will divide in the ratio of the respective loads per unit of phase displacement.

This fact is of considerable practical importance, for in the design of a frequency-changer set required to operate in parallel with another, the inherent characteristics should be made to correspond with those of the other sets unless external means are used to obtain the proper distribution of load.

Consider for a moment the phase displacement of a 25-60-cycle set. Owing to the difference of the mechanical angle subtended per pole on the two machines, a displacement on the 25-cycle motor transmitted by the shaft to the 60-cycle generator will be increased by the ratio 2.4:1. Thus, if the motor has a displacement of 20 electrical degrees, this becomes 48 electrical degrees when referred to the generator, and if the latter has an added displacement of 20 electrical degrees, the total displacement will become 68 electrical degrees at the generator or 28.3 electrical degrees at the motor. From this it will be seen that the lower frequency machine at a set is the more effective in producing displacement for the whole set.

FIVE METHODS OF REGULATING LOAD DISTRIBUTION

This may be considered in two ways—first, a periodic or continual operation of some device to compensate for various conditions of the load; second, a permanent adjustment of the apparatus or auxiliary apparatus to make an average compensation over the working range of the machines in parallel. Some of the methods outlined below are applicable to one way, some to the other and one or two to both. The methods are as follows:

(1) Rotation of the stator of any machine about its axis.

(2) Angular change of the pole position electrically with respect to the rotor.

(3) Connection of a reactor in series with the armature of one or more machines.

(4) Use of an "out-of-phase" booster direct-connected to a set.

(5) Variation of the field excitation of any or all of the machines included in the sets.

LOAD DISTRIBUTION BY ROTATION OF STATOR

This method of load regulation is the one in general use at present and is employed in nearly every case in the manner of a permanent adjustment. The frame is constructed so that it can be moved through a small mechanical angle in a cradle formed by the frame feet. With the numerous synchronizing positions possible[2] it is not necessary to provide for a movement of more than from 4 to 6 mechanical degrees, and once the adjustment of the stator is made it is not expected to require any further attention.

Such an arrangement allows the variation of the phase angle of the generated, or open-circuit, voltage of one set with respect to that of another. If two sets have similar characteristics, this angular difference will be adjusted to zero; but if one set *A*, whose characteristics represented by diagram (a), Fig. 2, are more "drooping" than those of *B*, Fig. 2 (b), the stator of *A* must be advanced by the angle $\alpha_a - \alpha_b$, as is shown in Fig. 3, to get equal distribution at the load considered. The angle $\alpha_a - \alpha_b$ is constant regardless of the load, so that at no load or light loads there will be circulating currents flowing between the two machines. At greater loads than the one indicated the load on *B* will increase beyond that taken by *A*.

In certain detached cases frame rotation has been used for occasional variation of load distribution, the movement being effected by motor-driven worm gears.

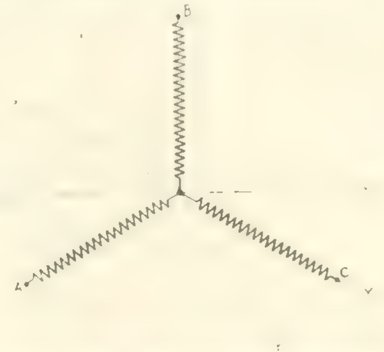


FIG. 4—SHIFTING OF POLAR POSITION

Thus the phase angle corresponding to $\alpha_a - \alpha_b$ can be varied as desired to suit the load conditions of the moment. Although such variation of load distribution is electrically desirable, this modification has not been used to any great extent, owing to the mechanical complications involved. Large forces are brought into play both when the auxiliary apparatus is in normal operation and, to a much greater extent, on occasions of short circuit where the frame must be held against abnormal torques produced by the short-circuit currents in the stator windings.

ANGULAR CHANGE OF POLE POSITION

If, instead of rotating the stator as in the last case, the angular position of the poles be changed with respect to the rotor, the same result will be accomplished. Consider this as follows: If a direct voltage be impressed on the collector rings of a wound secondary induction motor, we shall have, in fact, a synchronous motor with a distributed field winding: and if the direct currents in the various phases of the whole winding can be controlled to duplicate the instantaneous values of current of any period of a polyphase cycle, we shall have a motor in which the pole position can be revolved through any number of electrical degrees with respect to the rotor.

Let *A*, *B* and *C*, Fig. 4, be three terminals of a three-phase rotor winding, and let a direct voltage be impressed across the terminals *A* and *BC* (*B* and *C* being short-circuited), and the resultant poles will be along the axis *X*, *Y*. If the voltage be impressed across *A* and *B*, the pole axis will be X_1, Y_1. If the terminals *AC* and *B* be used, the pole axis will become X_2, Y_2. Thus by simply changing the terminals we can revolve the poles in steps of 30 electrical degrees. With the addition of rheostats the steps may be cut down as small as desired, giving control of the voltage displacement relations of the armature over the entire range of angular position.

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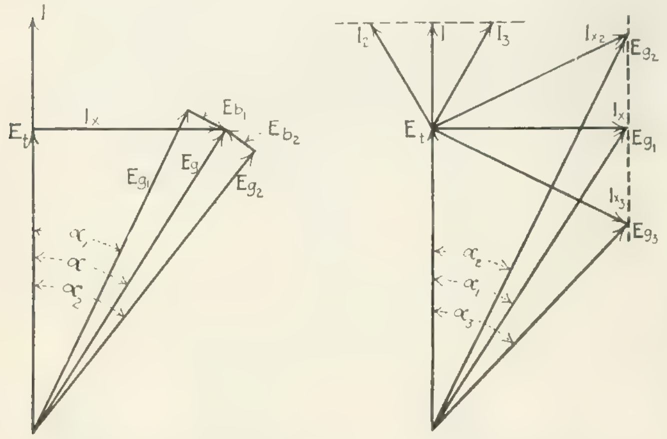
[1] It should be distinctly understood that the term "effective characteristics" does not fully express the conditions to which it refers, for it assumes the total reactance of the two machines to be combined in the circuit of one machine and its voltage to be induced with its phase relation corresponding to the load current of that machine, whereas the voltages generated in the motor and generator circuits have different phase relations even when the power factors at the terminals of the two machines are the same. The term is only used here to avoid complications in explanations and diagrams.

[2] "Parallel Operation of Frequency-Changer Sets," F. D. Newbury, *Electrical Journal*, November, 1916

Such a method of control has certain disadvantages: For instance, the rotor with a distributed winding has inherently less space for the exciting winding than a salient-pole machine which necessitates a heavier and more expensive construction; it further requires a rheostat to handle a large portion of the exciting current. For these reasons the method remains, for the present at least, no more than a theoretical possibility.



FIGS. 5 AND 6—SYNCHRONOUS BOOSTER AND FIELD EXCITATION METHODS OF LOAD CONTROL

By connecting external reactance in series with one set its inherent characteristics may be changed and the desired load division secured. On examining diagrams (a) and (b) of Fig. 2 it will be noticed that if the armature reactance drop Ix_b were increased by a drop Ix_e in an external reactance of such a value that $Ix_b + Ix_e = Ix_a$; then for equal loads the effective reactive drops for the two sets will be equal and then characteristics will have been rendered similar by external means. As a corollary, it may be stated that it is immaterial whether the reactance be wholly in the generator or partly in the generator and partly external to it, as long as the total reactance is the same in both cases. Furthermore, if the reactance be made variable, the load distribution between two sets may be varied within certain limits.

To show roughly the effect of an external reactance, suppose two 25-cycle-60-cycle frequency-changer sets of similar characteristics to operate in parallel. For the same given loads the motors will have a phase displacement in each case of perhaps 20 electrical degrees, and the generators also have a phase displacement of possibly 20 electrical degrees at this load; then the total effective displacement in each case will be $20 \times 2.4 + 20 = 68$ electrical degrees on the 60-cycle end or 28 electrical degrees on the 25-cycle end. If a 10 per cent reactance be then added in one motor circuit, the displacement of this machine will increase from 20 deg. to 25 deg. and that of the whole set from 68 to 80 electrical degrees on the 60-cycle end. This will cause a ratio of load division of 54:46, or a difference of 8 per cent of the total load. This rough calculation is worked out under the assumption of a load current at 100 per cent power factor. It will be understood that a change of power factor will modify such results to a certain extent.

Consider, now, the application of a direct-connected synchronous booster placing the booster rotor on the same shaft with the other machines of the set but with its poles displaced 90 deg. out of phase with respect to those of the machine whose voltage it is intended to modify. In such a case the excited booster will generate an out-of-phase voltage, producing an effect similar to that of reactance in series with the armature except that it may be either ahead or behind the main generated voltage and is always 90 deg. to it rather than to the load current.

A 15 per cent voltage booster will give a 8.5-deg. displacement of voltage either lag or lead, where, perhaps, 30 or 35 deg. corresponds to full load on the main machine; and if these values be applied to the motor of a 25-cycle-60-cycle set, the change of load distribution will be about 20 per cent in either direction.

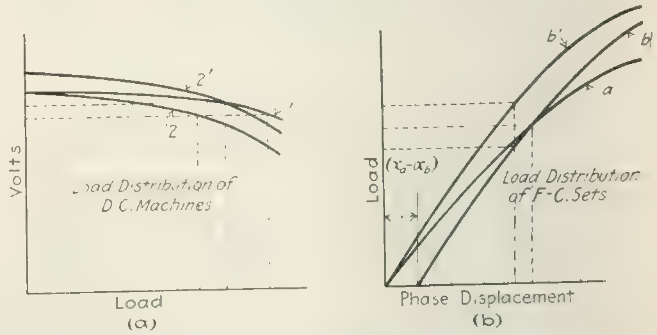
The reactance of the booster armature windings will have the effect of increasing the reactance of the motor; it is, therefore, desirable to keep the inherent reactance of the booster fairly low. Fig. 5 represents the motor and booster diagram.

Ix = the reactance voltage for both motor and booster armatures.
E_g = the generated voltage with booster inactive; E_{g_1} with booster boosting and E_{g_2} with booster bucking.
E_{b_1} = the boosting voltage.
E_{b_2} = the bucking voltage.
α, α_1 and α_2 = the various displacement angles under the three conditions.

Thus with the load kept constant the displacement can be given the range of from α_1 to α_2.

One point of difference may be taken up here which applies both to this condition and that of stator rotation and change of pole position as compared with the series reactance. For a machine of given effective inherent characteristics the angular displacement will vary with the load, and the first group of methods will not change this, but simply a constant initial angle is added to or subtracted from the displacement according to the adjustment.

In the second case, or that of adding a series reactance (which also applies for the reactance of the booster armature), the effective inherent characteristics of the machines or combinations of machines are changed; thus there will be a difference in the displacement angle for a given load regardless of any initial angular adjustment. Consider an analogy of two direct-current machines operating in parallel, of which the regulation characteristic curves are (1) and (2), Fig. 7. To change the distribution of load and increase the share taken by (2), some extra series field turns might be added to this generator, thus changing the



(a) (b)

FIG. 7—LOAD DIVISION OF FREQUENCY-CHANGER SETS MAY BE ACCOMPLISHED AS WITH DIRECT-CURRENT GENERATORS

characteristics of the machine. This would be equivalent to subtracting some of the equivalent reactance of a frequency-changer set; in other words, the "droop" of the curve is actually changed.

On the other hand, the shunt-field amperes of generator (2) might be changed to give the regulation curve (2′). This is an adjustment which will give the average distribution required over a certain operating range, which corresponds to the first group or adjustment methods of load distribution control for frequency-changer sets. This type of control may be made as flexible as desired, but it will remain a means of adjusting a definite initial value and not a change of inherent characteristics.

CONTROL BY VARIATION OF FIELD CURRENT

To explain this method, consider the vector diagram of a synchronous motor, Fig. 6: E_t = the terminal emf. I_1, I_2 and I_3 = three different load currents, all representing the same amount of power. Ix_1, Ix_2 and Ix_3 = the three reactive drops corresponding to the three values of current. Subtracting these values from E_t, we have E_{g_1}, E_{g_2} and E_{g_3}, and the corresponding angles of displacement α_1, α_2 and α_3. Now the assumption for all cases is that the in-phase components of current (and the power) are equal; therefore it is shown that for a given torque the displacement of the motor can be varied by varying the field excitation. For instance, assume that the motors of two similar frequency-changer sets are to have a combined power factor of 100 per cent. One motor may be operated with a current relation of I_2 and the other of I_3, one lagging and the other leading by equal amounts so that the combined effect will give a power factor of 100 per cent. For equal loads the displacement of the two motors will be respectively α_2 and α_3. For a concrete example with 25-cycle-60-cycle sets, take $\alpha_2 = 20$ deg. and $\alpha_3 = 32$ deg., and take the displacement of either generator for this load to be 25 deg.; then the total displacements for the two sets will be respectively 73 deg. and 102 deg. at the 60-cycle terminals. Therefore, assuming that the power factors of the two motors are kept as indicated, the loads will divide roughly as 58 per cent and 42 per cent, or a difference of 16 per cent.

If care were taken to design machines with the object of this type of control in view—that is, with high reactance and large field excitation capacity—the limits for relative change of load distribution might be increased still more.

Generally speaking, there is little to be gained in applying this method to the generators of the sets as well as for the motors, for when the kilowatt load is decreased on one generator the kilovolt-ampere load increases in almost the same proportion. However, in the case of heating of the field windings of one generator, relief might be applied by transferring some of the magnetization to the other generator and keeping the same kilovolt-ampere distribution as before by an equivalent inverse transfer between the two motors.

Effect of Ranges on Distribution Layouts

Distribution Engineering Applied in a Community Where Every House Has an Electric Range Shows How This Load Can Be Handled Most Economically

By H. P. SEELYE
Distribution Department, Detroit Edison Company

THE rapidly increasing use of electric ranges has introduced a new consideration into the problem of secondary distribution, and one which may eventually predominate. In districts where gas is not readily available for cooking—as in rural communities, some small towns and certain sections of larger cities—coal ranges are rapidly being displaced by electricity. This is especially true of sections where the houses are all new and of the better class. In such places nearly 100 per cent range load may be expected as soon as the houses are occupied. In older sections the change is more gradual, a new installation being made here and there from time to time, although it is probable that eventually these districts also may approach 100 per cent.

On secondaries with residence lighting load only and no cooking load the density of loading ordinarily may range from zero up to 20 kw. per 1,000 ft. (304 m.) of line, being ordinarily about 15 kw. for a well built-up district of the better class of single residences or two-family flats. Where a few ranges are interspersed with a large number of lighting services the peak load will not be increased very greatly since the heaviest range load will come during the day when the lights are off and can be cared for by the installations provided for the lighting load. Of course, the peak is affected somewhat, since in the winter months during the lighting peak the range load will overlap for a short time. As the number of ranges increases they become an increasingly important factor in the total load. When all or nearly all of the services have ranges the distribution system must be designed for the range load primarily and lighting load becomes of secondary importance. The load density in such a case must be figured considerably higher than for the lighting only. The diversity factor for range load is high, owing to the variations in the time of using different ranges and in the number of elements used at one time on any one range. On some tests recently made the average load per service was found to be about 2 kw. per range for five ranges of about 5 kw. rating each. The average load no doubt decreases with an increase in the number of ranges considered. Probably from 1 kw. to 2 kw. would be a fair average load to assume, depending on the number of such services. This would give a load density of 40 kw. to 60 kw. per 1,000 ft., which is two to three times greater than for lighting only in similar districts.

In the older districts mentioned, where the range load is "spotted" here and there, each new installation must be considered separately. The secondary wire is already in place and usually, especially when it is No. 4 or greater, it would be uneconomical to change it. In order to supply satisfactory service the transformer must be near enough to the range for good voltage conditions. It is impossible to make any general rules as to transformer spacing, as it is impossible to know when or where ranges will be installed next. Rules should be adopted as to the maximum distance allowable from transformer to range for each size of secondary considering the probability of there being other ranges in between. When a range is installed, if too far from a present transformer, a new transformer must be installed or an old one moved to care for it, providing at the same time for proper service to other neighboring ranges and to the lighting load as well. The size of transformer must also be adjusted to the change. In some cases it may be found economical to increase the size of secondary wire instead of installing an additional transformer. The economy of such a change should be determined, however, by a careful consideration of the annual cost of each type of installation, including the additional cost of making the change. It is seen that the problem in this case is one of providing satisfactory service for the individual load as it comes on rather than one of economical installation over a period of years to care for a general class of loading.

Specific Problem Encountered in New Community

Eventually in these older districts the range service will be frequent enough so that the load may be considered as uniformly distributed load of high density. This also is the condition met with in new sections as mentioned above. A good example of a problem of this kind was recently encountered and cared for as follows: A large manufacturer purchased a tract of land in the vicinity of his plant, subdivided it into lots 50 ft. by 125 ft. (15 m. by 38 m.) and proceedel to erect residences which he sold to his better paid employees, heads of departments, etc. As no gas service was available it was expected that practically every house would install an electric range. Such has since proved the case. The first section of houses built was in two blocks, each about 900 ft. (274 m.) long, or a total of 1,800 ft. (548 m.). The houses face on two streets with an alley between, giving, with 50-ft. (15-m.) lots, forty services 1,000 ft. apart, each pole carrying four services. The expected load was assumed as shown above to be 40 kw. to 60 kw. per 1,000 ft. In order to get an indication of the sizes of wire and transformers to be used, the problem was first attacked on a purely theoretical basis. The voltage was 220-110 volts, three-wire secondary. After comparing the annual costs on line transformers and energy losses, it was determined that the most economical size of wire would be, for a load density of 40 kw. per 1,000 ft., 54,400 circ.mil; for a load density of 60 kw., 66,600 circ.mil. No. 2 wire with a cross-sectional area of 66,370 circ.mil seemed to be the nearest available size. For No. 2 wire the most economical size and spacing of transformers would be: For load density = 40 kw., 31-kw. transformers, 784 ft. (239 m.) apart; for load density = 50 kw., 36 kw. transformers, 600 ft. (183 m.) apart.

It was decided that 25-kw. transformers spaced 600 ft. (183 m.) apart would be the best design, since an even spacing would be thus secured over the 1,800 ft. (548 m.) of secondary in question; that is, a transformer 300 ft. (91 m.) from each end and one-half way between. Since the full range load was not expected immediately, 10-kw. transformers were first called for in the two end positions with the center one omitted. As the load builds up the additional transformer and larger sizes will be added. This is sufficient to care for a load of 42 kw. per 1,000 ft. If the load goes beyond that, still larger sizes can be installed in the same locations.

This layout brings up two rather evident questions—first, as to the comparatively small size of transformer and short spacing for such load; second, as to whether a No. 4 wire would not be advantageous with such short spacing. In order to keep the voltage drop under 3 per cent, the transformer spacing must not be more than 825 ft. (251 m.) for 50-kw. density or 900 ft. (274 m.) for 42 kw. per 1,000 ft. on No. 2 wire. It was found that the annual cost of an installation of 50-kw. transformers at 900 ft. (274 m.) was about 15 per cent greater than 25-kw. units at 600 ft. (183 m.). No immediate size between 25 kw. and 50 kw. was available at the time. Likewise it must be remembered that a high diversity factor was used in determining the expected load. For good service the voltage conditions must be such as to care for the customer furthest from the transformer. With four services per pole the load transmitted to the farthest pole would probably be as high as 10 kw. at times. This would greatly reduce the spacing possible when the load is uniformly distributed. The same consideration would affect the use of No. 4 wire. If the load were uniform at 50 kw. per 1,000 ft., transformers could be spaced 680 ft. (207 m.) apart on No. 4 wire with 3 per cent drop. However, with No. 4 secondary and 25-kw. transformers, the savings in annual cost at 42-kw. load density is only about 2½ per cent, and it was considered more advantageous to obtain the better voltage conditions and greater adaptability to still larger loads by use of No. 2 wire rather than to save this amount.

The consideration of the economical aspects of such a problem involves the use of prices of copper, transformers, energy, etc., as they are at present. A change in those prices at some future date might give a somewhat different layout, but it has been found that a considerable variation would be required in order to affect the results. Moreover, the assumptions as to the character of heavy range loads may be considerably changed when more definite information is obtained as to the result of actual tests on such load. The building project which gave rise to the above problem is only the beginning of a program of considerable extent which when completed should be a fertile field for the study of such problems.

Heavy Range Development May Change Distribution Standards

It is easy to see that if the use of electric ranges becomes anywhere near universal in urban districts, present standards of distribution must be revised considerably. Larger sized secondaries will be called for than are generally used for lighting load. Probably a greater variety of large transformer sizes than are now necessary on any system will be found advisable, and the whole system of transmission feeders, etc., will have to be adapted to the heavier load. The effect on the load of the central station as a whole would be somewhat like that of a large additional power load with a comparatively low load factor.

An Analysis of Insulator Practice—II

Based on Reports from More than Forty Transmission Companies—Nature, Frequency and Expense of Tests and Inspection—Observed Causes of Failure with Discussions Regarding Principal Ones

THE type and rating of insulators used by more than forty transmission companies on lines operating at 13,000 volts to 150,000 volts were presented in the last issue of the ELECTRICAL WORLD with explanations regarding the operating conditions which determined the practice. In the present issue, information will be given regarding the nature, frequency, expense and effectiveness of insulator tests and inspection, and each company's report regarding observed causes of insulator failure and their remedies will be presented. Particular attention will be given to dead-end failures, effect of alternate exposure to heat and cold, deposits of dust and salt, effect of position of disk in string, preventing injury from arc-overs, use of ground wires, and ratio of puncture to flash-over voltage.

To facilitate comparison, the practices of every company in connection with each subject considered will be discussed as a group. Space does not permit repeating company names so that the key numbers given opposite the companies listed in the last issue are substituted.

Surprising to say, less than 50 per cent of the companies reported make any preliminary tests on their insulators before placing them in service or test them periodically after they have been in operation. Preliminary tests are probably omitted by some either because they are satisfied with the factory tests made by most insulator manufacturers or because the operating companies are not equipped to conduct any more conclusive tests than the factories. Some companies have a representative supervise the factory tests. Tests after the units have been in the service are omitted by some because visual inspection is considered sufficient. Besides, the causes of insulator failure have been almost purely hypothetical so far, and few knew exactly what tests would give information of value. In addition there had been few test methods developed until recently which could be conveniently and effectively used by operating companies outside of a laboratory. Pin insulators are not tested so much as those of disk type, company 38 specifying them according to the recommendation of Messrs. Cunningham and Klauber at the Del Monte (1918) convention of Pacific Coast Section of the National Electric Light Association.

To companies which are not satisfied with their present test method or those which have not adopted any the following résumé of practices may be of value:

Preliminary Tests.—Various methods of making preliminary tests are employed, namely flash-over (wet and dry) at normal frequency, megger, "buzz stick" (see ELECTRICAL WORLD, Sept. 13, 1919, page 1012), Keokuk testers (see ELECTRICAL WORLD, Dec. 6, 1919, page 568), oscillator, puncture test, equivalent porosity test, hot and cold test, etc. Flash-over and megger tests are in predominance, the first being used by companies 14, 20, 24, and 35, and the latter by companies 8,[1] 11A, 15,[1] 21,[2] 30, 32,[3] 34, 35 and 40[6]. The Keokuk tester, "buzz-stick," oscillator and special tests for porosity, puncture and effect of alternate hot and cold are about equally divided among the companies reporting, although the first two methods are so new that they have an opportunity to outclass the others, which have not been adopted more extensively despite the fact that they have been known for some time. These four methods are used by companies 15, 31,[5] 33, 36 and 11 respectively.

Company 1 subjects its insulators to a voltage just under the flash-over value at 60 cycles for five minutes; company 38 subjects insulators not given a factory test to 50-cycle high potential (about 90 per cent of flash-over) until no insulator under test fails during a two-minute period; company 14 occasionally tests at 25 cycles for wet and dry flash-over, and company 20 subjects insulators to dry flash-over at 60 cycles after the units have been soaked in salt water and wiped. Company 30 discards all insulators measuring less than 2,000 megohms, and 33 inspects all insulators for cracks and deformities, using an oscillator at 70 kv. or 20 per cent below flash-over for random samples. Flashing over with an oscillator is believed by company 33 to injure insulators, although company 36 does so for five seconds. Two companies, 12 and 37, have their units of the 66,000-volt class tested by the Electrical Testing Laboratories before installation. In addition company 37 applies normal voltage and frequency. Another company, 14, makes no systematic tests but occasionally picks out ten or a dozen insulators at random and tests their wet and dry flash-over values and observes breakdowns. The routine tests carried out by several insulator manufacturers and relied on by 50 per cent of the operating companies involve a five-minute normal frequency flash-over test, physical inspection to detect cracks and mechanical pull to eliminate defective cementing. Some manufacturers employ a high-frequency test or even combine it with a normal-frequency test. Megger tests are also made by some manufacturers.

Tests After Installation.—For testing the condition of insulators after they have been in service, the following methods rank in the order named as to extent of use: Megger, 8,[8] 9, 11, 11A,[14] 12, 14,[9] 21, 27,[10] 30,[11] 34, 35, 38,[15] and 40; "buzz stick," 1, 5, 7, 8, 11A, 20, 21,[12] 29, 31; Keokuk tester, 14,[13] 15, and 32;[13] telephone receiver, 30 and 39; oscillator, 33; wireless telephone set, 7. With the megger, company 8 tests disks twice yearly

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[1] Failures do not exceed 0.1 per cent between factory and towers.

[2] Will use in future.

[3] Only for 110,000-volt insulators.

[6] For suspension insulators; pin insulators tested at voltage just below flash-over; megger must show 2,000 megohms with fairly favorable surface conditions.

[4] One per cent of insulators subjected to this test.

[5] Immediately after installation.

[7] Suspension insulators of the 10-in. disk variety are given rigid factory tests and inspection according to this company's (38) specification No. 300 under the supervision of a company representative. The operating company believes it is better to incur this expense at the factory, even to the extent of destroying some units, than it is to have insulators of poor quality installed on the lines.

[8] Formerly used.

[9] For experimental purposes.

[10] Not found practicable.

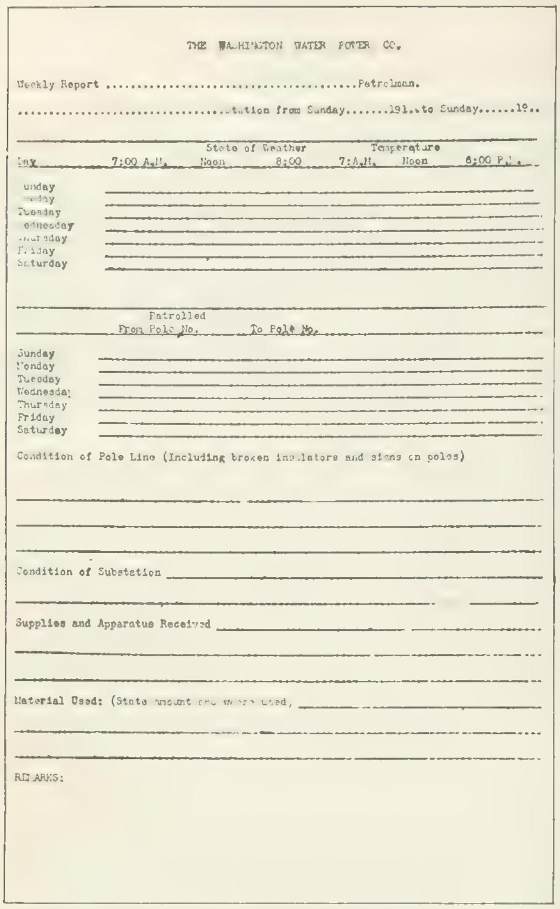
[11] Disk insulators below 2,000 begohms are discarded.

[12] Being investigated.

[13] Patterned after Keokuk tester.

[14] Until last year.

[15] Several other methods are being tried; with the older suspension insulators the defective insulators found by megger test range from one-half of 1 per cent to 29 per cent of the total; with suspension insulators purchased in the last three years the defective insulators found by megger test are almost negligible.



THE WASHINGTON WATER POWER CO.

Weekly Report ....Patrolman.

...................................station from Sunday.......191..to Sunday......19..

Day	7:00 A.M. (State of Weather)	Noon	8:00	7:A.M. (Temperature)	Noon	8:00 P.M.
Sunday						
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Saturday						

	Patrolled From Pole No.	To Pole No.
Sunday		
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		
Saturday		

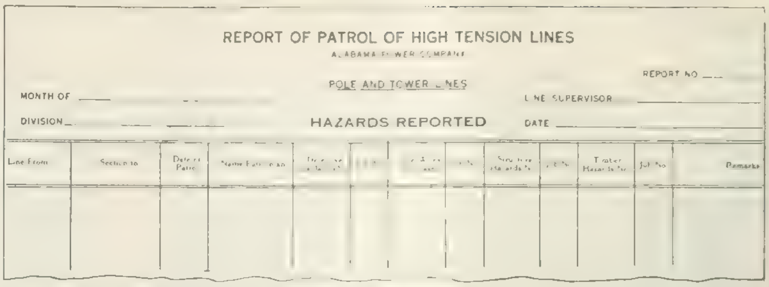
Condition of Pole Line (Including broken insulators and signs on poles)

Condition of Substation

Supplies and Apparatus Received

Material Used: (State amount and where used,

REMARKS:



REPORT OF PATROL OF HIGH TENSION LINES
ALABAMA POWER COMPANY

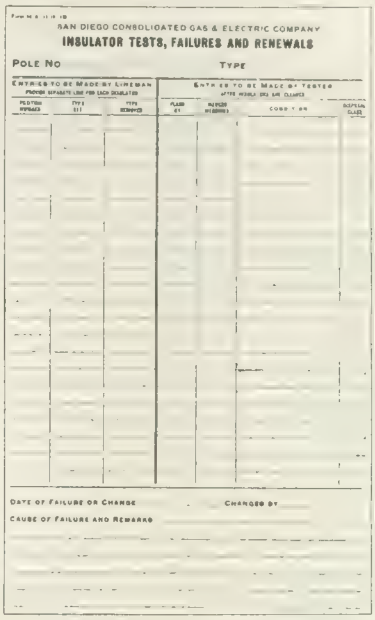
REPORT NO ___

POLE AND TOWER LINES

MONTH OF ______ LINE SUPERVISOR ______

DIVISION ______ HAZARDS REPORTED DATE ______

Line From	Section to	Date of Patrol	Name Patrolman	[illegible]	[illegible]	[illegible]	[illegible]	Structure Hazards	[illegible]	Timber Hazards	Job No	Remarks



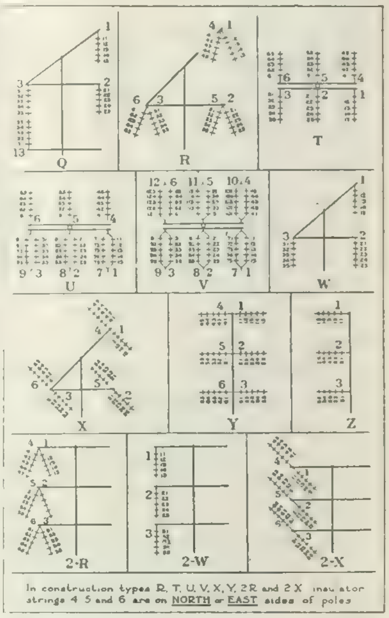
SAN DIEGO CONSOLIDATED GAS & ELECTRIC COMPANY
INSULATOR TESTS, FAILURES AND RENEWALS

POLE NO TYPE

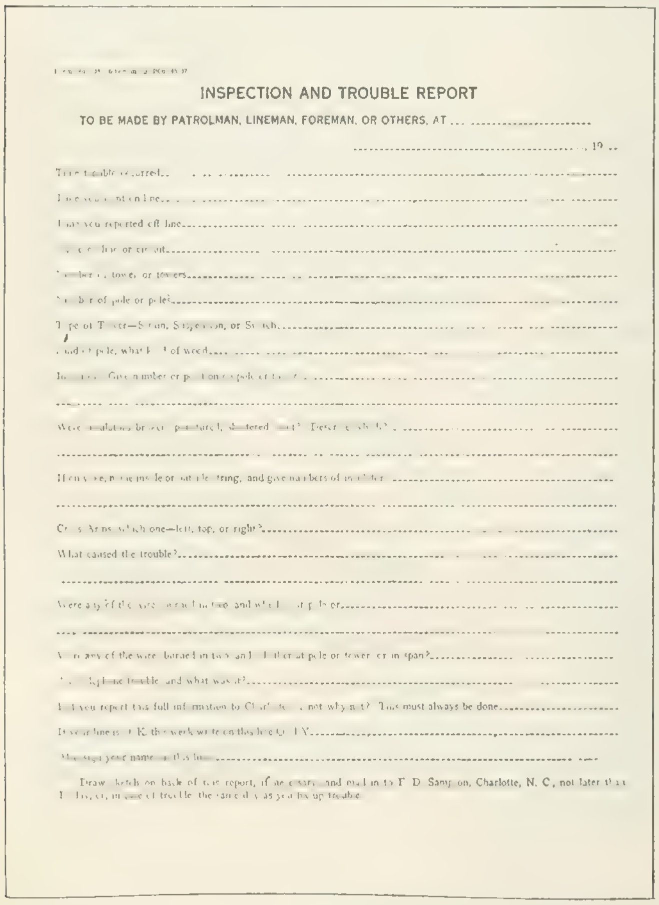
Entries to be Made by Lineman			Entries to be Made by Tester			
Position [illegible]	Type [illegible]	Type Removed	Flash At	[illegible]	Condition	Disposal Class

DATE OF FAILURE OR CHANGE CHANGED BY

CAUSE OF FAILURE AND REMARKS



In construction types R, T, U, V, X, Y, 2R and 2X insulator strings 4 5 and 6 are on NORTH or EAST sides of poles



INSPECTION AND TROUBLE REPORT

TO BE MADE BY PATROLMAN, LINEMAN, FOREMAN, OR OTHERS, AT ....

...., 19 ..

Time trouble occurred...

Time you went on line...

Time you reported off line...

Name of line or circuit...

Number of tower or towers...

Number of pole or poles...

Type of Tower—Strain, Suspension, or Switch...

If wood pole, what kind of wood...

Insulators: Give number or position on pole or tower...

Were insulators broken, punctured, shattered, etc.? Describe which...

If on suspension, mention single or multiple string, and give numbers of insulator...

Cross Arms, which one—left, top, or right?...

What caused the trouble?...

Were any of the wires burned in two and which [illegible] or...

Were any of the wires burned in two and if either at pole or tower or in span?...

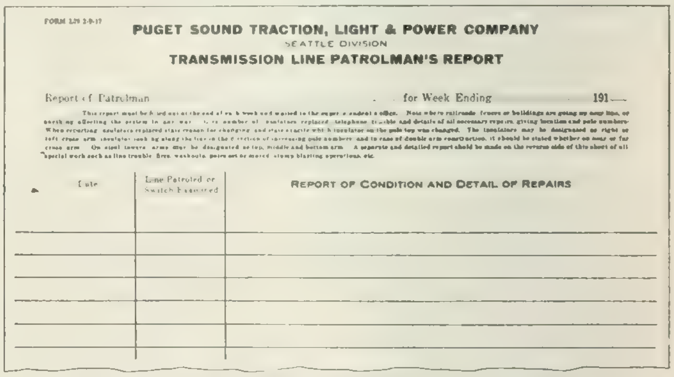
Any telephone trouble and what was it?...

Did you report this full information to Charlotte, if not why not? This must always be done...

If your line is O. K. this week write on this line O. K. ....

Please sign your name on this line...

Draw sketch on back of this report, if necessary, and mail in to F. D. Sampson, Charlotte, N. C., not later than Monday, or, in case of trouble the same day as you fix up trouble.



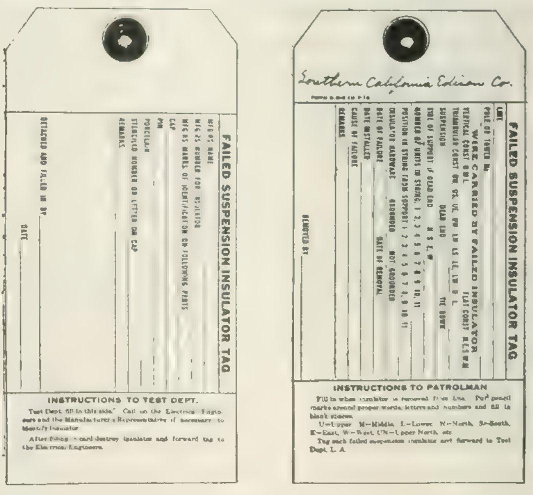
FORM 2/N 2-9-17

PUGET SOUND TRACTION, LIGHT & POWER COMPANY
SEATTLE DIVISION
TRANSMISSION LINE PATROLMAN'S REPORT

Report of Patrolman ______ for Week Ending ______ 191__

This report must be filled out at the end of each week and mailed to the superintendent's office. Note where railroads, fences or buildings are going up near line, or anything affecting the system in any way. Give number of insulators replaced, telephone trouble and details of all necessary repairs, giving location and pole numbers. When reporting insulators replaced state reason for changing and state exactly which insulator on the pole top was changed. The insulators may be designated as right or left cross arm insulator looking along the line in the direction of increasing pole numbers, and in case of double arm construction, it should be stated whether on near or far cross arm. On steel towers arms may be designated as top, middle and bottom arm. A separate and detailed report should be made on the reverse side of this sheet of all special work such as line trouble, fires, washouts, poles set or moved, stump blasting operations, etc.

Date	Line Patroled or Switch Examined	Report of Condition and Detail of Repairs



FAILED SUSPENSION INSULATOR TAG

MFG'RS NAME

MFG'RS NUMBER FOR INSULATOR

MFG'RS MARKS OF IDENTIFICATION ON FOLLOWING PARTS

CAP

PIN

PORCELAIN

STENCILED NUMBER OR LETTER ON CAP

REMARKS

DETACHED AND FILLED IN BY ______

DATE ______

INSTRUCTIONS TO TEST DEPT.

Test Dept. fill in this side. Call on the Electrical Engineers and the Manufacturer's Representative if necessary to identify insulator.

After filling in card destroy insulator and forward tag to the Electrical Engineers.

Southern California Edison Co.

FAILED SUSPENSION INSULATOR TAG

LINE

POLE OR TOWER No.

WIRE CARRIED BY FAILED INSULATOR

VERTICAL CONST U M L FLAT CONST N E S W M

TRIANGULAR CONST UN, US, UE, UW LN LS LE LW D L

SUSPENSION DEAD END TIE DOWN

SIDE OF SUPPORT IF DEAD END N S E W

NUMBER OF UNITS IN STRING, 1 2, 3 4 5 6 7 8 9 10, 11

POSITION IN STRING FROM SUPPORT 1 2 3 4 5 6 7 8, 9 10 11

INSULATOR HARDWARE GROUNDED NOT GROUNDED

DATE OF FAILURE DATE OF REMOVAL

DATE INSTALLED

CAUSE OF FAILURE

REMARKS

REMOVED BY ______

INSTRUCTIONS TO PATROLMAN

Fill in when insulator is removed from line. Put pencil marks around proper words, letters and numbers and fill in blank spaces.

U—Upper M—Middle L—Lower N—North S—South E—East W—West UN—Upper North, etc.

Tag each failed suspension insulator and forward to Test Dept. L. A.

A—SAMPLES OF TRANSMISSION COMPANIES' REPORTS

Left top—Weekly report used by Washington Water Power Company. Left bottom—Inspection and trouble report of Southern Power Company. Right top—Method of reporting line hazards on Alabama Power Company's system. Below are: Opposite sides of report form on insulator tests, failure and renewals used by San Diego Consolidated Gas & Electric Company; transmission-line patrolman's report used by Puget Sound Traction, Light & Power Company; opposite sides of tag used by Southern California Edison Company for faulty insulators.

with the line dead, and 9 and 38 yearly and sometimes twice or three times on bad sections; company 12 tests its 66,000-volt lines with this device. Company 10 does not consider insulators good unless they megger 5,000 megohms when dry, while company 38 says that a megger will satisfactorily pick out cracked insulators after a rain but not so well after a long dry period. No testing of pin-type insulators has been found more practicable by company 9 than to replace all units after maintenance becomes excessive. The removed insulators are subjected to flash-over voltage two to five minutes to weed out bad units, and serviceable ones are re-installed. Other companies remove a quantity of pin insulators after trouble becomes excessive and test the flash-over after meggering. If general weakness is observed, the remainder of the insulators of the same age are removed and tested. Company 29 merely inspects them visually, with the line dead, once a year, whereas company 40 tests them with a small spark coil. Live-line testing is permitted by the "buzz stick," companies 5 and 7 testing 66,000-volt suspension insulators in this way; 8 all disks twice yearly, and 31 yearly and sometimes oftener. The Keokuk tester is used with the line "dead" and is found particularly serviceable at night or when insulators are moist. Company 32 expects to use a device similar to the Keokuk tester for its 110,000-volt line this spring. The telephone receiver is used by companies 30 and 39, with lines "alive," for testing pin-type insulators. The test set employed by company 39 consists of a 2,500-ohm wireless receiver connected in series with a wire leading from the lineman's spurs to a sharp metal point on the end of a bamboo pole. The inspector, standing on the ground, thrusts the sharp metal point in the line pole some distance above the ground; a leaking insulator will disturb the normal hum in the receiver and produce a scratching noise. The defective unit can be located by touching the metal point at different points along the cross-arm. An oscillator test is made every two years by company 33, after visual inspection. Although the megger is rather erratic in detecting faulty insulation, the oscillator will indicate a fault whether the unit is wet or dry. The wireless telephone method will be used by company 7 for 13,200-volt and 33,000-volt lines.

3 FREQUENCY AND METHOD OF INSPECTION

Despite the fact that testing of insulators by operating companies is the exception rather than the rule, practically all inspect the units during service, some more frequently than others. The intervals between inspections range from one day to one year, although two companies (32 and 35) have no fixed period. The most frequent inspections are made on highly important lines, whereas infrequent ones apply to the less important lines, or those on which so little trouble has occurred that inspection is not considered essential. If the lines are along highways frequently traveled by men in discharge of duties, no patrol other than this is made by company 40. On the other hand, some sections of line not otherwise under observation may be patrolled as often as once a week, although the practice of company 40 during the past few years has been to reduce the frequency of patrol and lay more stress on a special inspection by men of greater responsibility than the average patrolman. Patrolmen report defects to the nearest switching station by telephone, and arrangements are made for their elimination through the load dispatcher's office. As practically all the transmission lines of company 18 parallel the company's interurban track, insulator inspection is made by division foremen having charge of overhead as well as transmission lines. These men are supposed to remove a defective insulator immediately if conditions are such that the line can be cleared. Testing and inspection are combined by some companies, 31 for example, whereas others employ visual inspection assisted by field glasses, the inspector walking, or riding on horseback or in an automobile. One company (36) reports that it detects some of its faulty insulators by the noise which they make. Watchman's time clocks are used by company 4 to insure regular inspection. On company 20's system each patrolman inspects 25 to 50 miles of line continuously.

Weekly inspections are in the majority, being adopted by companies 1, 2, 5,[9] 11A, 12,[10] 14,[11] 16,[12] 17, 19, 24, 29,[13] 30 and 36. Bi-weekly inspections rank next, being made by companies 3, 4, 6, 7, 10, 11, 15, and 16.[14] Inspections are made about every three weeks by company 39, the frequency depending on the importance of the line and whether city or suburban. In addition the "telephone" test mentioned in the preceding paragraph is made one to three times a year. Bi-monthly and monthly inspections are equally divided, the first being employed by companies 8, 22 and 33, and the latter by 21, 23 and 33. Daily inspections of 66,000-volt lines are made by company 5, whereas company 12 inspects its lines every day or two. Ten-day intervals are maintained by company 34, quarterly ones by 31 and yearly by 9[12] and 31. Special patrols are made after severe storms by 9 and 19. Occasional inspections at no regular intervals are made by company 3[15] which observes them from the ground. Anything unusual is telephoned to headquarters and later embodied in weekly reports.

Periodic tests and inspections of insulators enable most of the companies to remove from two-thirds to all of their faulty insulators before total breakdown occurs. These reports are based on the ratio of the number of insulators removed before total break-down to the total number that have to be replaced. Six of the companies (3, 12, 20, 21, 22 and 32) report that none or a very low percentage of insulators are removed before breakdown. Of 3,000 pin-type insulators replaced by company 29, twenty were removed after failure and 2,980 before failure. Of 2,000 link-type insulators replaced, twenty-two were replaced after failure and 1,978 before failure. During 1919 the suspension insulators involved in failures on company 38's system, including those removed by megger tests, amounted to 0.06 of 1 per cent of those in service. Many of these were undoubtedly good until destroyed by the failure of one or more other units of the same string. The number of failures was eighty-two, while the number of units destroyed was 286. Nearly all of them were of the older types.

TESTING AND INSPECTION EXPENSE

The cost of testing insulators ranges from 0.8 cents to 18 cents. Leaving out the extremes, which are far from the average, the expense averages 7 cents a disk.

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[9] 22,000-volt and 33,000-volt lines.

[10] 13,200-volt lines.

[11] Or monthly.

[12] Two or more times yearly in bad sections.

[13] Tests all link-type insulators yearly with buzz stick.

[14] Lines along interurban track are inspected by line repairmen; broken insulators and line defects are reported by trainmen, section men, etc.

[15] Lines removed from interurban lines.

A better appreciation of the cost of testing and inspecting insulators can be gained by studying the following compilation and comparing with the operating conditions and methods of test reported:

(1) One and one-half cents per insulator per year for testing.

(8) Eight cents per disk per test, 12 cents per disk per year for inspection.

(9) Eight cents per disk per year for testing eight-unit strings in suspension and ten-unit strings in strain (includes meggering good and bad and replacing faulty ones).

(11) Six hundred and eighty man-hours labor a year for testing 12,000 disk units and locating about 1,200 bad ones (work conducted by four crews, each consisting of patrolman and helper); time includes actual working hours and time lost in taking circuits out of service and restoring service; 640 man-hours per year replacing 1,200 insulators; 160 man-hours per year to and from storeroom.

(11A) $2 per defective unit to test and change defective insulators.

(20) Five and one-half cents per insulator per year by buzz-stick method, testing on tower lines.

(21) $2,280 on 120 miles of high and low-tension line a year.

(29) One and one-quarter cents per insulator per year for testing and inspection respectively.

(30) One and two-tenths cents per unit per year meggering; 7 cents per unit per year inspection.

(31) Eight-tenths of a cent per unit per year testing.

(33) Eighteen cents per disk per year for oscillation tests on 60-kv. tower lines; 10 cents per unit for inspecting pin insulators. The patrol cost per mile of line averages: 11 kv., $6.84; 22 kv., $8.18; 33 kv., $8.34; 60-kv. pole lines, $8.56; 60-kv. tower lines, $8.70.

(34) Six cents per unit per year testing; 12 cents per unit per year replacing.

(39) Ten to 20 cents per unit per year for testing 55,000-volt insulators; approximately 15 cents for inspection.

(X) Eight cents per insulator per year, testing twice.

(36) The cost of testing 75,000 units which had been in service, including the expense of testing and handling 23,000 new units required to replace faulty ones and the labor of testing and handling 15,000 additional units that were added to existing strings, amounted to approximately $25,000. This covered engineering, superintendence, automobile expense and labor—everything but cost of new units. The testing was not done with insulators in place. Instead all insulators were removed from towers and hauled to test camps established along the line about 10 to 15 miles (16 to 24 km.) apart. This method was more expensive than ordinary methods, but had the advantage that it allowed bad units to be changed immediately, and eliminated the necessity of a follow-up crew.

PROBABLE CAUSES OF FAILURE

Such variant answers have been received in reply to the question of "What are the observed probable causes of failure and how do they rank in importance?" that it is difficult to give the consensus of opinion. However, it may be pointed out that temperature changes and differences in expansion of insulator parts, malicious damage by hunters, boys, etc., surges due to line conditions, and lightning, were cited most often by twenty-seven companies in the order named. Porosity of porcelain, absorption of moisture, short-circuits by birds, squirrels, etc., deterioration of finish, dust and salt, and horizontal position of strain insulators were also given as observed causes. Very few believed that failures were due to electrical stresses.

Some companies classify the causes of insulator failure and give them relative weights as follows:

(1) Temperature changes, 90 per cent; lightning, 9 per cent; miscellaneous, 1 per cent.

(4) Lightning, 50 per cent; hunters, boys, etc., 50 per cent.

(5) Lightning, 90 per cent; mechanical, 10 per cent.

(16) Hunters, 80 to 90 per cent; temperature changes and line surges, 10 to 20 per cent.

(23) Hunters, 80 per cent; cracks, soft porcelain and improper ties, 20 per cent.

(24) Hunters, 60 per cent; lightning, 30 per cent; miscellaneous, 10 per cent.

(31) Porosity, 95 per cent; miscellaneous, 5 per cent.

(35) Line conditions, 90 per cent (dust, salt and fog); cleaning greatly reduces.

(37) Lightning, 75 per cent; rifle shots, 20 per cent; miscellaneous, 5 per cent.

Since the reported causes of failure in different parts of the country may influence the insulation of future lines or re-insulation of old ones in the same territory, the causes reported by other companies are given below in order of importance:

(2) Flash-over due to surges (sectionalizing reduces); puncture at head of pin on metal arms.

(3) Short pins allow birds to short-circuit conductor; hunters shoot at insulators.

(6) Mechanical stresses on long spans.

(7) Temperature changes; moisture absorption; hunters.

(8) Temperature changes.

(9) Spongy soft porcelain corrected by firing at higher temperature; differences in expansion of steel, porcelain, etc., corrected by cushioning.

(10) Mechanical; pin insulators on steel arms damaged by power arcs following spill-over.

(11) Temperature changes; porosity; power arcs.

(11A) Absorption of moisture and cracking.

(12) Temperature changes.

(14) Deterioration of finish and porosity of porcelain in pin insulators; absorption of moisture by cement in disks.

(19) Lightning, hunters, etc.

(20) Surface cracks.

(21) Electrical causes, rain and sleet causes flash-over on horizontally strung units, hunters, and possibly increased strain at dead-ends. All failures except those due to malicious damage have occurred on the 66-kv. line between Twin Falls and Iron River, Mich., within 11 miles (17.6 km.) of Iron River substation. Trouble began (1915) three years after the line was built and increased rapidly. The remainder of the line, 25 miles (40 km.), has not had a single puncture in six and one-half years. The trouble does not seem to be affected by the type of insulator used but rather by the location. No insulators have had to be replaced on Stager-Alpha line in four and one-half years.

(29) Flash-over due to lightning, puncture by lightning, flash-over due to surges, punctures due to surges, flash-over due to malicious interference such as throwing stones and shooting, and manipulation of clay in plastic state.

(30) Cracks, absorption, mechanical injury, flash-over.

(32) Flash-overs.

(33) Porcelain and design of insulator.

(34) Temperature changes (top insulators affected most).

(36) Mechanical design; examination of faulty insulators indicates that weak spots are in the side wall of insulator head opposite end of pin. Use of paraffin, felt or paper washers, and other easily compressed materials between parts having different expansion coefficients has helped alleviate troubles considerably.

(38) Faulty design and manufacture of early types indicated by minute cracks evidently caused by unequal expansion and contraction of parts; newer types are giving excellent results.

(39) Poor porcelain, mechanical damage such as falling trees, blasted stumps, thrown rocks and rifle shots.

(40) Porosity of porcelain with subsequent absorption of moisture and reduction of insulating value; cracking of porcelain due to different rates of expansion of attached metal parts; cracking of porcelain in pin types due to expansion of the cements or sudden contraction of the outer parts caused by rapid cooling (both of these causes would produce the same results so it is impossible to determine which is the cause, although some evidence points to more rapid cooling of the top part of the insulator); some failures have resulted from cracking due apparently to internal stresses in the porcelain.

(X) Temperature changes.

How Meter Installation Tests May Be Reduced*

On Small Induction-Type Meters Installation Tests Are Not Necessary, and Periods Between Routine Tests Should be Longer

BY R. A. KELLER

WITH the improvements in meter construction, particularly the induction type, there has arisen the question of eliminating certain installation tests and lengthening the periods between routine tests. It is common practice to test and adjust all meters as they are being sent out for installation, and it is thought that the test after setting up the meter is usually an unwarranted additional expense in the case of single-phase induction-type meters of capacities up to 25 amp. A majority of state utilities commissions set sixty days as the limit for making tests after installation. Some give thirty days. The table below shows the accuracy of 2,473 meters tested at installation by the Central Illinois Light Company during eight months of 1919:

Per Cent of True Reading	No. Tested 2,473	Total Per Cent 100.00	Per Cent of True Reading	No. Tested 2,473	Total Per Cent 100.00
Not recording	24	0.97	99 to 100	628	25.40
Under 80	11	0.45	100 to 101	738	29.80
80 to 90	[illegible]	0.36	101 to 102	388	15.70
90 to 95	37	1.50	102 to 103	158	6.40
95 to 96	19	0.77	103 to 104	44	1.78
96 to 97	32	1.40	104 to 105	9	0.36
97 to 98	96	3.90	105 to 110	19	0.77
98 to 99	258	10.40	110 to 120	3	0.12

The cost of making these tests was $1,181.78, an average of $0.48 per meter.

Data from several companies showed that 1.2 to 5 per cent were over 4 per cent slow; 2.8 to 3 per cent were 2 per cent to 4 per cent slow; 4.3 to 8.1 per cent were 2 per cent to 4 per cent fast; 0.5 to 1.2 per cent were over 4 per cent fast.

From these tables the loss in kilowatt-hours which should be measured amounts to about 0.5 per cent to 1 per cent of the total reading. These tests cover all classes and sizes of meters.

The Central Illinois Light Company serves twenty towns in a radius of 35 miles (56 km.) operating 21,500 meters, 19,000 of which are single-phase and under 25 amp. capacity. This company believes that commutator or mercury-type meters and large-capacity alternating meters should be tested at installation, but from the foregoing figures it is thought that on the 5-amp. to 25-amp. induction meters installation tests are unnecessary and uneconomical. Another Illinois company stated that installation tests are unnecessary and amount to 20 per cent of their cost of meter testing.

A contrary opinion held by a large company of the state is that any saving effected would be counteracted by loss of revenue and that the salary of an inspector must be paid to comply with the rest of the requirements. However, the figures in this article show that the revenue loss is small and the meter setter can satisfactorily meet the inspection requirements.

One Illinois company is eliminating installation tests by leaving the meter in the house and cutting the service wires at the pole. With the safety entrance switches this method could probably be used to advantage by locking the boxes.

In regard to the periods of routine tests the commissions differ as shown in the lower table.

The requirements of the State of Illinois in this respect are more complete and in much more detail than those of some other states and are more nearly a standard of practice, with the exception that small capacity induction meters should have the test period materially increased.

The following table shows the results of routine tests of all types and sizes of meters by the Central Illinois Light Company:

Per Cent of True Reading	No Tested 4,614	Total Per Cent 100.00	Per Cent of True Reading	No Tested 4,614	Total Per Cent 100.00
Not recording	34	0.74	99 to 100	887	19.3
Under 80	68	1.5	100 to 101	642	14.0
80 to 90	82	1	101 to 102	494	10.7
90 to 95	202	4.4	102 to 103	233	5.0
95 to 96	176	3.8	103 to 104	83	1.8
96 to 97	279	6 0	104 to 105	23	0.5
97 to 98	613	13.3	105 to 110	16	0.35
98 to 99	779	16.9	110 to 120	3	0.06

The company believes that the schedule shown here is correct for direct-current meters and the older type of alternating-current meters. It is desirable to test direct-current meters at least once a year, and large customers' meters are tested every six months or every three months because a small error represents a large amount of money. But for the 5-amp. to 25-amp. induction meters an increase in the period between tests should be allowed, some companies believe to four years or even five years.

One Illinois company makes the statement that, owing to war difficulties, periodic tests in a town of about 500 meters were discontinued for five years. When resumed the meters were found to be about as accurate as at the end of a thirty-month period. Manufacturers' laboratories have found that a variation of only 2 per cent was recorded for from 10,000,000 to 16,000,000 revolutions of the disk, representing probably ten years' use.

PERIODS BETWEEN TESTS—MONTHS

	Single-Phase, Two and Three-Wire			Polyphase, Self-Contained		Commutator and Mercury Type			
States	5–25 Amp.	5–50 Amp.	Over 25 and 50	To 50 Kw.	Over 50 Kw.	5–15	5–50	50 to 500	Over 500
Illinois	30	..	24	18	12		18	12	
Missouri	..	24	12				12	6	
Colorado	36	..	24	24	12	24	18	12	.
Indiana	36	..	24	18	12		18	12	
New Jersey	30	..	24	24	12		18	12	6
Ohio		..	.	..			.		
Connecticut	36	..	24	18	12		18	12	
Wisconsin	48 (Code)	..	..	..	.				
District of Columbia	24(non-code).. 36	..	.. 24	24	12		18	12	5

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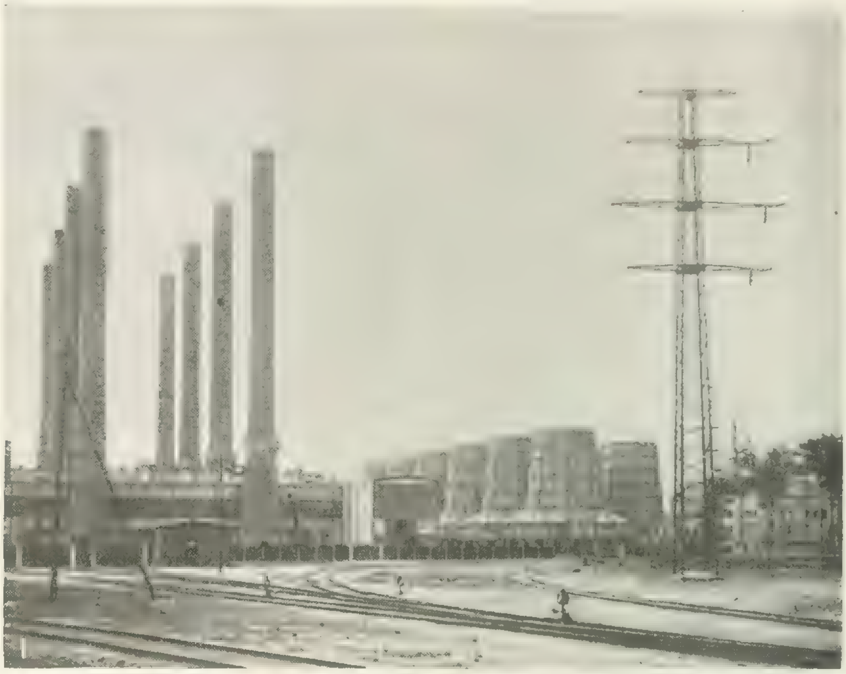
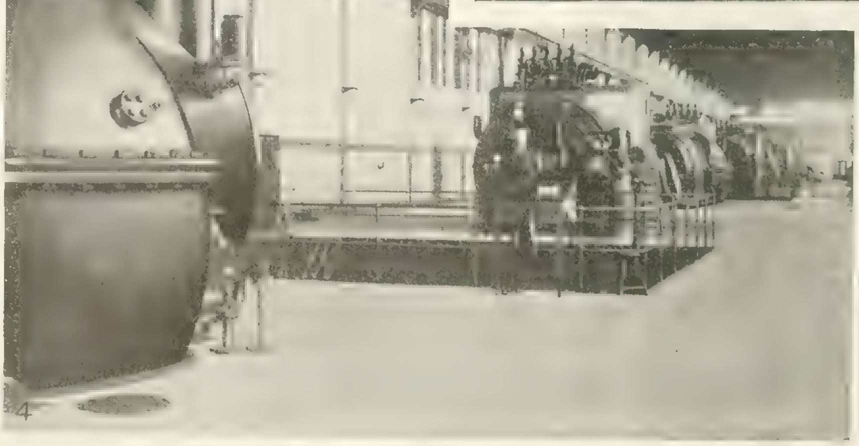
*From a paper read before the Illinois State Electric Association, Chicago.

Mammoth Generating Station Serving Berlin

DURING the World War the long-cherished plan of the late Emil Rathenau (the German Edison) to supply the city of Berlin with light and power from a station located in the heart of the lignite coal country was put into effect. This mammoth generating station is situated 120 km. southwest of Berlin and is capable of developing 128,000 kw., which is more than twice the light and power demand of the German capital.





No. 1—General view of 160,000-hp. generating station showing eight chimneys which serve sixty-four 8,000-sq.m. boilers and cooling towers for condensing water.

No. 2—Transmission line carrying energy to substation in suburb of Berlin.

No. 3—Some of the outgoing high-tension lines.

No. 4—Eight steam turbines rated at 16,000 kw. each are installed in this turbine hall.

Electrical Research Needs Strong Support

The Whole Electrical Field Should be Studied and Indexed to Guide Research Effort — Training Research Workers a University Function — Lessons in European Methods Should Not Be Overlooked

By **VLADIMIR KARAPETOFF**
Professor of Electrical Engineering, Cornell University

WHEN a rich new gold field has been discovered one would hardly expect the adventurous first settlers to do any careful surveying of the region. Digging is good almost anywhere, and who wants to waste valuable time for something uncertain? It is only later when gold becomes scarce that more systematic mining is resorted to and surveys are made.

A similar situation arises from time to time in this or that branch of science after an epoch-making discovery. At first the results of this discovery are viewed with some incredulity; then comes a rush to cover the most salient points, and finally a gradual withdrawal to more promising fields. In time there comes another patient group of scientists content to do the mining in abandoned workings of the pioneers. Finally the field becomes a common playground from which no one expects much, although every one is using it.

In some branches of the electric theory and applications we seem to be now at just such a stage of development, when the most brilliant minds have lost their interest in some topics and have turned their attention elsewhere. Perhaps the subject of electrical power machinery is illustrative of the situation. Further increase in size, better cooling and other such problems have been left to regular designers who in their modesty do not claim to be geniuses. The familiar names of those who have originally brought the electrical machinery to the present stage of perfection are now found under investigations of an entirely different kind.

Gaps in Our Present Electrical Knowledge

In these comparatively old workings abandoned by the pioneers it is time to make a survey and to take an inventory of what we have, what we need to know, and how to obtain it. The co-operative researches on core loss and on insulation recently organized under the auspices of the reorganized Council of National Research may be cited as an example. Probably the minds of the first magnitude in science cannot be interested in such an undertaking, except out of politeness, in an honorary capacity. Nevertheless, much good will undoubtedly result to the profession at large. Who knows, perhaps the large volume of carefully compiled data will lead to a new bold generalization in the mind of a future genius, and a new scientific cycle will be started with wonderful horizons and applications. Thus, some centuries ago, certain discrepancies between theoretical and observed astronomical data led to the boldest speculation of all times, that concerning the finite velocity of light.

What we need is a carefully prepared and exhaustive list of research problems and of the lacking data in the principal branches of electrical science and engineering. The field is so large that all our engineering societies with their numerous committees could work on it for years without interfering with each other. In the meantime groups of workers should be organized to fill at least some of the most flagrant gaps in our knowledge. This will give a useful outlet to wasted energies of many capable and willing workers who are now without leaders. The war has taught us to utilize even the unskilled hands of women and children for common good by properly organizing them. Is the problem of organizing professional men any more difficult?

Research in Pure Science

One lesson which nation-wide strikes of organized labor and the profiteering on the part of certain groups of capitalists should have taught humanity is, that no vital function in national life can be safely left to groups of individuals. It hardly seems necessary at this time, right after the war, to explain or to prove that research is a highly important national function and consequently must be taken care of in the future by the nation as a whole. If our future is to be safeguarded against possible narrow tendencies or near-sighted policies or against immediate commercial demands, then research should not be left entirely in private or corporate hands.

Since the beginning of the war this fact has been realized in England perhaps more clearly than in any other country, both on account of military necessity and because of a well-founded anxiety regarding the expected keen commercial competition after the war. In England the government, the professional societies, various trade associations, colleges and universities—in fact, all the cultural forces of the country—became united in a vigorous organization and pursuit of research. Indications are that the impetus gained will carry them for many years to come and that their enthusiasm will not die too soon.

In this country neither military necessity nor commercial competition has furnished a stimulus of anything like equal strength, and it is becoming more evident that our good resolutions concerning research, made during war time, have been put away together with the songs of war and the steel helmets.

Training Research Men a University Function

It is true that large industrial interests are beginning to realize the importance of research more and more clearly and are doing some work in this respect, even if the results of it are not immediately available for general benefit. Nevertheless, the industrial laboratories are handicapped in two respects. One is the lack of trained scientists, the other is the dearth of any fundamental data and theories. This means that much time that should be spent in applied research has to be devoted to the training of the personnel and the derivation of basic data and theories. Herein lies the prime importance of colleges and universities. It is their direct function to produce trained investigators and to promote pure and general science upon which the industrial progress of the future will be largely based.

It has been pointed out on more than one occasion that the sum total of scientific contribution by American colleges is surprisingly small, no matter what extenuating circumstances we take into account. There must be some quite cogent reasons for such a deficiency, and the sooner we discover and meet them the better it will be for our country and for the whole world. A perusal of reports of university presidents and an extended inquiry among professors themselves would probably elicit the well-known reasons, such as insufficient remuneration, lack of facilities, undue encumbrance with routine duties, etc.

These reasons should apply with much greater force in poorer countries, like Germany. Nevertheless, scientific contributions by professional teachers are particularly numerous and of high grade in that country, and this fact would indicate that the real reason for our backwardness in this direction must be sought elsewhere. Lack of support for higher studies and research is but an outward manifestation of the underlying attitude toward these things on the part of those who should know better. It has been rightfully claimed that this country spends immeasurably more per capita on the conveniences and luxuries of life than any other country in the world.

How long will it be before the present limitations in our universities will disappear and a new spirit will reign in them, the spirit of a renaissance? We had an inkling of this unselfish, idealistic spirit during the war. But do we really need a perpetual calamity to keep us in the right attitude toward science and research? Are we forced to acknowledge that, with a few exceptions, this country is destined to remain a business man's paradise and that research is to be carried on only for the sake of "what there is in it," colloquially speaking?

The ideals of the country need a thorough revision, and with this revision will come a new spirit in science and research. The only way to accomplish this change is by patient proselytizing and by example on the part of those who know the beauty of pure science and who see in it the only salvation of our industry in the next generation.

MATHEMATICAL RESEARCH HAS IMPORTANT FUNCTIONS

Any one perusing European magazines and proceedings of European societies in electrical engineering and physics cannot fail to be impressed with the far-reaching differences between their articles and American papers. Perhaps the most conspicuous distinction is a freer and a more skillful employment of mathematical means by the European writers. A more careful comparative study will further reveal that this freer use of mathematics goes hand in hand with a more pronounced European tendency toward generalization and rationalization, in contrast to our habit of publishing rather crude and disconnected data. In many cases these data are published even without literature references or mention of previous investigators.

Going back into the past of the science in Europe and in this country, one can readily see the profound historical reasons for this difference in scientific contribution. On the one hand, there has been the unbroken existence of a culture going far back into the Middle Ages, with well-established schools of thought and methods, traditions and standards; on the other hand, we have a new country, settled pre-eminently by men of the adventurous type who for nearly two centuries had problems to solve of a much more exciting character than those which they had left in their old homes. Even now, after a century of American science, our investigators are immeasurably more disjoined and separated than their European confrères. There are but a few definite schools of thought, geographically or figuratively speaking. In many cases the standard of scientific contributions in this country simply has to be sacrificed to quantity, in order to keep the professional societies and magazines active.

There is nothing either to conceal or to deplore in this situation. It is a result of our historial development, and we shall gradually approach European standards as time goes on. It is only necessary to see clearly our shortcomings and to cease thinking that we can disregard the progress of science in Europe. Mathematical research in physics and in electrical engineering must come to this country unless we are to be condemned to gross empiricism and to a maze of experimental data without a rational interpretation and without a possibility of prediction of new phenomena or numerical values.

Death of Dobrowolsky

Famous Engineer and Pioneer in Polyphase Machine and Transmission Work Passed Away in Heidelberg, Germany, in November

BY DR. CARL HERING

WORD has just reached this country of the death of Dr. Michael von Dolivo-Dobrowolsky on Nov. 15, 1919, at Heidelberg, Germany, in his fifty-eighth year. The pioneering and important work in electrical engineering accomplished by Dr. von Dolivo-Dobrowolsky was not so well known in this country as it should have been. He was one of the earliest to take up and develop polyphase transmission after Tesla had come out with his polyphase motor. He was at that time, about 1890, one of the leading engineers of the Allgemeine Elektricitäts-Gesellschaft of Berlin, and in co-operation with the noted C. E. L. Brown of the Oerlikon company in Switzerland he designed and constructed the world-famous Lauffen-Frankfort three-phase transmission plant, in which about 100 hp. was transmitted nearly 100 miles. This was the first practical long-distance alternating-current transmission plant in the world by which what was then a considerable amount of power was transmitted by commercial machines to what was then a great distance. At the time of this pioneering work in polyphase machines and transmission in the early nineties Dr. von Dolivo-Dobrowolsky wrote a number of articles for the ELECTRICAL WORLD. A number of his United States patents for polyphase systems, including that for the three-core three-phase transformer, were acquired by the General Electric Company.

A RUSSIAN BY BIRTH

He was a Russian by birth and nationality, his father's family belonging to the nobility of that country. His early life was spent in Odessa, in the south of Russia. He received his early education in that country, and was then especially interested in electrochemistry—what there was of it in those early days. In 1883 he went to Darmstadt, Germany, to take a postgraduate course in electrical engineering, which he decided to follow as a profession. The Polytechnicum there was one of the first institutions in the world in those early days to give a special course in electricity. This course was in charge of Prof. E. Kittler. A year later young Dobrowolsky was made the assistant to his professor, succeeding his intimate personal friend, the writer, in that position. Years later, after his creditable career, this institution tendered him the honorary doctor's degree.

PIONEER WORK IN POLYPHASE CURRENTS

Dobrowolsky was one of the pioneers in reducing the Tesla polyphase system to practice and in developing the polyphase induction motor. He claimed to have been the first to show that to make such motors a success the distinctively polar-field windings described in the early Tesla patents must be changed into a distributed winding. This has since become the general practice, and it was this which made this type of machine such a success.

It is maintained also that he was the one who first coined the term "wattless" current (*wattloser Strom*), as well as the term "Drehstrom," which may be translated "rotary current," presumably because such currents produce a steady torque in a motor. Dobrowolsky early recognized that these currents constituted a steady, uniform flow of energy, like a direct current, and at the same time had the advantages possessed by alternating currents in being easily stepped up and down. He was keen to appreciate that this would solve the then very important problem of driving motors with alternating currents. His first motors were all of the squirrel-cage type, of which he was the first and acknowledged inventor, if the writer's memory be correct.

HIS PROFESSIONAL LIFE

Dobrowolsky's ideal in his earlier professional life was to become a teacher, and after he had shown his ability by his work a special position as professor of electrical engineering was created for him in his native country, at the University of St. Petersburg. He then gave up his prominent position in Berlin to take up this new work, and returned to his native country to settle there. He soon found, however, that the conditions in Russia were intolerable to him, and he decided to expatriate himself. Not wanting to become a German citizen or to have his two sons serve in the Germany army, perhaps to fight his native countrymen, he settled in Switzerland for some years and became a naturalized Swiss citizen, after which he returned to his former high position in Berlin in the largest electrical manufacturing company in Germany. Dobrowolsky resigned last March to retire and settle in Darmstadt, the beloved home of his student days. He died of arterial sclerosis in Heidelberg, after a long and lingering illness, soon after his retirement from active work. He often wanted to visit the United States, but dreaded the long ocean voyage.

Professionally Dobrowolsky was an ardent student, a clear thinker, a man of decided views, an able engineer, bold and fearless in his departures from the beaten track, an inventor of note, a broad-minded, well-posted scientist, and a linguist proficient in four if not more languages. Personally, he was a true, loyal and devoted friend and a charming companion to those who knew him intimately. He was married twice, the second time to a native of Holland, of noble birth, a widow with three young children to whom he was a devoted father. These children survive him, as do the two grown-up sons of his first marriage, whose mother was a native of Greece.

Chilean Census Shows Power Used Industrially

THE Chilean census for 1916, issued not long since, contains detailed information covering the industrial development of that country. The installation of prime movers used in manufacturing industries, which includes stations producing electric power for public service but apparently excludes mining, had in that year reached a total of 107,929 hp., of which 20.8 per cent was electrified. The production of gas and of electricity are not separately reported, but the combined industry shows an investment of $43,051,566, of which $7,571,429 is in buildings and $18,926,523 in machinery. The annual operating expenses were $6,080,336. Salaries and wages required expenditures of $2,197,334, and materials entailed a total outlay of $1,933,555.

The distribution of power-generating machinery by industries and by the different kinds of prime movers is indicated in the accompanying table. Each establishment contained on an average 7.5 machines with an average rating of 5.5 hp. Steam furnished 49.7 per cent of the motive power used in manufacturing, being followed by water wheels with 36.7 per cent. The gas and electric industry accounted for 63,489 hp., which was 58.8 per cent of the total installation.

MACHINERY AND MOTORS USED IN MANUFACTURING INDUSTRIES OF CHILE IN 1916

Industry	No. of Estab.	No. of Machines	Steam		Gas		Suction		Electrical		Hydraulic		Petroleum	
			No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.
Alcohol and beverages	173	748	98	5,346	11	274	3	116	197	3,536	11	1,579	10	482
Pottery and ceramics	5	100	6	64	4	62	...	......	11	99	1	15		.....
Food preparations	738	2,757	194	6,998	72	703	18	598	356	4,403	97	5,080	68	1,324
Gas and electricity	92	73	98	27,323	4	465	25	1,777	58	5,813	56	29,603	35	4,321
Shipbuilding...	17	35	8	577	...			..	8	40		.....		
Clothing industries	312	1,988	7	161	4	97	2	80	82	321	1	25		....
Lumber industries	201	1,313	154	4,420	11	192		.	80	990		......	12	57
Building materials	55	110	8	1,924	...	......	3	170	21	381	8	450	2	240
Textile industries	27	1,773	13	1,299	2	38	5	420	49	709	27	927	2	68
Metals	207	2,315	29	592	39	388	15	603	138	1,018	6	100	15	245
Furniture .	62	241	12	127	3	36	1	4	22	15	1	5	..	..
Paper and printing	154	2,038	7	192	23	312		......	435	1,728	10	1,310	7	34
Leather and furs	315	4,420	47	1,251	21	579	3	194	159	1,871	11	166	3	55
Chemical products	112	953	63	2,034	10	176	5	187	60	749	12	369	6	72
Tobacco manufacturers	54	374	4	139	6	70	2	34	30	388	..	..	5	23
Vehicles.........	36	154	4	65	6	63	1	22	28	144	...	....	3	19
Other industries.	65	274	23	1,163			...	.	32	202	2	10	3	13
Total, 1916	2,625	19,666	775	53,675	216	3,457	83	4,205	1,766	22,547	243	39,639	171	6,953

Readers' Views and Comments

Proper Interpretation of Boiler Ratings

To the Editor of the ELECTRICAL WORLD:

SIR: I shall be pleased to have you publish a correction to my article on "Design of a Unit Boiler Plant" in the issue of Feb. 7. In the table showing kilowatt capacity from a given number of units it is stated that the light-face figures represent 275 per cent boiler rating, the boldface figures 350 per cent boiler rating. These figures as used are deceptive. The idea which I intended to convey was that the unit, including the economizer, would deliver a total output which measured by boiler-horsepower would equal 275 per cent and 350 per cent respectively of the rating of the boiler itself. A similar reference is made to these figures in the first paragraph at the top of page 317. LOUIS R. LEE.

Columbus, Ohio.

Wages, Hours and Production

To the Editor of the ELECTRICAL WORLD:

SIR: There was a time when the efficiency of American labor was such that it was profitable for contractors to pay the passage of—for instance—bricklayers to Europe and back and pay them while there the American scale of wages rather than employ the slower labor of the Old World. This was before there had been imported into America from that same Old World the doctrines of restricted production and dead-leveling that are now working havoc in many a trade. It is not a question of wages. Every reasonable employer will admit the justice of most of the very substantial increases in pay that have been made as a result of conditions following the war. The dollar buys only half as much of most commodities as it once did, and—without inquiring too closely into cause and effect—it is obvious that, unless the national standard of living is to be lowered, wages must be raised in the inverse proportion just as fast as it becomes possible to do so. The wage earner has borne his share of the war's financial cost. His immense losses in the value of savings and insurance can never be made good, but the relation between his pay and what he can get for it must eventually reach its old equilibrium at least. In many trades it has already done so. In some there has been an actual betterment.

When, however, labor, as represented by the trades unions, coupled with its demand for large increases in wages a further demand for shorter working hours it defied all logic and all reason. In the order of nature the two things do not go together. An unselfish public spirit might well have included with the demand for increased pay an offer—in the trades, that is, where the hours were already short, say eight or less—temporarily to extend the working day, without asking overtime, until something approximating the old rate of production should be attained. That would have been inspiring and would have placed the unions making the offer on a plane of practical patriotism entirely above criticism.

Doubtless it would have been too much to expect of human nature; but that an aggressive opposite course—whether inspired by laziness or by the wish to increase the wages asked still more by making overtime obligatory if the work was to be done—was the one chosen, showed that labor leaders as well as generals and statesmen can make blunders that resemble crimes. When men worked ten or twelve hours a day for six days a week at their trades, as they did within the memories of those far from old, how enticing and self-evident the old formula of "Eight hours for work, eight hours for sleep, eight hours for rest and recreation" seemed! Now eight hours is held by radical agitators to be little better than slavery. Similarly, in the view of such men, output must be limited by the standard of the incompetent or the slothful. Piece work—once the joy of the fit and the ambitious—is prohibited, or the speedy are held down to the level of the mediocre. In the meantime the world clamors for commodities and prices continue to mount. FRANK W. CHASE.

Brooklyn, N. Y.

The Pennsylvania Railroad's Electric Locomotives

To the Editor of the ELECTRICAL WORLD:

SIR: On page 127 of the ELECTRICAL WORLD for Jan. 17, I note an error in the description of the Pennsylvania Railroad's latest electric locomotive. The description says that it is a direct-current, side-rod-drive engine and used between New York and Manhattan Transfer, N. J.; also that the railroad operates an alternating-current locomotive which is the most powerful electric locomotive built thus far.

On the contrary, the picture shows the Pennsylvania's 259-ton, alternating-current, geared-side-rod freight locomotive, which was built at the Juanita shops of the railroad and has been in experimental service on the Philadelphia-Paoli electric division since 1917. It has never been this side of Philadelphia except while on exhibit at the American Electric Railway Association convention at Atlantic City last summer.

A few details follow:

1. It is operated on a 11,000-volt, single-phase, 25-cycle trolley through one or both double-shoe pantographs.
2. It is driven by four three-phase, wound-rotor-type induction motors, two pairs of which drive two jack shafts that in turn are connected to the 72-in. driving wheels through side rods.
3. It cannot operate on direct current.
4. A rotating phase converter changes the single-phase trolley current to three-phase for use in the motors.
5. Maximum speed is 20.6 miles per hour.
6. Speed variations are produced by use of a water rheostat in the rotor circuit of the main motors.
7. The engine has developed 140,000 lb. tractive effort in starting, being designed for heavy service on the mountain division not yet electrified.
8. The Pennsylvania Railroad has no other alternating-current electric locomotive of higher speed except the Norfolk & Western freighters, which make a maximum speed of 28 miles per hour.
9. The New Haven road has the fastest alternating-current electric locomotives in this country.

New York City. M. F. CLEMENT.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Compact Meter Installation

By ARRANGING the meters in a Worcester (Mass.) apartment house as shown the electric service company has made it possible to read the meters quickly and accurately. The service is brought into the basement by conduit and is carried through a main switch and fuse box and thence horizontally along the baseboard in the form of a protected three-wire bus from which the local branch circuits are tapped. The main fuses are rated at 30 amp. and the branch fuses at 6 amp., nine apartments being served. The branch circuits are fed through 5-amp. meters and are alternated on either side of the three-wire bus. Johns-Pratt service boxes are used, and not a single exposed wire appears in the installation. That there is a considerable diversity factor in the loads appears from the fact that the combined branch circuit fuses total 54 amp. against the 30-amp. main fusing.

ALL CIRCUITS, FUSES, SWITCHES AND TERMINALS ARE INCLOSED

Interpole Strength Adjusted on the Job

To OBTAIN sparkless commutation, which is the greatest advantage of using interpoles, care must be taken to have the correct strength of pole. This may be checked with exploring points or brushes placed $\frac{3}{16}$ in. (5 mm.) apart on the commutator when the machine is operating at full load. Under these conditions the voltage under the toe (leaving edge) of the brush should be 0.1 volt to 0.2 volt for 115-volt machines and 0.2 volt to 0.4 volt for 230-volt or 500-volt machines. The forward point should be even with the toe of the brush. If steady full-load cannot be obtained, any load over half full-load may be used, in which case the values given above should be multiplied by the proportion of full load carried.

It is not necessary to take observations of the whole curve from pole to pole. Readings from about 1 in. (2.5 cm.) ahead of the brush to about 1 in. behind it at intervals of $\frac{1}{4}$ in. (6 mm.) apart give the needed information, when plotted in the form of a curve. Sometimes when interpoles are not all of the same strength it is necessary to plot a curve for each brush and adjust the interpoles individually to make each one right.

Interpole strength can be adjusted as follows: If the interpoles are too weak, the shunt should be removed, but if doing this makes the strength too great, a higher resistance shunt can be used. If the shunt has already been removed, the interpoles must be shimmed to reduce the air gap. Bolted interpoles can be shimmed by loosening the bolts and placing a shim between the frame and the pole. Cast-in poles must have a shim placed between the pole and the shoe. To do this, however, the armature must be removed. If one interpole is considerably weaker than the rest, it is an indication that there are short-circuited turns in its winding. If the winding is in good condition, however, it may be necessary to add an extra turn or an extra shim. On the other hand, if interpoles are too strong, a shunt must be added or shims removed.

Sometimes the interpoles will be too strong and at the same time will give an irregular voltage curve. In such a case it will be better to weaken them by increasing the air gap instead of putting on additional shunts. Whenever it can be done the interpole strength should be adjusted so as to be correct without the shunt; then accidental changes are not so likely to occur in the future.

JAMES DIXON.

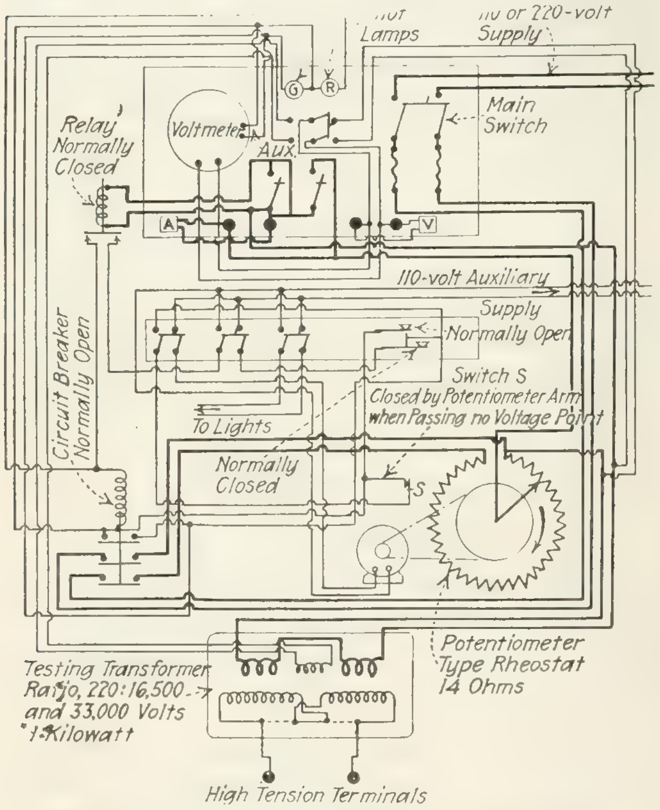
Ampere, N. J.

Oil and Glove Testing on Large Distribution System

A TESTING outfit for testing insulating oil and rubber gloves has been developed for the laboratories of the Hydro-Electric Power Commission of Ontario. The wiring diagram of this apparatus is shown here, and an account of the connections and method of operation follows.

The testing transformer used has a capacity of 1 kva. Its secondary may be connected in parallel or series and it is provided with series resistances of high value. The primary voltage is controlled by means of a circular potentiometer-type rheostat connected to the 220-volt mains. The secondary voltage is calculated from measurements across an exploring coil or on the primary winding. In the main supply circuit an electrically operated oil-immersed contactor which is normally open is inserted. This contactor is closed by applying 110-volt, 25-cycle energy to its operating coil and is opened by gravity. The rheostat arm is free to rotate continuously and is arranged to be driven by a motor through a reducing gear. When passing the no-voltage point the rheostat arm momentarily closes a small auxiliary switch in the control circuit, thus causing the main contactor to close and incidentally to short-circuit the auxiliary switch. The contactor remains closed as long as the control circuit is complete. Connected in the main power circuit is a small instantaneous overload series relay which on a heavy rush of current such as that caused by a flashover on the secondary load of the transformer opens the control circuit and allows the contactor to fall out. Push-buttons are provided for operating the contactor independently of automatic control. Pilot lamps indicate whether the contactor is open or closed.

The method followed in testing oil is as follows: The sample is placed in a cup within which is a spark gap formed by two 1-in. (25-mm.) disks, 0.1 in. (2.5 mm.) apart. The main knife switch is then closed. The voltage, being varied by the motor-driven rheostat, may at this moment have a value greater than the oil can withstand. If breakdown of the oil occurs, the resulting primary current rush acting through the small relay, opens the power circuit. The rheostat arm, driven at a constant speed, continues rotating, though electrically dead, until it reaches the no-voltage point, where it closes the auxiliary switch, thus operating the contactor and energizing the transformer. As the rheostat arm rotates the voltage steadily increases until breakdown through the oil occurs, when, as before, the relays at once clear the transformer from the line. The advantage of shortening the flash period is that it lessens the formation of free carbon in the oil and saves unnecessary heating of the rheostat and transformer. It also prevents burning of rheostat contact points.


Lamps
or 220-volt Supply
G
R
Main Switch
Relay Normally Closed
Voltmeter
Aux.
A
V
110-volt Auxiliary Supply
Normally Open
Switch S
Closed by Potentiometer Arm when Passing no Voltage Point
To Lights
Circuit Breaker Normally Open
Normally Closed
S
Potentiometer Type Rheostat 14 Ohms
Testing Transformer Ratio, 220:16,500 and 33,000 Volts 1 Kilowatt
High Tension Terminals

WIRING DIAGRAM OF CONNECTIONS OF APPARATUS FOR TESTING OIL AND RUBBER GLOVES

Meanwhile the voltmeter pointer has been rising, and at the moment that the power circuit is opened it is locked in the position of maximum deflection; thus ample time is given the operator to obtain a reading before the machine begins its next cycle.

On transformer oils that are not defective breakdowns are taken on each pint of the sample of oil. Two hundred or more samples can be tested in an eight-hour day.

In rubber-glove testing the rheostat is operated manually and the contactor is controlled by the two push-buttons. The auxiliary switch on the rheostat, not being necessary in this test, is cut clear by the switch which controls the motor. The gloves to be tested are filled with water and suspended with fingers down in a jar of water, being immersed to about 1 in. from their tops, thus insuring even potential stress over the entire surface. Voltage is applied between the inside and outside of the glove. A potential difference of 10,000 volts is generally used, this voltage being raised slowly and held for several minutes, the length of time depending on the test requirements.

For capacity tests on small condensers provision is made for connecting instruments into the primary circuit. Flat insulation may either be placed in various types of gaps or between points in the holder, or it may be tested in the cup under oil.

Toronto, Canada. **DOUGLAS BORDEN.**

Drying Generator Insulation After Shipment

THE insulation of a direct-current machine may absorb enough moisture between the time when it is shipped and the time it is ready to start to reduce the insulation resistance considerably. If this resistance is too low, enough current may flow through it to start charring and breakdown of the insulation. By the A. I. E. E. formula for the minimum allowable value a 200-kw., 250-volt machine should not have less than 210,000 ohms resistance. A safe and conservative practice is to dry out any machine showing less than 500,000 ohms when new.

The ordinary method of testing for insulation value is to operate the machine at about one-fourth of rated voltage and measure the voltage between each terminal and ground. If the voltmeter readings are not over two or three volts, the machine may then be brought slowly up to speed and voltage. When the machine is running at full voltage an insulation resistance of 500,000 ohms, if uniformly distributed, will give a voltmeter reading of 7 volts between each terminal and ground.

The voltmeter should be a high-grade meter with a resistance of about 100 ohms per volt, or 30,000 ohms for a 300-volt scale. If a switchboard meter is used, its resistance must be known to judge whether the deflection to ground is too great or not. The higher the resistance of the meter the greater will be its deflection for a given amount of leakage, and therefore the use of a high resistance meter is recommended.

Other methods, such as measurement of insulation resistance by megger or Wheatstone bridge are reliable and satisfactory, but apparatus for these tests is usually not available on the road.

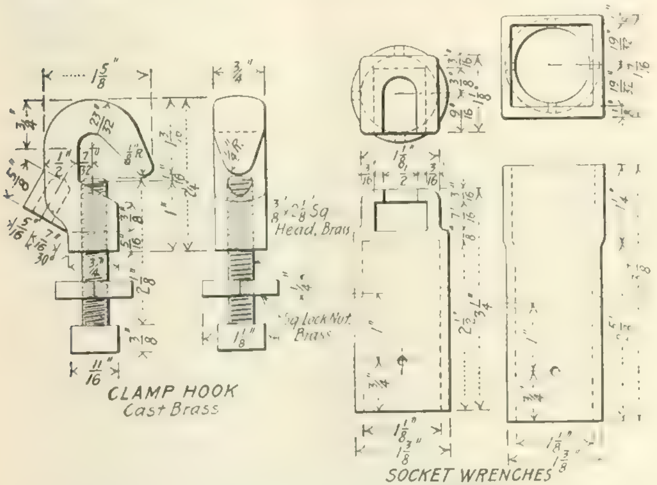
How to Test the Emergency Trip of a Steam Turbine

Weekly tests of steam-turbine governors and emergency trips should be made in all plants to guarantee their proper operation when needed. The emergency trip can usually be tested either by directly releasing the latch or, better still, by operating the governor with a small lever and overspeeding the turbine until the latch trips automatically. Of course, for this test the turbine must not be on load in parallel with another machine. **THOMAS HALL.**

Ridgway, Pa.

Safe Method of Tapping Live High-Tension Lines

TRANSFORMERS and branch lines can be tapped on to live transmission lines at any point without in any way endangering the linemen when a special connecting device designed by the engineers of a Middle West utility is used. The connector consists of a cast-brass hook with a square-head brass cap screw and a locknut. A special pair of wrenches mounted on opposite ends of a 6-ft. (2-m.) insulated stick are used to install or remove the clamp.



HOOK CLAMP AND SOCKET WRENCHES FOR CONNECTING TO LIVE LINES

Before installation the tap wire is cut to the proper length and is soldered into a hole drilled in the back of the connecting hook. The special wrench on one end of the stick is slipped over the bolt head and the device is hooked over the line wire. Then the wrench handle is twisted until the wire is tightly clamped to the line. By reversing the wrench handle the locknut can be screwed up with the socket wrench at the opposite end of the stick. If it ever becomes necessary to remove such a tap connection, the procedure is reversed. The device has been in successful use for more than three years on bare lines operating at potentials up to 27,000 volts. A longer wrench handle should be used on higher voltages. R. L. DODD.

Milwaukee, Wis.

Distribution Auditor Saves Transformer Purchases

SOME of the properties operated by Henry L. Doherty & Company have recently been visited by the company's distribution auditor with a resultant saving in transformers. In one city of the Middle West it was possible to suggest changes in the distribution system which saved so many transformers that the company will not need to buy any for more than a year.

The distribution auditor on visiting a station gets together the superintendent of lines, a foreman, a lineman, an automobile driver and his own engineer and studies the conditions. First, they follow a primary circuit from where it leaves the plant to its end and record data regarding every pole and cross-arm. After the primary lines have been studied they follow the secondary in the same way. Then they go back toward the plant on the same circuit, following every service and meter loop, taking readings on the meters and counting the customers' connected load. Later they make load tests on the feeder and load tests on each transformer. After the entire system has been thus inventoried the distribution auditor makes recommendations for such revisions of the system as may seem to be economical.

In distribution systems that are typical of average-sized cities it is said to be surprising how simple changes can sometimes be made to effect considerable savings. This is due to the fact that distribution systems have usually grown up in a piecemeal fashion and the necessary amount of time has not been given to co-ordinating the various parts.

Lamp Filaments Near High-Voltage Conductors Broken by Vibration

IN A NUMBER of the modern substations of the Southern California Edison Company, such as that shown in the half-tone, annoyance was caused by the breaking of filaments in incandescent lamps which were installed near the high-voltage conductors. The trouble was caused by the alternating magnetic field maintaining continuous vibration of the filament. Since it was advisable to have the lamps placed in the positions shown by the arrows in order properly to illuminate the disconnecting switches, it was necessary to replace type B "Mazda" lamps formerly used by type C lamps, which had more rugged filaments. As the brilliancy of these lamps is higher than that of those formerly used it was necessary to use bowl-frosted globes. Since the change was made the loss by breakage has been reduced to almost nothing. A. E. GEORGE.

Los Angeles, Cal.

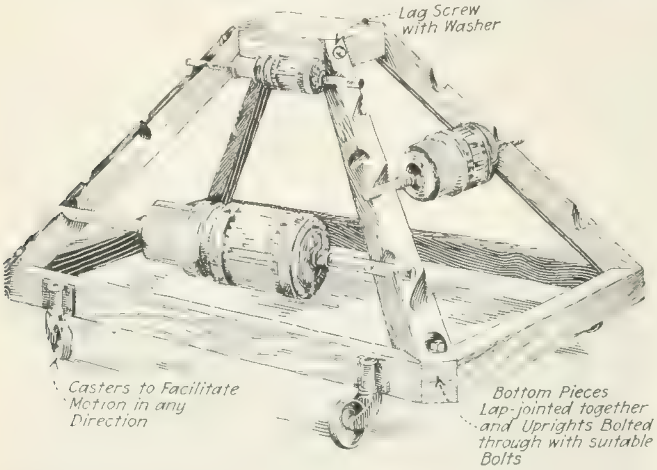
MAGNETIC FIELD NEAR CABLES BROKE LAMP FILAMENTS

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Large-Capacity Portable Stand for Holding Armatures

BOTH large and small armatures can be accommodated by the portable armature stand shown, which is in use in a large motor-repair shop in New York. This stand is made of timbers fastened securely together and slotted to receive the armature shafts. Strong casters at each corner of the base, make it an easy matter to move the stand anywhere in the shop. Besides being used for holding armatures of motors whose stators are being repaired, the stand is handy for supporting armatures to which air-drying varnish has been applied.


Lag Screw with Washer
Casters to Facilitate Motion in any Direction
Bottom Pieces Lap-jointed together and Uprights Bolted through with suitable Bolts

WOODEN ARMATURE STAND WHICH CAN BE MOVED AROUND THE SHOP

New York, N. Y. **W. A. Harris.**

Armored Cable 4,000 Ft. Long Lowered Into Shaft

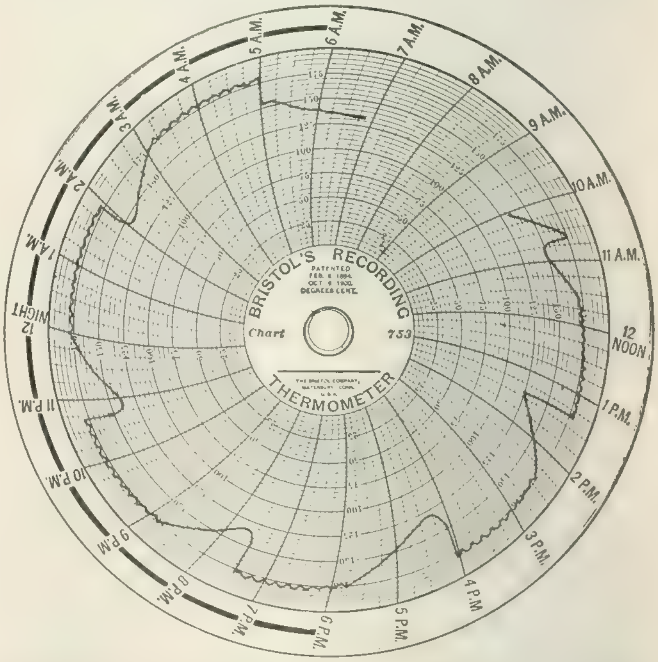
IN PLACING heavy armored cables in its shafts the Quincy Mining Company, Hancock, Mich., uses a steam locomotive to do the lowering. The reel is set up on a flat car near the shaft house, and a length of several hundred feet is fed down the shaft by turning the reel. An arrangement of heavy timbers at the door of the shaft house is then used to clamp the cable, and the engine is moved back away from the shaft house, unreeling the cable. The reel is then locked, the timber clamp released and the car and reel pushed toward the shaft house, feeding the cable down the shaft by its own weight. When the reel reaches the shaft house the cable is once more clamped with the timbers, and the engine moves back, unreeling several hundred feet more. This operation is repeated until the cable is fed down. The cable is then securely clamped to the mine timbers and the work is completed.

A piece of cable 4,000 ft. (1,220 m.) in length is the heaviest that has been handled in this district. The cable is made up of four No. 1 rubber-covered wires, insulated over all with rubber for a working pressure of 2,300 volts. Over this are coverings of jute and galvanized-steel wire armor. The weight of the cable is 4 lb. per foot (5.8 kg. per m.) or a total weight of 16,000 lb. (7,250 kg.).

With the exception of tearing off some of the outside covering, the installation was made without injury to the cable, but it is believed that this is about the limit of weight that can be handled in one piece. The shaft in which this cable was placed is inclined about 58 deg., and this partly accounts for the ability to handle a piece of cable of this weight. **J. C. Kendall.**
Chief Electrician.

Electric Coils Help Regulate Oven Temperatures

EXTREMELY close regulation of oven temperatures by the installation of both steam coils and electric grids has been obtained in a Massachusetts factory, the steam coil providing the main body of heat and the electric coil supplying the regulation required. The oven is 9 ft. x 7 ft. x 6.5 ft. (2.7 m. x 2.1 m. x 2 m.) in dimension and contains twenty legs of 2½-in. (6-cm.) coils supplied with high-pressure steam from the shop mains. There are also eight grids of 20 kw. combined rating, governed by an installation of Tycos temperature control, with Westinghouse solenoid switches and push-button equipment for starting and stopping.



TEMPERATURE CHART SHOWS CLOSE REGULATION OF OVENS

The accompanying record from a Bristol chart shows the temperature variations from 10 a.m. to 7 a.m., six heating cycles being made during this period. In a typical run the oven doors were opened at 1:20 p.m. to receive the charge, the temperature dropping from 180 deg. C. to 125 deg. C. (350 deg. F. to 250 deg. F.) in about four minutes. The charge was then inserted, and at 2:25 p.m. the operating temperature of 175 deg. C. was reached and maintained by the thermostatic control of electrical energy input until 4 p.m., when the work was withdrawn from the oven. During the period of steady heating the temperature fluctuated only about 5 deg. C., or approximately 2.8 per cent of the full-load temperature.

Chorded Armature Windings Reduce Reversal Emf.

BY THE use of fractional pitch or chorded armature windings on direct-current machines, commutation of this type of machines has been greatly improved, declares the Westinghouse Electric & Manufacturing Company. When full-pitch windings were used the two sides of each commutated coil were in the same slots as the other coils, being commutated at the same instant. Thus the normal emf. generated, due to commutation or reversal, was that due to upper and lower coils in each slot. By the use of coils having a throw of one or more slots less or greater than the pitch, the commutated coils could be made to lie in separate slots so that the emf. of reversal was thus very materially reduced.

Portable Equipment for Charging Batteries

ABSOLUTE automatic operation is the feature of the storage-battery charging equipment which has been built for use on several piers at San Francisco, Cal. Two outfits are in use, one being capable of both charging and discharging batteries and the other being used for charging only. The equipment consists of a two-bearing motor-generator set, a switch and meter board and a starting switch, all mounted on a rubber-tired truck. Each outfit will charge a battery of forty-two Edison type A 6 cells at a constant charging rate throughout the entire charge without the attention of the operator. The battery is placed on charge at night and in the morning the storage batteries are fully charged ready for operation. This is accomplished by automatically disconnecting the battery from the line when the battery is fully charged. If power to the motor should fail, the battery is automatically disconnected from the generator, so the battery will not run reversed. Upon the return of the energy to the motor, however, the motor-generator set is automatically started and the battery automatically reconnected. This feature is especially valuable because it eliminates constant attendance. The motor is protected against overload and single-phasing by means of an oil circuit breaker. The generator is also protected against overload by means of a single-pole carbon circuit breaker.

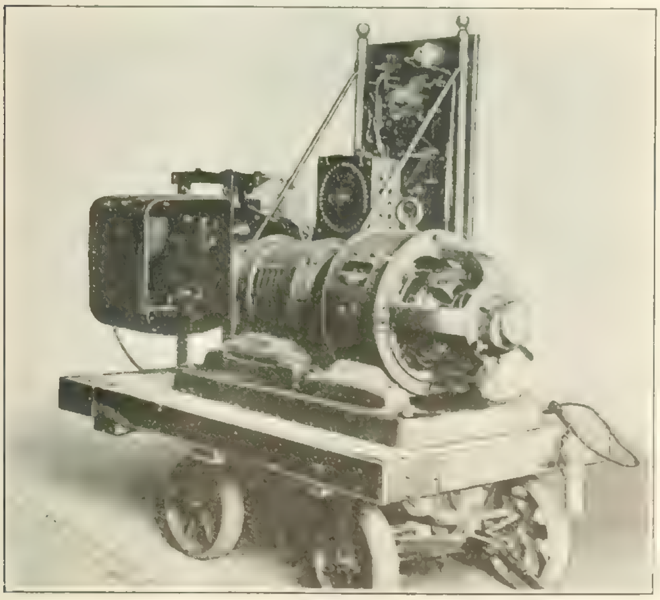


FIG. 1—REAR VIEW OF OUTFIT WHICH WILL BOTH CHARGE AND DISCHARGE STORAGE BATTERIES

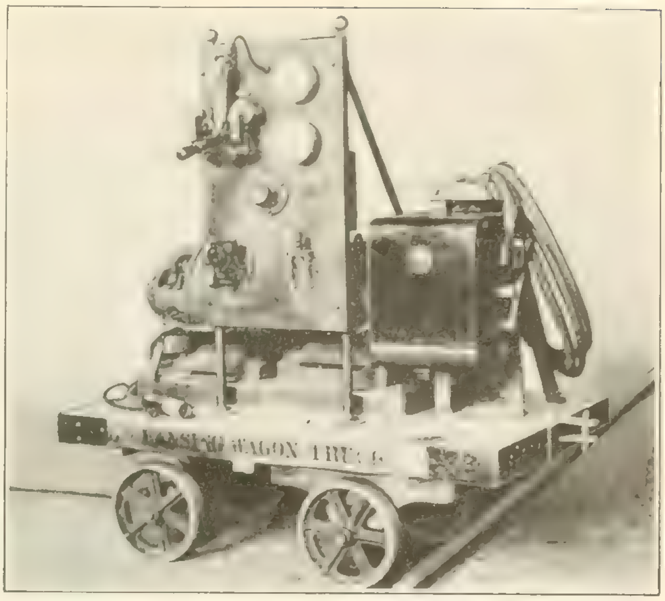


FIG. 2—FRONT VIEW OF OUTFIT USED FOR CHARGING ONLY

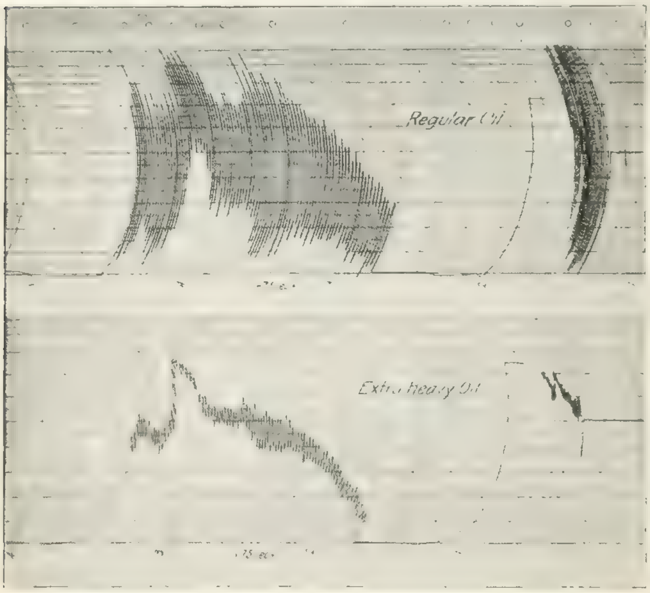
Loose Motor Shaft Causes Insulation to Chafe

CHAFING of insulation at the ends of the armature slots of a 15-hp. direct-current motor driving a drug mill, which resulted several times in a grounded winding, was found after a long investigation to be caused by a loose motor shaft. Before the cause of the chafing was determined the motor repeatedly gave trouble. The insulation was found cut in different slots, and although the motor was temporarily repaired by replacing the insulation, it finally had to be rewound. In rewinding, the coils were protected with extra layers of insulation, but the trouble did not disappear, so the armature was taken from the frame for examination. After removing the coils the armature was placed in a lathe and its core was made stationary by means of a tool held in the tool post. Then it was noticed that on pulling the lathe belt the motor shaft revolved slightly in the core. When the core was taken off the shaft the keyways in the core spider and the shaft were found to be of different widths, allowing some rotation of the core on the shaft. As the load on the motor was one which increased and decreased suddenly, the coil leads connected to the commutator were worked back and forth in the slots as the load changed, and this chafed the insulation. By cutting a new keyway and using a larger key the trouble was entirely removed.

Utica, N. Y. L. A. Francis.

Measurement of Curve Areas Facilitated by Overdamping Instruments

WHEN a graphic meter with the ordinary kind of damping oil is used it is difficult to planimeter the charts obtained from a suddenly changing load such as is produced by an electric elevator. While the pen does not overswing, the curve traced is not easily followed in measuring the area under the curve, nor can the general curve, exclusive of momentary "kicks," be easily visualized by the eye. To avoid these difficulties in making tests on suddenly changing loads the Merchants' Heat & Light Company, Indianapolis, has experimented with a very heavy oil in the damping box of an Esterline meter. The two charts shown were taken simultaneously on the same load, one with the ordinary oil furnished and the other with the heavier oil. With the heavy oil it takes about eight seconds for the needle to drop from full load to zero or to rise from zero to full load. Careful planimetering of both curves showed that the areas for any reasonable length of time were equal.



CHARTS FROM ORDINARY AND OVERDAMPED METERS

Outdoor Substation for Railroad Interlock System

BECAUSE continuity of operation is so essential in railroad signal equipment duplicate transformers have been installed for the electric interlocking system protecting the crossings of the Pennsylvania Railroad with the Buffalo, Rochester & Pittsburgh Railroad and the Erie Railroad at Riverside Junction, N. Y. The transformers, which are rated at 5 kva., single-phase, 22,000/3,300 volts, 60 cycles, are mounted, together with their switching equipment, on two wooden poles, as shown in the illustration. By means of two double-throw, single-pole disconnecting switches either transformer may be connected to the 22,000-volt source of supply. The high-tension equipment consists of long-turn choke coils, high-speed sphere-gap lightning arresters, carbon-tetrachloride fuses and air-break switches of the double break-per-phase type.

The 3,300-volt leads are connected by switches to a power distribution line over 2 miles (3 km.) long, supplying energy to the interlocking plant. This is transformed to 110 volts for operating distant signals and again transformed to from 8 volts to 12 volts for energizing track circuits. Transformers operating at 3,300/220 volts supply energy to a motor-generator set to charge a battery in the signal cabin. This battery supplies 110-volt direct current for operating and lighting the home and dwarf signals and for operating the switches and derails near the cabin.

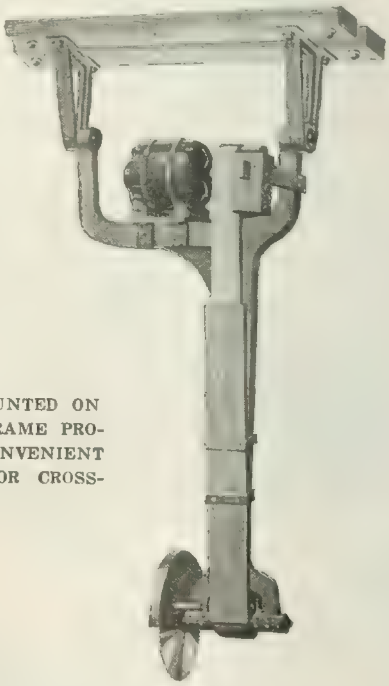
TRANSFORMERS FOR RAILROAD SIGNAL SYSTEM

Moloney transformers and Delta-Star high-tension equipment are used. E. W. Kolb.

Pittsburgh, Pa.

Individual Motor Drive for Swinging Frame Cross Cut Saw

FOR driving an American swinging-frame cross-cut saw, an industrial plant in Connecticut has adopted the method illustrated of mounting the motor directly on to the cross-frame of the saw. The motor is served from a wall outlet just back of it, the conductors being coiled to allow swinging of saw. In order that the operator shall not be injured by the belt it is incased as shown. The motor is controlled by means of a 30-amp. C.R. General Electric push-and-pull switch mounted near the operator.



MOTOR MOUNTED ON CROSS FRAME PROVIDES CONVENIENT DRIVE FOR CROSS-CUT SAW

Central Station Service

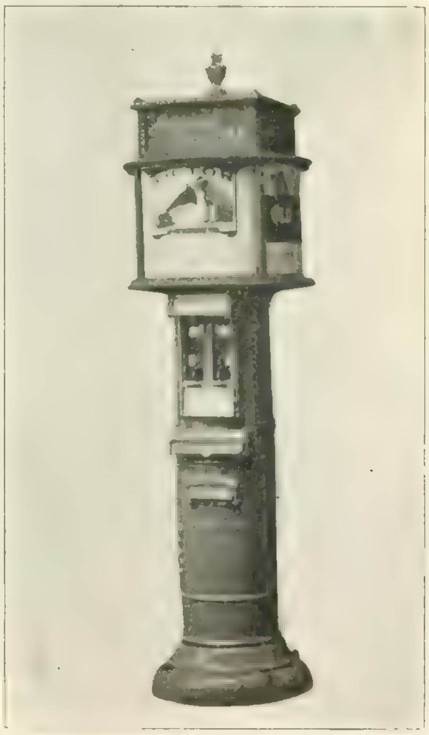
A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Sales of All Appliances Except Irons Increase

APPLIANCE sales made by the Public Service Company of Northern Illinois, Chicago, Jan. 1 to Dec. 1, 1919, reached an amount of money more than 75 per cent greater than the sales made in the corresponding period of 1918. This percentage will probably be increased when the figures for the month of December are considered. Fewer irons were sold in 1919 than in 1918, but with this exception every line of appliances gained over the previous year. Expressed in percentages of sales for the eleven months, washing machines gained 55 per cent, vacuum cleaners 155 per cent, fans 70 per cent, grills 200 per cent, portable lamps 350 per cent and vibrators 100 per cent.

Postal Pillars That Represent a Steady Load of 142 Watts Each

MORE than 200 postal service pillars such as are shown in the accompanying illustration are installed in the city of Toronto, Ontario, and electrically operated as a twenty-four-hour load with a demand of 142 watts from the circuits of the Hydro-Electric system. These pillars are operated by a company under a license from the government to install them wherever there is a postal delivery and in such quantities as are approved by the Post Office Department. The company erects the pillars and installs the stamp - vending machines, while the Post Office Department loads the machines and collects the money. The upper part of the drum shown in the illustration is used for advertising. The mechanism which moves this drum is operated by a solenoid which works a plunger acting against a spring. This solenoid is energized by a "flasher." The action of the mechanism is such that the drum is revolved through 90 deg. every three minutes. The advertisements are lighted by an electric light mounted inside the drum. The stamp-vending machines contain 1,000 one-cent and 1,000 two-cent stamps with an electric heating element to keep the stamps in a condition to be used.



STAMP VENDING AND ADVERTISING PILLAR INSTALLED ON STREETS OF TORONTO

Allowances to Customers Reduced 60 per Cent

ALLOWANCES to customers on bills rendered by the Springfield (Mo.) Gas & Electric Company were about $2,500 less in 1919 than in 1918. In terms of the gross revenue this means a reduction from 0.73 per cent to 0.31 per cent. C. N. Garrison, assistant secretary-treasurer of the company, attributes the marked reduction in allowances to greater promptness in adjusting complaints and to increased accuracy on the part of meter readers.

The policy of the company is to settle complaints concerning bills immediately if at all possible. It has been found that many customers who will settle for 50 cents when they make a complaint will not be satisfied with three or four times that amount a few weeks or days later. It is not only cheaper but it is considered good public policy to settle with a customer on the spot, even if the customer appears to be getting a little the better of the deal.

The source of most justified complaints is inaccurate readings. Hence meter readers are encouraged to do good work by a system of bonuses, $10 being given to every man who goes through a month without making a mistake. Those who make some errors are graded each month, and the first, second and third, in point of correctness, get $5, $3 and $2 respectively.

Disadvantages of Flat Rates for Irrigation Installations

THE present schedule of charges for irrigation pumping installations on the system of the San Joaquin (Cal.) Light & Power Corporation provides for a flat-rate system based on the number of months a year the motor is in use. The irrigation load is largely seasonal, and it was felt that, knowing the purpose for which the motor was designed, it was possible to determine in advance just when the period of use would be.

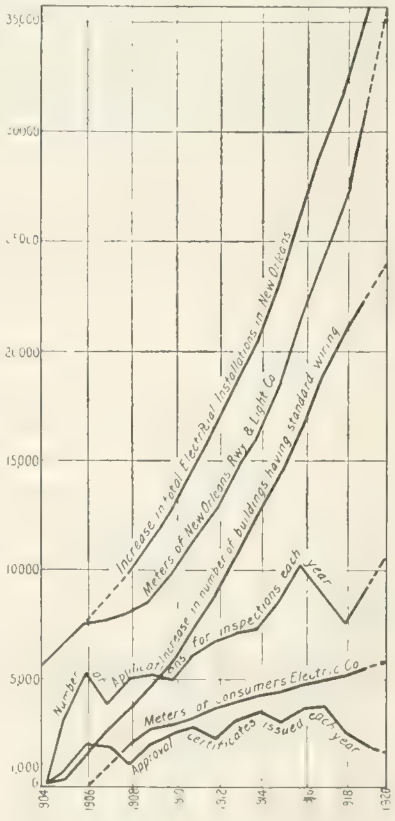
This type of rate in practice has, however, developed many difficulties. The progressive farmer needs power throughout the year. In the California valleys it is becoming more and more the custom to irrigate in winter in the preparation of the ground for the next summer's crops. With the continuing drain upon the soil it is found profitable to raise fertilizer during the winter and turn the crop under. Moreover, the farmer has other uses for his motor than to supply irrigation needs, and if he is free to use it, will install wood saws, silage cutters and other equipment. From the standpoint of the company which supplies the energy, on the other hand, the disconnecting of transformers itself has meant considerable inconvenience and expense. Some farmers have used power for three months in the year, with intervals between, necessitating that the installation be connected and disconnected each time. This has been done by disconnecting the primary transformer fuses and sealing the plant, and one man was kept continually busy tending to such requests.

These considerations, combined with the benefits which would be derived from distributing the load so far as possible, rather than to concentrate it within a few months, as is the tendency with the present rates, have led the San Joaquin Light & Power Corporation to apply for a new schedule of rates, which is now before the California Railroad Commission. The new rate calls for a yearly charge, to be paid monthly, based on the installed capacity, together with a monthly charge for the amount of energy actually consumed. This amounts to $15 per horsepower-year plus 1 cent per kilowatt-hour consumed in each month. It is felt that this type of rate will encourage the farmer to scatter the load and will work to his benefit and convenience as well as to that of the power company.

New Orleans Company Shows 70 per Cent Increase in Customers

On Dec. 31, 1919, the New Orleans (La.) Railway & Light Company, now under the management of John S. Bleecker for J. D. O'Keefe, receiver, had 31,799 meters connected to its lines. This was a growth of 3,807 for the year 1919, as compared with a growth of 2,284 for the year 1918. Of the 1919 installations about 250 were for power customers, while of the 1918 installations 215 were for power customers.

During the year a building boom was under way in New Orleans as indicated by the accompanying curves, made up by the electrical department of the Louisiana Fire Prevention Bureau, showing increases in the use of electricity and the regulation of wiring by electrical inspection. The curves show a decidedly upward tendency in all electrical work. The number of applications for inspection each year shows an upward tendency for 1919, while the approval certificates issued show a downward tendency for the year 1919. This is explained by the fact that the permits issued during 1919 were in the main for extensions on existing approved installations, on which approved certificates are not required. On the whole, these illustrations show a very healthy increase in the electrical business of the city.



GROWTH OF ELECTRICAL BUSINESS IN NEW ORLEANS FOR PAST FIFTEEN YEARS

Explaining the Differential

R. S. Hale Shows How His Company Bases Its Varying Rates on the Avoidance of Charges the Traffic Will Not Bear

Speaking before the Boston Edison Company section of the National Electric Light Association, R. S. Hale, in reply to an inquiry concerning the company's rates for electric heating, took occasion to emphasize the fact that the Boston Edison's rates are "made on the exact opposite to the theory which is so objectionable, of charging all the traffic will bear"—that is, the company "does not charge what the traffic will not bear." The plan of differential charges worked out with this principle in view was explained by Mr. Hale, who went back to the days when electricity was first sold for motor service.

"When people tried to use our product for power," said Mr. Hale, "they found that, though the quality was good, the price was so high they could not afford it; in other words, our price for power was more than the traffic would bear. I suppose we figured on cutting the price of lighting so that people could use the service for either, but we found that to make the price for all the service low enough to get the power business would bankrupt us. We did, however, find that by selling both lighting and power—that is, by adding the power sale to the lighting sale—we did not increase our expenses in the same ratio, because a lot of our work and plant could serve both light and power at no more cost than if we served only lighting alone.

"We found that if we made a power price different from the lighting price, and made the power price less than the traffic would bear, then we got both the lighting business and the power business, and in fact found we could make the price of each lower than if we sold only lighting, and lower than if we sold only power."

The same principle was in turn applied to obtain hotel, drugstore, big wholesale and other business, and as a result of its operation the price of lighting to small consumers, Mr. Hale said, had been reduced to one-tenth of what it originally was and perhaps to one-half of what it would be if there were no power rate, no long-hour rate, no wholesale rate or, finally, no heating rate. With special regard to the latter Mr. Hale said:

> Our heating rate is figured, as nearly as we can tell, so as never to be such that the traffic will not bear it. If we should make a rate for heating whole houses in order to compete with coal we should have to make a rate of about 5 mills a kilowatt-hour; but as it costs us nearly a cent for the coal alone for each kilowatt-hour we add to our output, we cannot compete for house heating. For heating bathrooms, however, and for making ice and for cooking food, we find that, though this kind of service can't pay our lighting rate or even our power rate, yet people can afford to heat bathrooms when they want the heat for only a quarter of an hour or so, and they can afford to use electric refrigerators, etc., at a rate lower than our power rate, and yet not so low but that we can supply the service and make more profit on the resulting total business than we could make if we charged more than the traffic would bear, in which case we would not get the business at all.
>
> Some people—for instance, the power people—say, "Why

can't we have the heating rate?" The answer is that if we are going to cut rates for any reason other than because we have to make a low rate to get business like the heating business, then it is not the power people alone who should get the cut, but it is our small customers who depend on us. If we can afford a cut to our existing business, it goes to the small customer.

In making the heating rate we try to make the rate so that we shall get the business; in other words, we try to make the heating rate so that the customers who want electricity for heating shall take our service and yet have a good profit left after they have paid our bills and all their other expenses.

Now, we may make mistakes, and, further, we cannot always classify as exactly as we should like to. For instance, a case could be made out that we ought to sell energy for melting steel at a lower price than for melting brass, just as we now sell energy at a lower rate for melting brass than for driving a machine-shop motor, but to go into these complications would, we think, not be practicable—at least not now.

We have designed our heating rate so that, in our opinion, the people who want heating can—at least most of them or a great many of them—take electric heating at our heating rate, and they can, we hope and think, make more money than they can if they don't take our service.

Allowing the Customer to Read the Meter

SEVERAL of the power companies on the Pacific Coast that have a large number of rural customers have adopted the system of leaving a post card for the customer to fill out and return with his own meter reading. The Washington Water Power Company at Spokane sends out post cards monthly to suburban districts, and the meter reader does not then revisit these districts until spring. The results have been found very satisfactory. The Wenatchee (Wash.) Valley Gas & Electric Company has followed this practice since 1911 throughout its rural districts. Some of its customers live forty miles away from headquarters, and regular methods of meter reading have been found out of the question. By the present practice the cards are sent monthly. It has been found that, although occasional delays occur, on the whole cards are returned promptly. The company then sends out a statement based upon this reading, which is returned with a check covering the amount due.

This practice is also followed by the Puget Sound Traction, Light & Power Company, at Seattle, Wash. This company not only finds it satisfactory from the accounting standpoint but thinks that it helps to establish confidence in the minds of the customers as to the company's integrity. It practically does away with complaints of bills being too high. Customers' readings are also frequently accepted for final bills, particularly in cases where the customer calls up to report that he is leaving town. In many instances the customers are asked to give the readings of their meters over the telephone. If they do not understand how to read a meter, this is briefly explained to them and the result of their reading is then compared with that of the previous month. The amount of the bill is given them over the telephone, and the check sent the next day is accepted as final payment. This plan has worked out very well, and the company feels that it has many accounts that have been paid at once which might have cost time and money to collect later had another system been in use.

Data on Electrically Operated Cafeteria in Louisville

EXPERIENCE with an electrically operated cafeteria in Louisville, Ky., indicates that it is turning out to be a money maker not only for the local central station but also for the proprietor. The restaurant is open from 7:30 a.m. to 9 p.m., serving three meals per day. It is operated on the self-service plan and is serving about 3,000 meals per day. According to its manager, the average customer's check is about 65 cents. This would show receipts of about $1,950 a day.

The electrical heating installation consists of the following equipment: Four hotel-type ranges, 22 kw. each; two bake ovens, 25 kw. and 5 kw. each; one griddle-cake baker, 6 kw., and one electric toaster, 3 kw., or a total of 149 kw.

FOUR HOTEL-TYPE ELECTRIC RANGES HAVING A TOTAL RATING OF 88 KW.

This heating and baking equipment has shown an average monthly demand of about 100 kw., and an average monthly energy consumption of about 25,000 kw.-hr. Under these conditions the cafeteria earns an electric rate of about 1.8 cents per kilowatt-hour on the electric cooking load. According to these figures the cafeteria owner pays the electric company about $450 a month for energy for electric cooking.

The original installation cost the cafeteria owner about $4,000, most of the electric heating equipment being furnished by the Hughes Division, Edison Electric Appliance Company. This first cost, however, does not include the cost of installation. The cafeteria owner is very well pleased with the installation, particularly in view of the fact that it enables him to use basement space for his kitchen without having to contend with disagreeable fumes such as arise from other fuels where the kitchen is in the basement.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Soldering of Short-Circuit Rotors.—In small and medium-sized induction motors, where the rotor bars are directly soldered to short-circuiting rings, much trouble is experienced by centrifugal action throwing out the soldering alloy, which is often heated to its melting temperature during start and when the load suddenly changes. According to a method used in the Bréguet factories, the soldered joints are covered by a thin capsule of copper, applied by means of the Schoop metallization process. Even though the solder may melt, it is thus prevented from escaping, and, upon cooling, it forms again a reliable joint.—*Revue Générale d'Electricité,* Nov. 8, 1919.

On the Use of Commutators in Alternating-Current Machinery.—L. GRATZMÜLLER.—The author analyzes the development of polyphase alternating-current commutator machines of various kinds, and discusses the application of the commutator to such problems as alternating-current motor-speed variation, phase advancing, and compounding of synchronous and induction generators. Considerable stress is laid upon historic development, and much attention is given to certain questions of patent priority in the field.—*Bulletin de la Société Française d'Electriciens,* July 1919, and *Revue Générale d'Electricité,* Nov. 15, 1919.

Lamps and Lighting

A New Mercury-Arc Lamp.—HENRI GEORGE.—One of the difficulties in utilizing the high efficiency of the mercury arc for lighting purposes (about 0.2 watt per candlepower) is the necessity to provide special means for starting the arc. Another disadvantage of the ordinary type of mercury lamp is the slow increase of pressure in the bulb and the resulting gradual approach to full intensity of light. The author describes a mercury-arc lamp of novel design which is completely automatic and attains stable conditions very quickly. The arc is formed between mercury electrodes in an atmosphere of helium, argon or neon at approximately atmospheric pressure, and therefore is of high brilliancy. Before starting the lamp the tube is filled with mercury which forms a metallic path through the lamp. The current rush heats a tungsten filament to incandescence, and when heat is transmitted from the filament to a gas chamber the expanding gas will drive out the mercury from the tube so that an arc is formed. The lamp is built for 110 volts direct current and the starting current is 11 amp., which in thirty-five seconds decreases to 6 amp. It is claimed that it is rugged enough to withstand severe handling.—*Revue Générale d'Electricité,* Dec. 6, 1919.

Improving the Automobile Headlight Lamp.—L. C. PORTER.—It is pointed out that lamps intended for use with lens systems or parabolic reflectors must have the light source placed along the axis, usually at the focal point. Manufacturing methods must be adopted which will insure uniform dimensions in lamps of a given type, in order to make quick satisfactory replacements. In this article are described manufacturing methods of making automobile headlamps stage by stage, indicating what is being done to secure a product as nearly uniform in dimensions and performance as possible.—*General Electric Review,* January, 1919.

Generators, Transmission and Distribution

Fusibility of the Coal Ash from Eastern Coals.—W. A. SELVIG, O. C. BROWN and A. C. FIELDNER.—Tables are given showing the fusing temperatures of the ash for coal mined in certain sections of the Eastern coal provinces, the sections chosen being parts of Ohio, Virginia, Kentucky, Maryland, Tennessee and Alabama. It is pointed out that the property of high fusing temperature of the ash is of great importance to the users of the coal and that the Maryland coals owe their high market values quite largely to the high temperature with which their ashes fuse.—*Coal Age,* Jan. 22-29, 1920.

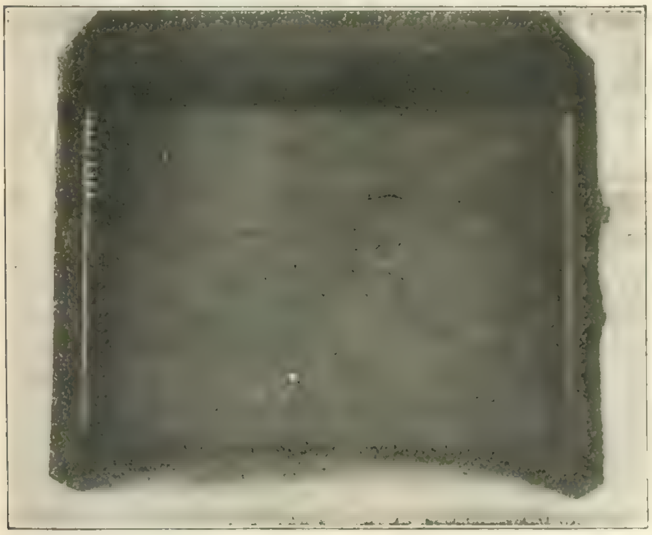
A National Power Distribution Project.—F. SCOUMANNE.—It is a huge project which the author here draws up as a suggestion for future power transmission policy in France. A complete consolidation of all power resources is proposed, under the direction of a central financial organization. Hereby all the advantages of diversity of load and high efficiency of the large central station could be combined with the benefits to be derived from interconnection between plants, co-operation in the matter of fuel purchases and transports, rate making, etc. In discussing the economical advantages of centralization in electric power generation the author shows by means of curves and examples how first cost per kilowatt decreases with increasing station capacity. The moment is said to be opportune for discussing a consolidation, since rebuilding of industry in the devastated areas and future railroad electrification will require great extensions in the present power distribution systems. Although the state would be the biggest customer of the proposed power system, complete state control, in the author's opinion, would not be desirable, primarily for the reason that a state-governed institution never can fully utilize the advantages of individual bargaining.—*Revue Générale d'Electricité,* Nov. 1, 8 and 15, 1919.

Traction

Calculation of Ground Currents Due to Direct-Current Electric Railways.—GIROUSSE.—The complexity of the ground-current distribution problem in case of railways with track return where many feeders are present makes a direct solution of the problem difficult to obtain. According to a semi-graphical method suggested by the author, the elementary current distribution, due to each feeder and each railway, is separately studied, the actual state of affairs being obtained by superposing a number of elementary solutions. The current distribution is defined by the track potential, which follows a hyperbolic cosine function of certain variables, proportional to track distance.—*Comptes Rendus,* Nov. 10, 1919.

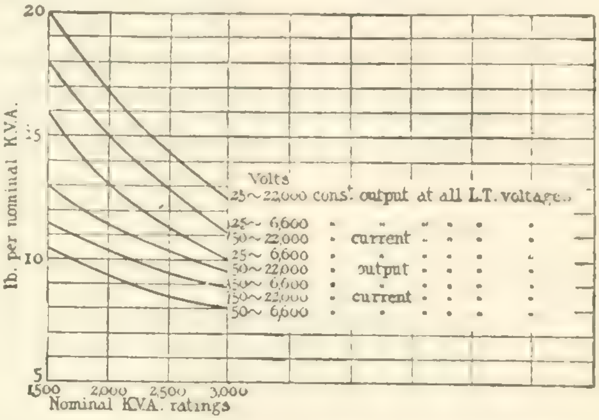
The Power Indicating and Limiting Apparatus for the Chicago, Milwaukee & St. Paul Railway.—B. H. SMITH.—The writer deals with the method of keeping the dispatching office in touch with the power being supplied at the various substations along the Coast and Columbia divisions of the Chicago, Milwaukee & St. Paul Railway. The dispatcher's office is near Tacoma at the western end of the division. At the easternmost substation there is a 1-kw. generator which produces a current with frequency so controlled that it varies with the power as measured by the wattmeter at the substation. The voltage generated is stepped up to 2,000 and transmitted to the next substation about 100 miles (160 km.) to the west. Here the frequency is not increased directly, but another alternating-current generator is introduced and so controlled that its speed and frequency are proportional to the power being measured at both of the substations. This process is repeated until the indication at the load dispatcher's office gives the total of all power received by the electrified section of the road. Since the railroad buys energy on the basis of a maximum five-minute integrated load, it is necessary to keep the peak loads as low as possible. This is accomplished through the agency of a load regulator which, when it reaches a predetermined point, closes its contacts in the lowering direction and sends out to the substations a direct current which acts on the field rheostats of the generators to reduce the normal 3,000 volts at the trolley at times of heavy overload.—*Electric Journal*, February 1920.

Present-Day Radiography.—G. W. C. KAYS.—The writer calls attention to the great stimulus given to the use of X-rays for surgery during the war. A new branch of radiography has been developed within the last year or two in the application of X-rays to the study of materials and structures. For this purpose it is said that the Coolidge tube is by far the biggest step in the progress in X-ray work. A number of examples are given of the use of X-rays in examining the internal structure of engineering materials.—London *Electrician*, Feb. 6, 1920.



RADIOGRAPH OF ELECTRICALLY HEATED EARTHENWARE COFFEE POT

Transformers for Electric Furnaces.—J. L. THOMPSON.—This is a comprehensive discussion of the present and future status of transformers for electric furnace work. The author states that at the present time electric steel furnaces have been designed for capacities of 15 tons and that the future will demand larger sizes up to 30 or 40 tons. Assuming that 200 kva. is required per ton, transformer groups of 6,000 kva. to 8,000 kva. will be required. While transformers of larger capacities have been designed, this particular problem is complicated by the low voltage and heavy currents required. The writer then deals with the design of the furnace with special regard to the heavy magnetic fields involved, the mechanical stresses and furnace layout. He states that in order to reduce the possibility of a heavy choking effect and unbalanced voltages, the following suggestions may be useful: (1) Transformers should be placed as near to the furnace as possible, so that heavy low-voltage leads may be of minimum length. (2) Low-voltage leads of the various phases should be symmetrically placed with respect to transformers and furnace. (3) The area between positive and negative low-voltage leads should be as small as possible and also that between phases so that inductance may be a minimum. (4) Low-voltage leads for heavy currents (above 5,000 amp.) should be in multiple and interleaved from the transformer to a point as near the furnace as possible. This will keep the inductance low and make that of each lead approximately the same, thus insuring that each parallel lead takes its proper share of the load. (5) Heavy current leads should not be run near any heavy magnetic structure such as girders or supporting columns unless both the positive and the negative leads are run together and interleaved. (6) No magnetic material should form a closed circuit around any positive or negative conductor, or heavy currents will be induced in that circuit. The positive and negative conductors interleaved may be run through a magnetic circuit. Clamps for heavy-current leads should be of non-magnetic material.—London *Electrician*, Jan. 30 and Feb. 6, 1920.



APPROXIMATE WEIGHT OF FURNACE TRANSFORMERS

Electric Mine Hoists.—G. HACAULT.—In the last installment of this extensive series of articles, the earlier parts of which we have already referred to in these columns, the author takes up for discussion the various systems of direct application of alternating-current motors for driving the hoist drums. In Europe the induction motor is only seldom used for high-power hoists, owing to the difficulties of adapting it for reliable regenerative braking. During later years, however, the alternating-current commutator motor has come into extensive use in this field, in units up to many hundred horsepowers. A popular type is the Deri motor, which works as a repulsion motor, having its stator connected directly across the mains, while the wound rotor is electrically isolated and provided with two mutually interconnected sets of brushes, one of which is movable with respect to the other. All adjustments of speed are made by moving the second set of brushes, and a very reliable regenerative braking is thus obtained. For three-phase supply bigger units are built as double motors, having two independent armatures and two Scott-connected stators for balancing the load. Ordinary three-phase commutator motors with armature-transformer are also rapidly coming into use for heavy hoisting. Summing up the foregoing discussion, the author states that each type of drive has its decided advantages and disadvantages and that no rules can be laid down for a choice.—*Revue Générale d'Electricité*, Nov. 8, 1919.

Electrophysics and Magnetism

Theory of Vacuum-Tube Oscillators.—ANDRÉ BLONDEL.—In a previous article (*Comptes Rendus*, Oct. 20, 1919) the author considers the limiting conditions for occurrence of undamped oscillations in triode circuits and, in analogy with singing-arc theory, introduces the "dynamic characteristics" of vacuum tubes. On a similar basis the present paper attacks the more general problem of predetermining the amplitude of the oscillating current. For this purpose the curvature of the characteristic surface of the tube is taken into account by considering the higher partial derivatives, and solutions are obtained in the form of Fourier series for the oscillating current and its harmonics in the simple case of a triode oscillator with tuned plate circuit.—*Comptes Rendus*, Nov. 24, 1919.

Methods for Computing and Intercomparing Radiation Data.—W. W. COBLENTZ.—This paper gives a simple method for computing spectral energy curves, using the Planck formula . A table of values of log $(\varepsilon^u—1)$ is given. There is also a chart for intercomparing thermal radiation constants with similar data obtained indirectly from photoelectric X-ray and ionization potential measurements.—*Scientific Paper* No. 360, *U. S. Bureau of Standards*, Jan. 21, 1920.

Electrochemistry and Batteries

Report of the Nitrogen Products Committee.—In this report the committee points out the fundamental importance of combined nitrogen in agriculture and munition work and gives a short account of the various nitrogen recovery and fixation processes. In dealing with this subject the committee adopted pre-war conditions as the best basis as far as costs and prices are concerned, and it is noted that the figures for cost represent pre-war production costs at factory and do not include any allowance for interest, marketing or profits, although the cost of electrical energy in all cases is taken as inclusive of capital charges upon the power installation. In conclusion it was said that the committee is satisfied that synthetic processes can at the present time be economically carried out in the United Kingdom. As regards nitrogen fixation in the British Empire generally, the ideal policy would be to make the British Empire independent of external supplies of all nitrogen products, and the investigations of the committee indicate that it is practicable. Canada, it is said, possesses exceptional water-power resources capable of easy development at a cost probably as low as or even lower than that of the very cheapest Norwegian powers, while in New Zealand, Tasmania, Egypt and India the method of synthetic nitrogen products can be profitably undertaken. In places where very cheap power can be developed nitrate fertilizers might be manufactured at a price that would compete with that of Chilean nitrate, while in other places where high-grade limestone and anthracite could be obtained the calcium-cyanamide process might prove the best—London *Electrician*, Jan. 23 and 30, 1920.

The Resistance of an Electrolytic Cell.—EDGAR NEWBERY.—The writer points out that the resistance of an electrolytic cell is made up in two parts, the resistance of the electrolyte and the transfer resistance from electrode to electrolyte. It is the transfer resistance which is studied particularly in this article.—*Transactions Faraday Society*, December 1919.

Units, Measurements and Instruments

Thermostatic Metal.—HENRY HERRMAN.—It is said that until recently German-made thermostats had some advantages over those of American makes, especially in that they developed a duplex metal with an absolutely homogeneous joint, the two metals being alloyed at the junction point so that no movement of the metals was possible. Recently, however, thermostats have been devised in this country which are fused at the junction point and offer a deflection per degree 18 to 20 per cent greater than that of the foreign product. The characteristics of this thermostat as deduced from careful laboratory tests are given in brief as follows: (1) Deflection upon temperature change varies inversely as the thickness, varies as the square of the length, is not affected by changes of width and varies directly with degrees temperature change. (2) Force exerted upon temperature change varies as the square of the thickness, is not affected by changes in length, varies directly as the width and as the square of the degree temperature change. (3) Weight required for permanent set varies as the square of the thickness (between narrow limits), inversely as the length and directly as the width.—*General Electric Review*, January 1920.

On the Use of Triode Tubes in the Laboratory.—K. HOHAGE.—Not only for signaling purposes are the thermionic tubes of ever increasing importance, but they are also being applied to a diversity of problems in connection with electrical measurements. As an example the author describes an alternating-current potentiometer, where two currents of exactly 90 deg. phase displacement are employed to induce a voltage of any desired phase in a secondary, rotating coil. From a resistance-capacity bridge of usual type quarter-phase voltages are carried to the grids of two triode amplifiers, each supplying one of the primary coils. Another useful innovation is the triode voltmeter. An alternating emf. is impressed upon the plate circuit of a three-electrode tube, and at a certain grid polarization the change in plate current is observed. The direct-current milliammeter in the plate lead thus can be calibrated so as to read alternating-current volts. The triode voltmeter has been employed by the author in investigations on telephone repeating coils, receivers and transmitters, and it is claimed that by use of this instrument in conjunction with a so-called "standard ear" the lack of objectivity inherent in measurements based upon oral comparison could be eliminated.—*Helios*, June 22 and 29, 1919.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

Conference Club to Elect New Members Next Week

MEMBERS of the Conference Club, which in January adopted the idea of dedicating itself to the electrical industry, will meet in the Cleveland Hotel, Cleveland, Ohio, on March 18, to elect new members from the unrepresented branches of the industry and also decide where the next meeting will be held. There is some question whether the meeting should be held in May in California, about the time of the National Electric Light Association convention and the jobbers' meeting, or later at White Sulphur Springs or Hot Springs, Va.

As a result of this Cleveland meeting the club can get fairly launched on its new program. It will then be possible to appoint the composite committee on bylaws.

Associated Manufacturers to Hold Annual Meeting

ARRANGEMENTS have now been satisfactorily completed for the fifth annual meeting and banquet of the Associated Manufacturers of Electrical Supplies, to be held at the Waldorf-Astoria, New York City, March 18. The business session will be held in the afternoon in the Waldorf apartment, at which time a review of the work of the year as covered by reports of officers and standing and special committees will be presented. The election of five new members to the board to succeed retiring governors will also take place. In the evening the annual banquet will be held in the Astor Gallery.

New Coast Electrification of Chicago, Milwaukee & St. Paul Opened

FRIDAY morning of last week the Olympian train left Seattle over the Chicago, Milwaukee & St. Paul tracks for Chicago, marking the opening of service on the newly electrified coast division of the system, which adds 207.4 miles to the 440 miles previously electrified in Montana. The coast division extends from Tacoma, Wash., to Othello, Wash. Between Othello and Avery, Idaho, the western end of the Montana electrification, there is an unelectrified stretch of 212 miles.

Electrification of these lines releases, or will release when it is completed and the Avery-Othello gap closed, about 250 steam locomotives and will employ in their place from ninety to ninety-five electric locomotives. Substitution of hydro-electric power for steam on the system will, when completed, mean a saving in fuel, based on the business of 1918, of approximately 300,000 tons of coal and 40,000,000 gallons of fuel oil annually.

The power furnished to the Milwaukee lines for the newest electrified section is taken for the Snoqualmie plant of the Puget Sound Traction, Light & Power Company at the west end near Seattle and from the Long Lake plant of the Washington Water Power Company on the Spokane River. Energy is delivered to the railroad's transmission lines along its right-of-way at 100,000 volts. There are eight step-down substations between Othello and Tacoma from which direct current is fed to the locomotives at 3,000 volts.

The first electrification of the lines of this system was put into operation in December, 1915. It was the Rocky Mountain division of 226 miles. The following year the Missoula division of 211 miles was placed under electrical operation.

Electric Service Lines Withstand Severe Blizzard

IN WHAT was characterized as the most severe blizzard, while it lasted, in years, the transmission and distribution lines of electric light and power companies in the East stood up almost 100 per cent. The blizzard, which visited the Western and Middle States in the early part of the week, reached the Atlantic coast on the night of March 5. Heavy rain was followed by sleet, hail and finally snow, accompanied by wind which reached a velocity of 72 miles an hour. Traffic was blocked and trains were stalled either in snowdrifts or by washouts from floods caused by the rain early in the evening.

Telephone and telegraph lines were put out of service, a district manager of the telephone company in New Jersey stating that this was the worst storm his company had experienced in the past ten years. The electric companies probably suffered the least of all utilities. The New York Edison Company stated that the storm caused no interruption of service in New York City, and in Yonkers but one circuit was out, for a period of only fifteen minutes. The Public Service Company of New Jersey, the Brooklyn Edison and the New York and Queens company each reported practically no trouble other than on one or two series incandescent street-lighting circuits. The Richmond Light and Railroad Company (Staten Island) stated that a few poles had been blown down but service was maintained.

In New England a few lighting circuits were reported down in outlying districts, but in no case was the number of customers affected very large.

Detroit Edison Issues $5,503,500 Ten-Year Debentures

THE Detroit Edison Company is issuing $5,503,500 ten-year 7 per cent convertible debenture gold bonds These bonds will be convertible at the option of the holder into paid-up shares of the capital stock of the company at par.

The proceeds of this issue, as stated by F. H. Fiske, assistant secretary of the North American Company, will be used for the development, extension and maintenance of the Detroit Edison Company.

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

SHORTAGES in stocks are worse, but the outlook is better. Improved weather conditions are expected to release more materials through betterment of transportation. The existing demand is very heavy, and increased purchases are being urged in some centers. The building program is getting under way, though there is still uncertainty about many projects. High prices are not being paid with the readiness of a few months ago.

METALS generally have shown a falling off in price in the last week. Copper dropped another quarter of a cent. Antimony and zinc also eased off slightly, while tin continues its downward plunge.

JOBBERS in New England were unable to receive goods or make deliveries outside their immediate centers of location last week with very few exceptions, owing to the severest weather conditions in many years. Central-station service, however, was well maintained, and confidence is felt that the worst of the fuel shortage is over.

EXPORT trade in electrical goods continues to fall off, the figures for January dropping to $6,347,497, which is lower than any month since September last and about 5 per cent lower than for January, 1919.

MOTOR prices moved upward Monday from 5 to 10 per cent in the case of units of 30 hp. and below manufactured at the Lynn works of the General Electric Company.

INDUSTRIAL plant construction is going forward in New England at a record-making pace, reflecting great confidence in the future.

SUBSTANTIAL increases of salary are granted to the employees of the Patent Office by a bill which has passed the House of Representatives.

WHOLESALE sale of electrical energy by street railways was vigorously opposed by central-station interests at a recent hearing given in Boston by the legislative committee on public lighting.

COMMITTEES similar to the Illinois Committee on Public Utility Information have been established in Indiana, Kentucky, Michigan and Minnesota, and one is being organized in Iowa.

STARTLING figures were made public at a conference of public officials in California held to consider the low-water situation and consequent shortage of power. The reservoirs of the state have only one-tenth last year's supply.

A TRAVELING representative is now covering the country to help build up the state and local bodies of the National Association of Electrical Contractors and Dealers.

THURSDAY of next week has been fixed as the date for the fifth annual meeting and banquet of the Associated Manufacturers of Electrical Supplies.

AS A RESULT of a meeting to be held in Cleveland next Thursday the new co-operative program of the Conference Club is expected to be fairly launched.

ELECTRIC refrigeration and industrial heating were discussed at a meeting of the Commercial Section of the Indiana Electric Light Association held at Fort Wayne.

SIXTEEN California power companies and the city of Los Angeles have signed an agreement requesting the Railroad Commission of that state to assume control of the distribution of electricity in the crisis caused by the drought, and an emergency water conservation conference has been formed under the commission's auspices.

THE NEWLY electrified section of the Chicago, Milwaukee & St. Paul Railway, which was opened on Friday of last week, extends from Tacoma to Othello, Wash., a distance of 207 miles.

AT A SPECIAL meeting of the Western Association of Electrical Inspectors' technical sub-committee on wireless-telegraph systems amendments to Rule 86 of the National Electrical Code, on radio signaling, were tentatively approved.

CONGRESSIONAL conferees on the water-power bill have again adjourned, to reconvene in two weeks. Friends of the measure are reported as satisfied with the progress made. The chief contention has been over the provisions relating to license charge and recovery.

LIBERAL arrangements for company insurance of employees have been made by the Westinghouse Electric & Manufacturing Company.

TEN-YEAR 7 per cent convertible debenture gold bonds are being issued by the Detroit Edison Company.

ELECTRICAL safeguards for the coal mines of Pennsylvania were discussed at a conference of public officials, coal operators and electrical manufacturers held in Harrisburg.

A BLIZZARD, characterized as the most severe for years, failed to disorganize the electric service lines of the East, although railroad and street traffic was blocked and telegraph and telephone lines put out of service.

A PLAN for the consolidation of Westinghouse, Church, Kerr & Company with Dwight P. Robinson & Company has been submitted to the stockholders of the former.

A LARGE attendance, many from out of the state, marked the convention of the Oklahoma Utilities Association at Oklahoma City.

DAYLIGHT saving is favored in many Middle West cities, including Chicago, Minneapolis and Aurora, Ill.

RAINFALL in California for January was 18 per cent and for February 15 per cent normal.

APPLICATIONS for water power amounting to 450,000 kw. have been received by the Oregon State Engineer since Jan. 1.

PLANS are being asked by the Southern California Edison Company for an additional 30,000-kw. steam turbine at its Long Beach plant. The company is increasing the storage capacity of Shaver Lake to allow production of an additional 46,000,000 kw.-hr. a year and is also starting work on Big Creek power house No. 8 as an emergency measure to furnish 100,000,000 kw.-hr. during 1921, with an installed capacity of 22,500 kw. to be furnished by the spring of 1921.

A LARGE factory is to be built in Oakland, Cal., by the Apex Appliance Company of Chicago to manufacture electric washing machines and other electric appliances.

PERMISSION to raise its rates on its industrial load is asked by the Utah Power & Light Company in order to meet a deficit of from $2,000,000 to $5,000,000.

CAPITAL stock of the Cleveland Electric Illuminating Company has been increased from $18,000,000 to $30,000,000.

Westinghouse Gives Insurance to Employees

COMMENCING March 1, an insurance policy for the sum of $500 will be given without cost to every employee of the Westinghouse Electric & Manufacturing Company who has been in the service of the company for a period of six months or more, according to a statement made this week by one of the officials of the company.

In addition, the employees, after April 1, may increase the value of their policies to amounts varying from $1,000 to $2,000, depending upon their length of service and continuity of savings. All employees who have been in the company's service for six months or longer and who deposit a sum each pay day in the employees' savings fund equal to 2 per cent or more of their earnings will not only receive 4½ per cent interest compounded semi-annually on such deposits but in addition will automatically have their insurance increased to amounts up to $2,000, depending on the length of time they have been with the company.

After an employee has maintained the required deposits for a period of five years he may discontinue or withdraw his deposits from the savings fund without in any way affecting the value of his insurance policy.

This insurance is to be made effective at all of the various offices and plants of the Westinghouse company and will affect approximately 50,000 people.

Water-Power Conferees Again Adjourn

WITH only two major points of difference between them, the conferees on the water-power bill adjourned March 9 without having reached an agreement. No further sessions of the conference committee will be held for two weeks, in order to await the return to Washington of Representative Taylor of Colorado and to give Senators Jones and Smoot an opportunity to go ahead with their work on other bills.

Prompt agreement may be expected on the reconvening of the conference committee, it is believed. Friends of water-power development regard the situation as very satisfactory. There had been some hope that the conferees would get together after a short discussion, but this was not realized. The items which have delayed agreement are those pertaining to license charge and recovery.

The conferees decided to eliminate the power project at Great Falls on the Potomac River. That project was placed in the bill in the Senate and carried an appropriation of $25,000,000. In its stead the following amendment was adopted:

"The commission is hereby authorized and directed to investigate and, on or before the first day in January, 1921, report to Congress the cost and, in detail, the economic value of the power plants outlined in Project No. 3, House Document No. 1400, Sixty-second Congress, third session, in view of existing conditions, utilizing such study as may heretofore have been made by any department of the government; also, in connection with such project, to submit plans and estimates of cost necessary to secure an increased and adequate water supply for the city of Washington. For this purpose the sum of $25,000 or so much thereof as may be necessary is hereby appropriated."

No announcement was made with regard to conclusions on other items, but it is believed that the Newlands investigating provisions will be eliminated. The opposition to having an army engineer as the executive secretary probably will be met by placing a civilian in that office with the authority to have an engineer officer detailed to assist in the work.

The principal discussion between the conferees, it is understood, centered on the Senate amendments numbered 28, 31, 44, 45 and 46. In the provision of the bill referring to the transfer of licenses the House measure was amended by the Senate to the effect that no voluntary transfer of any license or of the rights granted under it "by sale, assignment, consolidation, merger or otherwise" shall be made without the written approval of the commission. The Senate change is causing some trouble.

The Senate's amendment No. 31, another bone of contention, was a proviso to the effect "that the United States may have the option to redeem such site or sites by payment to the proper persons holding such title, under and by virtue of said mortgage, trust deed, judicial sale or tax certificate, of the entire amount due at the time such option applies for a period of one year from the date such right or title is secured, and if said option is acted upon, all rights to said lease or license shall revert to the United States."

Considerable controversy is understood to have taken place in regard to paragraph "J" under the section of the bill which specifies what each applicant for a license must submit to the commission. That paragraph, which was added by the Senate, reads as follows:

> The licensee hereunder shall not directly or indirectly discriminate or permit discrimination in the apportionment, allotment, transmission, distribution, sale or lease of power or electrical energy or current in favor of any municipality as against any other or others in respect of service, rates or the quantity of power or electrical energy or current transmitted or supplied to it or them; but the licensee shall fairly and equitably apportion, allot, transmit and supply power, electrical energy and current among and to such municipalities as can be efficiently served and supplied directly or indirectly by the licensee in proportion, so far as practicable, to their respective populations, industrial or commercial importance and prospects, needs and requirements, so as best to subserve the public interests. This condition shall be binding upon every person, association and corporation receiving power or electrical energy or current from the licensee and engaged in developing, transmitting, distributing, selling or leasing power, electrical energy or current to any municipality or to its inhabitants, and shall inure to the benefit of such inhabitants. Every contract, agreement or understanding between the licensee and such person, association or corporation shall be expressly subject to and limited by the provisions of this subsection. This condition may be enforced and regulated by the commissions or other agencies mentioned in, and in the manner and to the extent prescribed by, Section 19 of this act.

In the section of the bill providing for the construction of locks in navigable streams, the Senate, in its amendment No. 45, struck out the provision that the commission "may, before taking action upon such application, cause a report under such project to be prepared, and inserted a provision that the commission "shall take no action but" cause a report to be prepared. This change does not meet with favor on the part of the House conferees.

The most acrimonious discussion is understood to have waged around amendment No. 46, pertaining to severance damages.

Prominent Engineering Houses to Consolidate

A PLAN for the combination of Westinghouse, Church, Kerr & Co., Inc., with Dwight P. Robinson & Co., Inc., was submitted on March 2 to stockholders of the former. It is proposed to form a new company, under the Virginia law, to be called Dwight P. Robinson & Co., Inc. Including the holdings of the Westinghouse Electric & Manufacturing Co., the plan has the approval of 61 per cent of the Westinghouse, Church, Kerr stock.

Westinghouse, Church, Kerr & Co., formerly the Electric Properties Corporation, was formed in 1884, when the electrical industry was just starting. It was organized to do a construction and engineering business and engage in financing public utilities.

The Westinghouse Electric & Manufacturing Co. is the engineering company's largest stockholder, and the two companies have been closely identified in the eyes of the public. Because of the belief on the part of prospective clients of the engineering company that it would expect to use Westinghouse equipment in any construction, the engineering company, it is stated in the plan, has been handicapped in procuring business. It appears that it would be to the interest of both companies to terminate the association. It was thought best therefore to associate the company with any established engineering and construction company, and with this end in view this consolidation was proposed.

Dwight P. Robinson & Co. was organized in 1918 by Dwight P. Robinson, who for the past twenty-five years has been engaged in engineering and was for many years president of the Stone & Webster Engineering Corporation. It is stated in the plan that when Mr. Robinson formed his company the Westinghouse Electric & Manufacturing Co. and Guy E. Tripp, chairman of the board of the Westinghouse company, among others, became minority preferred and common stockholders, having in view that such an interest might later tend to bring about a union or merger such as is now proposed.

It is stated that the two organizations have supplementary experience and that the combination will absorb the entire personnell of the two companies. Dwight P. Robinson & Co. has been primarily engaged in power-plant construction, while the chief field of Westinghouse, Church, Kerr & Co. has been railroad and industrial construction work. The former company has on hand uncompleted construction contracts of approximately $14,000,000, and the latter company's uncompleted work under contract amounts to $8,000,000.

Traveling Representative for Contractorss' Association

AS A PART of its program to increase membership and to keep members in better touch with work at headquarters in New York the National Association of Electrical Contractors and Dealers has again, after a lapse of about six years, put a special representative into the field who will travel continuously. Laurence W. Davis has been engaged in this work since the first of February. He is now traveling in the New England States, after which he will cover the Western States.

Last year the national association increased its membership by 15 per cent, and since the first of the year it has added sixty-three new members. This brings the list up to virtually eighteen hundred members.

Proposed Revision of Electrical Code or Radio Signaling

AT A SPECIAL meeting of the technical sub-committee on wireless telegraph systems of the Western Association of Electrical Inspectors the following amendments to Rule 86 of the National Electrical Code were approved tentatively.

The proposed revisions to the code were made by Alfred N. Goldsmith, secretary of the Institute of Radio Engineers, and Mr. McNicol. The electrical committee will meet in New York for the code revision on March 22-25. Prior to that any comments on the proposed revision should be sent to William S. Boyd, 175 West Jackson Boulevard, Chicago, Ill.

Proposed Revision of Rule 86 National Electric Code.

(Note.—These rules do not apply to radio signaling apparatus installed on shipboard.)

In setting up radio signaling apparatus all wiring pertaining thereto must conform to the general requirements of this code for the class of work installed and the following additional specifications:

(a) Aërial supports to be constructed and installed in a strong and durable manner. Aërial conductors and wires leading from same to ground switch must be supported firmly on approved insulators such as porcelain knobs of approved design or petticoat insulators. Insulators must be so mounted as to maintain the conductors at least 5 in. clear of the surface of the building wall. In passing the aërial conductor through the side of the building a continuous tube or bushing must be used. The bushing or tube must be composed of non-combustible, non-absorptive insulating material and must extend 5 in. beyond the surface of the wall on both sides. The ground switch shall be mounted so that its current-carrying parts will be at least 5 in. clear of the building wall and located preferably in the most direct line between the aërial and the point of ground connection. The conductor from ground switch to ground connection must be securely supported.

(b) Aërial conductors must be effectively and permanently grounded at all times when station is not in operation by a conductor the periphery of the cross-section of which is not less than ¾ in. The ground wire must be of copper or other metal which will not corrode excessively under existing conditions. Ground connection should be made in accordance with the requirements of Rule 15A, Sections (o) to (t) inclusive, except where variation from these requirements may be allowed by special permission in writing.

(c) In radio stations used for receiving only, the grounding switch may be replaced by a similarly mounted and grounded short-gap (⅛ in. or less) or vacuum-type lightning arrester. The current-carrying parts of devices must be kept 5 in. clear of the building wall.

(d) Where the aërial is grounded as specified in Sections (a) and (b) the switch employed to join the aërial to the ground connection shall be a knife switch of approved design the blade of which must have a periphery of not less than ¾ in., and when open the current-carrying parts to which the aërial and ground connection wire are attached will be separated at least 5 in. The base of the switch must be of a material suitable for high-frequency service. Slate will not be approved.

(e) When supply is obtained direct from street service the circuit must be installed in approved metal or armored cable. In order to protect the supply system from high-potential surges there must be provided two condensers (each of not less than 0.5 microfarad capacity and capable of withstanding 500 volts test) in series across the line with midpoint grounded. A fuse not larger than 10 amp. capacity shall be connected between each condenser and the line wire connected thereto. Each condenser shall preferably be protected by a shunting fixed spark gap of $\frac{1}{32}$ in. separation, or less.

(f) Transformers, voltage reducers, keys and similar devices shall be of approved types.

California Commission to Act in Drought Situation

SIXTEEN California power companies and the city of Los Angeles have signed an agreement requesting the Railroad Commission of that state to assume the responsibility of determining rules of service, and pledging themselves to abide thereby, for the distribution of electrical energy during the emergency created by a season of unprecedented drought following two very dry years. The diminution or refusal of service and the exchange of energy between power companies will be involved as well as co-operative plans for preventing waste. Under the auspices of the commission there has been formed an emergency water conservation conference composed of federal and state officials who have expert knowledge of the water resources of California and the extent of the present menace.

This conference includes the following members, all acting in their official capacities: W. F. McClure, state engineer; Frank Adams, California branch, Irrigation Investigation, United States Department of Agriculture; E. H. Heck, director of the state's Department of Agriculture; C. H. Lee, state water commissioner; H. D. McGlashan, United States Geological Survey; H. D. Butler, state power administrator; Lt.-Col. L. H. Rand, Corps of Engineers, U. S. A.; H. D. Loveland, chief hydraulic engineer, California Railroad Commission. The purpose of the conference, which is headed by E. O. Edgerton, president of the Railroad Commission, is "to secure for the power and water users of the state the greatest benefits from the available water and power and to reduce to a minimum the damage resulting from the water scarcity." A list of suggestions addressed to all large users of power or water for irrigation has been sent out and plans for the greatest care in inspection and fair apportionment of all waters are under way. A series of meetings in various cities of the state has been scheduled.

SHORTAGE FIGURES

Some startling figures were made public by the conference showing that there is every need for conservation of the state's water supply. The reserve water supply in the storage reservoirs was shown to be practically depleted, while the underground water in most agricultural regions has reached an abnormally low level. The snowfall in the high Sierras is only about 20 in. in depth, whereas the normal January fall is about 80 in. January, 1920, was stated to have been the dryest January recorded in seventy years. The rainfall averaged over the State only 16 per cent of the normal, and the principal reservoirs owned by power and irrigation companies contain only one-tenth, approximately, of what they contained a year ago. The Lake Almanor reservoir of the Great Western Power Company, which has an approximate capacity of 300,000 acre-feet, now has impounded only about 15,000 acre-feet.

Lake Huntington of the Southern California Edison Company, with a capacity of 94,000 acre-feet, has only 5,000 acre-feet impounded. The Crane Valley reservoir of the San Joaquin Light & Power Company has 1,000 acre-feet in storage as against a capacity of 50,000 acre-feet. The Feather River at Oroville, which a year ago was discharging approximately 4,000 second-feet, is now discharging only 1,400 second-feet. The Sacramento River at Red Bluff is now discharging only 5,000 second-feet; a year ago the flow approximated 10,000 second-feet. The quantity at present in the Sacramento River is only 1,300 second-feet above the lowest amount ever recorded in that stream.

Reports by large numbers of United States Weather Bureau observers show that the ground-water level is the lowest ever recorded. In the southern portion of the state the underground supplies having a comparatively small tributary area are rapidly being depleted. In some districts in the San Joaquin Valley the water level has receded to such an extent that it is below the suction limit of the pumps now installed. Regarding this feature the conference reported:

"It will be difficult to supplement the present undeveloped underground supply by the installation of additional wells because of the shortage of electrical energy, which is very serious at the present time and prevents the taking on of new consumers by the various power companies. The power companies are either refusing to take on new business or are materially restricting it; furthermore, the leading companies handling equipment for well and pumping plants have practically no stock on hand and cannot make deliveries within from six to twelve months."

Wholesaling of Energy by Street Railways Opposed

AS COUNSEL for the Massachusetts Electric and Gas Association, E. W. Burdett, appeared recently before the legislative committee on public lighting at Boston in opposition to a petition of the Berkshire Street Railway for authority to sell electricity in bulk in the general power market. The railway company's petition, he declared, endangered the whole trend of legislative practice in the state, whereby it has long been the policy to keep separate the functions of public utilities of different character and to avoid the indiscriminate granting of competitive privileges. The hearing was one of the most important in the present session.

C. Q. Richmond of Pittsfield, general manager of the Berkshire company, informed the committee that his company desired to sell energy in bulk because it has a surplus in its steam stations at North Adams and Pittsfield and no longer supplies electricity for the operation of trains through the Hoosac Tunnel. The combined generating capacity of the plants named is about 14,000 kw. The company's transmission lines traverse the county from end to end, and the witness said that the demand for power exceeds the present ability or willingness of other agencies to supply. The loss of the tunnel load has resulted in a decrease in the operating efficiency of the steam station at North Adams. The Berkshire company has been obliged to refuse industrial power business offered it. One concern wanted 1,500 kw., and had the company had the legal right it could have furnished energy to the General Electric works at Pittsfield in the desperate fuel situation of the last few weeks. The company does not desire to sell less than 300 kw. in each case of bulk supply.

For the central-station interests. Mr. Burdett pointed out that the supply of electricity in bulk is competitive business and does not need to come under legal price regulation. It is therefore exempt from the ordinary rules in rate fixing. By Chapter 127, Acts of 1919, the Berkshire company was authorized to sell electricity to any electric company, to any municipal lighting plant or to any town in Berkshire County not already supplied with electricity; to sell to private consumers in those towns with the consent of the selectmen; to sell electricity in Blandford, outside the county, and, finally, the company received special authority to transmit for electric companies within Berkshire County electricity furnished by them for transmission to other electric companies in the county. At this point A. M. Robinson, for the Berkshire company, stated that the company had not proceeded in accordance with the act because of labor troubles and the severity of the winter.

Continuing, Mr. Burdett pointed out that if the Berkshire company desired to enter the field of power supply, it could organize a company for that purpose under the Acts of 1914, Chapter 742, and then be on the same level with every one else, subject to the regulation of the Department of Public Utilities and obliged to compete with other companies on even terms. E. C. Mason, for the Southern Berkshire Power & Electric Company, Great Barrington, Mass., also opposed granting the railway company's petition.

Heating Load Permits More Watts Per Dollar Than Motors

ELECTRIC refrigeration and industrial heating were discussed at the technical sessions of the March 4 meeting in Fort Wayne, Ind., of the Commercial Section of the Indiana Electric Light Association. The banquet in the evening was a "get-together" meeting for all the branches of the industry in Fort Wayne to hear William L. Goodwin of the General Electric Company and Samuel A. Chase of the Westinghouse Electric & Manufacturing Company.

Mr. Goodwin, after an emphatic criticism of municipal ownership, spoke of the need for investment in utilities by the local public "If everyone in the electrical industry would invest part of his earnings in central-station securities," Mr. Goodwin said, "we would all make it our business to see that the utilities were properly protected."

A paper by Robert Montgomery, commercial manager of the Louisville (Ky.) Gas & Electric Company, brought out that the average family able to buy a refrigerating machine costing $350 to $450 is paying about twice as much for ice at 50 cents per 100 lb. as it would cost to operate the machine at 3 cents per kilowatt-hour. In the discussion of the paper A. W. Shade of the Kelvinator Company, Detroit, held that energy at 10 cents per kilowatt-hour was about equal to ice at 50 cents per 100 lb.

A power customer can install twice as many watts per dollar in heating load as he can in motors, and the heating load has the additional advantage to the central station that it is balanced and has 100 per cent power factor and a very high load factor, it was contended by R. Thurman, Muncie, Ind., in his paper on "Industrial Heating." Uses for industrial electric heating were found in practically every factory in Muncie, and at the present time the customers of the central station in that city have ordered or installed a connected load of 3,375 kw. in industrial heating apparatus. M. S. Caldwell, South Bend, Ind., said that the central-station men had been depending too much upon the manufacturers of heating units to get this business for them.

Kansas Broadens Scope of Utility Law Radically

IN PLACE of the Public Utilities Commission of Kansas, which was abolished by law on Jan. 24, 1919, a Court of Industrial Relations has been established, with control over wages, working and living conditions and hours of labor in public utilities, in the mining or production of fuel, in the manufacture of food products and in the manufacture of clothing, in addition to all the powers, authority, jurisdiction and duties which were formerly vested in the commission. Any person who violates an order of the court or influences others to do so is subject to a fine not to exceed $5,000, to imprisonment up to two years, or to both.

No person, firm, corporation or association of persons shall willfully hinder, delay, limit or suspend the continuous operation of the specified industries. If it appears to the court that a controversy arising between the employers and workers may endanger the continuity or efficiency of the service of the designated industries, the Court of Industrial Relations may investigate the controversy upon its own initiative and make such orders as it believes will settle and adjust the dispute while protecting the parties, their property and the public interests.

In case the operation of any of these basic industries is suspended or limited the court may, in the interest of the public welfare, take over and operate the industry during the emergency, provided that the owners and the employees are in each case compensated on a fair basis.

Authority is given to appeal within ten days from the rulings of the Court of Industrial Relations to the Supreme Court of Kansas, and such proceedings shall take precedence over civil cases before the Supreme Court.

Water Shortage Brings Increase of $1,750,000 in Fuel Cost

THE Southern California Edison Company, Los Angeles, Cal., has filed an application with the California Railroad Commission asking a complete readjustment of its rates in the counties of Los Angeles, San Bernardino, Orange, Riverside, Ventura, Kern, Tulare and Fresno, claiming that its present charges, including a surcharge allowed by the commission in December, 1918, do not, because of greatly increased operating expenses, yield a fair return on the company's investment of approximately $84,873,000.

In its application, as a still further reason for a rate increase the company says that the scarcity of water will greatly increase its outlay for fuel oil. In 1920 the estimated expenditure for fuel oil will be $1,750,000 in excess of the expenditure in 1919. This increase in steam generation is due to the present shortage of water combined with the natural growth of the load. The company asks a temporary increase in rates pending a final settlement.

Higher Salaries for Patent Office Employees

A BILL authorizing substantial increases in the salaries paid to the employees of the Patent Office was passed by the House of Representatives March 5. The original draft of the bill was prepared by the National Research Council. It was shown conclusively that the salaries being paid in the Patent Office, especially in the positions where technical knowledge is a requisite, are so inadequate that most of the experienced employees of the bureau already have entered private employment and that there are no applications for the Civil Service examinations for these positions.

Linked with this legislation during the hearings was the proposal for the Patent Court of Appeals. The committee decided, however, that no practical proposition had been set forth showing how this court should be constituted. Consequently the measure will not be presented at this time.

The bill, as it passed the House, authorizes a salary of $6,000 a year for the commissioner of patents, $5,500 for the first assistant, $5,000 for the second assistant and $5,000 for each of five examiners-in-chief. In addition, there are increases for law examiners, examiners of trademarks, assistant examiners, translators, draftsmen and clerks. This allows an increase of $1,000 a year to the commissioner of patents, $1,000 to the first assistant, $1,500 to the second assistant and $1,500 to the examiners-in-chief.

Snow and Ice No Handicap to Electromagnet

AN ELECTROMAGNET *breaking out pig iron from snow and ice, pick and shovel work being dispensed with and weather conditions ignored, is shown here in operation at the factory of the Chapman Valve Manufacturing Company, Indian Orchard, Mass. The magnet shown is a 2,000 lb. Cutler-Hammer 43-in. electromagnet consuming 40 amp. at 220 volts direct current. Two hundred carloads of pig iron are unloaded in a year at this plant.*

Would Serve Power Company in Time of Shortage

IN COMPLIANCE with the order issued on Feb. 26 by the California Railroad Commission, the Sespe Light & Power Company filed a description of its plan for financing the construction of its power plant and irrigation system on the Sespe and Piru Rivers in Ventura County. The company proposes to issue $3,000,000 of first mortgage bonds and $1,000,000 capital stock for the construction of four dams, three water conduits and three power plants, which will constitute the first unit of the company's development. The estimated cost of the above work will total $4,023,000. The company plans to have no distributing system of its own, but is negotiating to wholesale power to the Southern California Edison Company when it would otherwise be consuming fuel oil or stored water. In addition to the power sales, the Sespe company plans to wholesale water for irrigation purposes.

Central Station Soft-Coal Consumption 35,000,000 Tons in 1918

ELECTRIC light and power utilities used 31,693,000 tons of bituminous coal in 1917, with an estimated consumption of 35,000,000 tons in 1918, according to the report of the distribution division of the United States Fuel Administration for 1918-1919, just made public. The 1918 estimate was based on reports from utility companies.

The total production of bituminous coal in 1917 was 551,194,000 tons, and in 1918 it was 579,386,000 tons. Thus 5.75 per cent of production in 1917 and 6.04 per cent of production in 1918 went to electric light and power plants.

In 1917 electric light and power stood fifth in the scale of consumption, greater consumption being registered under the headings "industrials," "railroads," "domestic," "beehive" and "coke." In 1918 electric companies stood sixth, by-product coke taking the fifth place in the table of consumption.

Cost of Running Utility Publicity Bureaus

COMMITTEES similar to the Illinois Committee on Public Utility Information have been created in Indiana, Kentucky, Michigan and Minnesota, and a number of other states are considering similar action. One of these states is Iowa, where a meeting was held recently to consider the formation of such a body. John F. Gilchrist, vice-president of the Commonwealth Edison Company and chairman of the Illinois Committee on Public Utility Information, was the principal speaker at this meeting. The discussion brought out that in Illinois the committee started with a fund of $4,000 accrued on the basis of a levy of 0.005 per cent of the gross earnings of the larger companies. Since that time three similar levies have been made. It is estimated now that the expense of maintaining such a bureau of information in Illinois will be approximately $15,000 a year. The work in Indiana was started on a levy of 0.01 per cent of the gross earnings of the utilities in the beginning.

The organization committee which will handle the work of getting the Iowa Committee of Public Utility Information under way has been appointed as follows: Representing the Bell Telephone interests, C. A. O'Rourke, Iowa Telephone Company; representing the independent telephone interests, C. C. Deering, Independent Telephone Company; representing the gas interests, A. L. English, Citizens' Gas & Electric Company; representing the street-railway interests, H. E. Weeks, United Light & Railway Company; representing the electric interests, M. G. Linn, Des Moines Electric Company.

Geological Survey's Power Figures for October

THE figures of electric power production for February, March, April and July issued by the Geological Survey last month and printed in the ELECTRICAL WORLD were based on returns received from about 3,000 power plants engaged in public service, including central stations, electric railways and certain other plants which contributed to the public supply. The returns for October do not include the output of plants of less than 100-kw. capacity. The output for October should therefore be increased 0.17 per cent to make it strictly comparable with the figures for the other months, making the October total 3,440,800,000 kw.-hr. All monthly reports represent returns received from plants whose aggregate generating capacity is about 90 per cent of the total of the country.

The average daily output in kilowatt-hours is as follows: February, 106,437,000; March, 101,511,000; April, 100,770,000; July, 101,275,000; October, 110,993,000, using adjusted output for October.

The percentages of total output produced by water power are as follows: February, 38; March, 41; April, 43; July, 39; October, 35. The decrease in the percentage produced by water power is, of course, due to the seasonal decrease in stream flow.

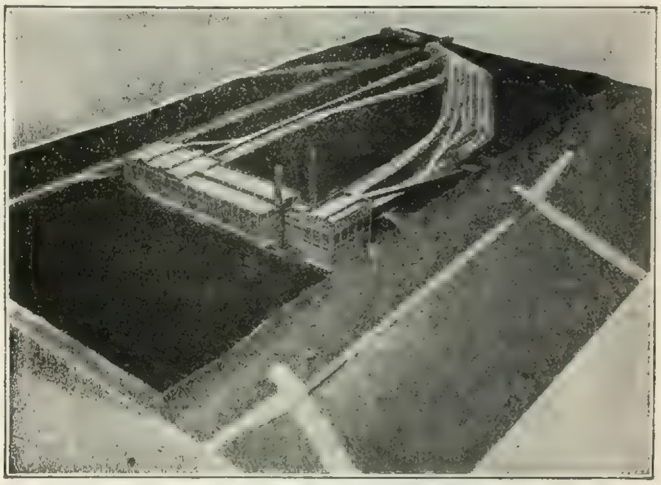
Reports for the other months of 1919, A. H. Horton, of the division of power resources, who compiled these figures states, will not be published. Beginning with January, 1920, it is planned to make reports for each month and to publish them at as nearly current a date as possible. With the January, 1920, report there will be given a summary for 1919, based on the five monthly reports for 1919 and January, 1920.

PRODUCTION OF ELECTRIC ENERGY BY PUBLIC UTILITY POWER PLANTS IN OCTOBER CLASSIFIED ACCORDING TO PRIMARY POWER

State	Thousands of Kilowatt-Hours Produced By Water Power	By Fuel
Alabama	15,899	15,102
Arizona	8,608	21,782
Arkansas	88	8,049
California	157,004	119,486
Colorado	14,861	17,466
Connecticut	10,349	54,827
Delaware		6,069
District of Columbia		20,543
Florida	961	9,040
Georgia	32,626	13,959
Idaho	40,127	1,270
Illinois	16,622	222,331
Indiana	3,442	62,594
Iowa	57,825	30,626
Kansas	807	41,751
Kentucky		18,205
Louisiana		17,353
Maine	20,019	547
Maryland	68	29,222
Massachusetts	33,231	106,363
Michigan	55,904	134,770
Minnesota	36,580	28,155
Mississippi		5,573
Missouri	3,189	44,800
Montana	68,078	770
Nebraska	1,466	19,284
Nevada	2,896	481
New Hampshire	5,112	3,554
New Jersey	146	88,207
New Mexico	110	1,531
New York	237,767	313,516
North Carolina	50,475	9,823
North Dakota		2,568
Ohio	2,597	222,585
Oklahoma	208	14,898
Oregon	26,285	14,168
Pennsylvania	42,775	273,804
Rhode Island	343	24,177
South Carolina	41,958	4,947
South Dakota	828	2,847
Tennessee	27,203	15,326
Texas	71	53,499
Utah	17,344	2
Vermont	14,621	165
Virginia	15,708	28,976
Washington	84,623	11,108
West Virginia	1,081	82,507
Wisconsin	44,401	38,280
Wyoming	179	957
Total	1,194,485	2,240,560

A Bungalow Type of Power Plant

PULVERIZED coal is to be burned in the Milwaukee (Wis.) Electric Railway and Light Company's 200,000-kw. "Lakeside" power plant, for which ground was recently broken. The elimination of coal-handling machinery and bunkers over the boilers has so reduced the height of the building that it is referred to as a bungalow type of construction. The pulverized-coal installation will cost considerably more than stokers. However, John Anderson, chief engineer of the company's power plant, has shown by a trial installation in the Oneida Street plant (reported in the ELECTRICAL WORLD for Feb. 28) that the increased efficiency and reduced operating costs to be obtained with pulverized fuel much more than compensate for the increased investment.



MODEL OF MILWAUKEE PLANT NOW BEING BUILT

The plant is to be built in three parallel sections. A model of the first section, which is to contain two 20,000-kw. turbines and eight (two spares) 1,306-hp. boilers, is shown. The two sections to be built subsequently will each be rated at 80,000 kw. The plant is laid out so that every section and each unit of all sections can be operated independently from both the steam and the electric side.

A revolving-car dump to the right of the plant will empty the coal out of the cars into hoppers. The coal is to be conveyed from the hoppers to adjacent crushers and then carried on an inclined belt to the green-coal bunker over the coal dryer in the building nearest Lake Michigan.

The small building between the two stacks is to contain the pulverizing mills. To the left of this is the boiler room, and then comes the turbine room. The switchboards will be at the end farthest from the lake, and the step-up transformers for transmission purposes will be in an outdoor substation across the road shown at the back of the plant.

The plans show two railroad tracks leading into the plant, one for coal and freight and the other for passengers. The two service tracks shown in the photo are for taking in and removing machinery. One track goes between the boiler room and the pulverizing room, and the other one leads into the turbine room.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

A New General Electric Company House Organ.—The employees of the Philadelphia works of the General Electric Company have begun the publication of *Switchboard Department News.*

Municipal Plant Seeks Aid.—Owing to increased demand and insufficient equipment, the city of Brigham, Utah, is negotiating with the Utah Light & Power Company for part or all of the electrical energy needed to supply its customers.

An Electrical Show for St. Louis.—As a preliminary to having a real electrical show in St. Louis next year, the St. Louis Electrical Board of Trade took for display purposes one-third of the available space at the Mississippi Valley Exposition held in the St. Louis Coliseum on March 1 to 13 inclusive.

Electricity in Ice Harvesting.—The recent application of electrically driven machinery to harvesting ice in the neighborhood of Sandusky, Ohio, made it possible to triple the amount stored as compared with former methods and also to effect a saving of 75 per cent in cost of labor. About 300 hp. has been used in the work, and a total of more than 250,000 tons of ice had been stored up to the middle of February.

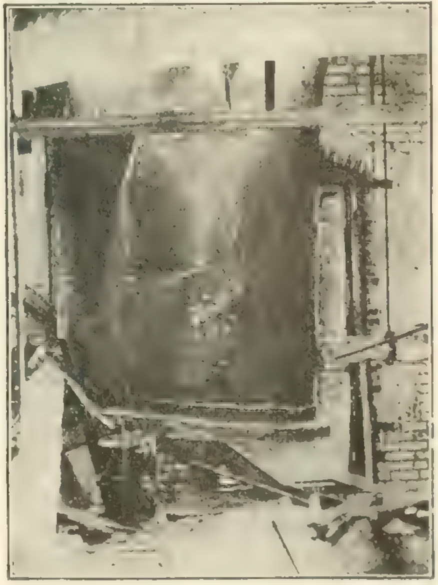
Traveling Fellowships for Scandinavian Colleges. — Twenty fellowships, with a stipend of $1,000 and in some cases $1,200 each, have been established by the American-Scandinavian Foundation, 25 West Forty-fifth Street, New York City, for award to men or women students born in the United States or Canada who desire to pursue technological research and humanistic study in the universities of Sweden, Denmark and Norway. Ten of the fellowships will be for study in the first-named country and five each in the other two. Hydro-electricity is one of the subjects for students sent to Norway and Sweden. Applications must be filed before April 1.

Features of Penn Central Company's System Explained to Bankers.—In order adequately to present the details of the physical properties of the Penn Central Light & Power Company to Philadelphia bankers interested in the sale of a new issue of preference stock of the company, J. G. Zimmermann, its secretary and treasurer, who is also a member of the firm of Day & Zimmermann of Philadelphia, has prepared a series of lantern slides with views of various parts of the transmission lines, substations, railways and power stations. This method of presentation makes it possible to explain the condition of the system and the growth which the company is expected to make. From the standpoint of interesting bankers in the sale of stock issues it has been found very effective.

A New Source of Rubber Supply.—Through the researches of the botanical department of the University of California a source of rubber supply has been discovered and opened up which, it is stated, could already yield three hundred million pounds for use in a national emergency. The desert plant from which this product is obtained is indigenous to the United States and flourishes in soil not adaptable to any other type of vegetation. Should its cultivation on a large scale be undertaken, the important part that electricity would be called on to play is obvious.

California Electric Utilities.—There are eighty-four electric utilities in the State of California, operating seventy-five hydro-electric plants with an installed capacity of 465,000 kw. and fifty steam plants with an installed capacity of 305,000 kw., making a total of 125 plants, aggregating 770,000 kw. During the year 1918 these plants generated a total of 2,892,000,000 kw.-hr., of which 2,163,000,000 kw.-hr., or 75 per cent of the total, was produced from water power. The power is transmitted through 7,300 miles of high-tension transmission lines to points of distribution from which 84,000 miles of secondary distribution lines extend. The installed capacity of consumers' lamps, motors and other power-consuming devices exceeds 1,800,000 hp. Nearly 900,000 kw. of distribution transformers are installed on these systems.

A Lucky Fall.—Here is shown the top section of an 80-ft. steel smokestack which was blown off the stack recently and fell on a safety valve in the boiler plant of the Springfield (Mo.) Railway & Light Company. The roof of the boiler room broke the fall so that neither the safety valve nor the boiler was injured. This part of the smokestack was known to be almost worn out, and the company had decided to have it removed at a cost of about $500 The wind did the job for nothing.



Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., Philadelphia Section.—The Philadelphia Section of the A. I. E. E. will meet jointly with the Franklin Institute on Wednesday, March 17. G. H. Clamer will present a paper on "Induction Electrical Furnaces."

Joint Philadelphia and Washington Meeting.—The Philadelphia Section of the Illuminating Engineering Society is to meet at the Cosmos Club, Washington, D. C., on Friday, March 19, when, under the auspices of the Washington Section, A. I. E. E., two illustrated papers will be presented—one by Ward Harrison on "Development of the R. L. M. Standards for Industrial Lighting," and the other by M. Luckiesh on "Residence Lighting."

New England Question-Box Conference.—The last call is now going out for the question-box conference of the New England Section of the National Electric Light Association, to be held at the American House, Boston, on March 18. A forenoon session will be devoted to commercial relations, lighting, merchandising, power, ranges and water heating, and in the afternoon the principal subjects will be accounting, advertising and the electric vehicle.

Electrical Contractors' Association of Connecticut.—W. L. Goodwin and Samuel M. Chase addressed this association at New Haven on March 2 upon trade relations. About 100 members and guests were present. The policy of cut-price sales by central stations was vigorously attacked and the importance of co-operation on the part of all interests in the industry emphasized. James E. Wilson, secretary of the Massachusetts branch of the National Association of Electrical Contractor-Dealers, told of the progress that has been made by the organization in northern and central New England.

Chicago Section, A. I. E. E.—The coal saving which railroad electrification in the United States can effect was discussed by S. T. Dodd, engineer of electrification, General Electric Company, Schenectady, N. Y., before this section and other Chicago engineering societies on March 4. Mr. Dodd showed that a locomotive requires the equivalent of 7.56 lb. of coal per kilowatt-hour to drive it, while the efficient central station requires about one-fourth of this amount. The speaker also showed the enormous quantities of coal consumed by the railroads in hauling the coal they use. The paper followed the same general lines as one by A. H. Armstrong, read before the Schenectady Section of the American Institute of Electrical Engineers on Feb. 20.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Commission Not Vested with Arbitrary Powers.—That the Public Utilities Commission of Illinois has no arbitrary powers and that its orders and decisions are subject to review and must be reasonable and lawful is the judgment of the Supreme Court of that state in a proceeding arising from the commission's refusal to issue a certificate of convenience and necessity to a bus line. (125 N. E. 373.)

Charging for Arrearages.—The Supreme Court of Mississippi held, in Meridian Light & Railway Company vs. Steele, that a contract with an electric light company for service in so far as it binds the customer to pay arrearages on account of a former residence before the installation of service in a new residence is void and that the company delaying service for such reason is liable for damages. (83 S. 414.)

Injury to Gossiping Workmen Not Engaged at Task.—By a decision of the Supreme Court of New Hampshire, in a factory where it was customary for temporarily idle employees to go about the room and talk with others it cannot be maintained as a matter of law that it was not the duty of the employer to exercise reasonable care in guarding machines so as to protect such an employee from possible injury. (108 A. 690.)

Determining Degree of Workmen's Disability.—The workmen's compensation act of Colorado, according to the Supreme Court of that state, vests the widest discretion in the Industrial Commission to determine whether under particular circumstances there should be applied the rule that the degree of disability is to be determined by general impairment of earning capacity without respect to any particular kind of labor or whether it should be determined by impairment of earning capacity in the kind of labor in which claimant was employed when injured. (186 P. 522.)

Application of Workmen's Compensation Act in Case of Accident Outside of State.—The acceptance of the workmen's compensation act of New Jersey is optional and hence contractual; in New York the scheme of compensation is mandatory. However, in the case of an employee of the New Jersey corporation who accepted the law of that State and was accidentally killed in New York, the New York Court of Appeals has decreed that the New Jersey act may be enforced in New York, there being nothing in the public policy of the latter state to the contrary. (125 N. E. 675.)

Confiscatory Rates.—It has been declared by the New York Supreme Court, in Bronx Gas & Electric Company vs. Public Service Commission, First District, that the returns from a gas company's electrical department cannot be considered on the question whether a statute fixing gas rates is confiscatory. Nor has the court jurisdiction to enjoin the Public Service Commission from interfering with the enforcement of a new rate filed with it in a case where the statute fixing a lower rate has been declared confiscatory as to the rate but effective to prevent the commission from fixing a higher rate, since the granting of the injunction would, in effect, be a determination by the court that the rate sought by the utility was a reasonable one and the court has no power to fix rates. (178 N. Y. S. 218.)

Transmission Company Not Negligent Because of Failure to Label High-Voltage Lines. — In a suit brought against the Pacific Gas & Electric Company to recover damages for the death of a minor employed by a contractor it was brought out that the contractor, desiring to move a pile driver on or near a road alongside which a 2,300-volt electric line was carried on poles, asked the agent of the electric company to move the wires, which the latter agreed to do. The promise not being kept, the contractor moved the pile driver on his own responsibility and accidental contact with the wires killed his employee. The Supreme Court of California held that the electric company was not negligent in failing to provide a sign to indicate that the line was operated at high voltage, for the fact that it was a power line must have been evident and it is common knowleldge that any line carrying electricity for power is dangerous. The fact that the insulation on the wire was hanging in strips only made the need for caution more evident. (186 P. 354.)

Penalty for Failure to Supply Electric Power as Agreed.—In Coal District Power Company vs. Katy Coal Company the Supreme Court of Arkansas has ruled that failure of a power company to provide the service contracted for could not be excused by the fact that the war made it impossible to procure certain supplies; that a power company so failing in a case where it was understood that electric power was to be substituted for steam power and steam machinery removed was liable in damages for the net profits that would have been made in the time during which complainant's mine had to be closed; that, however, complainant was not entitled in addition to money for excessive labor and power employed in the partial operation of the mine as all operating costs should have been taken into account in ascertaining the loss of profits, and that the damages allowed cannot be called speculative or conjectural where testimony showed the output of the mine when its operation was not interfered with, the profit per ton, and the time during which there was suspension of operation due to the lack of power. (217 S. W. 440.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

By-product Operation—Federal Income Tax.—Two recent *obiter dicta* by the Indiana Public Service Commission are that, under present conditions, the operation of a hot-water-heating plant in connection with an electric plant cannot be considered as a by-product operation, and that the federal income tax is not a proper charge to operation.

Refusal to Increase Rates.—The Missouri Public Service Commission has refused to increase the rates of an electric company, although such rates were producing a return of only 4.64 per cent on the value of the property, where it appeared that the company had lost business and therefore revenue because of its failure to keep its generating plant in a good operating condition and it further appeared that the average earnings of the electric department during the last five-year period would still exceed a reasonable return.

Obviating Estimates of Transformer Losses.—In determining a schedule of electric rates the Wisconsin Railroad Commission endeavored to design one which would not only produce the required revenues but result in an economic use of the energy by consumers, and rather than include provisions which would necessitate estimates of transformer losses on rural and power consumers, the commission, in the case of rural consumers, provided for a differential in the rate, and, in the case of power consumers, recommended the installation of disconnecting switches for the large users which would permit cutting the transformers off when not in use.

Principles of Valuation.—In an application for authority to increase rates, made by the Elkhart Lake Light & Power Company, the Wisconsin Railroad Commission declared that (1) some allowance should be made for an investment in a hydro-electric development in determining the reasonableness of the rates of an electric utility, although the electric company purchases its energy from another company, where it appears that the hydro-electric plant has some real value in voltage regulation; (2) discarded equipment should be deducted from the book value of a plant, and, upon disposition, any loss that the company may have suffered as between the original cost and the junk sale price, plus the depreciation set up for it, assuming that a reasonable provision has been made for such depreciation, should be amortized over a period of years and the equivalent amounts charged to operating expenses.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

R. S. Bell of the Northern Ohio Traction & Light Company, Akron, Ohio, has been transferred to Jackson, Mich., and is now doing industrial power work for Hodenpyl, Hardy & Company.

J. F. Mayo, formerly illuminating engineer for the Consumers' Power Company, Jackson, Mich., has been made sales superintendent of the Jackson district for the same company.

O. B. Coldwell of Portland, Ore., who has recently been appointed second vice-president of the Portland Railway, Light & Power Company, has for a number of years been prominently identified with the light and power industry in the Northwest. During all of this period he has served as chairman of the executive committee of the Northwest Electric Light & Power Association, and he was also one of the early presidents of that association. He received his technical education at Leland Stanford Junior University with the class of 1902 and later at Cornell University. Upon returning to the West he entered the employ of the Portland Railway, Light & Power Company on its engineering staff, rapidly rising to the position of chief engineer. For several years he has been general superintendent of the Portland Railway, Light & Power Company. Mr. Coldwell is chairman of a special committee which, with the indorsement of the Northwest Electric Light & Power Association, is planning to run a special train from that section to the Pasadena convention of the National Electric Light Association next May.

O. B. COLDWELL

Thomas W. Martin, vice-president and general counsel of the Alabama Power Company, Birmingham, Ala., has been elected president of that company, succeeding James Mitchell, who has resigned to become chairman of the board of directors on account of ill health.

James Mitchell, who was one of the organizers of the Alabama Power Company and has held the position of president since its formation in 1912, has resigned and been elected chairman of the board of directors of the company. This change in duties had been requested by Mr. Mitchell on account of ill health.

Walter N. Walmsley, general manager of the Alabama Power Company, Birmingham, Ala., has been elected vice-president of that company.

Rudolph Schmutz has been appointed chief engineer at the Drumright plant of the Oklahoma Gas & Electric Company, succeeding F. C. Bray.

Townsend H. Soren, vice-president of the Hartford (Conn.) Electric Light Company, has been elected president of the Hartford Home Building Association, Inc.

W. L. Mason, heretofore vice-president of the Keene (N. H.) Gas & Electric Company, was elected president of that company and the Ashuelot Gas & Electric Company.

Edward S. Clinch, Jr., consulting engineer, has opened offices at 116 West Thirty-ninth Street, New York, for handling all matters connected with the mechanical equipment of industrial plants, hotels and other buildings.

Robert Howes has reopened his consulting engineering office at 1039 Henry Building, Seattle, Wash. During the war he had charge of work for the United States Housing Corporation at Bremerton, Wash. He also served as technical assistant to the Pacific Coast manager of the United States Housing Corporation at San Francisco.

Col. George E. A. Fairley, Baltimore, Md., for five years assistant chief engineer of the Electrical Commission of the city of Baltimore, who resigned that position to enter government service, has received a promotion to the grade of lieutenant colonel, Reserve Corps of Engineers. Colonel Fairley served fifteen months in France.

Albert Milmow, who for a number of years has been attached to the Charlotte (N. C.) office of the Westinghouse Electric & Manufacturing Company as engineer in charge of special textile work in North and South Carolina, has resigned to become associated with the firm of Michael & Bivens of Gastonia, N. C., which is one of the largest electrical contractors in heavy industrial work in the South. Mr. Milmow has been prominently connected with sales work in the South for the last fourteen years. He opened and organized the sales office of the General Electric Company in Charlotte. Later he was called upon to organize the power sales and mill engineering of the Southern Power Company. Then he was connected with the Alabama Power Company and the Union Gas & Electric Company of Cincinnati, returning to Charlotte to take the position he has just resigned.

Frederick H. Smith, for the past year superintendent of distribution of light and power of the Newburyport (Mass.) Gas & Electric Company, has resigned to become local manager for J. J. Merrill, electrical engineer and constructor. Before his association with the Newburyport company Mr. Smith was for eight years with the Turners Falls Power & Electric Company.

William Rawson Collier, formerly operating and sales manager of the electrical department of the Georgia Railway & Power Company in Atlanta, Ga., was appointed general sales manager of that company on Feb. 1. Mr. Collier's engineering career began with his graduation from the Massachusetts Institute of Technology in 1900, from which institute he entered the consulting engineering field as junior member of the firm of Collier & Brown. In 1902 he joined the engineering staff of the Georgia Railway & Electric Company as assistant engineer and in rapid promotions has served as contract agent, sales manager Georgia Railway & Power Company and Atlanta Gas Light Company, and operating and sales manager, electric department, Georgia Railway & Power Company. In his present position as general sales manager of the company he is in charge of all sales of electric light, heat and power, gas and steam heat. In addition, the gas shop, gas storeroom, gas meter department, electric meter department and the management of the Carrollton, Gainesville and Franklin districts served by the company are placed under his direct supervision. During the war Mr. Collier served as local public utility representative of the priorities committee, War Industries Board, and later, during the recent coal strike, as public utilities representative of the regional coal committee. This latter position involved the handling of the fuel supply to all gas, water and electric utilities in the Southeast. As a member of the National Electric Light Association and other similar bodies Mr. Collier is an active participant in all matters looking toward the betterment of the industry, having been prominently identified with most of the constructive work of this nature throughout the Southeast.

W. R. COLLIER

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Record-Breaking Demand for Motors Continues

THE market for electric motors is fast approaching a point where the manufacturers will be unable to make deliveries before fall unless present handicaps to production can be relieved. Already it is impossible in many cases to secure deliveries this year on fractional-horsepower motors, and it would be little exaggeration to state that the washing-machine or vacuum-cleaner maker who has not already contracted for his 1920 consignments stands small chance of obtaining motors before next January. In the field of general service motor conditions are not quite so serious, but the demand is increasing so fast that manufacturing facilities simply cannot keep pace with it, and even the most strenuous efforts to enlarge existing factories and establish new ones have thus far only stemmed the tide sufficiently to avoid a literal deluge of unfillable orders.

The demand for motors comes from all sections of the country and from practically all branches of industry. Notwithstanding the situation in foreign exchange, an overseas call for American-made motors is springing up. This is adding greatly to the pressure already exerted by the domestic demand. Up to March 1 the demand for motors upon representative factories exceeded that of the same period last year by 25 per cent. Bids for 1921 delivery were wanted on $250,000 worth of motors by one concern which entered the market a few days since—a striking instance of the confidence felt by manufacturers, in some fields at least, as to the continuance of active business for some time.

Relation of Credit to Unequal Price Level

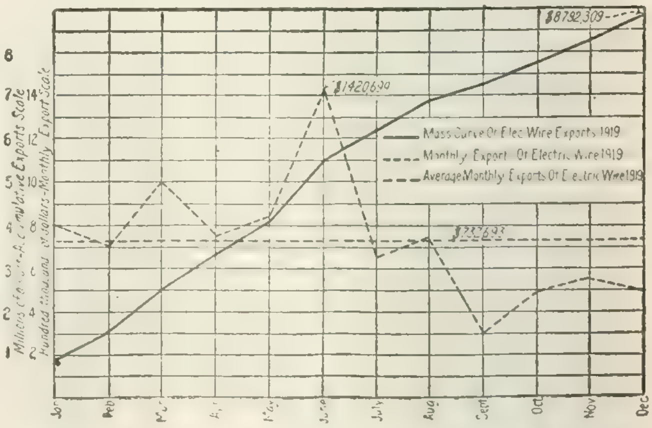
MOTOR buyers are finding that, contrary to all precedent, prices asked by smaller manufacturers are higher than those asked by the larger concerns. By the time these words are printed it seems likely that a similar situation will prevail in the electric controller field. It is true, of course, that the smaller companies are making much quicker deliveries than the larger ones, and it is this item of delivery which helps them to make sales under their terms. In the old days, when a buyers' market prevailed, it was not usual to find the smaller companies underselling the larger ones. They felt they had to offer some inducement to get business, so they offered an attractive price. Later, as demand more nearly equaled supply, the prices of practically all manufacturers were very close together. All were affected in about the same way by increasing prices of labor and material, and as prices advanced there was until recently little change in the level competitive price situation. Higher costs have continued to beset the manufacturers, and the smaller concerns have gone ahead establishing new prices that will continue to give them their usual margin of profit without waiting to see whether larger competitors intended to do likewise. In taking this step the smaller companies have had their courage fortified by a stack of future delivery orders.

A large factor affecting general business prosperity is credit, and this has been greatly inflated. Deflation appears necessary and in fact has already begun in speculative and investment credit through the increasing discount rate of the Federal Reserve banks with respect to call money. Now, if the aid of the same machinery is invoked to reduce commercial credit inflation, and if the Federal Reserve banks' discount rate for commercial paper is increased, the natural result to expect is large cancellations of existing orders. Perhaps one-half of all orders will be canceled. At such a time the manufacturing concern which has twice as many orders on its books as it can actually fill will, theoretically at least, occupy a very desirable position. The observers who argue in this way point out that the hope of getting twice as many orders as they can fill is the motive which keeps some motor manufacturers from raising prices. These observers also declare a belief that when the period of order canceling comes it will be of short duration because the great basic demand must be filled. When the manufacturers who are raising prices are confronted with this argument they express a belief that it will be just as well for them to meet the cancellation period with a surplus of dollars stored up against that time and taken out of adequate profits today as to sacrifice profit today in order to enter the period of depression with bona fide orders to fill.

It is natural to expect that some concerns will try to work out combinations of the two policies discussed above. Perhaps the most common of these combination methods is the one adopted by a concern which is increasing its prices and its sales effort simultaneously in an endeavor to get both a large immediate profit and an adequate supply of future orders.

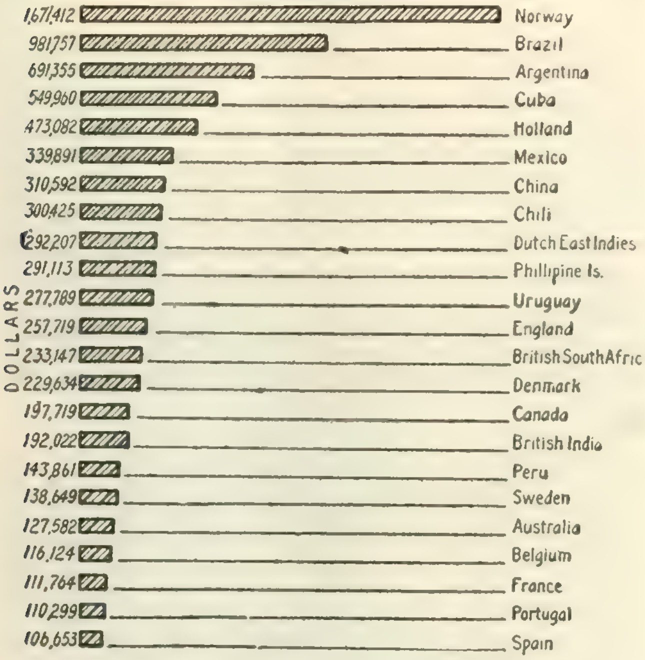
Analysis of 1919 Insulated Wire and Cable Exports

ALMOST 10 per cent of the value of electrical exports in 1919 was in insulated wire and cable, last year's exports of these products amounting to $8,792,309. Owing to the changing price of wire it is difficult to make month-by-month comparisons. Nor is it possible to make any very careful studies based on domestic prices. Export prices for wire are affected by a different set of factors. The curve in Fig. 1, however, shows the monthly variation in value of insulated wire and cable exports. The first half of the year, it will be noticed, was well above the average, while the opposite is true of the second half. Advancing rates of exchange undoubtedly were a factor the latter part of the year.



MONTHLY VARIATIONS IN VALUES OF INSULATED WIRE AND CABLE EXPORTS

Data compiled by the ELECTRICAL WORLD indicate that Norway imported almost twice as much insulated wire and cable from America as did any other country, with a total of $1,671,412. Brazil and Argentina were second and third, with $981,787 and $691,355 respectively. Fig. 2 indicates the large extent of the South American market for this class of electrical goods. Five of the countries of that continent imported American wire and cable valued at more than $100,000, or a total of $2,395,185. To our neighbors, Canada, Mexico and Cuba, exports of these goods totaled $1,087,570. Taking into consideration only such countries as imported $100,000 or more of this class of American electrical goods, continental America trade accounted for $3,482,755 worth, or 39 per cent; European imports totaled $3,215,336, or 37 per cent, and the remaining $2,094,211, or 24 per cent, went mostly to China, the Dutch East Indies and British South Africa. Australian orders totaled only $127,582.



EXPORTS OF AMERICAN INSULATED WIRE AND CABLE TO FOREIGN COUNTRIES

The above figures are based on export statistics issued by the Bureau of Domestic and Foreign Commerce for 1919.

Extensive Changes in Control Design Anticipated

LOCAL inspection rules in Chicago and in San Francisco now call for the inclosing of all face-plate types of control equipment. Manufacturers of electrical control equipment who have been viewing this development of the rules believe that the activity of the inspection bureaus of the electrical departments in the two cities named will impose a handicap on controller manufacturers and especially on the smaller ones.

Inclosing face-plate equipment will require a considerable amount of sheet iron in gages which are extremely scarce at the present time. It means that manufacturers of control equipment will have to go into the business of making sheet-metal boxes, will have to put on new drafting crews to design them and will have to enlarge the tool departments for making dies and bending tools. One of the smaller controller manufacturers has stated that his concern will have to make numerous drawings, templets, dies, jigs and special tools to meet the demands of the Chicago market. With his limited line of control equipment it will require nineteen complete sets of dies, jigs, templets and tools, which will cost around $12,000. Some of the control manufacturers contend that it should be sufficient to have the electrical contractors inclose the starters or speed regulators of the face-plate type in sheet-iron boxes with hinged covers which are opened when the machine is being operated.

It is the attitude of the inspection department of Chicago at least that the inclosure must be made by the manufacturer. It is permissible to design the equipment with a handle extending through the slot if the design will eliminate the danger from flying sparks and will inclose all live parts. It is believed that the additional expense which the industry will be put to to meet these demands will be justified by the increased safety gained in installations of this character. This is the point of view on the safety features and elimination of fire hazards which the electrical bureaus are announcing to the manufacturers interested in the production of this equipment.

Canadian Laco Lamps, Ltd., to Take Over Dominion Plant

The Canadian Laco Lamps, Ltd., has just been incorporated under the laws of the Dominion of Canada to operate under a license granted by the Canadian General Electric Company to the Canadian Laco Philips Company to manufacture tungsten lamps under the Coolidge and Langmuir patents.

This new concern, according to a statement made to the *Electrical World*, is arranging to place its stock largely in the hands of Canadian electrical interests and has no connection either direct or indirect with the Philips Glowlamp Works of Holland, as was erroneously intimated in *Electrical World* for Feb. 28.

The new company will take over the plant of the Dominion Lamp Company, Ltd., of Montreal.

Export Trade Continues to Fall Off

DURING January the exports of electrical goods dropped to $6,347,497, which is lower than any month since September last and about 5 per cent lower than during January, 1919.

A new high record of $183,404 was hung up in telegraph apparatus. The exports of insulated wire and cable and of transformers were also better than they had been for some months. On the other hand, the January shipments of metal-filament lamps were very low. Shipments of rheostats, telephones and miscellaneous supplies were lower than usual.

The figures for the month, which follow, were obtained from the Bureau of Foreign and Domestic Commerce:

	1919	1920
Batteries	$345,811	$374,730
Carbons	189,351	139,640
Dynamos and generators	249,853	413,293
Fans	176,526	29,587
Heating and cooking apparatus	98,515	113,819
Insulated wire and cable	804,481	661,842
Interior wiring supplies	194,565	168,889
Arc lamps	206	90
Carbon filament lamps	20,034	7,133
Metal-filament lamps	578,175	211,697
Magnetos, spark plugs, etc	279,174	261,542
Meters and measuring instruments	324,404	188,133
Motors	680,882	733,822
Rheostats and controllers	48,436	18,558
Switches and accessories	177,159	294,036
Telegraph apparatus	56,541	183,404
Telephones	214,172	230,186
Transformers	309,028	350,364
All others	1,975,211	1,966,672
Total	$6,722,524	$6,347,477

Mexican Heating Appliances on Display

THE Associated Manufacturers of Electrical Supplies has added to its collection of foreign-made electrical products a number of electric heating and cookery appliances made in Mexico. The open-resistance coil is used in each case and is held in grooves in a native baked clay. The samples, seven in all, were presented to the association by the Westinghouse Electric International Company.

The samples and list prices follow: Round stove, $2.50; one-burner square stove, $3; two-burner square stove, $6; electric oven, $11.50; large water heater, $2.50; small water heater, 75 cents; one-burner square heater with cover, $3. Discounts are allowed from these prices of from 10 to 25 per cent, depending upon the quantity.

Glassware Shortage Directs Residential Fixture Design to Candelabra Type

AMONG the fixtures for residential use the candelabra type can be said easily to predominate for 1920. Perhaps eight out of ten fixtures shown at the Detroit fixture market were candle fixtures of some design equipped with bare, round frosted lamps, generally of the 25-watt size. Credit for the origin of this style of fixture, which is heartily detested by illuminating engineers, is said to lie with the glass manufacturer, who has forced it through his inability to deliver illuminating glassware to the fixture manufacturer. It is said that, even with this style established and with the demand for glass thus reduced, glassware is still the neck of the bottle in the production of fixtures requiring it. It appears, however, that in the days ahead, shortages in steel sheets will claim more attention than shortages in glass. Even now it is almost as cheap to build a fixture of brass as of steel.

Besides the candelabra idea, one other residential fixture tendency is apparent. That is the movement to make fixtures in such a way that their entire appearance may be changed by the housewife easily and at reasonable expense. Along with this plan appears the attempt to combine with these fixtures fundamental ideas of good lighting that will not be eradicated by whatever changes are made in the fixtures. Evidence that the tendency is growing rapidly toward this type of fixture is at once apparent when the observer remembers that it has been only a few months since the first design appeared and already several other designs are on the market, while still others are about ready to be announced.

Metal Market Situation

METALS generally showed a falling off in price during last week. Copper dropped another quarter of a cent. Antimony and zinc also eased off slightly. Tin is still in a fast downward plunge. On Monday Straits was quoted at 61.50, a drop of 3 cents during the week. Lead stiffened slightly. Old coppers and brasses followed the downward trend of the new metals.

Copper futures are being held for better prices. Second quarter copper is quoted at 18¼ to 18½, third quarter, 18¾ to 19 and fourth quarter, 19¼ to 19½. Little of the present business is being done with producers who are holding out for 18¾. Buyers generally seem indisposed to place large buying orders while holders of stock are reported to be releasing them.

Demand for copper sheets is reported to be large but a very small call for copper and brass tubes is noted. Copper sheets were quoted at 29½ on Tuesday, rods at 26¾ and seamless tubes at 32.

NEW YORK METAL MARKET PRICES

	March 2	March 8
Copper	£ s d	£ s d
London, standard spot	119 7 6	121 0 0
	Cents per Pound	Cents per Pound
Prime Lake	19.00	18.75
Electrolytic	18.50	18.25
Casting	18.37½	18.00
Wire base	22.25	22.25
Lead, trust price	9.00	9.25
Antimony	11.62½	11.37½
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Spelter, spot	9.10	8.85
Tin	63.50	61.50
Aluminum, 98 to 99 per cent	31.00 to 32.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	17.00 to 17.50	16.50 to 17.00
Brass, heavy	9.50 to 10.25	9.50 to 10.00
Brass, light	9.00 to 9.25	8.75 to 9.00
Lead, heavy	7.50 to 7.75	7.75 to 8.00
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

SHORTAGES are worse, but the outlook is better. Improved weather conditions are expected to release more materials through improved transportation conditions. Increases in conduit, porcelain, small motors, storage batteries, poles and hardware are reported this week. More and more items are going on the price at delivery basis.

Demand is very heavy and increased purchases are being urged in some centers. The building program is getting under way, but there are indications that many proposals will be withdrawn. Expressions of a feeling of uneasiness are becoming more numerous. The abandon with which high prices were paid a few months ago is not so evident.

NEW YORK

During the past week jobbers have been playing a waiting game which consisted principally in waiting for shipments of rigid conduit, porcelain, outlet boxes, flexible armored conductor, lighting fixtures and many other products, which were delayed by the recent snowstorm. Demands for building materials are mounting high, and the jobbers' hopes are that quantity shipments will arrive in time to prevent delays or hold-ups in the work. Rigid conduit and flexible armored conductor are particularly scarce. Manufacturers have issued rigid-conduit card No. 44 which contains several changes.

Shipments which have been side-tracked or stalled in the snow are again reported moving, and it is the popular belief that by next week a considerable number of carloads of material will have arrived.

In the absence of much material, which is badly needed, jobbers have busied themselves by booking large orders of washing machines, vacuum cleaners, lighting fixtures, brassware and sockets.

Price advances are announced on porcelains and on the Thor No. 12 vacuum cleaners.

Rigid Conduit.—Demand for rigid conduit has brought about a serious shortage, especially in the larger sizes. Manufacturers have issued a new card No. 44. No advance is made on carload lots, but for 10,000 lb. and less the increase will amount to approximately 5 per cent. Where formerly four points were charged for warehousing in New York City the new card charges six points.

Porcelain.—Building plans call for more porcelain than jobbers can obtain. They are meeting present demands fairly well, although a shortage is in sight. Effective Monday, the list price was increased approximately 100 per cent, the discounts of 60 per cent on tubes and 65 per cent on knobs and cleats remaining unchanged.

Flexible Armored Conductor.—Two-wire conductor is scarce. Few jobbers report enough for a medium-sized order. Shipments are expected which will help considerably, although it is known the shortage may last for some time.

Vacuum Cleaners.—Orders continue to pile up with but slight chances of being filled in the near future. On Monday a price advance of from $35 to $42.50 was made on Thor No. 12 vacuum cleaner. The attachments were increased from $8 to $9.50.

Lamp Cord.—Stocks are almost all depleted. Several jobbers report less than 500 ft. on hand. Supplies are expected daily.

Washing Machines.—Demand is constantly increasing and jobbers can sell all available machines. One firm which has a number of carloads en route has ordered three additional car loads to clear up present orders.

Heating Appliances.—Jobbers' shelves are virtually bare with manufacturers' deliveries growing longer, six to eight months being quoted by two manufacturers. Delayed shipments will help the situation considerably.

Lighting Fixtures.—Good volume of sales in lighting fixtures is reported from New Jersey districts and the outlying suburbs. Jobbers report heavy demand for next two months.

CHICAGO

Sales in continued heavy volume are reported by both jobbers and retailers, with the prevailing condition of no fixed prices in many lines seeming to have no effect on the flow of business. The volume of retail sales in appliances and the prospect of its continuance are indicated by the growth of the Commonwealth Edison Company's electric shop here. This concern has leased 9,000 sq. ft. of retail sales space and 6,000 sq.ft. of storage space in an adjoining building.

Delivery conditions remain very bad. Some jobbers report a volume of material on back orders, in certain lines equivalent to a whole normal year's business. This is true of loom and various styles of lamp cord. Orders for all kinds of conduit, armored conductors, outlet boxes and covers, molding fittings, standard porcelain, certain lines of heating devices and ironing machines are accepted by jobbers only at the price prevailing at time of shipment, delivery at manufacturers' convenience.

The Illinois Central Railroad is perfecting a separate organization to handle the job of electrifying its terminals in Chicago under the direction of Vice-president A. S. Baldwin.

Certain jobbers are advising architects and engineers to place orders now for any conduit they feel certain they will need during the course of the next eight months, even though plans for the buildings in question are not yet completed. This advice is being followed in many instances and has resulted in a further accumulation of back orders for this class of material. In like manner dealers are being urged to order stocks regardless of price or delivery date.

Building permits in Chicago last week totaled $2,250,000.

Wire.—While no changes have occurred in quoted prices, delivery conditions have become steadily worse. The best promise that can be secured on small quantities of weatherproof is four to five months, with some manufacturers refusing to book any additional business.

Loom.—Quotations have been withdrawn, orders being placed for delivery at manufacturer's convenience.

Rigid Conduit.—A slight let-up in demand for immediate delivery has temporarily eased up stock shortage. Delivery of orders booked for future shipment will render this condition of short duration.

Lamp Cord.—Without exception, all styles of lamp cord are completely out of stock. Jobbers complain that manufacturers' prices show a range of as much as 30 per cent on similar grades.

Motors.—A readjustment of prices, with increases ranging from 5 to 10 per cent, is looked for at an early date, although nothing has yet been officially announced.

Poles.—Demand greatly exceeds supply. New prices were issued this week. Poles 30 ft. and 6 in. are now $8.30 and 35-ft., 6-in. poles are $11.05, against former prices of $6.80 and $9.05 respectively. Seven-inch poles are quoted at $11.05 for 30-ft. and $14.90 for 35-ft., comparing with previous quotation of $9.05 and $12.40.

Batteries.—Fair stocks insure deliveries at least for some time. An advance of approximately 15 per cent is noted on "Hot Shot."

Electric Locomotives.—Unprecedented demand is noted for electric locomotives to run on rails for use in industrial plants. Orders are for equipment ranging in size from 2 tons to 50 tons, with the 10-ton size predominating.

Hydraulic Governors.—Volume of orders is causing one manufacturer to increase his space 50 per cent. He states that even this enlarged capacity will be insufficient to handle the business in sight.

BOSTON

Orders are coming in again in full tide, but deliveries are very uncertain on account of continued severe weather. Northern New England was practically overwhelmed by the blizzard of last week, with a complete tie-up of transportation. Collections are holding up fairly well in central and southern New England. Jobbers' stocks are extremely spotty, and occasional arrivals of carload shipments of fast-moving supplies are almost immediately absorbed. Prices still tend upward, with advances in small motors and alkaline storage batteries and stiffer quotations on armored flexible conductor. Building contracts to March 4 total $44,406,000, compared with $12,940,000 for the same period in 1919. The Salem Electric Lighting Company will add a 7,500-kw. turbine unit and boiler to its plant.

Motors.—A price increase amounting to between 5 and 10 per cent on the average was announced Monday on motors manufactured at Lynn, Mass., by the General Electric Company. This covers small motors (not fractional horsepowers) up to about 30 hp. in both direct-current and alternating-current designs. The demand for motors of all standard makes is record-breaking, and below 50 hp., few immediate shipments can be made by either manufacturers or dealers.

Lamps.—A surplus no longer exists, even with the larger distributers. Local stocks are somewhat spotty, with the most acute shortages in 25, 40 and 50-watt clear tungstens. Shipments are being sharply controlled.

Storage Batteries.—Edison batteries are up 10 per cent in price. Orders are coming in very rapidly, and local stocks in some makes are sold into early summer.

Electric Ranges.—The demand exceeds manufacturing abilities. Factory stocks are bare. A 10 per cent advance on Simplex ranges was recently announced. Manufacturers are operating regularly, but are anxious about supply shipments and outgoing transportation conditions.

Wire.—A few deliveries are being made by water shipments, but railroad movement of wire is at a low ebb. The demand is brisk for all ordinary grades and sizes. Rubber-covered, No. 14, is quoted at $11.50 per 1,000 ft. in lots of 5,000 ft. and over; $13 in coil to 5,000 ft. and $16 per 1,000 ft. on less-than-coil lots. Weatherproof wire, triple-braid, No. 10, is quoted at 27 cents per pound, and the bare base is around 25 cents on No. 4/0 to No. 8.

Armored Flexible Conductor.—Prices are firm, No. 14 single-strip being quoted at $100 per 1,000 ft. in coil lots and $105 in less. Stocks are very low, and one jobber received 10,000 ft. Monday only to have it vanish before night.

Non-Metallic Flexible Conduit.—Prices are steady, with slim stocks. The 7/32-in. size brings $37 per 1,000 ft. and the ½-in. size $40.

Sockets.—Prices are shifty, although fair stocks are in hand. Pulls in standard packages brought 47.5 cents net, keys 28 cents and keyless 26 cents the first of the week. The present demand, while large, is being well met.

Fixtures.—Some excellent stocks of residential lighting fixtures can be located here, but industrial equipment is harder to obtain. There seems little probability of overstocking the industrial market this year.

Fans.—Early shipments have not materialized as yet. The outlook for obtaining additional shipments above orders previously placed for this year is at present dim.

Appliances.—The demand for washers and cleaners continues heavy. Irons are being ordered for fall delivery. One of the large New England wringer factories has been forced to shut down temporarily for lack of raw material.

Rigid Conduit and Porcelain.—Stocks are appallingly low, with no relief in sight.

ATLANTA

Business conditions continue very active, and all jobbing firms are complaining of inability to get large enough shipments. Building activities slowed up somewhat because of inclement weather and then took a fresh start. Reports indicate that no slackening in the orders has been felt despite the sharp advance in prices of a number of lines, notably poles, pole-line hardware, lamp cord and fans. There is an increasing number of articles on which prices have been withdrawn and which are being sold only on the basis of price at the date of shipment.

Jobbers report that business for the month of February, 1920, exceeded the business done in the same month of the preceding year by from 50 to 100 per cent, while sales to date seem to indicate that March will do even better. Contrary to predictions of some, there are not enough cancellations of back orders being received to be worthy of mention. Collections are reported good throughout the section.

Wire.—Stocks of wire are not so good as last week, particularly in the popular sizes of Nos. 6, 8 and 10. Despite fair shipments, the demand for these sizes prevents the accumulation of any stocks of moment. Wire prices remain steady with rubber-covered at 28 cents and weatherproof at 29 cents base.

Condulets.—One jobber reports the receipt of a very large shipment of condulets which were promptly absorbed by back orders and current demand.

Poles.—A price advance of 10 per cent is announced on white cedar poles. Stocks in the territory are reported fair, but car shortage makes delivery difficult. Price on 30-ft., 6-in. tops, is $9.40.

Pole-Line Hardware.—Owing to the construction of new distributing systems and the expansion of present systems, the trade reports a brisk movement of hardware. Prices have advanced from 10 to 15 per cent in the past week. Stocks and shipments are reported fair.

Motors.—Industrial plants changing over from mechanical to electric drive keep motor stocks in a very spotty condition. It is almost impossible to obtain a prompt delivery on any of the popular sizes, shipments averaging from twelve to eighteen weeks. One of the largest manufacturers announces a 10 per cent increase, effective March 1.

Fans.—The few warm days just past have ushered in the first of the fan season, and jobbers report their stocks beginning to move. As heretofore mentioned, local stocks will be in good shape by the time the season is in full swing, and dealers are anticipating a record fan season in the face of a 12 per cent price advance.

Glassware.—No material stocks are in the territory, and best shipments promised are approximately five months. As a result jobbers who succeed in accumulating a fair stock of this article will obtain a high price for their holdings. All sales are being made on the basis of price at date of shipment.

Fixtures.—Contrary to the usual form, this being the off season, the demand for fixtures is holding up remarkably well. Jobbers report that a big business is being done, particularly in the smaller rural communities, while prospects for the summer and fall indicate a record business.

Sewing Machines.—A price advance of 20 per cent is expected on this item in the next week or ten days. Local stocks are reported in good shape. Though the movement in this line is rather slow, the spring weather will materially stimulate demand.

SEATTLE—PORTLAND

Seattle jobbers and dealers report an increase in business over the past few weeks, particularly in house-wiring devices, appliances and fractional motors. Transformers and generators are not moving to any extent, and the sale of larger size motors is very light. Complaints of slower and more unsatisfactory shipments are heard everywhere in this district.

Stocks in some lines are very incomplete, while others have vanished. Demand for certain household devices, washing machines in particular, is far in excess of supply. Eastern Washington and Oregon jobbers also report serious appliance shortages. Residence construction continues brisk, increasing from week to week. Shipyards are negotiating for new work and contract awards are not far distant. It is reported that the Northwest yards have been asked by the government to submit figures on five scout cruisers which were to have been built by the Norway Pacific yard in Everett. Lumber mills and logging camps in western Oregon and Washington are running on approximately capacity basis. The only unfavorable element in the lumber situation is said to be the continued shortage of cars.

Reports from eastern Washington power and irrigation companies state that indications point to a shortage of water this summer because of a light snowfall in the mountains. In some cases wells are being drilled and in others arrangements are being made for pumping water from other sources of supply. Confirming this condition, Spokane jobbers report increasing sales of power apparatus and pumping equipments.

In the Portland territory it is becoming more and more a problem how materials can be obtained. Orders are coming rapidly, but the factories are from six to eight months behind and the condition is rapidly growing worse. Bankers in this district are endeavoring to stabilize conditions somewhat by tightening up on loans for building projects. Retail electrical stores report that business for the past week or two has materially slowed down.

Switches.—One prominent Seattle jobber notes an increasing call for double-throw knife switches for electric range installations. The standard switch recently increased in price from 20 to 25 per cent in various quantities. Safety switches also show an increase ranging from 5 to 15 per cent.

Storage Batteries.—Business is good and increasing, but stocks are being maintained after a fashion. Prices show no advance, in spite of an advance in the price of lead. A considerable portion of the volume of sales is from towns in the outlying districts.

Sockets.—Heavy demand continues, and at present stocks are low.

SAN FRANCISCO

Building permits issued during February, 1920, were: San Francisco, $2,330,000; Los Angeles, $3,286,000; Oakland, $921,000. During February, 1919, the totals were: San Francisco, $650,000; Los Angeles, $1,008,000; Oakland, $492,000. The construction of the $50,000,000 Pacific Coast naval base in San Francisco Bay, will be delayed until 1921. In the meantime a huge warehouse is being constructed in San Diego which will be made the destroyer base for the Coast.

A 25-ft. rise in the levels of Sierra Lake used as power reservoirs has definitely removed all fear of a serious drought and will no doubt remove some of the San Joaquin Valley restriction for lighting use.

Farm Plants.—Demand has been very light but has not been felt severely because of continued poor delivery conditions from the East. Deliveries of 32-volt motors have seriously affected the growing call for appliances such as washers and cleaners.

Weatherproof Wire.—Coil lots in base sizes are selling for 34 cents per pound. Stocks are good, demands fair.

Dishwashers.—There seems to be a constantly increasing demand for family size. The Western Electric dishwasher has been temporarily withdrawn from the market, but a redesigned model on the basic principles of the first design is promised for April delivery.

Porcelain Insulators.—Insulators for 6,000 volts and other light power service have increased about 10 per cent and are selling for about 20 cents each in average quantities. The demand is light and spasmodic. Considerable local stocks are carried.

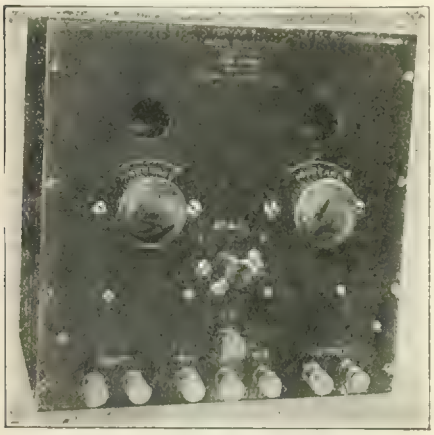
Lamp Cord.—Coast stocks are good, except in the light 1/64-in. insulation cord known as fixture-lamp cord. Because of stocks en route the Underwriters have set aside for six months, to July, 1920, the ban on this cord. This has resulted in heavy orders.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Two-Stage Radio Amplifier

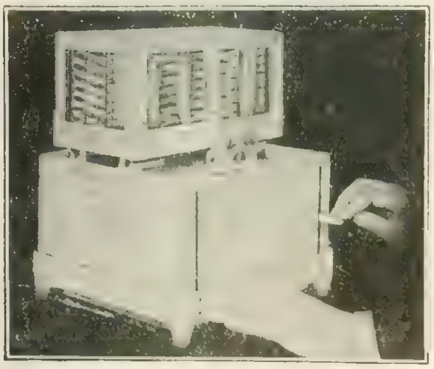
A two-stage radio amplifier is being made by the Clapp Eastham Company, Cambridge, Mass. The entire instrument is mounted on one panel of bakelite, 7 in. x 7 in. A switch is provided for changing the connections for one-stage or two-stage amplification as desired, and an auxiliary negative "C" battery may be connected to convenient posts. It is said that the amplification is high and particularly free from disturbing noises.



TWO-STAGE RADIO AMPLIFIER

Automatic Toaster

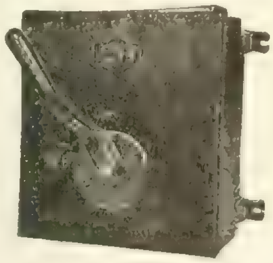
An automatic timing arrangement to turn off the current after the toast is made is incorporated in a toaster for the use of hotels and restaurants, manufactured by the Strite Automatic Toaster Company, 422 Plymouth Building, Minneapolis, Minn. After the toast is done it is automatically raised out of the machine and allowed to rest on top of the oven above the warm grid. A lever operating along a scale permits adjustment. The machine is made of polished aluminum and has five heating elements. It is made in a four-slice size, but switches are so arranged that either or both of the end elements may be cut out when toasting two or three pieces of bread. The toaster may be had for operation at either 110 volts or 220 volts and has a full capacity rating of 2,750 watts The machine is 12 in. square, 14 in. high and weighs 18 lb.



CURRENT AUTOMATICALLY CUT OFF WHEN TOAST IS DONE

Inclosed Starter for Small Direct-Current Motors

A small starter entirely inclosed to remove danger from exposed parts and to protect the contacts from damage due to dust or spraying water has been developed by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. This starter, known as "Bulletin 2111," is to be used for small direct-current motors in exposed locations driving line shafts, fans, blowers, pumps, drills and small motor-generator sets for arc welding. It consists of the familiar type of direct-current hand starter inclosed in a sheet-metal case, having an external lever which engages the movable arm of the starter. This lever is insulated from the revolving contact arm by a block of molded insulation. A pointer on the lever and legends stamped on the cover indicate whether the starter is "off" or "on." A low-voltage release coil is connected in series with the shunt field to protect the motor in case the voltage fails or the field opens while the motor is running. The armature resistor is completely inclosed in the starter case, which is ventilated by a flue in the top. Renewable contacts are provided on all starters except the smallest, which also has a black insulating composition knob in place of the lever. The inclosing case is arranged for the entrance of conduit from the under side. The starter may be mounted on any flat surface by means of four bolts. It is made in various capacities up to 50 hp., operating at 115, 230 and 500 volts.



NO LIVE PARTS EXPOSED ON THIS STARTER

Interchangeable Threadless Pipe Fittings

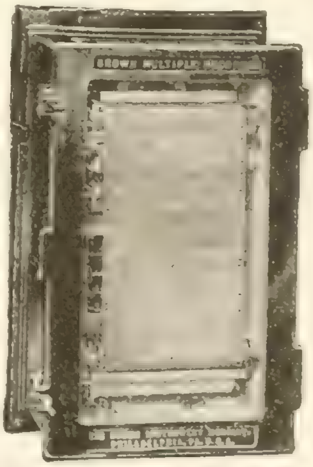
In the description of the interchangeable pipe fittings manufactured by the Erie Electrical Equipment Company printed in the ELECTRICAL WORLD of Feb. 14 a wrong address was given. The correct address of the firm is Johnstown, Pa.

Renewable Fuse Without Loose Parts

A new renewable fuse without loose parts is being placed on the market by the Monarch Refillable Fuse Company, Jamestown, N. Y. No change has been made in the link, but several improvements have been made in the container. Heavy brass machined sleeves threaded into the fiber on the inside have on each end swinging bridge pieces designed to give alignment to and prevent endwise movement of the knife blades. Heavy machined caps, into the ends of which brass washers are spun, close the ends of the containers. The ferrule type differs from the knife type in that a heavy slotted washer holds the link against the caps, which have been designed to produce as nearly perfect a contact as possible.

Multiple Recording Pyrometer

A recording pyrometer designed to take as many as ten records at one time has been developed by the Brown Instrument Company, Philadelphia, Pa. Different types of the instrument are made to give from one record up to ten. The records are made in five different colors in dotted lines. For as many as five records single dotted lines are used, and for more than that number double dotted lines are used, repeating the same five colors. The rolls are 7 in. wide with rectangular coordinates. Record paper and marking ribbon are said to last about two months before renewal and the paper may be allowed to unfold in the case or be rerolled on a fiber tube. The instrument can be connected to any 110-volt or 220-volt line and is rated at 0.017 kw. Dry cells can be used if the energy supply should fail. The clock is self-winding.



PRINTS TEN RECORDS AT ONCE

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

R. D. PATTERSON, formerly with the Northwestern Electric Equipment Company, New York City, has been appointed Eastern representative of the Lindsley Brothers Company, Spokane, Wash., with offices in the Hudson Terminal Building, 50 Church Street, New York City.

LEATHER BELTING MANUFACTURERS CONSOLIDATED.—The leather belting business of E. R. Ladew, Inc., Glen Cove, L. I., and of Graton & Knight, Worcester, Mass., has been combined through a transfer of stock. No change was effected in policy, manufacturing or personnel.

THE PEERLESS LIGHT COMPANY announces that it has moved its Chicago office to 663 West Washington Boulevard, as its former headquarters were altogether inadequate for the production of "Make-UR-Own" batteries and lighting fixtures.

L. M. WILLEY, formerly district manager of the Diehl Manufacturing Company, at Chicago, and later production manager for the company is now in charge of the sale of electrical equipment for the United States Government, New York District Salvage Board, with headquarters in New York City.

THE BAKER R & L COMPANY, Cleveland, Ohio, has transferred the business of manufacturing the Rauch & Lang electric vehicles to Rauch & Lang, Incorporated, Chicopee Falls, Mass., and it is necessary to vacate the sales and service department at 7100 Euclid Avenue, Cleveland. Wishing to provide continuous service for the many owners of these vehicles in Cleveland, the company has arranged with the R & L Service & Garage Company at 1661 East Eighty-first Street and W. C. Shultz, 11913 Detroit Ave., to continue the service which has been rendered to owners of Baker and Rauch & Lang cars.

THE STANDARD UNDERGROUND CABLE COMPANY'S Detroit sales office, which for several years has been a sub-office of the Chicago office, has been made a full branch office with R. E. Green in charge. Mr. Green has been in charge of the Detroit office since it was first opened. He has been connected with the Standard Underground Cable Company since 1909 as salesman and is well known in his territory.

THE POOLE ENGINEERING & MACHINE COMPANY, Baltimore, Md., on Feb. 1 moved its general office from 50 Churh St., New York City, to its works at Baltimore. The company will still maintain a district office at 50 Church Street. All general correspondence should be addressed to Baltimore, Md.

THE LAURAINE MAGNETO COMPANY, INC., Long Island City, N. Y., held its annual stockholders' meeting on Feb. 7, and the following officers were elected: M Feldine, president; M. G. Leslie, first vice-president; Leo Potter, second vice-president; A. C. Leslie, secretary and treasurer. There are many magnetos to be shipped for export, so far the main outlet of the company, says President Feldine, but production was enlarged and immediate steps were taken to supply the big demands of the domestic trade.

THE MONO CORPORATION OF AMERICA, 48 Coal and Iron Exchange, Buffalo, N. Y., announces that it has purchased the entire stock of Mono apparatus and accessories from the F. D. Harger Company, Buffalo, N. Y. This includes all rights for the manufacture and sale of their various types of Mono apparatus for the automatic analysis of CO_2, CO, O_2, H_2, SO_2, N_2, C_1, etc. F. D. Harger has not severed his connection, but will serve as general manager of the new corporation. A service and inspection department connected with the laboratory is now in operation and a chemical engineer in charge.

E. A. THORNWELL has recently organized a manufacturers' agency for railway and power equipment with offices at 1026-7 Atlanta Trust Company Building, Atlanta, Ga. Agents' arrangements have been completed with seven manufacturers of power station and electric railway supplies. Among power companies he will handle the Bennett lightning arrester made by the Electro Service Company, of Marietta, Ga. He will also handle the Valentine-Clark Company's cedar poles and will later have a complete line of outdoor switching and protective equipment. For a number of years Mr. Thornwell has held a responsible position as district representative of the Westinghouse Electric & Manufacturing Company, as representative from the Atlanta district office.

PAGE STEEL & WIRE ACQUIRED BY AMERICAN CHAIN.—The American Chain Company, Inc., Bridgeport, Conn., has purchased the control of the Page Steel & Wire Company, with mills at Monessen, Pa., and Adrian, Mich. It is the intention of the American Chain Company to continue the business of the Page Steel & Wire Company as heretofore, taking only its surplus product. The latter's plants consist of open-hearth furnaces, rolling mill and wire mills, as well as fence factories. The officers elected under the reorganization of the company are: Walter B. Lashar, president; William T. Morris, vice president; Wilmot P. Wheeler, treasurer; John E. Carr, assistant treasurer, and William M. Wheeler, secretary. E. C. Sattley, general manager of the Page Steel & Wire Company, will continue in that capacity with offices in Pittsburgh, Pa. The American Chain Company has its general sales offices in the Grand Central Terminal Building, New York City, and district sales offices in Chicago, Boston, Philadelphia, San Francisco, Portland and Pittsburgh.

WESTINGHOUSE CHANGES. — Announcement has been made by the Westinghouse Electric & Manufacturing Company of the appointment of W. S. Rugg, manager of the railway and marine departments, and Charles Robbins, assistant sales manager, as assistants to vice president. Mr. Rugg's service with the company dates from the early days of its growth. Soon after his connection with the organization he was transferred from Pittsburgh to Chicago, and in 1901 he was transferred to New York as special engineer, becoming manager of the New York office eight years later. In 1917 he was recalled to East Pittsburgh to take charge of the railway dapartment, and in 1918 he was also made manager of the newly created marine department. Mr. Robbins began his connection with the company in 1899 at its New York office. He was transferred in 1906 to the main offices at East Pittsburgh as assistant to manager of the industrial and power departments. He retained this position until his appointment to the position of manager of the industrial sales department in 1910. In August, 1915, he was made assistant sales manager of the company, from which he was promoted to his present position. Myles B. Lambert, for many years connected with the railway department, has been appointed manager of that department.

THE RADIANT MANUFACTURING Company, Sandusky, Ohio, which announces that its output over the last two years has been entirely taken by a small number of large jobbers, will soon inaugurate a vigorous advertising campaign among dealers and farmers, under the direction of A. H. Ambrose, who has just been appointed advertising manager. Mr. Ambrose was for the last eight years assistant advertising and sales promotion manager for the Associated Manufacturers' Company, Waterloo, Iowa, and has also had wide experience in the manufacture and sale of farm-lighting plants. He expects 1920 sales to treble 1919 production.

EDWARD T. FOOTE, for the last three years manager of the New England office of the Cutler-Hammer Manufacturing Company, with headquarters at Boston, Mass., has been transferred to the clutch and magneto department of the Milwaukee factory. His successor has not yet been named.

THE EASTERN ASBESTOS COMPANY has been established with offices at 417 Grosvenor Building, Providence, R. I., and the company will sell both standard and special asbestos products, including yarn, tape, cord, cloth, twine, listing, gaskets, carded fiber, gasket cloth, friction disks, sheet and high-pressure packing. P. O. Baker, who has been in the electrical industry for the last eighteen years, is manager. Mr. Baker has just resigned as purchasing agent of the D & W Fuse Company, Providence, and was formerly employed by the Western Electric, and Simplex Wire & Cable companies.

THE PELTON WATER WHEEL COMPANY, San Francisco, Cal., has announced the recent appointment of W. D. Ward as manager of its Atlantic department at 90 West Street, New York City. Mr. Ward has been associated with the company for more than twenty-five years, having been the ranking sales engineer in the home office at San Francisco previous to his assumption of the post in New York.

THE AMERICAN ARMATURE ENGINEERING COMPANY, Bluefield, W. Va., has let contracts for a plant, 40 x 100 ft., at Mullins, W. Va.

THE HARTFORD BATTERY MANUFACTURING COMPANY, Hartford, Conn., has increased its capitalization from $250,000 to $350,000 for general business expansion.

THE NEW MICA COMPANY, Auburn, N. Y., has just announced a capital increase from $20,000 to $60,000.

THE U. S. BATTERY COMPANY, 157 West Fifty-fourth Street, New York City, has planned for the immediate erection of a four-story brick and steel structure, about 72 ft. by 100 ft., at 161-67 West Sixty-fourth Street, to cost $100,000.

THE MINIATURE INCANDESCENT LAMP CORPORATION, Newark, N. J., has made plans to acquire a three-story building at Eighth Avenue and High Street, to be used for a new works.

WILLIAM T. POULTERER, who for a number of years has been engineer with the Philadelphia Electric Company Supply Department, has resigned and become engineer of the Electrical Development & Machine Company, Philadelphia. The Philadelphia Electric Company Supply Department formerly acted as sales agents for the line of "Franklin" central-station specialties, manufactured by the Electrical Development & Machine Company, but since the first of the year the Eastern territory has been handled by the Utility Products Corporation, New York City, while the rest of the field is being handled direct by the manufacturer.

THE CHICAGO PNEUMATIC TOOL COMPANY on Jan. 21 and 22 held a general conference of executives, plant and branch managers and salesmen at its Detroit plant, Second Avenue and Amsterdam Street, on the occasion of the formal opening of a large five-story addition. It was reported that much of the proposed increase in production was already absorbed by orders for future deliveries.

THE ANDERSON ELECTRIC & EQUIPMENT COMPANY, Chicago, is the new name of the Anderson Electric Specialty Company. There is no change either in the officers or the company's organization. The change has solely been made to render the corporate name more descriptive of the character of the products manufactured by the company and to eliminate the word "specialty," which the company says does not properly describe the Anderson lines these being staple articles known and sold throughout the world.

THE ELECTROLABS COMPANY is consolidating its officers at 2635 Penn Avenue, Pittsburgh, Pa., with a branch office at 30 Church Street, New York City.

THE UNITED STATES RUBBER EXPORT COMPANY, LTD., New York City, export division of the United States Rubber Company, is, through its wire division, as conditions warrant, adding to its facilities for the exportation of rubber-insulated electrical wires, cables, tapes, etc., manufactured at its plant at Bristol, R. I. Already twelve direct branches and numerous distributers carrying stocks of these commodities are successfully operating in important centers of the world. Sales are showing a gratifying increase year by year. The promotion of export wire and cable sales is handled from the New York office, H. C. Morehouse in charge.

THE STERLING VARNISH COMPANY, PITTSBURGH, PA., announces that Alvin S. King, its Eastern manager for many years, died in New York after a short attack of pneumonia on Feb. 3.

THE BLACK & DECKER MANUFACTURING COMPANY, Baltimore, Md., announces the establishment of a permanent office and showroom at 1436 South Michigan Avenue, Chicago, in charge of R. G. Ames, whose territory has been extended to cover the entire Mid-West. F. E. Marrion and J. N. LaBelle will assist Mr. Ames.

THE MALONEY ELECTRIC COMPANY intends to combine its four St. Louis factories into one large plant and is seeking a tract of land from 10 to 15 acres in size for this purpose. Enlarged production at earliest possible time is desired.

Supply Jobbers' Notes

F. W. GREUSEL, president of the G.-Q. Electric Company, Milwaukee, Wis., announces the company's removal to 23-25 Erie Street. The new location gives 35,000 sq.ft., which is considerably over the former capacity. The company is inaugurating several departments for handling household appliances, farm lighting plants and other electrical specialties. It is also increasing its sales organization to care for anticipated increases in business and is operating on a wholesale basis only, coöperating with local contractors and dealers as much as possible.

W. H. VILETT and HARRY BOHN, who formerly operated the Sterling Electric Company, Minneapolis, Minn., have purchased the household appliance section of the Sterling Electric Company's business and disposed of the company's jobbing and contracting business. The name of the household appliance department has been changed to the Gainaday Electric Company, and it will continue to operate at 29 South Fifth Street, Minneapolis, Minn. The new Gainaday Electric Company will sell Gainaday washing machines, Simplex ironers, Rudd automatic water heaters, Ohio Truex vacuum cleaners, electric dish washers, White electric sewing machines and Minneapolis heat regulators. The company plans to do an appliance business of $1,000,000 in 1920. Prior to the segregation of the company's business, Mr. Vilett was for twenty years in the electrical industry in the Northwestern states. Mr. Bohn was the manager of the household appliances department of the Sterling Electric Company.

W. H. VILETT

PETTINGELL-ANDREWS COMPANY ISSUES HOME-WIRING BOOKLET—A twenty-four page booklet, "The Relation of Electricity to the Proper Planning of the Home," has just been published by the Pettingell-Andrews Company, electrical supply jobber, Boston, Mass. It is designed to aid home owners, home builders, architects and electrical contractors in the layout of electrical outlets and wiring, fixtures and household conveniences in harmony with the best modern practice from the esthetic and the utilitarian side. The booklet closes with an outline of the growth of the company from a small one-room shop in 1886 to the present establishment of 100,000 sq.ft. of floor area, with its electrical and illuminating engineering and fixture-designing departments, sales service and organization.

Foreign Trade Notes

AUSTRALIAN WIRE IMPORTS.—It is reported that the revised conditions under which rubber-covered wire may be imported into Australia will come into operation April 1.

ELECTRICAL EQUIPMENT NEEDED IN TAMPICO.—Consul Dawson reports the need of electrical equipment in Tampico, Mexico. Never, he states, has the supply been equal to the demand. The present shortage is stated to be holding back developments there. This is a prosperous oil country. Names of those interested in building operations there may be had by referring to file No. L. A. 44, Bureau of Foreign and Domestic Commerce.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

P. Ravet, electrical engineer, has opened an office at 17 Cours de Vincennes, Paris, France, and desires representation of high-grade American electrical goods.

A Brazilian firm (No. 31,995) through its United States agent would like to represent an American manufacturer of incandescent lamps.

A man in Switzerland (No. 31,950) wishes to purchase and secure an agency for electrical heating and cooking apparatus. Payments to ninety days through bank.

A merchant in India (No. 32,044) is looking for an agency for electrical goods. Payment through bank in Bombay.

An Australian (No. 32,062) wishes to secure an agency for automobile-starting batteries and also for farm-lighting plants up to 2,500 cp. Cash against documents.

The representative of an American firm is looking for an agency in Holland (No. 31,973) for electrical measuring instruments and appliances. Cash against documents.

An electric lighting company in Chile (No. 31,990) is in the market for electric equipment. Plans may be secured upon application to the company.

Government contractors in Egypt are in the market for electrical supplies on a commission basis. American bank credit against documents.

Trade Publications

REFLECTORS.—"Hubbell Reflectors for Industrial Plant Lighting" is the title of a recent catalog of Harvey Hubbell, Inc., Bridgeport, Conn.

FIXTURE PARTS.—Catalog No. 21 of the Lightolier Company, New York City, is descriptive of its interchangeable fixture parts.

HEADLIGHTS.—The Ohio Brass Company, Mansfield, Ohio, has issued price list No. 206, applying to catalogs 201, 202, 202A, 203 and 205, on Crouse-Hinds "Imperial" headlights, both arc and incandescent.

CIRCUIT BREAKERS.—Bulletin No. 47,448, superseding bulletin No. 47,400, has recently been issued by the General Electric Company, Schenectady, N. Y., descriptive of its types FK-12 and FK-12-B oil circuit breakers up to 22,000 volts.

WASHING MACHINES.—A pictorial story of the production methods and the organization work of the Hurley Machine Company is given in a thirty-two-page booklet entitled "Where the Thor Is Made," by the Hurley Machine Company, Chicago, Ill.

ASBESTOS-COVERED WIRE.—A catalog on Rockbestos, describing asbestos-covered wires and cables for every service, has been issued by the Marlin-Rockwell Corporation, Insulated Wire Division, New Haven, Conn.

REFLECTORS.—"How to Make Reflectors Reflect" is the title of a folder sent out by the Thompson Electric Company, Cleveland, Ohio.

ELECTRIC HEATER.—A new small folder describing electric space heaters, known as publication 494, has been issued by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

COMMUTATOR BRUSHES.—The Graphite Products Company, Germantown, Philadelphia, has issued its 1920 catalog and price list relative to fiber graphite commutator brushes and Ward carbon and metal brushes.

New Incorporations

THE COUNTRY HOME POWER & LIGHTING COMPANY of Louisville, Ky., has been incorporated by W. G. Simpson, Jr., of Louisville; Hubert and Graham Vreeland of Frankfort, Ky. The company is capitalized at $30,000 and proposes to operate an electric light and power plant.

THE VALLEY DEVELOPMENT COMPANY of Brattleboro, Vt., has been incorporated by Robert Fitts, H. C. Fenton and G. E. Murphy, all of Brattleboro, Vt. The company is capitalized at $50,000 and proposes to develop a hydro-electric project in the southern part of the state.

THE BRIER HILL (N. Y.) ELECTRIC LIGHT & POWER COMPANY has been incorporated by F. E. Graves, A. W. Gregory and M. L. Stevenson of Brier Hill. The company is capitalized at $10,000 and proposes to generate and distribute electricity for lamps and motors in Brier Hill.

THE EASTERN UTAH ELECTRIC COMPANY of Price, Utah, has been incorporated with a capital stock of $75,000. The officers are: Neil Madsen, president; N. S. Neilsen, vice-president and Harold Leonard, secretary.

THE THREE RIVERS ELECTRIC LIGHT & POWER COMPANY of Des Moines, Ia., has been incorporated with a capital stock of $500,000 to supply electricity for lamps and motors to the farmers and small towns in central Iowa. The officers are: H. E. Slack, president; C. F Keeling, vice-president; Fred F. Kethley, secretary, and C. A. Willett, treasurer.

J. I. ROBIN & SONS, INC., of New York, N. Y., has been incorporated by E. London, J. I. and B. J. Robin, 130th Street and Park Avenue, New York City. The company is capitalized at $250,000 and proposes to manufacture brass and other electric and gas fixtures.

THE ELECTRIC SUN COMPANY of Asbury Park, N. J., has been incorporated with a capital stock of $80,000 to manufacture electric signs. The incorporators are Charles T. Day, Arthur J. Haight and Albert Klebs.

THE MOUNTAIN STATE ELECTRIC COMPANY of Charleston, W. Va., has been incorporated by R. S. White, H. R. Sapp and Fred O. Blue. The company is capitalized at $100,000 and proposes to construct and operate an electric power plant and system.

THE CITRONELLE (ALA.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $10,000 by John A. Burt, A. G. Woodbury and J. S. Lynch.

THE PEOPLE'S ELECTRIC COMPANY of Marianna, Ark., has been chartered with a capital stock of $50,000. The officers are: M. D. Miller, president, and D. G. Norment, secretary and treasurer.

THE MENARD (TEX.) LIGHT & ICE COMPANY has been incorporated with a capital stock of $30,000 by A. E. Nauwald, Peter Anderegg and W. M. Bevans.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

HERMON, ME.—The Black Stream Electric Company contemplates the construction of a 1-mile feeder line. H. H. Leathers is manager.

MOUNT DESERT ISLAND, ME.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has postponed date of receiving bids for construction of new electric transmission station (Specification 4135) at the local yard from March 3 to March 17. C. W. Parks is chief of the bureau.

PORTLAND, ME. — The Cumberland Power & Light Company has petitioned the City Council for permission to lay conduits in certain streets in the city.

PORTLAND, ME.—The Central Maine Power Company is negotiating for the purchase of the Androscoggin Electric Company, Oxford Electric Company and Knox County Electric Company. After the transfer the company plans extensive improvements, to include several new power stations, transmission lines, etc.

SKOWHEGAN, ME.—Bids will be received until March 15 by the Central Maine Power Company for the construction of a power house with complete electrical equipment, including five turbine waterwheels, each of which will develop 4,300-hp., and a dam. The cost is estimated at $100,000. J. A. Leonard is engineer.

VINAL HAVEN, ME.—The construction of a transmission line to North Haven is contemplated by the Vinal Haven Light & Power Company A. A. Peterson is manager.

SOMERSWORTH, N. H.—The Great Falls Manufacturing Company plans to build a mill at Somersworth, to cost about $4,500,000. Electricity will be used for motive power.

FITZDALE, VT.—The Fitzdale Paper Company has broken ground for power-plant extensions, to cost about $10,000, including machinery and equipment. The C. A. Conrad Construction Company, Fitzdale, is the building contractor. J. F. King is treasurer.

MORRISVILLE, VT.—The village has voted to purchase the mill property and power plant of H. A. Slayton & Company to increase the municipal electric service.

BOSTON, MASS.—The Eastern Massachusetts Electric Company contemplates extending its transmission system from West Peabody to Danvers. R. S. Tenney is assistant treasurer.

BOSTON, MASS.—The Edison Electric Illuminating Company, it is reported, has purchased a site on the Weymouth, Fore River, at North Weymouth, on which, it is said, it will erect a large power plant, to cost about $4,000,000.

BROCKTON, MASS.—The installation of two 600-hp. boilers and the construction of 10 miles of 13,000-volt transmission line is contemplated by the Edison Electric Illuminating Company. A. F. Nelson is manager.

BROOKLINE, MASS.—The Board of Selectmen has recommended an appropriation of $80,000 for street lighting for the coming year, of which $6,000 will be used for the installation of an ornamental lighting system at Coolidge Corner.

FRAMINGHAM, MASS. — Considerable electrical and mechanical equipment will be required in connection with the proposed addition to the plant of the Roxbury Carpet Company.

GROTON, MASS.—The construction of a new copper trunk transmission line from Ayer is contemplated by the Electric Light Commissioners. W. H. Dodge is superintendent of plant.

LOWELL, MASS.—The installation of a 12,500-kw. turbine with boilers and auxiliaries and the construction of 2 miles 13,000-volt transmission line is contemplated by the Lowell Electric Light Corporation. J. A. Hunnewell is manager.

NEW HAVEN, CONN.—The Model Laundry Company, City Point district, is having plans prepared for an addition to its works, extension in boiler plant and the erection of a garage. Considerable electrical and mechanical equipment and laundry machinery will be required.

Middle Atlantic States

BERKSHIRE, N. Y.—The Public Service Commission has granted the Delco Lighting Company permission to construct and operate an electric plant in Berkshire. The company has also been granted permission to issue $6,000 additional capital stock.

BROOKLYN, N. Y.—Arrangements have been completed by the Brooklyn Edison Company for the issuance of $3,000,000 in bonds. Part of the proceeds, it is understood, will be used for extensions and improvements.

BROOKLYN, N. Y.—Plans have been prepared by P. M. Marko & Company, Atlantic Avenue, between Nostrand and New York Avenues, for the construction of an addition to their plant. Alterations and improvements will also be made in the existing building. The company manufactures storage batteries.

BROOKLYN, N. Y.—Bids will be received until March 19 by the Superintendent of Buildings, Board of Education, Municipal Building, Manhattan, for the installation of electrical equipment in Public School 144, in connection with alterations and an addition to building.

BYRON, N. Y.—The Genesee Light & Power Company has been granted permission by the Public Service Commission to construct an electric light and power plant at Byron, and also approval of a franchise granted by the Byron town officials. W. C. Lewis is president and treasurer.

CAYUGA, N. Y.—The village contemplates holding a special election to vote on the proposal to install an electric lighting system, the service to be furnished by the Empire Gas & Electric Company.

NORTH TONAWANDA, N. Y.—The capital stock of the North Tonawanda Power Company has been increased from $750,000 to $2,000,000, for general business expansion.

OSSINING, N. Y.—Bids wil be received until March 23, by C. F. Rattigan, superintendent of state prisons, Capitol, Albany, for construction of undeground electric conduit feeder system and pump house for Sing Sing prison. L. F. Pilcher, Capitol, Albany, is state architect.

SYRACUSE, N. Y.—The Du Pont Engineering Corporation of Wilmington, Del., has been awarded contract for construction of plant, including complete power and transmission system for the Brown-Lipe-Chapin Company, 110 Seneca Street, to cost about $700,000.

PLEASANTVILLE, N. J.—The Public Utility Commission has granted the Atlantic City Electric Company permission to take over the property and holding of the Pleasantville & Shore Electric Company.

SUMMIT, N. J.—Plans are under consideration by the Common Council for the construction of a new electrically operated pumping station to be used in connection with its sewage disposal plant.

SUMMIT, N. J.—The Commonwealth Electric Company is reported to be considering plans for the erection of an addition to its plant.

ALTOONA, PA.—The city will receive separate bids for the purchase and erection of 48 new metal artificial-design lamp standards during March. The estimated cost is $11,000. F. D. Hain, City Hall, Altoona, is engineer.

McKEE'S ROCKS, PA.—Arrangements are being made by the Common Council for the installation of a new electrically operated fire-alarm system.

OXFORD, PA.—The Oxford Electric Company plans to extend its transmission system at an expenditure of approximately $100,000. J. H. Ware is manager.

RIDGWAY, PA.—The Ridgway Electric Light Company contemplates the installation of one 5,000-kva. turbo generator, boiler and condenser equipment, and also the erection of about two miles of 22,000-volt transmission line. W. H. Brown is superintendent.

SOUDERTON, PA.—The Souderton Light & Power Company contemplates the construction of a three-phase transmission system. J. J. Hutchinson, manager.

BALTIMORE, MD.—The Board of Trustees of Johns Hopkins Hospital has had plans prepared for the installation of a new heating and lighting plant in connection with the proposed seven-story addition.

CUMBERLAND, MD.—The plant of the Wellington Glass Company, manufacturer of lighting fixtures, was destroyed by fire on Feb. 29. The loss estimated at about $350,000.

ELKTON, MD.—Arrangements have been completed by the Oxford Electric Light Company for the purchase of the electric light plant of the Tome Institute at Port Deposit, Md. Plans are also being prepared for the erection of a new power line from Oxford to Rising Sun.

HUNTINGTON, W. VA.—The Consolidated Light, Heat & Power Company contemplates the construction of an 11,000-volt transmission line from Kenova to Huntington, and an 11,000-volt line in Huntington. H. L. Evans is superintendent.

MULLENS, W. VA.—The Union Powder Company, recently incorporated, has purchased the property of the Mullens Light & Power Company. Extensive improvements, including the installation of a street lighting system, are contemplated. The main office of the company is at Charleston, W. Va. S. T. Preston is general manager.

SOUTH CHARLESTON, W. VA.—The Bureau of Yards & Docks, Navy Department, Washington, D. C., contemplates the construction of an outdoor electric substation at the local naval station, to cost about $40,000.

BLACKSBURG, VA.—The trustees of the Virginia Polytechnic Institute contemplate the installation of a complete new generating system in the heat and power plant. W. E. Ellis is director.

FRONT ROYAL, VA.—The installation of two new waterwheels, one waterwheel governor, one generator, new switchboard equipment and other improvements in the municipal electric light plant is contemplated. D. W. Harrison is superintendent.

SHENANDOAH, VA—The installation of a 300-kva. generator in the municipal water and light plant is contemplated. A. V. Kern is superintendent.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 25, for furnishing and installing lighting fixtures in United States post offices at Bellefourche, S. D.; Decatur, Ala.; Denton, Tex.; Eldorado, Kan.; Honey Grove, Tex.; Mount Pleasant, Mich.; Rhinelander, Wis.; Sunbury, Pa., and the post office and court house at Woodward, Okla.

North Central States

CAMDEN, MICH.—The construction of transmission lines to Ray, Ind., and Frontier, Mich., is contemplated by the Economy Electric Company. S. P. Hull is secretary.

CARO, MICH.—The Caro Light & Power Company contemplates the installation of a three-phase generator. N. B. Atwood is manager.

CASS CITY, MICH.—The installation of a steam-driven 2,300-volt generator, and possibly a water works pump, in the municipal electric light and water plant, is under consideration. W. N. Straube is superintendent.

DETROIT, MICH.—The Commissioner of Purchases and Supplies, Municipal Courts Building, will receive bids until March 16 for furnishing a complete stoker with steam engine for installation in the municipal light plant.

DETROIT, MICH.—The Department of Public Works contemplates the installation of two 800-hp. boilers, one 600-hp. boiler, feed-water heater and a 150-kw. motor-generator in connection with new two-story steam-power building. The cost of the equipment is estimated at $250,004. Esselstyn, Murphy & Hanford, Marquette Building, are the engineers, and J. Scott & Company, 2326 Dime Bank Building, are architects.

GLADWIN, MICH.—The construction of a new 33,000-volt transmission line to Beaverton is contemplated by the Gladwin Light & Power Company. S. B. Wiggins is superintendent.

MONTGOMERY, MICH.—The construction of a 4 mile transmission line to Roy is contemplated by the Economy Electric Company. S. P. Hull is manager.

OTTER LAKE, MICH.—C. C. Tinker, owner of the local electric light plant, contemplates the construction of a 13,200-volt transmission line to Mayville, a distance of 7 miles.

RIVER ROUGE, MICH.—The Board of Education contemplates the construction of a high school, for which considerable electric equipment will be required. The estimated cost is $750,000. VanLeyen, Schilling & Keough, Union Trust Building, Detroit, are architects and engineers.

ADA, OHIO.—The installation of new engines, generators and water pumps is contemplated by the Ada Water & Light Company.

ARCHBOLD, OHIO. — The Archbold Electric Light & Power Company contemplates construction of transmission lines into the farming districts. T. S. De Vries is the president.

CAREY, OHIO—Plans are being prepared by W. Frolough & Emery Company, engineers, Toledo, to rebuild the municipal electric light plant on West Findlay Street. The project will require entire new equipment, including one alternating-current 60-cycle generator. M. C. Reynolds is superintendent and chief engineer.

CLEVELAND, OHIO.—The capital stock of the Cleveland Electric Illuminating Company has been increased from $18,000,000 to $30,000,000.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until March 19, for furnishing electric meters for division of light and heat.

CLEVELAND, OHIO.—E. Shattuck, city purchasing agent, will receive bids until March 19, for furnishing 1,900 electric meters for heat and light division. The estimated cost is $19,000.

COSHOCTON, OHIO.—The Ohio Service Company contemplates the installation of two new boilers in connection with coal handling system, additional water supply for generating system, and also the construction of 35 miles 33,000-volt, double-circuit transmission lines. J. J. Dolan is superintendent of power.

DAYTON, OHIO.—The city is considering proposals to abandon gas for street-lighting purposes and to use electric lamps throughout the entire city after the present contract expires in April. A. Barlow is City Manager.

GALION, OHIO.—The installation of one 1,000-kw. turbo-generator in the municipal electric light plant is under consideration. H. C. Dye is superintendent.

SPRINGFIELD, OHIO.—The Springfield Light, Heat & Power Company contemplates the installation of one new 8,000-kw. Westinghouse turbine, condenser and auxiliaries. B. C. Cobb is president.

PADUCAH, KY.—The Paducah Traction & Light Company, it is reported, contemplates improvements including the reconstruction of the local street-car lines and various installations in its power and light plant.

EVANSVILLE, IND.—The Evansville Paint & Varnish Company, 311 First Street, is having preliminary plans prepared for the construction of a power plant on Columbia Avenue. H. D. Bourland is president.

FOUNTAIN CITY, IND.—The Winchester (Ind.) Heat, Light & Power Company has contracted with the authorities of Fountain City to extend its transmission lines to Fountain City and to supply electrical service. The lines will be rebuilt to carry the added current. The company is arranging to install a 500-hp. engine at its plant in Winchester.

GARY, IND.—The National Tube Company, a subsidiary of the United States Steel Corporation, is planning to build a new plant east of Gary harbor, to cost about $40,000,000. The company will also build a street railway to the plant, at a cost of about $1,000,000. Work on four blast furnaces will begin at once and will be followed by the erection of tube mills, shops, office buildings and other structures. The company also plans to build a large number of houses at Gary for its employees.

INDIANAPOLIS, IND.—The Interstate Public Service Company of Indianapolis has petitioned the Indiana Public Service Commission for authority to sell $226,000 stock. The company furnishes electricity for lamps and motors in a number of counties in Indiana.

SHELBYVILLE, IND.—The Interstate Public Service Company has asked the Indiana Public Service Commission for permission to erect a transmission line from Shelbyville to the Shelby-Johnson County line, where it will connect with a line to be extended from Franklin.

MOLINE, ILL.—A joint petition has been filed with the Public Utilities Commission to authorize the People's Power Company of Rock Island to sell electricity to the Coe Light & Power Company in Port Byron and Coe Townships and for the joint use of the poles of the People's Power Company by the Coe Light & Power Company.

SHERRARD, ILL.—The Sherrard Electric Light Company contemplates extending its lines from Orion to Lynn and Osco.

WEST BEND, WIS.—The Young America Electric Machine Company, Young America, near West Bend, has had plans prepared for the construction of a plant, about 44 ft. x 122 ft., two stores. F. Woodfort is manager.

ELY, MINN.—The installation of three Heine boilers with a capacity of 213 hp. and a new condenser in the municipal electric light plant is contemplated. W. Mitchell is superintendent.

GRANITE FALLS, MINN.—Plans are under consideration to increase the generating capacity of the municipal electric light plant. A. W. Thompson is manager.

MADISON, MINN.—The installation of an 18-ft. x 72-ft. horizontal boiler in the municipal electric light plant is under consideration. T. B. Leasman is manager.

BOLIVAR, MO.—Extensions and improvements are contemplated to the municipal electric light plant, including the installation of a larger generating unit. A. F. Leavitt is the light and water commissioner.

DEADWOOD, MO.—The St. Joseph Lead Company of 61 Broadway, New York City, is planning to build a power house in Deadwood. Stone & Webster, 120 Broadway, New York City, are the contractors.

KANSAS CITY, MO.—The City Council has authorized cables to be laid on Baltimore Avenue between Twelfth Street and Southwest Boulevard, before paving, for the proposed ornamental lighting system. Single-lamp standards will be used, the expense to be borne by property owners.

MOUNTAIN GROVE, MO.—The Mountain Grove Light & Power Company plans construction of a dam, power plant and transmission lines to supply hydro-electric power to the towns of Mountain Grove, Willow Springs, Cabool, Hansfield and Gainesville. The dam and power plant will be located at Double Springs.

TOWNER, N. D.—The installation of a new semi-Diesel engine is contemplated by the Towner Light & Power Company. T. K. Strand is president.

LINCOLN, NEB.—The municipal electric light and water department is planning to build a new plant, to be equipped with new turbine, boilers, coal conveyor, etc. P. W. Doerr is superintendent.

MORRILL, NEB.—The installation of a 100-hp. directly connected unit in the municipal light and power plant is under consideration. O. T. Moline is the clerk.

RANDOLPH, NEB.—The installation of an alternating-current generator in the municipal electric plant this spring is under consideration. R. J. Kirk is secretary and district superintendent.

SCHUYLER, NEB.—The Light and Water Commissioners contemplate the construction of a new generating room and the installation of new equipment, including one 125-kva. and one 210-kva. unit; also new switchboard and street-lighting equipment. E. A. Schmid is chairman of the Light and Water Commission.

SCOTIA, NEB.—The installation of a new engine and generator, as well as an 11,000-gal. distilling tank, is contemplated by the municipal electric light department.

BURLINGAME, KAN.—The installation of a 500-kw. turbo-generator and a 250-hp. Heine boiler and also the construction of a new engine room and spray pond for cooling water at the municipal electric light plant are under consideration. H. R. Williams is superintendent.

LA CYNGE, KAN.—The installation of one 75-kw., 2,300-volt, 60-cycle generator in the municipal electric light plant is contemplated, and also the erection of additional pole lines and transformer. W. W. Petifish is superintendent.

MORAN, KAN.—The municipal electric light and water department contemplates rebuilding its transmission line. M. M. Humphrey is superintendent.

OTTAWA, KAN.—The City Commissioners contemplate the construction of a new dam to cost about $25,000 and the installation of a new boiler at the municipal water and light plant and erection of a 17-mile transmission line to Richmond.

PRETTY PRAIRIE, KAN.—The installation of one 70-kva., 2,300-volt, 60-cycle, three-phase generator in the municipal electric light and power plant is under consideration. J. J. Siebert is manager.

ST. FRANCIS, KAN.—The installation of a new generating unit in the municipal electric plant some time this year is under consideration. W. Roelfs is superintendent.

Southern States

WAKE FOREST, N. C.—Bids will be received until March 25 by the Mayor and Commissioners for construction of waterworks and sewerage systems, including, for the former, five miles of 6-in. to 10-in. pipe; valves, hydrants, pumping stations, tower and tank, motor-driven pumps, etc. Plans and specifications may be obtained from W. M. Platt, engineer, Durham, N. C.

WILMINGTON, N. C.—The Delgrado Cotton Mills have contracted with the Tidewater Power Company to supply electricity to operate the entire plant and an extension. Orders have been placed for motors, transformers, substations, etc. An additional transmission line will be erected from the power house to the Delgrado plant.

CHARLESTON, S. C.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to erect a 300-ft. radio station, with foundation at the local navy yard. The estimated cost is $17,000.

GADSDEN, ALA.—The Gulf States Steel Company of Birmingham, it is reported, contemplates the installation of a turbo-electric generating plant at its local plant, the equipment to include 4,000-kw. steam turbines driven by waste steam, to cost about $350,000. N. Rybitski of New York, N. Y., is engineer.

EDWARDS, MISS.—An election will be held March 22 to vote on the proposal to issue $7,500 in bonds for construction of a electric light plant.

DE WITT, ARK.—The De Witt Rice Mill Company is in the market for electrical equipment for a rice mill. The cost of mill is estimated at $300,000.

ALEXANDRIA, LA.—The installation of one 200-hp. motor-driven air machine in the municipal electric light plant and waterworks system is contemplated.

BOYCE, LA.—Bids will be received until March 18, by the Mayor and Board of Aldermen for improvements to the municipal electric light and waterworks plant, including crude-oil engines, alternators, fire pumps, air compressor, oil-storage tank, power station building and machinery foundation. X. A. Kramer, Magnolia, Miss., is consulting engineer.

DE RIDDER, LA.—The installation of a 250-hp. engine and a 200-kva. General Electric generator is contemplated by the De Ridder Light & Power Company. M. B. Morgan is treasurer.

JENNINGS, LA.—The Public Service Company of Southwest Louisiana contemplates changing its system from direct to alternating current. C. L. Pardee is assistant manager.

NATCHITOCHES, LA.—The installation of two 150-hp. crude-oil engines and one 125-kva. generator in the municipal electric light plant and waterworks is contemplated. G. J. Shehane is superintendent.

ANADARKO, OKLA.—The installation of two 200-hp. Diesel oil engines in the municipal light and water plant is contemplated. N. A. Kunkel is superintendent.

BARTLESVILLE, OKLA.—The installation of a 1,000-kw. turbine and the construction of two feeder lines is contemplated by the Bartlesville Gas & Electric Company. W. W. Lowe is manager.

CLEVELAND, OKLA.—The Oklahoma Utility Company contemplates the installation of one gas engine unit in its plant. H. C. Warfield is manager.

FAIRFAX, OKLA—The Fairfax Light, Heat & Power Company contemplates the installation of a 200-hp. engine and a 170-kva. generator. C. I. Huffaker is manager.

KINGFISHER, OKLA.—The installation of one 500-kw. turbo generator unit in the municipal electric light and water plant is under consideration. E. Fisher is superintendent.

ECTOR, TEX.—The city contemplates construction of a municipal electric light plant.

SAN AUGUSTIN, TEX.—Contracts have been placed for machinery for the proposed municipal electric light plant. Equipment, including wire, poles, etc., for distributing system has not yet been purchased.

Pacific and Mountain States

SEATTLE, WASH.—The Post Street station of the Puget Sound Traction, Light & Power Company, at Western Avenue and Post Street, was wrecked by an explosion recently.

WHITE BLUFFS, WASH.—Tentative plans are being made by the White Bluff Irrigation District for development of a district of 60,000 acres, to cost about $1,000,000. The project includes a hydro-electric development at Priest Rapids.

CONDON, ORE.—The Condon Electric Company contemplates the installation of one 100-hp. Fairbanks-Morse Company oil engine and one 125-kw. generator during the summer. A. B. Brower is the engineer.

PORTLAND, ORE. — Application has been filed by E. G. Hopson, Central Building, with P. A. Cupper, state engineer, Salem, for diversion of 1,200 sec.-ft. of water from Metolius Creek for power purposes. The project will involve construction of dam, canal and headgate and the installation of 43,000-hp. electric generators, to cost about $1,500,000.

FRESNO, CAL.—The San Joaquin Light & Power Corporation contemplates the installation of a 12,000-kva. steam turbine in connection with its hydro-electric development on King's River, and also the erection of transmission lines. E. J. Crawford is assistant general superintendent.

GARFIELD, UTAH.—The Utah Copper Company, it is reported, contemplates the construction of a power plant to operate the concentrators at the Garfield plant and possibly at Bingham.

OGDEN, UTAH.—T. P. Mosso, electrical contractor of Spokane, Wash., has been awarded contract for installing electrical machinery and fixtures to cost about $100,000 in the flour mill under construction at Odgen for the Sperry Flour Company. Electrical equipment to generate 1,600 hp. will be installed and also 3,000 lighting fixtures.

Canada

WINNIPEG, MAN.—Bids will be received by the chairman of the committee on fire, water, light and power at the city clerk's office until March 22 for furnishing and erecting three complete 47-kw. exciter generators in the power house at Point du Bois, Manitoba.

UKIAH, CAL. — The Snow Mountain Water & Power Company has been granted permission by the State Railroad Commission to issue $1,500,000 in capital stock, the proceeds to be used to construct a dam at the Gravelly dam site and for improvements to its power house and service in Lake County.

MONTREAL, QUE.—Tenders will be received by the Lignite Board of Canada, 2 Youville Square, Montreal, until March 20 for furnishing three 72-in. x 18 ft., horizontal return tubular boilers, built to conform to the requirements of Saskatchewan. Specifications and further information may be obtained at the office of the secretary of board. Leslie R. Thomson is secretary.

Miscellaneous

ARECIBO, PORTO RICO.—The installation of one 75-kw. generator and a 100-hp. Meitz & Weiss engine in the municipal electric light plant is contemplated. Extensions will also be made to the transmission lines. J. M. Gonzalez is superintendent.

Record of Electrical Patents

Notes on United States Patents

(Issued Feb. 24, 1920)

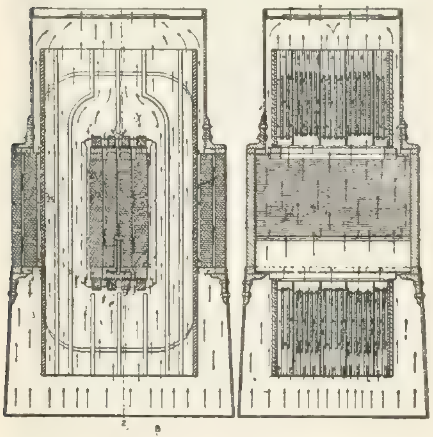
1,331,486. Plaiting Machine; Thomas E. Clark and Charles W. Ward, Detroit, Mich. App. filed Jan. 8, 1918. Resistance for heating rolls.

1,331,496. Electric Heater; John R. Goldthwaithe, Atlanta, Ga. App. filed Dec. 4, 1915. Melts wax when sealing.

1,331,568. Riveting Machine; George A. E. Jones, New London, Conn. App. filed Nov. 10, 1919. Two rivets in series heated and prepared for heading dies.

1,331,571. Electrolytic Cell; Ernest A. Le Sueur, Ottawa, Ont., Canada. App. filed Jan. 25, 1919. Heavy current to sheets beneath surface of electrolyte.

1,331,625. Flexible Connection for Electric Furnaces; James H. Critchett, Niagara Falls, N. Y. App. filed July 19, 1919. Reduces mutual inductive effect.



No. 1,331,896—Transformer

1,331,640. Sending Device for Subaqueous-Current-Line Telegraphy; Walter Hahnemann, Kitzeberg, near Kiel, Germany. App. filed Jan. 29, 1915. Impulses sent through water by alternating-current generator from iron vessels.

1,331,634. Attaching Plug; Thomas D. Finzio, Kitchawan, N. Y. App. filed March 3, 1916. Removes plug from socket without twisting cord.

1,331,669. Telephone Mouthpiece; William M. Parker, Parkersburg, W. Va. App. filed Dec. 6, 1917. Combined metal and porcelain construction.

1,331,756. Electric Light Fixture; Richard S. Giese, Pittsburgh, Pa. App. filed Feb. 12, 1919. Combined ceiling bowl and shade.

1,331,761. Dry Cell; Clarence W. Hazelett, Lakewood, Ohio. App. filed May 9, 1919. Cell construction prevents excessive corrosion.

1,331,762. Dry Cell; Clarence W. Hazelett, Lakewood, Ohio. App. filed May 9, 1919. Lining with insulated coating.

1,331,763. Dry Cell; Clarence W. Hazelett, Lakewood, Ohio. App. filed May 9, 1919. Spot welding binding post to zinc.

1,331,764. Electric Battery; Clarence W. Hazelett, Lakewood, Ohio. App. filed May 9, 1919. Applies celluloid cement outside of cell.

1,331,773. Station Indicator; Lloyd Keeling, Denver, Col. App. filed July 5, 1917. Motorman operates device by foot power.

1,331,780. System of Hoist Control; Ray C. Newhouse, Wauwatosa, Wis. App. filed June 17, 1911. Automatic skip-hoist system may be manually controlled.

1,331,815. Automatic Electric Regulating Device; August Kazenmaier, Stuttgart, Germany. App. filed Oct. 28, 1918. Pressure plate controls alterable resistance.

1,331,819. Electric Toaster; Edward P. Taylor, Ottawa, Ontario, Can. App. filed Feb. 20, 1919. Both sides of slice toasted simultaneously.

1,331,867. Automatic Regulator; Arthur W. Greene, Richmond, Va. App. filed Jan. 22, 1917. Controls either or both draft and stoker conditions.

1,331,877. Electric Battery; Otto E. Ruhoff, Madison, Wis. App. filed July 5, 1918. Cell kept three years without deterioration.

1,331,888. Coated Strain-Hardened Metal; Willis R. Whitney, Niskayuna, N. Y. App. filed June 15, 1918. Springs coated with metallic tin, electroplated without injury.

1,331,896. Transformer; Frederick F. Brand, Pittsfield, Mass. App. filed Nov. 21, 1916. Improved ventilation shell-type transformers.

1,331,898. Regulating System; Robert M. Carothers, Schenectady, N. Y. App. filed May 27, 1919. Increases range of regulation.

1,331,915. Demand Apparatus; Chester I. Hall, Port Wayne, Ind. App. filed Dec. 9, 1916. Periodically restores indicating element to zero position.

1,331,936. Barrier or Arc Deflector for Dynamo-Electric Machines of the Like; Jesse J. Linebaugh, Schenectady, N. Y. App. filed March 6, 1918. Prevention of flash-overs or arcing between sets of commutator brushes.

1,331,940. Electric Ship Propulsion; Henry M. Hobart, Schenectady, N. Y. App. filed May 19, 1916. High-speed elastic-fluid turbine direct-connected to a polyphase induction generator.

1,331,967. X-Ray Tube; Ralph H. Small, San Francisco, Cal. App. filed Dec. 8, 1917. Regulates vacuum within tube.

1,331,970. Coil-End Support; Robert B. Williamson, Milwaukee, Wis. App. filed Oct. 8, 1914. Holds projecting-end portions of coils of large alternators.

1,331,979. Automatic Light Regulator for Motion-Picture Apparatus; Charles R. Carleton and Gideon W. Carleton, New York, N. Y. App. filed March 16, 1916. Electromagnetic switch controls circuit through resistance coil and light.

1,331,998. Electric Generator; Alfons H. Neuland, Jersey City, N. J. App. filed Dec. 24, 1917. For both ignition and lighting currents without objectionable interference by either coil.

1,332,017. Spark-Plug Tester; William S. Wolff, St. Paul, Minn. App. filed March 28, 1919. Air supplied to spark plug while being tested.

1,332,029. Electric Heating Apparatus; Ora A. Colby, Larimer, Pa. App. filed Sept. 21, 1916. Exposed resistances.

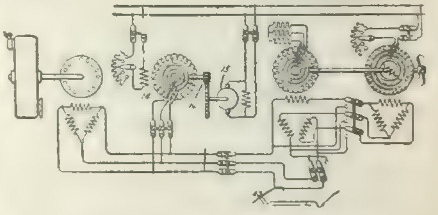
1,332,030. Electrical Resistance; John Collinson, Manchester, Eng. App. filed Sept. 9, 1916. Grid type made from expanded metal.

1,332,032. Starting Mechanism for Automobiles; William A. Dick, Pittsburgh, Pa. App. filed Aug. 28, 1915. Flywheel part of magnetic circuit.

1,332,040. Switch; Paul M. Hengstenberg, Wilkinsburg, Pa. App. filed Jan. 10, 1917. Thermal-responsive quick-acting type.

1,332,052. Electric Air Heater; Emanuel A. Martin, New York, N. Y. App. filed June 19, 1918. Flue shaped to conduct cold air through heater.

1,331,940.



No. 1,331,940—Electric Ship Propulsion

1,332,078. Separation and Extraction of Dust and Iron from Brass Borings, Brass Turnings and Like Material; Walter Sowden, Leeds, Eng. App. filed July 20, 1917. Magnetic separation with air blast.

1,332,133. Support for Telephone Receivers; August G. Mass and Louis Nusbaum, Cincinnati, Ohio. App. filed May 24, 1919. Receiver returns to inactive position.

1,332,155. Method of Welding; Vincent G. Apple, Dayton, Ohio. Rapid discharge of current from inductive circuit localizes heat.

1,332,167. Liquid Rheostat; George F. De Wein, Milwaukee, Wis. App. filed Nov. 6, 1918. Rapid discharge of electrolyte secured by weir-type rheostat.

1,332,172. Circuit-Breaker Terminal; George N. Frey, Pasadena, Cal. App. filed Oct. 16, 1918. For sectionalizing switch.

1,332,182. System of Automatic Control; Morris E. Leeds, Philadelphia, Pa. App. filed Aug. 1, 1917. Electrical, thermal or chemical condition maintained constant.

1,332,184. Process of Electric Welding; James L. Adams, Jr., Milwaukee, Wis. App. filed Nov. 3, 1919. Welding tubes from sheet-metal plates.

1,332,186. Process of Electric Welding; Joseph W. Fay, Milwaukee, Wis. App. filed Nov. 3, 1919. Fusible metallic electrode and welding ribbon used.

Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 75 New York, Saturday, March 20, 1920 *Number* 12

Development of Water Power an Economic Necessity

THE development and utilization of the water powers not only of this country but of the world is an obligation and a duty devolving chiefly on the engineer. On the electrical engineer in particular does the obligation press most heavily, because he is peculiarly fitted by training to make the most of the latent powers of the streams and waterfalls and to transmit the energy thus generated to points of utilization with the least possible loss.

Why, then, are water powers still flowing to waste and why are coal and oil still used in such huge quantities for power purposes? Is it because the electrical engineers are not alive to their opportunities or are remiss in their public duty? To ask the question is to answer it. The profession is noted for its energy and for its promptness in responding to public needs. It is willing to spend and to be spent in the service of mankind and is ever seeking new fields of endeavor and obligation. Neither negligence nor a desire to shirk responsibility can be laid to its charge. The reason for our undeveloped streams and falls lies elsewhere. The restraining hand that has held back enterprise and deprived industry of electric power is lifted by some one else.

The Conversion of Congress

Up to the present the government has been the chief retarding influence and has worked against the interest of the people, imposing restrictions that have made it impossible to obtain water-power development. Apparently Congress has at last seen a great light, and before long the intolerable condition which has prevailed will be remedied. When the enacting legislation now awaiting the agreement of the conference committee of the House of Representatives and the Senate is passed—and it cannot be passed too quickly—and has received the Presidential sanction, water-power development should go forward by leaps and bounds.

Approximately 5,000,000 hp. on the navigable streams of the land awaits engineering enterprise. Of course, it must be recognized that water powers cannot be developed everywhere without regard to competing conditions. Coal is still plentiful and the great industrial centers of the country still depend for the most part on electricity generated from this source, but with the rising costs of coal and labor the situation becomes more and more favorable for water-power development, and the interconnection of systems and the improvements in the art render transmitted energy less and less subject to interruption. Unfortunately, water power does not always abound in sufficient quantities where the power is most needed, nor is it always within transmitting distance; but where it is to be found and economic conditions at all warrant it water power should be developed.

Dangers Inherent in Delay

The rapid extension of transmission and distribution networks brings more and more water power within the range of possible development, and in the congested districts all streams and waterfalls should be harnessed and contribute their quota of electricity to the needs of the community. Naturally, with the high prices prevailing there is a tendency to wait until conditions are more nearly normal before undertaking new work. That is why more construction is not now under way. In the public utility field, however, delay is dangerous. Power requirements must be met, and it is incumbent on public service corporations to supply all needs. No community or industry should be kept back or handicapped for want of power, and no utility operating in a state possessing a public service commission is justified under normal conditions in restricting service.

The Public Need Comes First

While it is true that there are limits to the amount that should be paid for equipment and labor, especially in public utility work which is to last and on which rates will have to be predicated, still the public need is uppermost, and inasmuch as all expenditures must be sanctioned by the commission, rates based on high costs must be sanctioned also. From one end of the country to the other there is a growing shortage of power because electric public utilities have not kept abreast of the demand. In many cases the fault is not theirs, but is due to war and after-war conditions. The fact remains, however, that a shortage exists, and this should be remedied as speedily as possible by the installation of more equipment, preferably hydro-electric equipment if water is available in a degree that makes its employment economical.

Money Must and Will Be Found

With the enactment of the pending legislation it should be easier for public utility companies to obtain money for hydro-electric development. In fact, it can be shown that the prosperity of whole communities and sections of the country depends on the continued growth and expansion of hydro-electric systems, so that chambers of commerce and public service commissions and other bodies should, as a public duty, see to it that money for building the developments is forthcoming. It is not always appreciated how greatly the community is indebted to the public utility company. When once this obligation is brought home to the community there is no doubt of the proper support. This is one of the bright sides of public utility work and means much for the development of our hydro-electric resources.

Regulation Extended to Employees

THE Public Utilities Commission of the State of Kansas has been superseded by a Court of Industrial Relations, which is founded upon the principle that government should give society the same protection against the consequences of industrial strife that it gives against recognized crimes. The powers vested in the court are very broad. Public utilities, the mining and production of fuel and the manufacture of clothing and food products are considered basic industries. Their operation is placed under the control of the court in the interests of the general public. Living conditions of employees and a reasonable minimum wage for them are among the things that come under its jurisdiction.

To the court has also been given more authority over the operation of public utilities than was vested in the public service commission, and none of the powers of the latter appears to have been taken away. Under the new law it is now a misdemeanor for any person, firm or corporation engaged in the specified industries to curtail or stop operation, and it is likewise unlawful for workers or others to hinder, limit or suspend continuous and efficient operation of these industries.

It is gratifying to see that a fundamental rule of the entire central-station industry—namely, that service must be maintained at all costs—has been adopted by the State of Kansas and made law. Kansas has by this measure probably gone further than any other state in an attempt to protect the general public from the effects of labor troubles. However, it can be enforced only by and with the consent of the governed, and its success and permanence will depend upon the manner in which the judges administer it.

Drift of Hydro-Electric Design

TWO broad influences have been at work modifying hydro-electric design since the early days of the art that have a definite bearing on future projects. The first of these is the growth of the transmission network. The second is a greater freedom of design both in generators and waterwheels. In the early days, W. M. White points out in this issue, each plant was independent and had to be so planned as to obtain the best and most reliable running conditions. Consequently the number of units was planned with reference to the sound canonical rule of so distributing the output between several units that one of them might be put out of action without seriously imperiling the load. This meant usually three or four generators. As conditions now exist a great interconnected network rather than a single station can be treated as the unit, and its sources of supply must be so constituted as to obtain maximum continuity of service in the simplest way possible. This means that of its generating stations none need be independent in the old sense, and it is often just as well to put the whole output in one or two units, provided that the conditions are favorable. The whole plant is operated by a load dispatcher, and it makes little difference to the network whether a spare generator is held in reserve in one place or another.

The second feature of modern design is that the efficiency of generators and, particularly, of waterwheels has been very materially increased. Wheels are in use today such as no designer imagined a quarter of a century ago in point of high efficiency over a considerable range of output. Moreover, the dynamo designer is less fearful of low speeds than of old. Construction has been standardized in a way that makes it feasible to get the speeds of waterwheels and generators together without violation of technical proprieties. It used to be necessary to pick out a standard generator of as nearly the required output as possible and then to couple on wheels as nearly standard as possible to obtain the necessary output and speed. Sometimes this led to very unhappy hydraulic conditions with serious loss of efficiency. Today, and particularly in connection with the large units called for by the practice just mentioned, it is feasible without unreasonable expense to make generator and wheel to fit each other, with much gain in efficiency and simplicity of general station layout. Owing to this tendency the vertical-shaft wheel has come back again into favor and where conditions are favorable with very great utility. Oftentimes the hydro-electric problem, particularly if it does not involve great magnitude, can readily be solved by a horizontal wheel and standard generator, but the trend of practice is steadily toward building the whole set as a unit. An incidental improvement which is of considerable moment is the development of turbines for fairly high heads, bridging the gap which had previously existed between the field of the impulse wheel and that of the turbine proper.

Public Utilities Must Be Allowed to Earn More

AFTER years of delay there seems now a prospect that a reasonably sound and fair water-power bill will become law. The pity is that it has been so long delayed, the procrastination causing untold loss to the country. While our industries were struggling under the strain of war and the fuel supply was disastrously short, literally billions of kilowatt-hours were streaming downward unused into the sea. Such loss is sheer economic waste, irretrievable, inexcusable. The disastrous outstanding feature of the situation, even as it is today, is that it is by no means so easy to establish hydro-electric plants now as would have been the case five years ago. We publish this week two comments on the subject by consulting engineers of national reputation. Both bring to the front the same story of the financial difficulties which beset our belated developments. We are in a period of wild inflation, with the value of the dollar settled on about a fifty-cent basis and the price of the necessaries of life rocketing sky-high. Electric power supply is about the only thing important to human industry of which the price has not been materially increased. Relatively at least, the price of electricity is too low to permit the financial returns which are due to those who invest in hydro-electric developments. The cost of construction has substantially doubled during the period of inactivity. The cost of operation, fortunately not so large a factor in hydro-electric plants as in those deriving their power from fuel, has considerably increased, but public utility revenue has not kept pace.

Public service commissions have been disposed to take the attitude that power companies should be limited to about 8 per cent return on the invested capital. What one of all the great manufacturing industries which have grown up within the past five years could stand such a limitation? In order to attract capital to hydro-electric developments it is necessary to adopt a more generous attitude—to give the investors a fair and liberal return on the money actually put in, and to make full provision as well for the upkeep and necessary depreciation of the property.

With the prices of coal what they are and are likely to be, there is an opportunity for the profitable development of water powers if a fair financial chance is accorded. H. L. Cooper, the author of one of the articles, notes that as things stand today, even with the enhanced cost of material and labor, hydraulic plants can compete favorably with steam power, and the chances seem to be that with rising costs of fuel this advantage will be retained. One advantage besides must not be forgotten, that there has not yet been a single interruption of electric transmission service due to strikes, owing probably to the comparatively small amount and superior grade of labor necessary to successful operation. The prospects for development are not what they were five years ago and the losses of the past can never be recouped, but we are still hopeful, and if the regulating commissions will lend a hand and see that capital invested in this all-important industry shall have a square deal, immense benefits to the public may still accrue.

Losses That Occur in Shipping Coal

UNPLEASANTLY large losses have recently been experienced in shipments of coal received. A good many central stations have felt the effect of them somewhat severely, one manager reporting losses in winter as high as 8 per cent as between the coal reported when loaded and that actually received, and, from his experience, judging that the average shortage through the year would run between 4.5 and 5 per cent. Losses of this magnitude cease to be a casual matter readily to be overlooked. They may easily amount to thousands of dollars a year and deserve searching investigation. An inquiry of the traffic manager of the National Coal Association brought out the statement of fact which we lay before our readers in this issue. To begin with, it is clear that one does not weigh coal on a chemical balance, and a certain variation must necessarily be allowed. This is customarily 1 per cent and often 5 per cent, for evaporation.

The principal diminution of weight is reported to be losses in transit from coal loaded too high and shaken out during switching operations. This would indicate careless loading and handling. Then, too, there may be leaks in the cars which might affect fine coal to a very material degree. A little investigation of the losses as affected by the kind of coal shipped might prove illuminating. Theft and incomplete unloading of cars used for other purposes than coal also have their part in the final discrepancy. The loss from theft is not to be overlooked at the present time when a few shovels of coal have a very perceptible value. The main question is, What is to be done about it? Probably rigorous following up of the losses and filing the appropriate claims will have more effect than anything else, particularly since the railroads have been turned back to their rightful owners and there is a definite responsibility. The station manager who raises his boiler efficiency 5 per cent has cause to congratulate himself, and if he can make a similar gain based on the coal paid for, the opportunity assuredly should not be neglected.

Charging Duty on Scientific Apparatus

HOUSE bill No. 7785, which has recently been reported to the Senate without amendment by the committee on finance of the Upper House, establishes duties of 60 per cent ad valorem on chemical glass and porcelain ware and surgical and dental instruments and 45 per cent ad valorem on optical glass, optical instruments and scientific apparatus generally. The war brought us to a sudden and somewhat startling appreciation of the extent to which we had come to depend on importations, particularly from Germany, of these vital tools of the scientific trades. Under the sudden stress American manufacturers responded with a degree of success which is altogether remarkable. Even optical glass, the manufacture of which is of peculiar difficulty, was, before the end of hostilities, turned out in large quantities and of highly creditable quality considering the speed with which the industry had to be built up almost from the very beginning. It is well that protection has been accorded it. The most striking feature of the new bill is that the free list previously extended to educational institutions is now suspended. The wisdom of this step has been much called in question, but it is undoubtedly a fact that this free entry has been one of the grave hindrances to American manufacturers in the home production of scientific apparatus.

In certain classes of instruments, including a large proportion of those used in electrotechnics, the American manufacturer has attained well-deserved supremacy and foreign competition cuts comparatively little figure; but this is not true of all branches of scientific manufacture. Certainly we in the United States do not want to be again dependent on Germany, or any other country, for our means of research. There is, however, one phase of the matter which ought to be very carefully considered before the bill is finally passed. It is an unfortunate fact, owing perhaps in some measure to the former free list, that certain classes of scientific apparatus have never been made at all in this country and perhaps are unlikely to be put into regular commercial production as they are abroad. An import duty on such apparatus is a tax on research which does not benefit any American manufacturer nor can it do so until he puts such apparatus into production and thus actually has to face competition. Would it not be the part of wisdom therefore, to insert in the bill a clause granting free entry to apparatus not at present manufactured in the United States or patented here until such time as American makers seriously undertake its production? As soon as it can be obtained from the American source in regular course of manufacture let it take its place under the specific duty provided. We do not mean by this that special pieces of apparatus of peculiar pattern, manufactured abroad and which some one here may prefer when American articles substantially of the same grade are available, should be granted this free entry. If it is merely a matter of paying for a fancy, the American should be a "good sport" and pay the tax. One could make, however, a very considerable list of apparatus which, generically, is not in production on this side of the Atlantic, and it is to such apparatus that this suggestion applies. The American manufacturer should be fully protected on the products he makes not only on general principles but to help the country's industries. However, research in this country should not be taxed merely for the petty cash account of the Treasury.

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William States Lee

A Southerner whose leadership and engineering ability have pioneered the way in water-power development and electrification of industries in the South

AT ANDERSON, S. C., in 1898 the first 11,000-volt generators to be installed in this country were placed in operation in the Portman Shoals plant of the Anderson Water, Light & Power Company on the Seneca River. William States Lee, who was graduated from the South Carolina Military Academy four years before, was in charge of this work as resident engineer. This marks the beginning of his career in the development of Southern water powers and the building of a system which now includes eight hydro-electric and four steam plants, totaling 280,000 kva.; 2,050 miles of transmission lines, and 201 outdoor substations operated by the Southern Power Company, of which he has been vice-president and chief engineer for the past fifteen years. Mr. Lee gained his reputation as an engineer through his dogged persistence and success in damming the most treacherous streams of the South about twenty years ago. His work at India Hook Shoals on the Catawba River, near Rockhill, S. C., where in 1904 he completed a concrete dam after three contractors had failed owing to quickly rising floods, and the plans for future electrical developments in the section which he unfolded at that time to J. B. Duke, himself a North Carolinian, led to the formation of the Southern Power Company in the spring of 1905. The subsequent creation of the extensive system of that company has been due to the financial assistance and interest of Mr. Duke in developing Southern industries on the one hand and to the engineering vision, indefatigable perseverance and executive ability of Mr. Lee on the other. The accomplishments of these two men through the able staffs they have created, without outside financial or engineering assistance or absorption of other organizations, stand unparalleled in this country among achievements involving the design, construction and operation of large generating and transmission systems. Other details of Mr. Lee's part in this work are given on page 699 of this issue.

Financing Water-Power Developments

By HUGH L. COOPER
Consulting Engineer, New York

Cost of Construction, Return on Investment, Relation of Estimates to Actual Cost, Competition with Steam Power, Dependability of Service, Ability to Obtain Labor, Return During Development

THE world is going through the wave of unrest which has repeated itself all through history after every great war. It is difficult to analyze the many causes, but whatever they may be, we shall eventually learn after the upheaval has subsided that increased production along all fronts, individual as well as collective, accompanied by frugal ways of living, reduced the aggravating condition—high cost of living. Therefore why not take the bull by his horns and eliminate under-production by directed intelligent effort rather than let the situation clear itself automatically by a long-drawn-out and painful process? In this problem engineers can do more than any one else by developing and extensively applying labor-saving devices. To do this, however, involves keeping the power supply up to the demands of industry.

The writer is of the opinion that one of our greatest aids in the present situation will be to develop water power all over the world wherever such developments are economically warranted. Aside from providing the much-needed power, hydro-electric plants would save many thousand tons of coal—which is fast being exhausted—and would release considerable coal-carrying equipment on railroads for other purposes. For example, the development of 1,000,000 hydro-electric horsepower would release about $60,000,000 worth of railroad equipment. Besides, for every 35 hp. developed there will be a saving in labor of one man every year compared with the labor required for steam-power generation (based on a ratio of one to eighty-five for large water-power and steam-power plants respectively). The foregoing results are just a few of the many distinct aids that can come to the present situation by the development of water powers, both foreign and domestic.

The reader may very properly inquire why water powers are not being developed in the United States at top speed. The coal costs all over the world have advanced from 80 to 500 per cent, and there is now no relief in sight to correct the ever-increasing tendency to still higher prices. As a result there is a world-wide demand that water powers be everywhere developed as rapidly as possible, and the call is made to private capital to engage in this work, for the all-sufficient reason that it can be carried out most economically from the consumers' standpoint by private capital properly regulated as to rates and service.

ENABLING LEGISLATION EXPECTED SOON

Water-power development in the United States has been practically at a standstill for the last twelve years. This lack of development is a direct result of the absence of enabling legislation. Engineers all over the United States have been trying for twelve years to secure constructive legislation, but their efforts up to date have been abortive because of the great skill as obstructionists of a lot of well-meaning cranks who appeared on the scenes twelve years ago and have since actively and successfully opposed water-power legislation on the silly and erroneous theory that there was a water-power trust in our country that was trying to grab up all of the water powers and develop them entirely in its own interest. The skill of these obstructionists has been very remarkable, but it is only one case among many that might be enumerated where a small well-organized minority has been able to bamboozle a great majority and make the latter suffer widespread financial loss.

What price the public will pay for those twelve years of failure to develop our water powers it is not worth while at present to conjecture, because now the lost power is mostly sea water. What concerns us most is new construction that will increase production, and as it now seems likely that Congress and the President will at an early date give us satisfactory water-power legislation, the hydro-electric engineers will probably be called upon at an early time to get busy.

In the United States are many undeveloped water powers the development of which is justified even in the face of present-day greatly increased costs of labor and materials. After the hydro-electric engineer is certain that he has found a water power that can be justifiably developed the next problem is to find the funds required. However, he will find that the banker is the same old pessimist he used to meet and will have a lot of new objections to furnishing the money. The principal one will be the abnormally high existing construction costs and prices of materials and labor. The banker may also say that all of the water powers in his experience have exceeded the financial estimates and therefore, with the present high costs of material and labor, the new construction will exceed the financial estimates in a still greater degree. Unless this pessimistic contention is overcome, the rest of the banker's objections need not be enumerated.

There are five answers that the well-informed engineer can give to these objections, summarized in the following paragraphs:

Fixed Minimum Return Assured.—The water-power bill as it will pass Congress provides for absolute regulation of rates and service by public service commissions and provides for a fixed absolute fifty-year term franchise and for a minimum reasonable rate of return on the cash cost of the work. It also provides that at the end of the fifty-year term, if the owners cannot agree with the government on the terms of a new franchise, they shall receive back the total amount of their net investment less any amortization that has accumulated above the reasonable return on the net investment named in the original lease.

Thus the banker can pass in advance upon the attractiveness of the minimum rate of return specified in the lease and the opportunities provided in the lease for earnings in excess of this minimum rate.

In examining this question the banker will have in mind the sale of the proposed securities to his clients, who as such are entitled to a very conservative estimate of all the risks involved. If he finds the minimum rate of interest attractive, then he only has to make certain that the proposed plant shall be capable of earning this rate of return in competition with steam, provided, of course, that he has made certain that the estimate of the cost of the hydro-electric plant was made by engineers whose past records warrant the use of their figures.

Relative Cost of Water and Steam Power.—Based on present-day costs of construction, material, labor and coal, a kilowatt-hour from central steam stations will cost an average of one and a half times the cost of a kilowatt-hour from water power*. Consequently the banker will find a margin of protection of approximately 50 per cent over the nearest competitor, which is steam. Considering this margin, the banker will hardly take the position that steam costs can ever be reduced to a point below present hydro-electric costs, especially when all tendencies are in the direction of larger returns to labor. The banker will undoubtedly accept the view that it will take the world a long time to recover from the loss of twenty million men in the last six years, and therefore will agree that the margin of protection between the cost of the steam kilowatt and the hydro-electric kilowatt is more definitely assured than are similar margins in almost every other line of investment.

Dependability of Service.—Some bankers may say that they have heard much about the non-dependability of service from water power. Unless they are satisfied on this point they will have nothing to do with the proposal. It can be pointed out that in the pioneer stages of water-power development many things had to be learned and numerous mistakes had to be registered and paid for. Out of this experience, however, many valuable lessons have been learned, so that today water-power development is a science and not a gamble. Proof beyond question can now be submitted that the service dependability of hydro-electric plants in modern existing installations is at least equal in reliability to that of the modern steam station.

SKAGIT RIVER, WASH., WHERE WATER IS NOW BEING IMPOUNDED FOR 200,000-HP. DEVELOPMENT

The objection is sometimes raised that some hydro-electric developments in the past have been very disappointing because of mistakes in estimating the quantity of water that was available for power purposes. The banker and his investors can be protected against this contingency, however, by dealing only with engineers whose records justify confidence in their predictions.

An outstanding difficulty in the past has been the failure to recognize that hydro-electric engineering is a specialty by itself. Water powers have been disappointments to some bankers because they have assumed that inasmuch as the engineers speaking to them were eminent as railways engineers or in some other line they knew all about water-power development too. In such cases the banker is quite as much to blame as the engineer.

Obtain the Labor to Develop Water Powers.—Another question that may arise is "Where are you to get labor to build anything these days?" To this the ingenious and progressive engineer will reply that construction methods and machinery have been devised which greatly reduce the amount of labor required, and that the length of time required for hydro-electric construction is great enough to justify the adoption of construction methods that will attract the best character and the necessary amount of labor. Because of the smaller amount of labor required by the modern methods of construction more attractive wages can be paid.

Return During Development.—Finally the banker may say that he does not want to put any money into water-power construction because it will take three or four years to complete the work. The answer is found in the fact that interest during construction is just as much a part of the net cost of the enterprise as the cost of the cement and, therefore, that the net investment upon which the banker is entitled to the specified return will take care of this objection. Several water powers proposed for construction have an abundant market waiting their completion.

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*The writer has records available to substantiate this statement, but space does not permit including them in this article. Data to back up this and other statements will be presented later.

In addition to answering the foregoing answers to objections, the engineer can enumerate for the consideration of the banker some of the unusual advantages inherent in water-power securities.

Benefits to General Public

The first big advantage relates to the fact that the power consumer is immediately saved a very large amount of money compared with his steam costs. The sale of a million new horsepower, financed under present conditions, in the United States will save to the consumers thereof more than $30,000,000 annually. Certainly such a fact will cause water-power securities to be looked upon with special favor by those concerned about sound economics.

COLUMBIA RIVER, WASH., AT PRIEST RAPIDS

Development at the Dalles on this river would rival the Keokuk plant in rating. However, financial conditions and the necessity of creating a market are delaying this development

Another point that the water-power engineer could emphasize to advantage is the freedom of hydro-electric operation from strike interruptions, first because the number of employees required is relatively very small and second because it is not dependent on fuel of which the supply may be interrupted by strikes. Up to date the history of hydro-electric operation does not record a single interruption from strikes. The banker will see that future costs of water-power production can be influenced only in a very minor degree by increased costs of labor.

Another appealing point about water-power securities is the fact that where dams are built for storage or on navigable streams distinct aids to inland navigation are created. In virtually every case these improvements to navigation are made without public expense, and water thus stored has its effect in reducing the amount of flood damage that occurred annually before the water power was developed.

Other broad benefits to the general public could be enumerated if space permitted. Obviously water-power securities are sound as to legal structure and as to their ability to fulfill the promise made. Such securities are certain to have an increased and unusual value to the investor when he knows that the basis of his security is conferring increased efficiency, increased production and conservation of labor and coal and promoting countless needed industries that could not otherwise exist, and is doing this at a period when the world needs such aid.

In conclusion, the banker may say to the engineer, "You have given me a considerable number of good reasons for the development of water power. Now be honest with yourself and with me and tell me what harmful influences may be set in motion thereby." Two possibilities may be considered—(1) damages to overflowed lands and (2) the loss of production that is caused by this overflow. The first drawback is virtually negligible and is so far outweighed by the corresponding benefits that it should be ignored. The remaining objection loses much of its importance when it is considered that some farmers whose lands abutted a water power in the Central West complained bitterly of the fact that as a result of the water-power development their farms were increased in value so much that they had to pay considerably more taxes than they did before!

Cost of Preparing Pulverized Coal

THE data presented below were prepared by E. P. Mathewson and W. L. Wotherspoon in connection with the investigation of the use of pulverized coal for blast furnaces, but the cost of preparation is one of importance in steam-raising plants as well.

The cost of preparing pulverized coal will vary considerably, as there are several factors bearing on the matter, among which are labor, power, fuel for drier and repairs, in addition to interest and depreciation on buildings and equipment. The energy required for crushing, drying, elevating and conveying the pulverized coal will be about 20 hp.-hr. per ton of coal handled, and with modern equipment under average conditions the cost will be about 8 cents per ton-hr.

At the International Nickel Company's smeltery the average cost of preparing and delivering the coal to the furnace, in 1913, was as follows: Labor, $0.15; energy, $0.10; repairs, $0.145; coal for drying, $0.055.

100,000 Hp. Capable of Development in These Rivers

Sites exist on the Genesee River in New York State, in a region of large power demand at which approximately 35,000 hp. could be developed. The utilization of the power available would save the equivalent of coal and benefit industry. Water power can be developed on the Potomac River within the District of Columbia that will give about 66,000 hp. half the time and 10,000 hp. continuously at minimum flow. This development would be within transmitting distance of Washington, D. C., and Baltimore, Md., and would eliminate the burning of considerable coal.

Water-Power Development Must Come

Bill Now in Conference Removes Certain Obstacles, But Serious Impediments Still Exist Which Must Be Removed Through Public Enlightenment—Hydro-Electric Power a National Necessity

By an Eminent Consulting Engineer

MUCH of the present-day coal shortage, congestion of railroad traffic and general industrial delay might have been avoided if an active development of water powers had been in progress during the last twelve years. Fortunately, the present Congress has tried to undo the incalculable economic damage which has been inflicted on industrial America by past legislative prejudice, would-be reformers and other forces in this country, and it is quite certain that the water-power bill now in conference will soon become a law. While this bill removes some of the big obstacles which have stood in the way of the water-power development, it remains to be seen whether there will be the expected stampede to bring about development. Other serious obstacles have arisen in very recent years. The high cost of labor and materials, labor shortage and the high cost of construction money, combined with the excessively low rates at which power is sold, may be insuperable obstacles unless the economic conditions shall be radically changed.

The cost of power from a water-power plant consists chiefly of the fixed charge on its construction cost. Under present conditions not only are construction costs about double what they were before the war but the interest rates on construction funds even if obtainable are unprecedently high. Even operating companies of established earnings are obliged to pay 7 per cent and 8 per cent for money for extensions, refunding, etc., and a new water-power enterprise, if it could be financed at all, could only obtain capital by paying an interest rate directly or indirectly considerably higher than that. Therefore, with the combination of double construction cost and double interest cost, together with high operating labor expense, a prospective water-power enterprise is likely to show a power production cost four times that prevailing before the war.

Unfortunately, the market price for power has not been allowed to increase in this same proportion. This condition confronts virtually all the power companies of the country. The result is that the only power-plant construction being carried on at the present time is that of absolutely necessary extensions which power companies are obliged to make to maintain their position. Where such extensions are made the lowest possible first cost controls, which means that a steam plant must be installed. In general, little provision is being made to meet future demands for power despite the fact that industrial demands are doubling almost every five years. Power companies cannot afford to lag behind this rate of growth, nor can the public as a whole afford to place any impediment in their way that will obstruct electric service development.

THE FUNDAMENTAL OBSTACLE TO POWER DEVELOPMENT

The fundamental difficulty with the power business, a difficulty which has been steadily increasing for ten years, is that the profits of the business are not sufficiently attractive and are not comparable with those derived from other forms of industrial enterprise. From the majority of systems power is being sold at too low a rate and below its fair value to industry. The narrow-minded position taken by some power consumers, working through the public service commissions, has held power rates down to a point where many important power systems are facing financial starvation. As a result the power business has ceased to be an attractive field for the investment of new capital and is not receiving for itself a proper share of the profits of industry in general.

Industry in this country has to a great extent built itself up on the shoulders of the power distribution systems and has been free to take for itself an unrestricted profit. It has, however, constantly and increasingly denied to the power system the right to share even a reasonable part of such prosperity. Fabulous profits have been made from such industrial plants, but the power company, tied down to the limit by regulation and restriction, has been obliged to struggle along, selling power to these prosperous factories at a figure little above actual cost and faced at all times by serious financial difficulties. Such a situation is not reasonable and in the long run is against the best interests of the consumer of power.

The point of view of industry as a whole with respect to the power company seems to be wrong. The consumer of power, a manufacturer for instance, pays a liberal profit to the corporation which supplies him with raw material. If he sells wholesale, he expects the retailer to make a liberal profit. When, however, he purchases his power, the most basic of all his raw materials, he denies the right of the power company to make more than a profit which he himself would consider trivial in his own business—a percentage of profit which would soon put a manufacturer out of business.

The doctrine often proclaimed by public service commissions that the total earnings of a power company must not exceed 8 per cent on the invested capital is both stupid and destructive. No manufacturer would think of entering business on any such restricted basis, and the power business is little different from manufacturing enterprises and is subject to many of the same contingencies.

Few power companies can exist in a healthy financial condition with earnings so restricted. They should be permitted by the regulating commissions to earn enough to pay out a liberal return in interest or dividends and in addition a sufficient amount for ample maintenance and for the accumulation of surplus. Only in this way can power companies establish the credit necessary for obtaining promptly the funds for extensions to meet the demands of industry. It will be greatly to the advantage of power consumers if they can look at the matter broadly and assist in bringing about this result.

Power companies are partly to blame for the circumstances in which they find themselves at the present time. Many of them have underestimated their real costs in delivering power and have allowed precedents to be established in low power rates which have been difficult to overcome. One cause of excessively low prices for power has been the competition between central-station power and the theoretical cost to the consumer of producing power from a power plant of his own. Such estimates are almost always fallacious, but the power companies in their desire to sell their output have too often surrendered to the argument. Even if an isolated power consumer can correctly figure the cost at which he could produce his own power, he should be willing to pay the power company a higher price in order to avoid the investment and complication of entering the power business himself. In the long run it will pay him well to do so.

In most industries, according to an extensive analysis presented in the ELECTRICAL WORLD of Sept. 20, 1919, the cost of energy for most manufacturing purposes is less than 2.5 per cent of the total value of products, being only 0.2 per cent for tobacco, 0.6 per cent for leather, 0.8 per cent for lumber, 1 per cent for vehicles and food, 1.3 per cent for textiles, 1.8 per cent for liquors, 2.2 per cent for metals except iron, and 2.4 per cent for paper and railroad repair shops. If power rates were even double throughout the country, the selling price of most commodities should not be materially increased. Therefore, a substantial increase in power rates would not be a handicap to industry, while it would mean the difference between prosperity and poverty to many power companies. The latter condition is against the interest of all consumers of power.

LIBERAL ATTITUDE ON PART OF INDUSTRIES NEEDED

The industrial world should adopt a new and more liberal attitude toward the power industry, should appreciate the importance of its growth and expansion and should realize what a fundamental factor it is in the development of manufacturing. If the power companies are to prosper, industry must co-operate with them and assist them in securing a fair share of industrial profits. If they do not, power companies cannot follow up the growing demands of manufacturers.

Let public service commissions devote their attention more to the distribution of earnings between interest, dividends, maintenance, surplus and amortization, than toward the limiting of earnings themselves. Many power properties are not being maintained as they should be, and too much of the expenditure on plant is now charged to capital which should be paid for out of surplus earnings as an operating expense. Only the companies which have been the most prosperous can afford to do otherwise.

Before any extensive construction of new water powers can be carried out by private corporations the general financial status of power companies must be improved. This can be brought about only by a radical revision upward in power rates. If the power consumer cannot be made to appreciate the necessity of this, then let each manufacturer provide himself with his own source of power and bring down upon himself the consequence of a policy which is so disastrous and so shortsighted.

While it seems very doubtful under prevailing conditions that the necessary capital can be attracted for new water-power enterprises, the economic conditions of the country and the constantly increasing fuel shortage demand that new water powers be developed, and developed at once, as a national necessity. As a consequence, unless such enterprises can be made attractive for the investment of private capital, the state governments or the federal government will be forced to lend credit for their development. We will then have political control and management of our water powers, together with all that signifies in inefficient management, poor service, waste, delay and more taxation.

Let us hope that the passage of the water-power bill will be followed up by an enlightened movement toward higher rates for power, so that the stagnation in the development of this most important and basic American industry can be removed.

Experience Shows Economy of Automatic Operation

IN A RECENT report on the installation and operation of two automatic railway substations it was shown that the increased cost of the equipment was wiped out in three years and one year respectively.

One of these substations was to replace a floating storage battery on the Rochester & Sodus Bay line of the New York State Railways at Williamson, N. Y., and the other the Manlius substation on the Oneida line of the West Shore electrication between Syracuse and Utica. The Manlius substation is about 5½ miles (8.8 km.) east of Syracuse and was equipped with two 300-kw. rotaries, one of which was removed and placed elsewhere on account of changed traffic conditions. Prior to the installation of the automatic equipment, this remaining machine was operated by three men working on eight-hour shifts. These two stations are of particular interest, owing to the fact that one was built especially for an automatic operation while the other is an adaptation of a manually operated substation to automatic control. The automatic equipment at Williamson eliminates the operation of the rotary 50 per cent of the time, during which it would otherwise have been operating, and at Manlius 36.5 per cent of the time. At Williamson this produces an annual saving of $236.52 in power cost and at Manlius a saving of $201.48. A table shows that it required only one and one-tenth years of operation to cancel the original cost of installing the automatic equipment.

DATA ON MANLIUS CENTER AUTOMATIC SUBSTATION

Substation operated non-automatically, hours per day	20½
Substation operated automatically, hours per day	13
Saving in operating time, hours per day	7½
Per cent of non-automatic running time substation operates automatically	63.5
Cost to install automatic equipment	$3,400.00
Freight	42.00
Miscellaneous material, conduit, wire, etc	275.42
Total	$3,717.42
Labor cost	483.20
Total cost to install	$4,200.62
Annual charges:	
Fixed charges and depreciation, at 10 per cent	$420.06
Repairs to automatic equipment (estimated)	100.00
Labor cost to inspect, one and one-half hours per day, at 45 cents	246.60
Annual yearly expense	$766.66
Annual gross saving:	
Labor of three men at 45 cents per hour, eight hours per day	$3,942.00
Relief operator seventy-eight days per year, eight hours per day, at 47½ cents per hour	296.40
Saving in power estimated, 7½ × 8 kw., 60 kw.-hr. per day, 21,900 kw.-hr. per year at 0.92 cents	201.48
Saving in coal for heating substation	200.00
Gross saving	$4,639.88
Annual charges	766.66
Net annual saving	$3,873.22
Number of years to cancel original cost	1.1

The Modern Trend of Hydro-Electric Engineering

Equipment of Different Periods Compared — Future Possibilities — Reasons for Tendencies Toward Use of Fewer and Larger Machines of Vertical Design, Higher Efficiencies and Individual Pipe Lines

By W. M. WHITE

Manager and Chief Engineer Hydraulic Department Allis-Chalmers Manufacturing Company

AN ANALYSIS of the trend in the use of hydro-electric machinery shows a tendency more and more toward vertical units of as large a capacity as the particular development will warrant or as can be constructed and transported. So far only a minor portion of the water powers have been developed, but it is hoped that laws will soon be passed which will induce a flow of capital to this line of public service.

Fifteen to eighteen years ago the paramount object in hydro-electric developments was to select and arrange apparatus so that continuity of operation would be maintained in each plant. This practice was necessary because the majority of the plants were isolated and thus dependent upon their own power equipment for all power delivered. As a result the standard for hydro-electric machinery for plants at that time was for not less than four units, each unit having an overload capacity of 25 per cent, so that with one unit out of service for repairs the three remaining units could maintain the service. The size of the units was fixed by this rule. The average hydro-electric plant of those days was not large, although the units were of such size as to command interest when they were first installed.

As the demand for power increased the size of the units increased, and at one period of development the manufacturers of hydraulic equipment were put to a task to develop and build machines of the size demanded by the economic considerations of each particular development. Now the size of hydraulic turbines is limited only by the ability to construct and transport the parts when not controlled by economic considerations. The intricacies of the problems involved in the design and construction of these machines have drawn a body of able, enthusiastic, clear-thinking, young engineers to the work, and consequently there has existed for some time a greater rivalry in the engineering forces of the competing companies than probably exists in any other line of similar endeavor. The competition, particularly in the engineering end, is keener than the profits in the work would justify, but the intricacies of the problems involved hold the interest of those engineers devoted to this subject.

When the machinery which has been installed in the various hydro-electric plants in the United States is considered, one is impressed with the fact that the trend has always been toward the simplification of the machinery. It is interesting to note that the early turbines installed in the middle of the last century were of the vertical type. For a time the trend was toward the horizontal design, first because of the difficulty of supporting the revolving weights when held in the vertical position and, second, in order to provide higher speeds for the generators. However, the invention of the Kingsbury bearing has switched the trend back to the vertical machines.

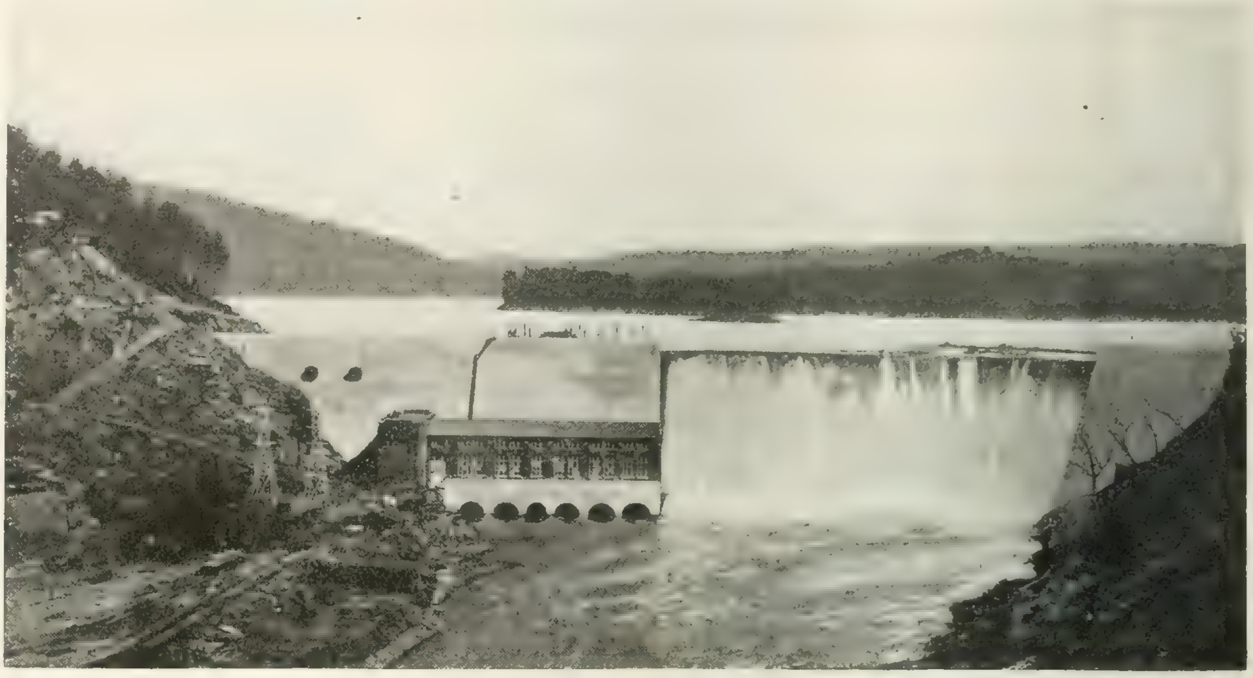
Electrical engineers' recommendations as to size and speed of the generators had a predominating influence at one time, making it necessary for the waterwheel builders to arrange a multiplicity of runners on horizontal shafts to meet the high speeds then demanded. At the present time, however, the trend is in the direction of the proper size and speed for the hydraulic equipment first and a suitable size and speed of the generators second.

To assure the highest degree of continuity of operation, many companies have installed steam reserve in the cities served, especially where the location of the hydro-electric plants has necessitated long transmission lines that might be the cause of serious interruptions. Operating companies have sought even greater factors of safety by interconnecting their lines with other companies so that energy may be exchanged in times of need. This community spirit among the operating companies is splendidly exemplified in the various companies operating in the Carolinas, Tennessee, Alabama and Georgia. The rains in these states are quick, sharp and torrential. The terrain is hilly so that the floods quickly run to the sea. That section of the country has abundant rainfall, and the hilly terrain provides a multiplicity of streams. As the rains are usually local in extent, it frequently happens that one stream may be flooding its banks while the adjacent stream is at low ebb. The power interests in that section of the country are now interconnecting and combining their operation so as to take the greatest advantage of the flood waters in any stream for the benefit of all. Thus naturally the trend of hydro-electric development is to overdevelop any given river to a greater extent than would be justified if a community of interests did not obtain. Such overdevelopment has even greater justification when one company controls many plants on several streams.

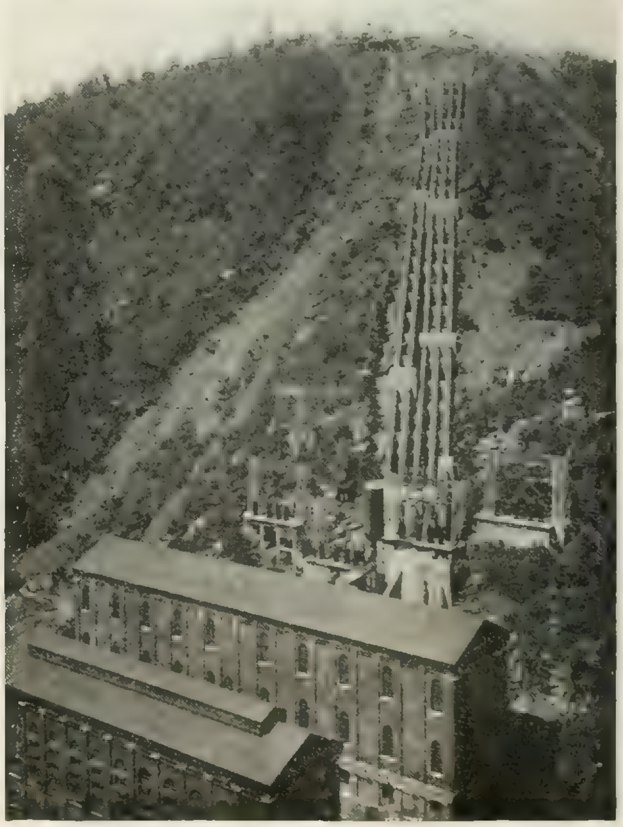
As the steam auxiliaries and interconnecting lines have increased in numbers the demand for a multiplicity of units in any hydro-electric station has decreased, and it is not necessary, except in unusual cases, to multiply the units in any given development for the purpose of maintaining service continuity and practically full-power output from that station. The modern trend, therefore, in the selection of machinery for any given development is dominated by the one thought of ultimate economy in the completed development. In several recent developments the power house contains only one hydraulic unit.

In most of the recent hydro-electric developments the turbines have been of the single-runner vertical type for the purpose of obtaining the maximum efficiency at the minimum cost. When horizontal turbines are used

Two Noted Southern Developments That Save Coal



Ocoee River plant of the Tennessee Power Company at Parkville, Tenn., that develops more than 15,000 hp. This is one of two developments on this river having a total rating of about 24,000 hp. The installation has permitted industrial development that might not have occurred otherwise. Tallulah Falls development, shown in the lower right-hand view, with a rating of 72,000 kw. was barely finished when the shortage of coal supply and the rapid increase in power demand due to the war forced the Georgia Railway & Power Company to provide additional storage for the operation of the maximum rating of this station. This company controls about 275,000 kw. in undeveloped water-power sites; 97,000 kw. in developed hydro-electric plants. The view at the left shows the falls before development of this natural power had been begun.



it is necessary to turn the water through a 90 deg. bend immediately after it has left the runner. This elbow is the cause of considerable loss. The vertical turbine, therefore, affords higher efficiency and enables keeping the water away from the electrical apparatus. The larger the river developed the larger usually the variation in the tailwater level, so that the vertical units provide for keeping the generator above flood elevation.

In the older developments of small-sized units one pipe line was generally used, with branch pipe lines to each of the units. The modern tendency, however, is to have a separate pipe line to each of the turbines. When the pipe line is of considerable length, butterfly or needle valves are usually installed in or near the power house so that immediate control is had of the water to the units. Where the pipe lines are short and up to a length of approximately twice the operating head the tendency is to install headgates at the forebay for the control of the water to the unit. On developments where the usual riveted plate-steel penstock is used the tendency is to terminate the penstock in a spiral plate-steel casing in line with the practice of constructing concrete spiral casings when the head is sufficiently low to make it possible to take care of stresses in the concrete.

The larger vertical turbines are designed with as high a speed as is practicable for the head under which the desired power is to be developed. There are limitations, however, to the speed which can be used with safety, and certain definite empirical formulas have been developed on these limitations. The diameter of a runner is fixed by the speed and head and varies inversely as the speed; consequently when the diameter is very small such a high discharge velocity may result that it will consume considerable energy. This is now one of the major losses in hydraulic turbines. A considerable portion of the discharge loss can be eliminated by the use of a "hydraucone regainer" which was developed as a result of a series of experiments conducted about five years ago. There is feverish activity along this line of development just now, and it is evident that the greatest improvements in hydraulic turbine efficiency is to come from the utilization of that form of draft tube which will regain the greatest energy from the water discharge from the turbine. It is expected that considerable rivalry and contention concerning this line of development will exist for some time to come.

One of the difficult problems in hydro-electric plants heretofore has been the governing apparatus, but the leading hydraulic turbine builders have developed governors which are now effective, positive in action, and uniform in performance. Directly connected fly-balls mounted upon the main turbine shaft have been used on several large units recently with good results. It is predicted that the trend of governor design for hydraulic turbines will be toward directly connected fly-balls and the incorporation of the valves and control mechanism nearer the turbine and possibly within the turbine pit, instead of installing them on the main generator floor as has been done heretofore.

The greater use of long tunnels driven into solid rock is an evidence of the trend toward permanent construction and is an attempt to eliminate all possible operating expenses.

The efficiency of hydraulic installations has steadily increased, so that it is possible now on the larger plants to secure 90 per cent efficiency between the water delivered to the power house and the switchboard.

The elaborate oiling systems which have heretofore been used in connection with the thrust bearings in supporting the weights of the revolving parts are no longer essential. This is evidenced by recent experiments, and it is predicted that the smaller plants will hereafter use air-cooled bearings and the larger ones water-cooled bearings without any circulation of oil outside the bearing housing itself.

In considering large, high-head developments it has been the plan recently to balance the estimated cost of the development in one plant against the development of the stream by several plants. The latter scheme has the advantage of keeping down the overhead charges when only a portion of the power resulting from the complete development of the stream could be used at once.

Some good results have already been achieved by automatic hydro-electric stations, and it is thought that considerable activity will take place in the future on this type of plant. These plants usually require induction or asynchronous generators, although synchronous generators have been installed in one recent hydro-electric plant which is controlled and operated automatically from a distant point. Recent inquiries for automatic governors for the control of these automatic plants illustrate the trend of thought among engineers in this direction, and a recent invention relating to governors for these plants may have some influence on this type of development.

Keeping Up Steam in Idle Boilers Takes Over 0.02 Gal. of Oil per Hp.-Hr.

KEEPING boilers fired in readiness to carry load requires 0.00653 gal. to 0.02248 gal. (0.025 l. to 0.085 l.) of oil per rated boiler-horsepower-hour, according to records of three Pacific Coast companies. The lower figure is for a 1,000-hp. plant, the second figure is for a 15,000-hp. plant, while a third plant of 12,000 hp. in boilers consumed 0.02204 gal. (0.0833 l.) of oil per boiler-horsepower-hour when boilers were carrying steam but were idle.

FUEL OIL CONSUMED TO KEEP BOILERS HOT

Station	Days	Consumed Oil (Gal.)	Boiler Hp.-Hr.	Oil Consumed per Boiler, Hp.-Hr. (Gal.)
1	14	2,470	37,816	0.00653
2	24	50,482	2,201,350	0.02204
3	50	34,293	1,524,000	*0.02248
3	55	18,112	1,027,450	†0.01762
3	105	52,405	2,549,450	‡0.02053

* No machines running during these days.
† Machines running part of day.
‡ Mean of above.

This expense is only a part of the cost of being ready to serve at any time. Other items entering into the total cost of this service are interest on the investment, depreciation of apparatus and actual operating expense during the standby period. Under this last item, besides labor, repairs and supplies, is the fuel cost, of which the foregoing are examples. Added together, these expenses amount to a good share of a company's total expense.

Water Powers of the United States

Analysis of Developed and Undeveloped Sources Made by the "Electrical World" Indicates that the Total Potential Water Power Is 59,360,000 Hp., of Which Only 9,823,540 Hp. Is Developed

THE amount of developed and undeveloped water power in the United States should be of utmost interest to the electrical industry at the present time in view of the crying demand for more power, the necessity of conserving fuel, the importance of relieving railroads of fuel transportation, and especially because of the probable early passage of the water-power bill. To answer some of the questions which may arise the ELECTRICAL WORLD has made a survey from which it has estimated as closely as possible the potential, developed and undeveloped water powers of the country as well as the probable energy market in 1930. This analysis has been based on data obtained from the Surface Water Resources Branch and Land Classification Board (United States Geological Survey), Commissioner of Corporations, Forest Service (Department of Agriculture), Census Bureau (Department of Commerce), Dr. Charles P. Steinmetz's and Philip Torchio's analyses, and data obtained by the statistical department of the ELECTRICAL WORLD.

The Census Bureau made estimates on developed water powers in 1902, 1907, 1912 and 1917. However, the full 1917 report has not been issued to date, and the latest detail data of all states from this source is the 1912 census. Herman Stabler, chief engineer of the Land Classification Board, United States Geological Survey, has recently made an estimate of the developed water powers of the United States segregated into central station and electric railway installations and isolated plants of all kinds. The figures of this estimate appear below. They are based on the various census reports on central stations and electric railways, census data for manufactures, mines and quarries, and all available data on the innumerable small water-power plants which are accessible only to an engineer in Mr. Stabler's position.

TABLE I—INSTALLED CAPACITY OF WATERWHEELS IN THE UNITED STATES IN TENS OF THOUSANDS OF HORSEPOWER

Year	Central Stations and Electric Railways	Isolated Plants of All Kinds, Including Manufactures, Mines, Quarries, Federal and State Institutions, Etc.	Total
1902	*49	319	368
1903	63	325	388
1904	79	334	413
1905	98	342	440
1906	120	349	469
1907	*144	357	501
1908	170	366	**536
1909	198	371	569
1910	228	372	600
1911	260	372	632
1912	*294	372	666
1913	330	372	702
1914	367	373	740
1915	406	373	779
1916	446	373	819
1917	*488	373	861
1918	530	374	904
1919	573	374	947
1920	617	374	991
1921	661	374	1,035
1922	706	374	1,080

* U. S. Census Figures.

The above figures for isolated plants appear nearly constant over a period of years. This does not mean, however, that there were no new private installations

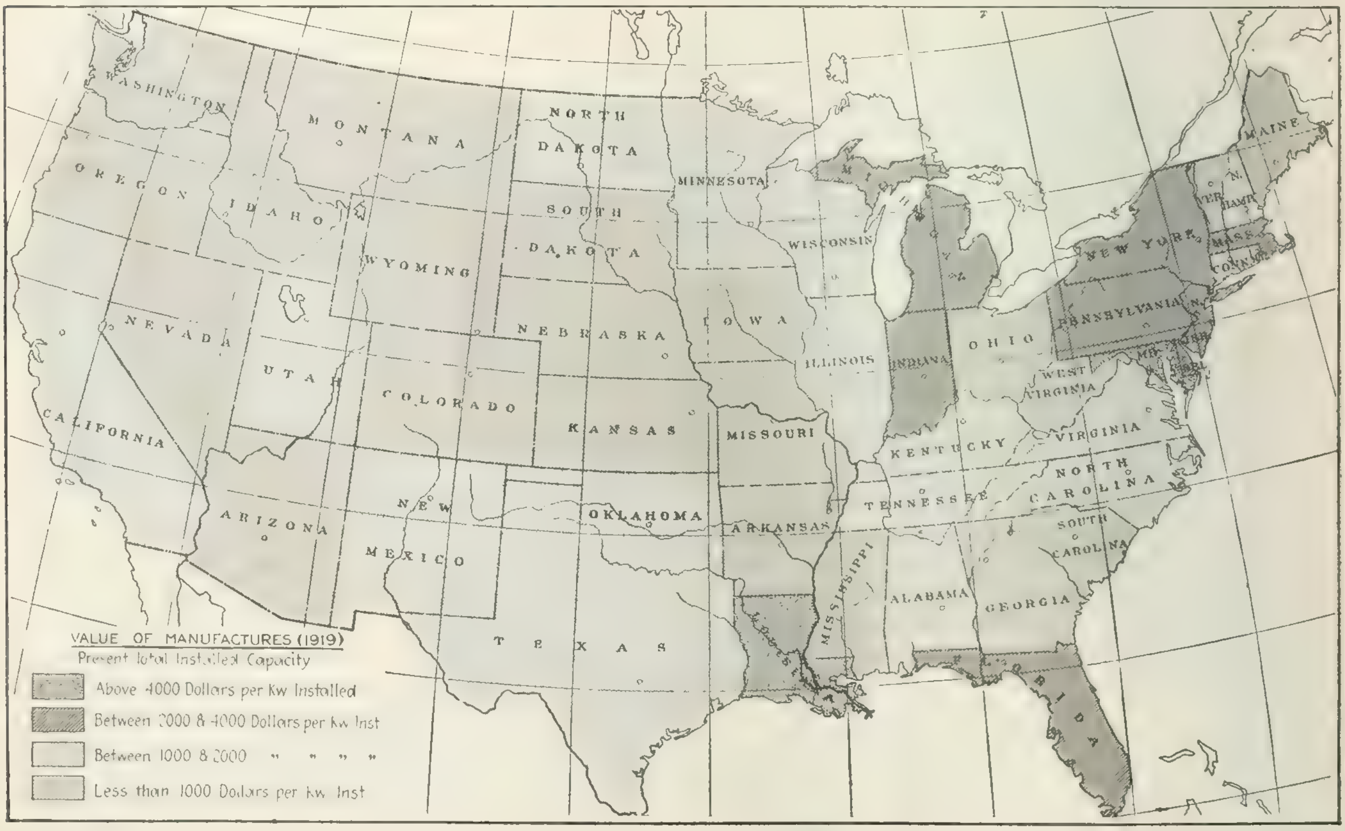


FIG. 1—COMPARISON OF INDUSTRIAL POWER DEMAND WITH TOTAL GENERATING CAPACITY OF POWER PLANTS OF ALL KINDS

during these periods, but that some of them have become central stations and have been transferred to the central station and electric railways column. Instances of this are the Green Creek plant, near Bodie, Cal.; plants of the Ophir Hill Consolidated Mining Company, Utah; New England Power Company plant No. 3, and the plant of the Reclamation Service on Boise River, Idaho.

A study of the installations of central stations of the country given in the "McGraw Central Station Directory and Data Book," 1919 edition, affords a basis upon which to estimate the total developed water powers of the country by states, using the 1920 Stabler estimate given in the above table. For instance, on Jan. 1, 1919, the waterwheels installed in North Carolina central stations totaled 144,405 hp., and the total installed waterwheels of the central stations in the United States were rated at 4,493,569 hp. The waterwheels of the central stations of North Carolina, therefore, were 3.2 per cent of the total for the country. Assuming that this ratio will hold for isolated plants for 1920 of 3,740,000 hp., a total of 316,000 hp. is obtained as the installed water capacity of all kinds of electric power plants in North Carolina. In a few instances this method of computation will possibly not hold, and corrections were found necessary based upon state and private reports. The estimate for the state of New York is that given by the State Conservation Commission in its 1919 report.

The United States Geological Survey made the first comprehensive estimate of the undeveloped water powers of the country in 1908. This report, however, did not include estimates for individual states but was based on drainage areas as the unit. A later estimate, made in 1915, was segregated by states. Other estimates of the undeveloped water powers were made by the Commissioner of Corporations in 1912 and by the Forest Service in 1916. All three of these reports also include estimates of the developed water powers, the Forest Service estimate, however, being the same as the 1912 census figures. The above estimates will be found in detail in the table on page 658. Since 1916 no detailed estimate has been published of either developed or undeveloped water powers, with the exception of a few separate state reports by the Census Bureau, based on the 1917 census, and three or four state conservation reports.

Estimates of the potential water powers of the country as a whole have been made by several prominent engineers. Probably the most technical investigation of this question was undertaken by Dr. Charles P. Steinmetz, chief consulting engineer, General Electric Company. His analysis was presented in a paper read before the annual convention of the American Institute of Electrical Engineers at Atlantic City, June, 1918. From a consideration of rainfall and topography Dr. Steinmetz estimates "950,000,000 kilowatt-years (twenty-four-hour service) as the total potential water powers in the United States, or the hydraulic energy of the total rainfall from the elevation where it fell, down to the sea level. An approximate estimate, after a minimum allowance for agriculture and losses, gives the maximum available potential energy from rainfall at about 380,000,000 kw. (twenty-four-hour service) or 230,000,000 kw. (twenty-four-hour service) at 60 per cent efficiency." Obviously only a portion of this power will ever be developed.

Another estimate based on the number of heat units produced by the coal consumed in the country was presented before the National Electric Light Association in 1915 by Philip Torchio, chief electrical engineer, New York Edison Company, and before the A. I. E. E. just recently. Mr. Torchio states that the 542,000,000 tons† of coal produce a total energy, figured in terms of British thermal units, of 3,908,320,000

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†Consumed in 1915

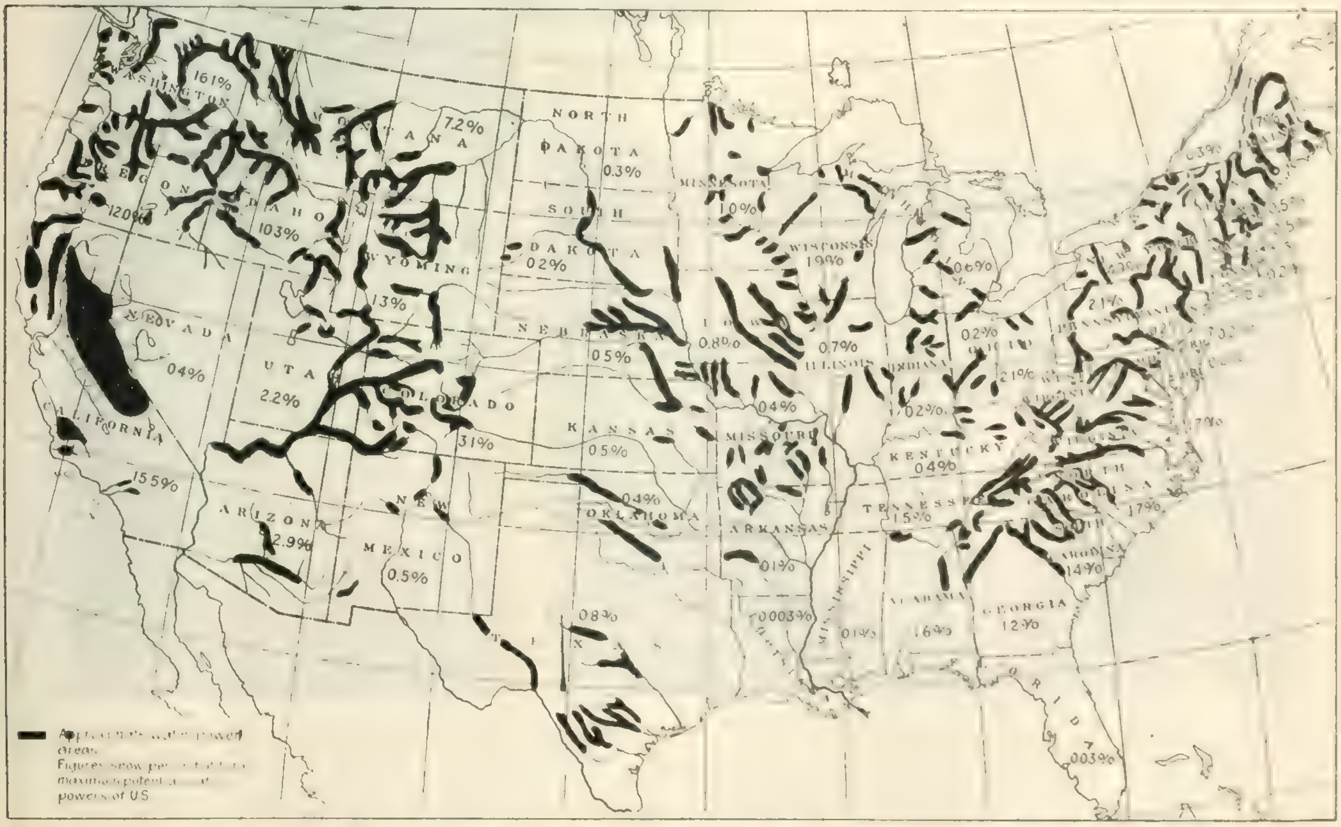
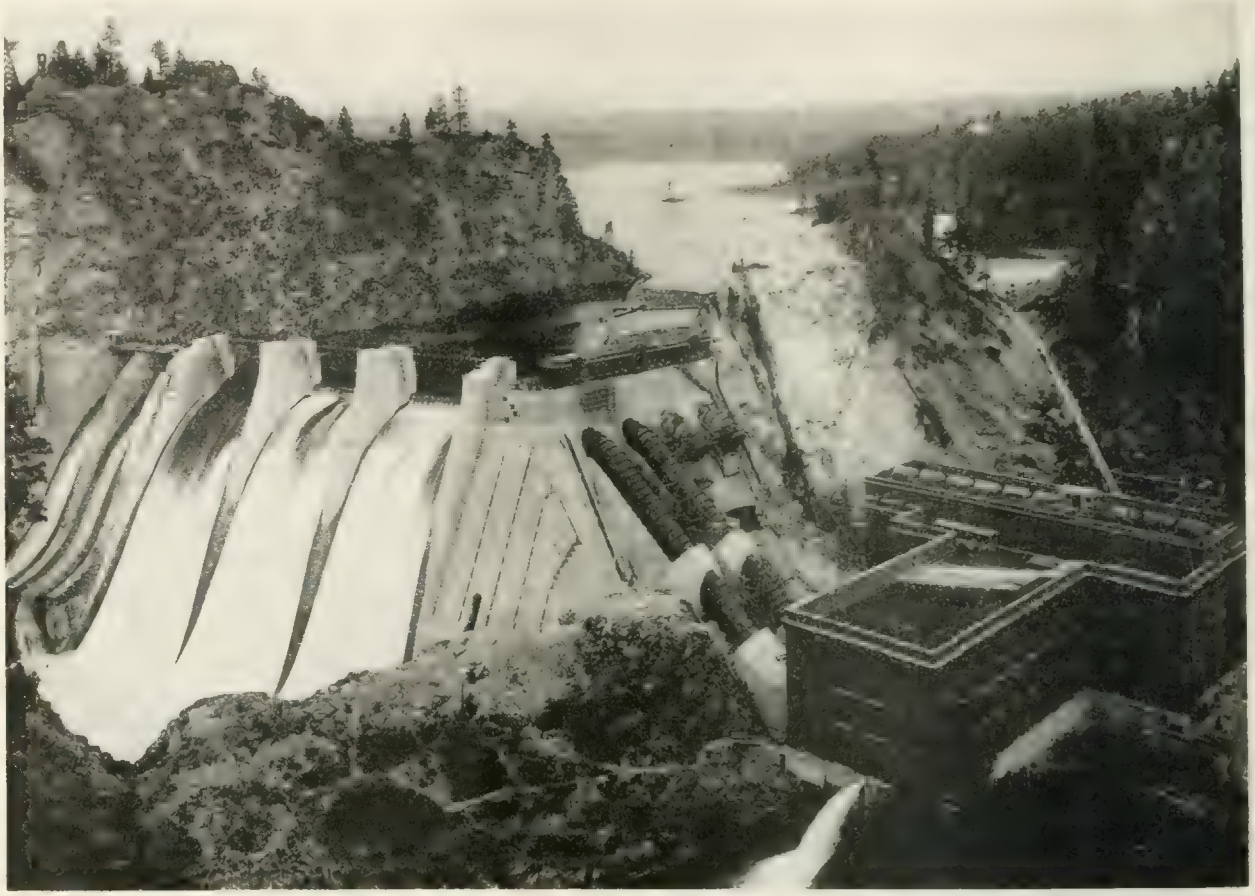
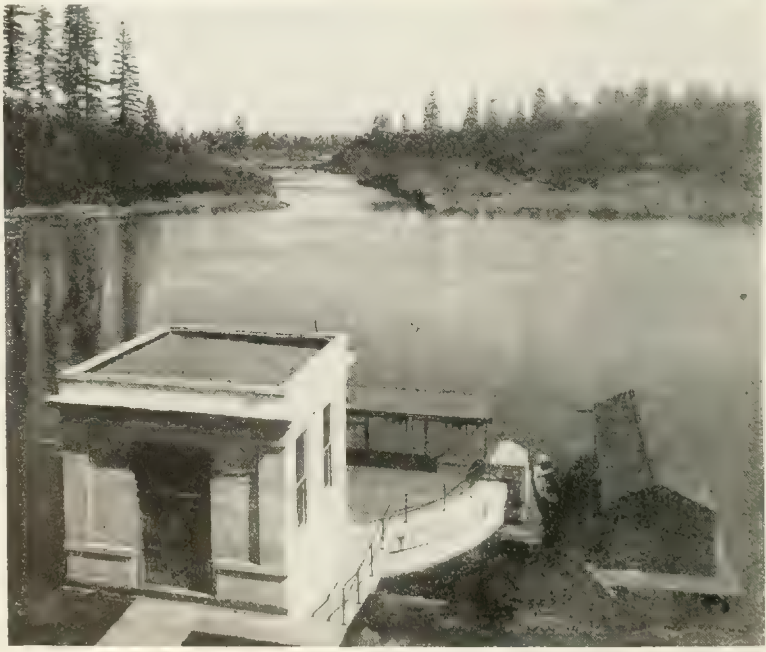
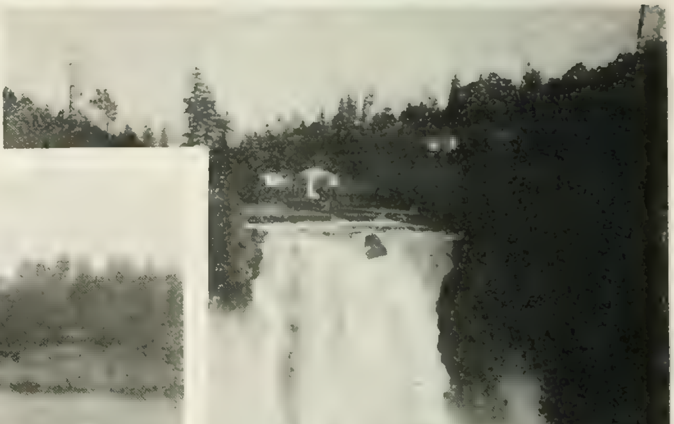


FIG. 2—IMPORTANT POTENTIAL WATER POWERS OF THE UNITED STATES AND THE PERCENTAGE OF TOTAL IN EACH STATE



Electrification of the C., M. & St. Paul Railroad Was Made Possible by These Plants





The view at the top shows Long Lake station on the Spokane River, Wash., the principal hydro-electric plant of the Washington Water Power Company, whose system is interconnected with the Puget Sound Traction, Light & Power Company to furnish motive power for the Chicago, Milwaukee & St. Paul Railroad, giving a total backing of 300,000 hp. on the east and west sides of the Cascades. Below (at left) is the tunnel intake of the White River power plant of the Puget Sound company. The canal in back ground connects with huge storage reservoir. The illustration at the right shows Snoqualmie Falls which furnishes a head of 268 ft. for an underground station of the Puget Sound Company.

units, 121,620,000 units in the Western States and 3,786,700,000 units in all other states. If all the water powers of the country were utilized, they could replace 1,046,000,000, or 27 per cent, of the above units. Of this, 746,000,000 units, or 614 per cent of total energy used, are available in the Western States and 300,000,000, or 8 per cent of total energy used, in all other states. The water powers already developed represent 73,900,000 units, of which 22,900,000, or 19 per cent of the total energy used, are in the Western States, and 51,000,000, or 1.4 per cent of total energy used, in all other states. The Western States possess large water-power resources sufficient to furnish several times their total power and heat requirements, but all other states are inadequately supplied with water powers.

Estimates of potential water power vary according to the basis upon which they are made. As indicated above, Dr. Steinmetz took into consideration only the rainfall and topography. The United States Geological Survey, the government authority on surface-water computations, bases water-power estimates upon three assumptions: (1) the power which may be produced by a minimum flow, (2) the assumed maximum development, and (3) the additional power that may be recovered by developing the available storage capacity in the upland basins and using stored water to compensate the low-water periods. In determining the minimum development the flow for the lowest two consecutive seven-day periods in each year is determined and the mean of these values for the period of record is taken as a minimum flow. The maximum development is that amount the continuance of which can be assured during six months of the year. The figures given in the table on page 658 are based upon assumptions 1 and 2.

In the investigation to ascertain the potential water powers of the country the ELECTRICAL WORLD has used as a basis the 1915 estimates of the United States Geological Survey. A careful study has been made of water-power reports issued by engineers of the Geological Survey since 1915, reports of other Federal departments, State conservation and surface-water reports, as well as private engineering reports. Corrections to the Geological Survey estimates of 1915 have been made based upon these various reports.

The maximum potential water powers of the United States are estimated by the ELECTRICAL WORLD to total 59,360,000 hp. at 90 per cent efficiency. Of this amount 9,823,540 hp., or 16.6 per cent, has been developed, leaving 49,536,460 hp. still undeveloped. No estimates of the power possibilities with storage are believed practicable in view of the limited data available. An estimate of 200,000,000 or more horsepower as the possible water horsepower with maximum storage was made by the United States Geological Survey in 1908, but later computations by that bureau have led to the belief that this figure is somewhat too large.

The Pacific States lead in potential water power, while the Atlantic States show the largest amount of development. Washington leads the states in potential water powers, and New York heads the list in water powers developed, being followed closely by California. The estimates by states and sections will be found in detail in the table on page 658. Fig. 3 shows the potential, developed and undeveloped water powers of the country by sections.

It should be remembered, in comparing estimates of undeveloped water powers with figures for developed powers, that the former are usually given in terms of continuous or twenty-four-hour horsepower, while the developed horsepower is stated as the installed capacity, which is developed in many instances only during a portion of each day—in the case of power for a manufacturing plant about ten hours per day. Moreover, most estimates of undeveloped power are based on minimum stream flow, while estimates of developed horsepower, including those given in the United States census reports, are the combined capacity of the plants. The error in comparing such figures is apparent. For instance, the McCall's Ferry hydro-electric plant on the Susquehanna River has an installed capacity of 108,000 hp., while the capacity of this site based upon minimum stream flow is only about 15,000 hp. It will be found in most instances that figures given for the maximum development of a power site are more comparable with figures for developed water powers than are those for low-water possibilities. With the incomplete data available any estimate of this nature cannot be regarded as accurate and should be used with discrimination and always with the understanding that the figures are rough approximations.

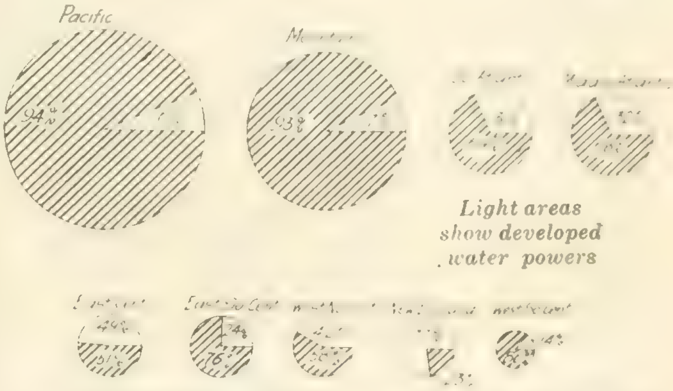


FIG. 3—POTENTIAL, DEVELOPED AND UNDEVELOPED WATER POWERS OF THE UNITED STATES BY SECTIONS

An attempt has been made to estimate the probable energy market in 1930 which cannot be accommodated by the present installed capacity of the electrical generating plants of the country. In making this estimate it has been considered that the demand may take the form of (1) more energy needed to supply the present industries using electricity as a prime mover, (2) a demand for energy by an entirely new industry, or (3) the replacing of present forms of prime movers by electric drive. The present ratio between the value of manufactures (which is a measure of the industrial power demand) and the total installed horse power of generating plants of all kinds is indicated by Fig. 2. A comparison of this map with Fig. 1 will indicate the present probable high or low energy market calling for increased hydro-electric or steam installation in each state.

The figures in the last column of the table on page 658 give the additional installations which it is believed must be installed in the next ten years to supply properly the market for electrical energy in 1930. In making this estimate the 1914 census of manufactures and primary power used in manufacturing establishments has been used as a basis. To obtain the total installed generator rating in 1914 a study has been made of the central-station installation as given in the 1914 edition of the "McGraw Central Station Directory and Data Book," and the results have been used in connection with

Potential, Developed and Undeveloped Water Powers of United States, and Estimate of Increased Generator Installation Required in Next Ten Years

State	Commissioner of Corporations Estimate of 1912				U. S. Forest Service Estimate of 1912				U. S. Geological Survey Estimate of 1915			"Electrical World" Estimate, January 1, 1920					
	Potential		Developed		Potential		Developed		Potential	Developed		Potential	Developed		Undeveloped	Growth	
	Minimum	Maximum	Horsepower	Per Cent of Maximum	Minimum	Maximum	Horsepower	Per Cent of Maximum	Maximum	Horsepower	Per Cent of Maximum	Maximum	Horsepower	Per Cent of Maximum	Maximum	Hp Required in 1930 in Excess of Present Station Ratings	% of Total Station Ratings
New England States	1,042,000	1,925,000	631,165	33.0	868,000	1,605,000	1,059,810	66.2	1,921,000	1,441,000	75.0	1,951,000	1,506,500	77.2	444,500	1,113,000	23.7
Atlantic States	4,441,000	8,092,000	1,392,083	17.2	3,703,000	6,745,000	1,721,696	25.5	10,922,000	3,019,000	27.7	9,348,000	2,952,850	31.6	6,395,150	5,633,000	47.8
Central States	3,805,000	7,612,000	816,823	10.7	3,174,000	6,346,000	836,909	13.2	7,797,000	1,589,000	20.4	7,360,000	2,699,200	36.7	4,660,800	6,067,000	42.1
Mountain States	8,991,000	16,356,000	344,000	2.1	8,694,000	16,131,000	359,884	2.2	17,100,000	800,000	4.7	14,851,000	1,113,990	7.5	13,737,010	70,000	3.7
Pacific States	13,804,000	27,693,000	831,754	3.0	11,504,000	23,078,000	888,810	3.9	25,750,000	1,760,000	6.8	25,850,000	1,551,000	6.6	24,299,000	470,000	19.0
Total United States	32,083,000	61,678,000	4,016,127	6.5	27,943,000	53,905,000	4,867,109	9.1	63,490,000	8,609,000	12.7	59,360,000	9,823,540	16.6	49,536,460	13,353,000	37.9
Alabama	611,000	1,132,000	16,450	1.5	509,000	943,000	26,446	2.8	1,130,000	170,000	15.1	943,000	180,000	19.1	763,000	67,000	15.5
Arizona	1,071,000	2,038,000	16,200	0.8	893,000	1,698,000	9,346	0.6	2,000,000	34,000	1.7	1,698,000	67,600	4.0	1,630,400	55,000	40.4
Arkansas	26,000	73,000			22,000	61,000	3,768	6.2	75,000	12,000	16.0	75,000	13,400	17.9	61,600	7,000	5.0
California	4,109,000	9,382,000	435,467	4.6	3,424,000	7,818,000	440,243	5.6	9,250,000	910,000	9.8	9,250,000	942,000	10.2	8,308,000	314,000	19.7
Colorado	1,010,000	2,036,000	69,690	3.4	842,000	1,697,000	83,230	4.9	2,000,000	190,000	9.5	1,850,000	238,000	12.8	1,612,000		
Connecticut	86,000	164,000	47,519	28.9	72,000	137,000	98,544	71.8	165,000	130,000	78.8	165,000	161,800	97.7	3,200	26,000	2.1
Delaware	6,000	13,000			5,000	11,000	5,970	54.3	13,000	9,000	69.3	13,000	9,000	69.3	4,000	28,000	46.7
District of Columbia	6,000	13,000			4,920	10,530	1,000	9.5	13,000	1,000	7.7	13,000	1,000	7.7	12,000	12,000	8.6
Florida	9,000	16,000	5,000	31.3	8,000	13,000	7,303	56.2	16,000	16,000	100.0	16,000	16,000	100.0			
Georgia	449,000	752,000	139,277	18.5	374,000	627,000	111,501	17.7	750,000	250,000	33.4	750,000	420,000	56.0	330,000	95,000	13.7
Idaho	1,394,000	3,080,000	52,100	1.7	2,362,000	5,067,000	55,054	1.1	6,000,000	160,000	2.7	6,110,000	89,400	1.5	6,020,600		
Illinois	230,000	414,000	51,211	12.4	192,000	345,000	53,850	15.6	410,000	110,000	26.9	410,000	191,000	46.7	219,000	1,302,000	41.2
Indiana	52,000	141,000	14,675	10.4	43,000	118,000	30,733	26.1	140,000	38,000	27.2	140,000	183,000	130.0		558,000	46.3
Iowa	192,000	458,000	151,400	33.0	160,000	382,000	13,368	3.5	450,000	23,000	5.6	450,000	423,000	94.2	27,000	78,000	10.4
Kansas	133,000	323,000	6,800	2.1	111,000	269,000	17,223	6.4	320,000	21,000	6.6	320,000	105,000	32.8	215,000	7,000	1.1
Kentucky	99,000	236,00	.		83,000	197,000	5,841	3.0	250,000	15,000	6.0	250,000	61,400	24.6	188,600	62,000	16.8
Louisiana	1,000	2,000			1,000	2,000			2,000	1,000	50.0	2,000	1,000	50.0	1,000	94,000	25.4
Maine	532,000	971,000	233,698	24.0	443,000	809,000	387,073	47.8	970,000	520,000	53.7	1,000,000	780,000	78.0	220,000		
Maryland	51,000	146,000	5,376	3.7	43,080	122,470	12,651	10.4	145,000	27,000	18.6	145,000	5,500	3.8	139,500	308,000	110.0
Massachusetts	142,000	273,000	130,619	47.8	118,000	228,000	214,558	93.8	275,000	280,000	102.0	275,000	268,000	97.5	7,000	900,000	54.2
Michigan	216,000	352,000	133,102	37.9	180,000	293,000	178,079	60.8	350,000	310,000	88.7	350,000	357,000	102.0		1,535,000	127.0
Minnesota	278,000	593,000	168,015	28.3	232,000	494,000	174,537	35.4	600,000	220,000	36.7	600,000	233,000	38.8	367,000	261,000	43.2
Mississippi	38,000	75,000			32,000	63,000	335	0.5	75,000	8,000	10.7	75,000	10,600	14.1	64,400	6,000	5.9
Missouri	86,000	195,000	1,344	0.7	72,000	163,000	5,647	3.5	200,000	10,000	5.0	200,000	39,500	19.8	160,500	49,000	6.9
Montana	3,299,000	5,197,000	139,260	0.3	2,749,000	4,331,000	119,300	2.8	4,500,000	250,000	5.6	4,250,000	395,000	9.4	3,855,000		
Nebraska	235,000	439,000			196,000	366,000	13,449	3.7	430,000	19,000	4.4	280,000	65,200	23.3	214,800		...
Nevada	206,000	331,000	14,200	4.3	172,000	276,000	12,709	4.5	250,000	33,000	13.2	250,000	55,500	22.2	194,500	4,000	6.4
New Hampshire	162,000	295,000	120,108	40.7	135,000	246,000	203,772	82.7	295,000	280,000	95.0	295,000	76,000	25.8	219,000	94,000	42.0
New Jersey	53,000	127,000	7,200	5.7	44,000	106,000	22,132	20.9	125,000	40,000	32.0	125,000	44,830	35.8	80,170	1,052,000	50.3
New Mexico	192,000	527,000			160,000	439,000	864	0.2	300,000	3,000	1.0	320,000	650	0.2	319,350		
New York	1,244,000	2,037,000	713,371	35.1	1,037,000	1,698,000	896,229	52.8	4,500,000	1,320,000	29.4	2,926,000	981,520	33.5	1,944,480	2,410,000	83.4
North Carolina	693,000	1,050,000	97,010	9.2	578,000	875,000	110,203	12.6	1,000,000	280,000	28.0	1,000,000	316,000	31.6	684,000	219,000	50.0
North Dakota	105,000	248,000			88,000	207,000	655	0.3	250,000	1,000	0.4	150,000	1,000	0.7	149,000	10,000	25.0
Ohio	71,000	213,000	4,025	1.9	59,000	178,000	25,572	14.3	215,000	51,000	23.7	215,000	200,000	93.0	15,000	1,150,000	85.8
Oklahoma	90,000	250,000			75,000	208,000	2,825	1.3	250,000	8,000	3.2	250,000	25,700	10.3	224,300	290,000	123.0
Oregon	3,777,000	7,935,000	95,777	1.2	3,148,000	6,613,000	168,807	2.6	7,000,000	280,000	4.0	7,100,000	248,000	3.5	6,852,000	54,000	13.7
Pennsylvania	331,000	821,000	169,632	20.6	276,000	684,000	190,956	27.5	1,250,000	500,000	40.0	1,250,000	359,000	28.7	891,000	1,334,000	41.2
Rhode Island	7,000	16,000	5,376	33.6	6,000	13,000	35,169	270.0	16,000	41,000	256.5	16,000	12,700	79.5	3,300	93,000	26.7
South Carolina	552,000	812,000	182,497	22.5	460,000	677,000	221,492	32.6	810,000	310,000	38.3	810,000	459,000	56.7	351,000	36,000	6.4
South Dakota	51,000	90,000	5,000	5.6	43,000	75,000	7,774	10.4	90,000	21,000	23.4	90,000	11,900	13.2	78,100		...
Tennessee	555,000	913,000	62,000	6.8	463,000	761,000	37,396	4.9	910,000	150,000	16.5	910,000	286,000	31.4	624,000	46,000	7.9
Texas	306,000	661,000	...		255,000	551,000	5,156	0.9	500,000	11,000	2.2	500,000	74,500	14.9	425,500	235,000	19.1
Utah	892,000	1,581,000	52,700	3.3	743,000	1,318,000	77,532	5.9	1,250,000	125,000	10.0	1,320,000	263,000	19.9	1,057,000	12,000	3.1
Vermont	113,000	206,000	93,845	45.6	94,000	172,000	120,684	70.2	200,000	190,000	95.0	200,000	208,000	104.0			.....
Virginia	590,000	1,044,000	51,320	4.9	492,000	870,000	123,079	14.1	1,040,000	210,000	20.2	1,040,000	201,000	19.5	839,000	77,000	8.1
Washington	5,918,000	10,376,000	300,510	2.9	4,932,000	8,647,000	279,760	3.2	9,500,000	570,000	6.0	9,500,000	361,000	3.8	9,139,000	102,000	21.3
West Virginia	457,000	1,261,000	21,400	1.7	381,000	1,051,000	19,181	1.8	1,260,000	30,000	2.4	1,260,000	140,000	11.1	1,120,000	73,000	18.2
Wisconsin	430,000	804,000	202,952	25.3	358,000	670,000	234,255	35.0	1,150,000	390,000	33.9	1,150,000	237,000	20.8	913,000	298,000	34.9
Wyoming	927,000	1,566,000	...		773,000	1,305,000	1,849	0.1	800,000	5,000	0.6	750,000	4,840	0.6	745,160		.....

the Stabler waterwheel estimate of isolated plants in 1914. The total rating of central-station generators installed in 1914 was 9,380,000 hp., of which 3,120,000 hp., or 33.3 per cent, was waterwheels. The Stabler estimate of the total installation of waterwheels in isolated plants in 1914 was 3,730,000 hp. Assuming that the same relation will hold in isolated plants as in central stations between total installation and waterwheels, it is found that the total electrical installation of isolated plants was 11,200,000 hp. The 1914 census states that 3,917,655 hp. of generator rating in central stations was employed for industrial service; therefore the manufacturing establishments of the country called for a total generator rating in 1914 of 15,117,655 hp. The value of manufactured products in the United States in 1914 was $24,246,000,000; therefore the value of manufactured products per installed horsepower of generators was $1,602. The value of manufactured products in 1930 was computed for each state, based on the 1914 census, assuming that the rate of increase for each five years between 1914 and 1930 will be the same as between 1909 and 1914. Dividing these quantities by 1,602, the value of manufactured products per installed generating horsepower, gives the total installed generator rating which will be required in 1930 in each state. Subtracting from these computed state totals for 1930 the estimated state totals of 1920 gives the increase in generator rating (in horsepower) required between 1920 and 1930 to supply the increased energy market. This estimate indicates the increased generator rating required for manufacturing plants only and does not include that needed to supply energy for illuminating and electric railway purposes.

TABLE II—DEVELOPMENTS CONTEMPLATED ON NAVIGABLE STREAMS

State	River	Horsepower To Be Developed	State	River	Horsepower To Be Developed
Washington	Columbia	410,000	Tennessee...	Clinch	25,000
Washington	Pend Oreille	250,000	Alabama	Coosa	180,000
Montana...	Missouri	100,000	Kentucky	Cumberland....	26,000
Minnesota ..	St. Croix	30,000	Georgia......	Flint	20,000
Iowa ...	Des Moines .	60,000	N. Carolina..	Little Tenn....	200,000
Maryland..	Susquehanna	110,000			
Mass.-Conn	Connecticut	30,000	Virginia.....	New	20,000
Georgia.....	Chattahoochee	138,000	Virginia.....	Roanoke .	35,000
Alabama....	Tennessee	410,000	S. C.-Ga.	Savannah . . .	78,000
Total .					2,122,000

LACK OF WATER-POWER LEGISLATION A SERIOUS HANDICAP

The correctness of the assumed increases in manufactures will depend to a large extent on the money market of the next two or three years. The present scarcity of money and the high returns demanded by the investing public perhaps make the assumption questionable at this time, but it is believed that industrial and financial conditions will improve sufficiently during the next ten years to warrant it for that period. The proportion of this electrical energy market which will be supplied by hydro-electric plants is, of course, problematical, but the passage of water-power legislation by Congress and helpful state legislation will do much toward increasing this proportion.

The result of lack of proper legislation has been to hold back hydro-electric development on navigable streams. To show the extent to which such development has been retarded because of restrictive laws it is merely necessary to cite a list of developments contemplated on navigable streams alone, not including the boundary streams.

It is estimated that, in addition to that shown in Table 2, the development of more than 2,000,000 hp. would be undertaken upon non-navigable streams in California, Idaho, Oregon, Nevada, Montana, Utah, Colorado and Arkansas.

SURFACE WATERS CONTROL FUTURE OF AMERICAN INDUSTRY

The future of American industry is to a large extent bound up in the surface waters of the nation. Still, as shown by this survey, the inexhaustible "white-coal" supply which exists in every state in the Union, is now being brought into service for the convenience of humanity only to a small extent. While water power can supply only 10 per cent of the demand in the East, it is unfortunate that conditions have not been considered favorable to greater water-power development since operation of steam plants not only involves the uncertain labor factor and the difficulties of obtaining the necessary fuel supply, but, in addition, the fuel supply is becoming exhausted and must be conserved more and more as time passes. Nature has provided a source of mechanical energy which is inexhaustible and which is independent of the industrial eruptions which periodically take place throughout the country. The restrictive laws are being removed by Congress, and new energy markets are being created daily. The total estimate of the increased electrical energy market by 1930 is believed to be conservative. Whether a large proportion of this future market will be supplied by hydro-electric energy will depend to a very large extent on the regulations adopted by the federal and state governments, as well as on the general interest taken in this branch of the electrical industry by the investing public.

Comparative Economy of Oil-Burning Equipment

THE relative economy of coal and oil-burning equipment depends greatly upon the cost and availability of the two fuels. For the determination of the comparative economy a simple formula has been stated which says that when the cost of oil in cents per gallon is one-half the cost of coal in dollars per long ton the cost of generating a given amount of power is about the same for the two kinds of fuel. This does not take into account the differences in labor in the two cases, which will be more favorable to oil. With this rule it is assumed that oil has 18,600 B.t.u. per pound and the coal contains 14,300 B.t.u. per pound.

Where the load factor is low, oil will undoubtedly be preferable as a fuel to coal, provided that the supply of oil is adequate. On the other hand, where the power factor is high the use of coal is most likely to be more economical. While it is very difficult to assign fixed values to such comparisons, a load factor of about 50 per cent seems to be the dividing line above which coal will probably show an advantage, and below which oil will probably be preferable from the economic standpoint.

According to the statements made by E. H. Peabody of the Babcock & Wilcox Company before a recent meeting, it has been found from experience that the best method of atomizing fuel oil is with steam, which method is the most economical.

AEROPLANE VIEW OF NIAGARA RIVER AT THE FALLS

From Niagara River only 26 per cent of the total flow is diverted for generating electricity. Sixty per cent might be diverted without marring the scenic beauty of the falls. There is practically no variation in the flow of this river throughout the year, making it ideal for hydro-electric development. Millions of horsepower are now going to waste here merely to satisfy sentiment. A treaty with Great Britain limits the amount that can be developed now

Power Development at Niagara Falls

Economic Importance of Niagara Falls in the Development of the Electro-Chemical Industries of New York State — Views of Morris Cohn, Jr., and John L. Harper of the Niagara Falls Power Company

TO SPEAK of water power in connection with the industries of New York State—particularly those of the western tier of countries—is to bring to mind instantly Niagara Falls, with its great present and far greater future part in hydro-electric development. No men probably are more competent to tell just what this means to the state and the nation than Morris Cohn, Jr., vice-president and general counsel, and John L. Harper, vice-president and chief engineer, of the Niagara Falls Power Company. In discussing the power situation on the Niagara frontier, Mr. Cohn said, recently:

"From 1850 until the last few years water-powers were more or less discredited. The invention and development of the steam engine, the enormous supplies of cheap coal, the disinclination of manufacturers to be influenced in their location by the question of power alone, made water powers of much less value and importance than they are now. Moreover, the difference in cost between electric energy produced from coal in large units and stations under favorable conditions and the cost of hydro-electric energy was not enormous until very recent years. The location of an ordinary manufacturing plant today is seldom controlled by the cost of power alone. Accessibility of raw materials, labor markets, transportation facilities and other factors determine the site of most industries. At Niagara Falls it was the rise of the electrochemical industries of the United States that gave a measure of early success to the power development, or perhaps, rather, the cheap power at Niagara Falls gave rise to the electrochemical industries of the United States, making that point the electrochemical center of America and probably of the world.

EARLY OPPOSITION TO USE OF FALLS

"A great many years ago, when water power was a drug on the market, the Hydraulic Power Company sought the consent of the city of Buffalo to enable it to deliver hydro-electric power in that city. The application was not favorably acted upon, and the owners of the hydraulic property for many years worked diligently to procure customers for its power nearer home. About the year 1902 a commission was appointed by the federal government to investigate the desirability of prohibiting further diversions of water from the Niagara River for power use. Niagara Falls had no representative upon that commission, but one of the most distinguished citizens of Buffalo was a member of it and reported in favor of a limitation of the diversion of water for power purposes here to an amount of less than 20,000 cu.ft. per second. That he and the other members of the commission sincerely believed, as did the Congress at that time, that the preservation of the scenic grandeur of Niagara Falls required this limitation is undoubtedly true. We, at Niagara Falls, did not then believe and do not now believe that such limitation of diversion is necessary, and we believe that far greater benefits will come to humanity from the lifting of this limit than can come from its continuance.

"I am heart and soul for a greater hydro-electric development at Niagara Falls. At least double the amount of water now being used could be diverted here for power purposes without injury to the navigability of the lake or river and without injury to the scenic grandeur of Niagara, provided that suitable remedial works were constructed to regulate the flow of the water. One million horsepower additional ought to be available on the American side of the Niagara River in the next twenty years. I am sure that the development from such additional diversion would be of great value to our nation. Indeed, so highly is Niagara regarded industrially that there are some who declare a belief that had Germany possessed Niagara Falls and the Allies had no equivalent source of energy, the result of the war might have been different.

"From about 1896 to 1915 substantially all of the electric energy distributed in Buffalo was hydro-electric energy from Niagara Falls. Wise men in Buffalo, like C. R. Huntley and Mr. Urban of the Buffalo General Electric Company, long before 1915 saw what was coming. Effort after effort was made at Washington to allow the limit of diversion to be increased, but at every hearing and on every occasion some one professing to represent the city of Buffalo put his foot in the door and prevented favorable action.

"Hopeless of any relief in this direction, the officers of the Buffalo General Electric Company, with foresight and courage and real patriotism which must always be to their credit, raised millions of dollars and entered upon the construction of its wonderful steam-electric plant in Buffalo. I hope that some time the people of Buffalo will recognize the debt of gratitude they owe the Buffalo General Electric Company for building this steam plant, which certainly saved Buffalo from an industrial collapse during the period of the war. Still, the Buffalo company now receives approximately 70,000 hp. from the hydro-electric developments on both sides of the Niagara River, and I think I am safe in saying that its charge per kilowatt-hour for hydro-electric power is far less than the rate at which the tax-free Hydro-Electric Commission of Ontario delivers electric energy at the city of Toronto."

SIXTY PER CENT OF FLOW CAN BE SAFELY DIVERTED, SAYS MR. HARPER

In a recent address before the American Electrochemical Society at Buffalo, John L. Harper, chief engineer of the Niagara Falls Power Company, who has been largely responsible for the present power development at Niagara Falls, among other things said: "Water powers may be divided into two general classes —those in which the rate of development may be controlled by full or partial water storage and those in which no storage is possible. To the latter class belongs Niagara Falls. The ideal load for this second class of water powers is electrochemical and metallurgical processes where the use factor is large and where the cost of power entering into the process is large compared with the cost of labor. Such is the character of 95 per cent of the industries that the company serves at Niagara Falls, established right at the source of power. For the future development of these industries the supply of electric energy is of grave importance. With the present flow of Niagara Falls of 210,000 second-ft. it has been shown that 60 per cent could be diverted for power purposes without marring the beauty of the falls. To secure this diversion we have worked out a plan for placing concrete booms in the upper river so as to divert the water from the channel and spread it over the falls to cover completely the rocks that now show through at the edges because of the corrosion and wearing away of the channel at the middle of the falls. By the diversion of 60 per cent of the river flow there would be available 3,600,000 hp., and the remaining 40 per cent under the conditions stated would not only discharge ice during winter but improve the scenic beauty during summer."

In May, 1918, the United States government authorized the extension of the hydraulic plant of the Niagara Falls Power Company, and nineteen months later the first of three 37,500-hp. units was placed in operation. To appreciate more fully the small element of time consumed in this construction it is necessary to resort to comparison with earlier power-plant construction. In 1886 authority for power development was granted the Niagara Falls Power Company. Col. C. B. Gaskill, Thomas Evershed and William B. Rankine bore the great burden of organizing and planning the project, while its financing fell upon the shoulders of Edward D. Adams and Francis Lynde Stetson. It was not until October, 1890, that actual construction work was begun. It was five years lacking a few weeks before the first electricity was delivered, in August, 1895. A year later the first electricity was transmitted to Buffalo.

The hydraulic plant of the Niagara Falls company has been built, extended and operated for the last forty-six years almost exclusively by members of the Schoellkopf family, the third generation of which now furnishes the president of the consolidated company in the person of Paul A. Schoellkopf.

TOTAL CAPACITY OF NIAGARA FALLS COMPANY'S PLANTS

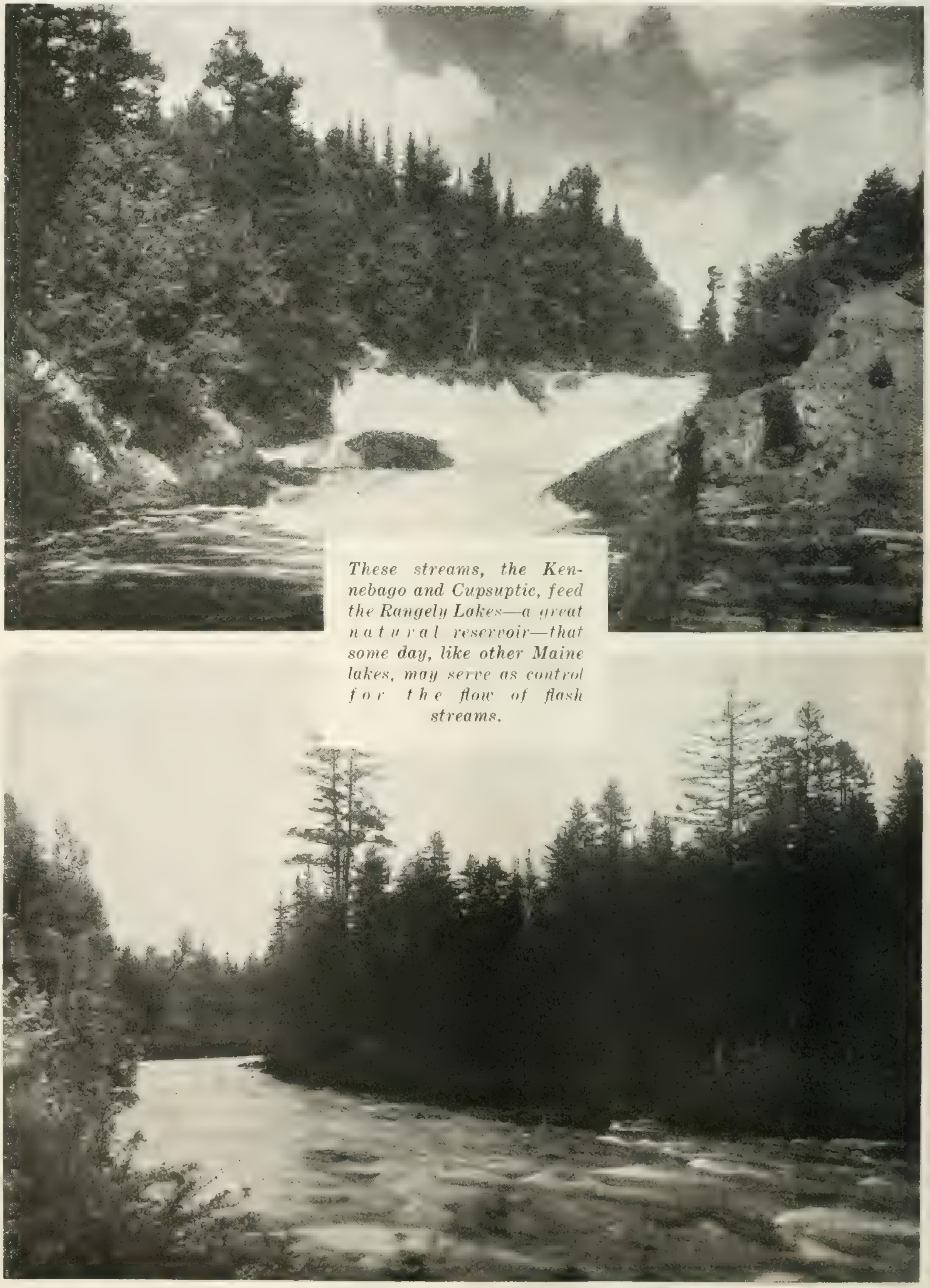
The following table shows the installed capacity of the plants now operated by the Niagara Falls company:

	Rating in Hp.
Niagara No. 1	55,000
Niagara No. 2	61,500
Hydraulic No. 2	26,500
Hydraulic No. 3	242,500
Canadian Niagara	112,500
Total	498,000

In hydraulic plant No. 3 three new generators, each rated at 37,500 hp., were placed in operation during December, 1919, and January of this year. On this new extension about $8,000,000 was expended in carrying into effect the river channel deepening, hydraulic canal deepening, lower basin enlargement, construction of the new forebay, the three large penstocks driven through solid rock from top to bottom of the high embankment, and the construction and equipment of the power-house addition. An efficiency of about 22 hp. per cubic foot of diversion is obtained by the large new units, and 93 per cent efficiency of the water will be obtained, as against 10 per cent obtainable in power from coal.

The plans of the Niagara Falls Power Company propose further construction to the extent of probably six more units of 32,500 kva. rating. This is intended for the purpose of redeveloping the water now diverted by the plant of the company on the upper Niagara River. This work will not, however, be started until after the water-power bill now before Congress becomes a law and the commission authorized thereunder has sanctioned it.

Two Sources of Potential Power in New England



These streams, the Kennebago and Cupsuptic, feed the Rangely Lakes—a great natural reservoir—that some day, like other Maine lakes, may serve as control for the flow of flash streams.

Pond-Level Control for Hydro Plants

Relative Advantages and Disadvantages of Eleven Methods in Use—Value of Installing Automatic Gates Calculated for a Specific Plant—Methods of Making Gates Dependable

By **EARL STAFFORD**
Engineer with John F. Vaughan Engineers, Boston

ONE of the most neglected features of water-power development is control of pond level to secure maximum head at all times of the year. The larger public utility developments are more careful in this respect, but smaller ones and private plants built for supplying power to mills often waste a great deal of power as a result of insufficient preliminary study before constructing the plant or as the result of careless operation.

Riparian rights and back-water conditions causing interference with plants in most cases determine maximum pond levels. Ordinarily the height of the dam is fixed to give sufficient depth of flood water on its top for passing the maximum flow of the river without exceeding the allowable pond elevation. This depth depends upon spillway length, but is rarely less than 6 ft. (1.8 m.), and is often two or three times as much. Head lost during the greater part of the year in such instances on the medium and low-head plants most common in New England amounts to from 5 to 15 per cent. During dry parts of the year removable flashboards which are used add only a few feet of head. Moreover, boards are often washed away by occasional small floods, causing waste of material and additional labor for replacement. Usually a week is lost before the water is again raised to the top of new boards. Where plant operation calls for drawing the pond to absorb night flows, there is a more or less constant labor charge for keeping boards tight; conversely in many instances water is wasted.

ELEVEN METHODS OF CONTROL CONSIDERED

Several devices have been developed for installation on top of the dam for keeping the pond level always at or near the maximum allowable. Most of them depend upon human control. They must be opened and closed according to the volume of water flowing. Sudden floods coming at night before gates can be opened would result in considerable damage, often with loss of life. The following list covers the more important devices used to regulate pond levels and provide discharge capacity for floods: Pin flashboards, hinged flashboards, needles, submerged sluices, chanonine wickets, vertical gates between piers—sliding type, Stoney type, tainter gates, swinging gates hinged horizontally—bear traps, rolling gates, and automatic swinging leaf gates.

Flashboards supported by pins or horses may be used to increase the head from 1 ft. to 6 ft. (0.3 m. to 1.8 m.) intermittently. In most cases their use requires considerable labor and material maintenance charge. Except for large storage areas with small fluctuations in elevation, the use of flashboards generally gives less head than can be obtained by control gates.

Hinged flashboards pivoted about the lower edge and supported by an inclined prop are not new, but their construction and operation have lately been brought to a more refined state of development. They are working successfully on large rivers where frequent floods, log driving and severe ice conditions make the pin type of board unsatisfactory. In one case they have withstood treatment so rough that ash planking with grain running vertically was used to eliminate the splintering caused by floating objects striking crossways to the grain. A button fastened to a cable on the downstream side of the top of the dam, when pulled along, trips the prop of each section successively. When properly built the sections drop down without breaking, regardless of whether water is going over the tops. They are made about 4 ft. (1.2 m.) wide and have been built to stand 4 ft. high with 2 ft. (0.6 m.) overtopping. When down they may be raised by hand after the water has dropped to within a foot of the level of the hinge by standing behind the section already raised and working successively along the crest. Men working from a cableway have no special difficulty in reaching down through several feet of water to fasten a hook which pulls the section up sufficiently to allow the prop to drop in place.

NEEDLES, SUBMERGED SLUICEGATES AND CHANONINE WICKETS

Needles or vertical stop planks require a bridge across the top of the dam. Their use is restricted and few dams are equipped with them today. Maintenance and operating costs are relatively high.

Submerged sluicegates have in some instances given satisfaction when used for flood control. In the majority of cases, however, there is trouble, either from gates and gate mechanism jamming or gate openings clogging with débris, or erosion of masonry downstream by scour of the water at high velocity. The difficulty of repairs makes their use undesirable.

Chanonine wickets and similar devices consist of a hinged leaf held nearly vertical by braces or props which are tripped automatically by the pressure when the water level gets too high, allowing the leaf to fold down flat. They are subject to being put out of order by débris or by cold weather and are not in common use.

GATES THAT SWING OR SLIDE VERTICALLY

Vertical gates sliding up and down between piers require expensive hoisting mechanisms. Ice forming in the gate grooves and along the top edge makes it very difficult to open them in the winter. The Stoney type runs on a roller nest which reduces friction to a point where the gate hoist is considerably lightened. Such gates have had wide use on many important dams, even in very cold climates. Steam-heating coils around the gate grooves and inside the gate (of hollow-steel construction) have been partly successful in eliminating ice troubles. In many instances other types will accomplish the work of these gates at less cost.

Tainter gates consist of a cylindrical face which swings up out of the water about a pivot. Like vertical gates they require division walls or piers at intervals along the top of the dam. These gates are made of steel or wood and work out more economically than sliding gates. As there are no gate grooves at the pier face, the chopping out of ice for opening is much easier. Steam heating has been used with success. Instances where tainter gates have not worked out well are the result of faulty design. The tendency often has been to make gates of too light a construction, and they have been broken by ice or floods which overtopped them.

Swinging gates hinged about the lower edge are raised by cables or chains extending from the top edge to hoists on a bridge spanning the piers between which the gates work. Since the hoist cables must carry from one-half to one-third of the total water pressure, the hoisting mechanism is heavy and expensive. Gate movement, as in the case of tainters, is dependent upon human control. Except for this and the heavy hoists, these gates have the advantageous features of the automatic type described later.

Bear traps are inverted "V"-shaped structures made by two flat leaves hinged horizontally, one at the up-stream and one at the downstream side of the top surface of the dam, their top edges meeting and hinged by sliding links. A continuous surface on the up-stream and down-stream sides is formed. Movement up and down to suit the pond elevation desired is by changing the angle of the "V." When arranged so that the movement is caused by water pressure from the pond, admitted to the hollow space under the "V," hoists are eliminated and the gates are relatively simple mechanically. While subject to ice troubles, they are working successfully on many dams. They are usually placed on dams at the outlet of storage reservoirs and are kept from being frozen in by allowing a stream of the relatively warm pond water to flow through them. Large gates of this type are costly.

Rolling gates are a type of automatic gates little used in this country, though there is one large installation in the West. Many of all sizes are in use in Switzerland. The moving part consists of a large hollow-steel cylinder of a diameter equal to the depth of water to be controlled. When it is desired to pass a flood, the gate rolls up on a track at the abutment piers and allows the water to flow beneath. First cost is one of the chief reasons why other types have been used instead.

SWINGING-LEAF GATES HAVE DESIRABLE FEATURES

Swinging-leaf automatic gates are the latest development, and their reliability and simplicity should appeal to all when their value becomes known. They consist of a swinging leaf, hinged horizontally at the top of the permanent part of the dam, which through a system of balancing levers and counterweights allows the gate to swing up or down and discharge water over the top edge according to the volume of water flowing. The pond level meanwhile will vary only a few inches, regardless of whether the flow of the river is at maximum flood or minimum low. The sloping upstream face and curved top edge are favorable to the passing of large ice cakes, logs or débris. When such objects strike the gate they push it down and slide over the top. This type of gate has been used successfully under the most severe winter conditions. Since there are no grooves or pockets or sliding parts, possibility of ice trouble is practically eliminated. Sizes as used in this country range from 7 ft. high by 46 ft. long (2.1 m. x 14 m.) to 10½ ft. high by 64 ft. long (3.2 m. x 19.5 m.). The design of such gates may be adapted to larger or smaller sizes according to the demand. First cost is no greater than for any other non-automatic gate for the same purpose and is very small when compared with power gained over that from using flashboards. It is only a question of time before they will come into common use. Development in Europe and successful demonstration of the reliability of these gates has taken place in the last few years, during which there has been little water-power work done. Designers of new plants that will be built with the coming activity should carefully consider this type of control gate.

ACTUAL VALUES OF AUTOMATIC GATES

The following hypothetical case showing the value of the automatic gates just described is based upon an actual plant for which studies of development have been made:

Maximum allowable pond level during spring and fall floods 6 ft. over top of dam, during remainder of the year 3 ft.	
Head as developed at present (ft.)	20
Possible to add by providing discharge capacity for small floods (ft.)	3
(Flashboards not suitable here because floods from ordinary rains would cause the water to flow over their tops several feet deep before washing them away, causing damage to crops along the banks.)	
Spillway length (ft.)	250
Normal rated capacity of plant at 20-ft. head (kw.)	500
Maximum continuous rated capacity at 23-ft. head (kw.)	615
Annual load factor (per cent)	50

Ten per cent of the year flood flow causes rise in headwater and tailwater levels so that average head on plant is but 20 ft. (6 m.) and it cannot be increased by any control device on dam.

Fifteen per cent of the year the flow is equal to or greater than plant can use, and without any control device on dam the average head on plant is 20 ft., but with automatic control it varies with tailwater level and averages about 22 ft. (6.7 m.).

Twenty-five per cent of the year the flow is about equal to plant demands and with automatic control the average head is increased to 24 ft. (7 m.).

Fifty per cent of the year the average flow is about equal to one-half normal rated plant capacity, or 250 kw. continuous at 20-ft. head and with automatic control the head is increased to 23 ft. and the same average flow is equal to 287 kw. continuously.

TABLE I—VALUE OF INSTALLING AUTOMATIC GATES FOR SPECIFIC PLANT

Comparative Head and Outputs:

	As At Present		With Automatic Control Gates	
Per Cent of Time	Head (Ft.)	Output (Kw.-hr.)	Head (Ft.)	Output (Kw.-hr.)
10	20	220,000	20	220,000
15	20	330,000	22	380,000
25	20	550,000	23	630,000
50	20	550,000	23	630,000
Total annual kw.-hr.		1,650,000		1,860,000

Kw.-hr. added by using automatic control	210,000
Value at prevailing rate of 1.3 cents with coal clause, coal at present price: 1.7 cents × 210,000	$3,570
Condition as at Present:	
Flow causing rise of 3 ft. over top of dam (c.f.s.)	5,000
Maximum fllow during spring floods (c.f.s.)	12,000
Depth over dam at flood stage (ft.)	6
New Arrangement Maintaining Same High-Water Condition:	
With water 3 ft. above top of present dam, two gates, 40 ft. x 7 ft discharge (c.f.s.)	5,000
With water 6 ft. above top of present dam, two gates, 40 ft. x 7 ft. deep discharge (c.f.s.)	9,000
Remainder of spillway, 165 ft. long built up permanently, 3 ft. with 3 ft. of water over top (c.f.s.)	3,000
Total	12,000
Cost of permanent wooden flashboards on part of dam 165 ft. long, 3 ft. high	$500.00
Cost of two gates, 40 ft. x 7 ft. each	5,600.00
Engineering and miscellaneous	1,900.00
Total	$8,000.00

Result:

Annual increased income of $3,570 is nearly 50 per cent of first cost, and with the exception of about 15 per cent of the year, when flood conditions reduce the head, 23 per cent is added to the capacity for peaks and emergencies. On a more flashy stream, where more free board is recoverable, automatic gates would be of even greater value.

TABLE II—AVERAGE INCREASE IN CAPACITY AND OUTPUT THAT MAY BE OBTAINED BY THE INSTALLATION OF AUTOMATIC GATES (LOAD FACTORS TAKEN AS 50 PER CENT)

Head (Ft.)	Average Freeboard Allowed (Ft.)	Recoverable Under Average Conditions (Ft.)	New Head (Ft.)	Capacity Added to Waterwheel, Per Cent	Annual Output Added, Per Cent
8	4 to 6	3	11	60	30
10	4 to 6	3	13	47	25
12	4 to 6	4	16	54	25
14	4 to 6	4	18	45	25
16	5 to 7	4	20	40	25
18	5 to 7	5	23	45	25
20	6 to 8	5	25	40	20
25	6 to 8	6	31	38	20
30	6 to 8	6	36	31	15

Automatic gates can be installed more economically on new developments where the layout is planned for their use, but there are a great many cases where they can be placed on old dams with very little extra expense. They work out best when added to short spillways on small or medium-size rivers. The head that is recoverable is comparatively large and the gates may be placed over the entire length of spillway. Additional construction involved in any case consists mainly of concrete piers, 30 ft. to 40 ft. (9 m. to 12 m.) apart, and changes at the crest of the dam for attaching the gate. By making deep gates it is unnecessary to extend them entirely across the spillway; the remaining part may then be permanently built up with wood or concrete to new pond level.

When plants are tied in with public utility systems under an arrangement for exchange of power, the load factor is usually high, sometimes to the point of requiring all the power available except in the rainy season. Automatic gates for such plants may be extremely valuable. For instance, in the hypothetical case cited above the annual income would be almost doubled (equal to the first cost of the gate) if the plant were tied into a system requiring twenty-four-hour load.

OPERATING PROBLEMS AND SOLUTIONS

The chief objection to gates for providing flood discharges is that they are not infallible. No risks can be taken that may allow unexpected floods to overtop and destroy the dam. Human operation may fail through carelessness, or gates may be frozen in or jammed, or the operating mechanism may get out of order. The new type of automatic gates is free from such objections. They are operated by the rising pressure of the water and are entirely independent of human control. There are no gears or mechanical devices that will break or jam. The water pressure on the long movable face of the gate increases very fast as the pond level rises. Any obstruction or ice frozen around the ends will be sheared off before any great rise in pond level has occurred. For instance, a gate 50 ft. (15 m.) long and 4 ft. (1.2 m.) high, if held against the water pressure until the level rises 2 ft. (0.6 m.), would be subjected to an additional pressure of 27,000 lb. (12,000 kg.) tending to push it open.

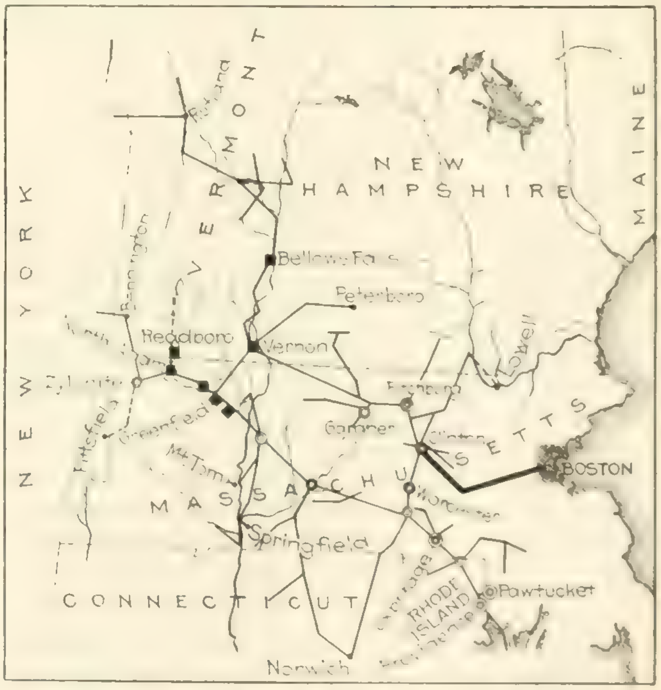
Siphon spillways, where permissible, allow the permanent crest of the dam to be built practically at maximum pond level. Their use is restricted, however, to localities where there is no ice at times of high water and where débris is not of sufficient size and quantity to clog the throat of the discharge tube. They are inapplicable to any developments on our Northern streams and to most of those on Southern rivers.

A new patented idea for eliminating ice troubles around all kinds of gates was successfully tried in Michigan in 1917. It is applicable to installation of gates on deep ponds. Water is drawn from the bottom of the dam by a centrifugal pump and piped to outlets along the gate pier faces. This water is relatively warm, and only a small amount is required to keep an open pool around the upstream face of the gate. Power required is negligible, as the pump works only against the friction head of the circulating pipe.

Compressed air has been used with perfect success in preventing ice from freezing around the large vertical sliding-type gates. A pipe extending the length of the dam fed by a low-pressure blower at one end supplies each gate through branches which extend under the water around the piers and along the gate. The air bubbling up through the water causes sufficient circulation of the deeper, warmer water to prevent freezing. Each branch is controlled by a valve, and it is only necessary to treat the gates intermittently at times when ice is forming.

Generating Capacity of 500,000 Kw. Interconnected in New England

CONTINUOUS electrical connection has been established from the Berkshires to the edge of Cape Cod, tying together about 500,000 kw. in steam and water-power stations. This interconnection was made by the completion of the 25,000–66,000-volt line between the New England Power Company and the Edison Electric Illuminating Company of Boston, Mass. Among the stations interconnected are the hydro-electric plants of the Harriman system on the Deerfield and Connecticut Rivers and of the Turners Falls Power & Electric Company on the Connecticut and the steam stations of the Springfield, Worcester, Providence, Boston, Salem, Fall River, Eastern Connecticut and other companies. By taking advantage of the demand factor and a varying water supply it is estimated that more than 500,000 tons of coal per year will be saved by the co-operation of these systems.



TIE LINE CONNECTS THE POWER SYSTEMS OF BOSTON WITH THOSE OF WESTERN NEW ENGLAND

Prospective Power Development in the Far West

Inactivity in Copper Mining, Financial Situation, Cessation of Shipbuilding and Need for Further Interconnection Delaying Some Development—Conditions More Favorable in Idaho and California

SNOW-CLAD PEAKS, AMONG WHICH IS MOUNT WHITNEY, THE HIGHEST MOUNTAIN OF THE UNITED STATES, FROM WHICH KINGS RIVER, CAL., DEVELOPMENT IS TO BE FED

IN A CONSIDERATION of hydro-electric development the Far Western States may be assumed to consist of three principal groups determined by certain underlying economic and financial conditions: Colorado, Utah, Arizona, Nevada, Montana, Wyoming, New Mexico and Idaho constitute one group. All the companies in these states are in the same category with the possible exception of one or two. Washington and Oregon form another division and are so placed because the development in those states hinges upon very much the same basic principles. The third division consists of California, which is thus placed in a class by itself, as the conditions in that state are dissimilar from those in any other portion of the Far West.

As is well known, the Mountain States, comprising the first division noted, are the large producers of the nation's metals. In the states of this division the bulk of the country's output of copper is mined, and the copper-mining industry was during the war a large consumer of power. With the cessation of hostilities the production of copper was immediately curtailed. The loss of the copper and other mining loads in the Mountain States placed the power companies in a position where they did not find it necessary immediately to increase their generating capacity. With the reduction of the activities in the mining industry a large proportion of the normal population went to other fields, and this further reduced the demand upon the power company.

One exception of note in the intermountain district is the Idaho Power Company, which is at the present time making some small additions to its generating capacity. In this territory the further reclamation of land by irrigation is considered of the greatest importance in connection with the continued development of the states and their resources. Irrigation projects are generally considered to be entitled to a special rate for electric service. Such a rate was put into effect in 1915. Unfortunately the irrigation business of the utility company has been growing faster than other classes of business; consequently the development rate has been working a great hardship on the utility, since additional power-plant and transmission-line investments are required every year to take care of a business that is not self-supporting and which is growing so rapidly that other lines of business cannot compensate for its losses. This is particularly true in view of the rapid increase in operating costs during the five years in which a fixed development rate has been in effect and during which there has been no change in the rate.

In the extreme Northwestern territory the further immediate development of hydro-electric power is held in abeyance for three principal reasons. First and most important of these is the financial situation. At the present time it does not seem possible for the power companies to obtain revenue as a return on their investment sufficient to encourage further investments. This is not due entirely to lack of proper water-power legislation, although power companies cannot amortize their investments in a hydro-electric plant during the period of the proposed lease term. A more cogent reason is that the revenues permitted are not sufficient to warrant further great increases in investment. The only remedy for this phase of the situation is the immediate increase of rates to an extent which will make the securities of the power companies comparable with those of other high-class investments.

In the states of this division there were important war industries which were large consumers of power, such as the shipbuilding and allied industries. With the armistice and the cessation of work in shipbuilding activities the power companies of this territory met with a decrease in load. This, however, at the present time has been largely recovered in other ways.

The hydro-electric developments which are to be considered next are to a great extent those which are best developed in large units. These projects may only be developed after more extensive interconnection of the several systems, since it would be economically unwise for any of the companies operating separately to undertake the development of a block of power many times greater than it could itself immediately utilize.

With the exception of the Skagit River development of the city of Seattle, no very large project is now under way. Two of the large companies of this territory are so situated that they will not require further extensive hydro-electric development during the immediate future. Some years ago the Washington Water Power Company made what is known as the Long Lake development, where the initial installation of generating units was less than the ultimate capacity of the project. For this reason the company will have only to install additional generating units in order to keep pace with the further growth of load. Recently the Northwestern Electric Company, operating in Portland, Ore., has completed a 45,000-hp. steam generating plant burning hogged fuel. The present capacity of this plant is sufficient to take care of the company's load in the immediate future, and it is expected that further increases in load will be met by increasing the capacity of the plant and, in part, by a development on the Lewis River which, it is expected, will necessitate an ultimate expenditure of $5,000,000. The company has for some time had surveyors at work on this project to determine its feasibility.

The great increase of hydro-electric power in California is due to two principal reasons: First, California is rapidly developing as an industrial and agricultural district; second, the rates allowed by the California State Railroad Commission are such as to encourage capital investment.

In connection with the first point it should be noted that during the last six months the water sources covered by applications for irrigation have been sufficient to irrigate one and one-half times the land now under irrigation, or approximately 26 per cent of the total irrigable area of the state. This, in turn, is due to the rapid increase in population and the fact that there is sufficient hydro-electric energy available for raising the water necessary for the irrigation of these lands. That rates are reasonable and are being adjusted from time to time to meet the demands of the increasing cost of installation and operation is undoubtedly one of the greatest factors in the rapid development of hydro-electric power in California. If it were not for this, that state would in all probability be in the same situation as the states of the Northwest.

Plans for Development in Different States

Idaho. The Idaho Power Company is now installing a 6,000-kw. turbine in its Thousand Springs station, which is an appreciable percentage of the rating now installed (36,000 kw.) on the whole system. The increased demand for power over the entire system of the Idaho Power Company during the past year has been exceptionally large, and it is anticipated that the coming year will see a consistent increase in its load, which is largely for agricultural purposes.

An interesting development in Idaho is that called the Sand Spring Irrigation Project. In the Box Canyon of the Snake River there is a spring which has an average flow of 450 second-ft. (12.6 cu.m. per second), the records showing that this flow is very seldom departed from. This spring is to be utilized in a 7,000-hp. plant operating under a 200-ft. (60 m.) head. Energy will be transmitted 1 mile (1.6 km.) to the Sand Springs pumping plant, where water will be lifted into two irrigation canals, one 56 ft. (17 m.) above the pumping plant and the other 100 ft. (30 m.) above the pumping plant. Approximately 1,500 kw. will be utilized in this plant, the remainder being available for the use of the nearby farming and industrial industries.

Montana.—According to the reports of the Department of the Interior, the State of Montana contains potential water-power resources equal to 8 or 9 per cent of the total of the United States. However, only a small proportion of the available power has been developed. In addition to the plants already built and in operation, there are a large number of large power sites and numberless smaller ones ready for development as soon as the demand for power increases and there is available capital for their construction. Although these possible developments are in all parts of the state, the largest possibilities exist in the northwestern section of Montana, where the waters of the Flathead and the Kootenai River and other large streams will, when harnessed, furnish more than 500,000 hp. The power site at the mouth of the Flathead Lake, which is one of the most feasible in the state, has been reserved by the Government in connection with the reclamation system covering a portion of what was formerly the Flathead Indian Reservation. A number of smaller power sites have also been reserved, while many others are under private ownership.

The proposed developments of the Montana Power Company amount to 100,500 kw. and include the following: Madison No. 3 on Madison River (20,000 kw.); Great Falls "C," on Missouri River above Great Falls, (28,500 kw.); Sheep Creek on Missouri River below Great Falls (28,500 kw.); Fish Creek on Missoula River (13,500 kw.); Black Eagle on Missouri River, reconstruction project (10,000 kw.). With the generating facilities that the Montana Power Company now has, it appears that even with an increase in load of 10 per cent per year it will be four or five years before the load equals the present installed capacity. An average increase in load greater than 10 per cent per annum might be expected, provided that the mining industry shall be restored to a normal basis and the electrification of railways continue as the present indications are that it may continue. In this event the surplus capacity of the Montana Power Company may be reached within the next three years.

Oregon and Washington.—Three water-power developments are contemplated in Oregon: (1) The Enterprise Electric Company is planning the construction of a 4,400-hp. plant on the Wallowa River in Oregon. (2) Application has been made for the diversion of 5,000 second-ft. (140 cu.m. per second) of water from the Deschutes River for power development. This project is waiting favorable action on the water-power bill and proper methods of financing. (3) Another application has been filed seeking the diversion of 600 second-ft. (16.8 cu.m. per second) from the north fork of the Santian River for one development of 6,500 hp. Walla Walla, Wash., is now contemplating the development of a small municipal plant on one of the streams in western Washington. The proposition has been prepared for placing before the voters.

417.000 Hp. Available in These Four Sites

Power available here exceeds that developed in Arizona, Colorado and Nevada.

No. 1. Diamond Creek site in Arizona where 140,000 hp. can be developed and utilized for railroad electrification, mining and general public use in the Southwest, all within economical transmission distance. Oil, which is fast becoming scarce and increasing in price, would be saved and industrial development stimulated.

No. 2. The 18,000 hp. now provided in the Shoshone plant of the Colorado Power Company for Denver and vicinity is only one-half of the power available in the Grand River Canyon above Glenwood Springs. Here again railroads, industry and the public could utilize the power to advantage.

No. 3. Development of Sherar Falls on the Deschutes River, Ore., should provide 40,900 hp. dependent on a market. About 500,000 hp. is available in the entire river, but power will probably not be developed until it becomes feasible to generate part-year power. Reservoir capacity, is available to permit complete control of flow.

No. 4. 200,000 hp. could be developed in Z-Canyon, Clark Fork, Wash., by damming this narrow chasm, but an industrial demand would have to be stimulated coincident with development. Railroad electrification and development of industry offer possibilities.

California.—In California the construction of hydroelectric plants was delayed during the war period, owing to the necessity of curtailing the use of material essential for the conduct of the war. Consequently the power companies of California found themselves upon the signing of the armistice seriously short of generating capacity. The load had increased steadily during the war period, and it was only due to the fact that previous to the war the capacity somewhat exceeded the requirements, that the companies were able to permit their load to increase.

Immediately following the signing of the armistice the Southern California Edison Company issued new securities to the extent of $10,000,000, the money from which has been used in the development of plants on Big Creek and the Kern River. The development on Big Creek includes the installation of an additional 16,000-kw. generator in the Big Creek No. 1 plant, to be placed in operation during the summer of 1920. Construction work is under way on a storage reservoir at Shaver Lake to impound the drainage from 32 square miles (83 sq.km.) naturally tributary to this basin, and additional waters from other sheds at those times when the runoff exceeds the capacity of the No. 1 plant. The water from this reservoir will be utilized in the Big Creek No. 2 plant and in the lower plants. Work is also under way on the construction of the Big Creek No. 3 power house, which will be the largest of the developments on this stream and will have an ultimate capacity of 175,000 kw., utilizing the entire flow of the San Joaquin River and Big Creek after its utilization in power houses further up stream.

Construction work on the Kern River No. 3 plant of the Southern California Edison Company has reached such a stage that it is expected this plant will be in operation during the fall of 1920. As pointed out in the July 19, 1919, issue of the ELECTRICAL WORLD, this plant will consist of two 15,000-kw. generators driven by reaction turbines operating under 800-ft. (244-m.) head.

The Bureau of Power and Light of Los Angeles is now constructing the San Francisquito No. 2 power house, and it is expected that this plant will be in operation during the summer of 1920. This plant will have a capacity of 20,000-kw., and since it is directly on the line of the Los Angeles Aqueduct it has not involved a large expenditure for construction of water conduits.

The San Joaquin Light & Power Company is rapidly completing the construction of a 30,000-kw. plant on the San Joaquin River, to be known as the Kerckhoff plant. The static head from the normal height of water in the dam to the water in the tailrace will range from 350 ft. to 310 ft. (107 m. to 94 m.), depending upon the height of the tailwater. Three vertical-shaft 15,000-hp. turbines, operating at 360 r.p.m., will be employed.

Another development by the San Joaquin Light & Power Company, one whch is planned for the near future, will be known as the Little Kerckhoff plant. This plant will be built just below the diversion dam of the larger Kerckhoff project, will be rated at 8,000 kw. or 10,000 kw. and will utilize the flood water of the San Joaquin River in excess of those which the larger plant can handle.

The Kings River power development of the San Joaquin Light & Power Corporation, located on the north fork of Kings River, will be developed within the next few years. It has a total reservoir storage of 202,200 acre-ft. (24,200 hectare-m.) and a rating of 271,250 hp. The storage is embraced in the three reservoirs—Lake Wishon, with 128,000 acre-ft. (15,350 hectare-m.); Deer Lake, with 21,000 acre-ft. (2,520 hectare-m.), and Bear Lake, with 53,200 acre-ft. (5,380 hectare-m.).

The power is derived from seven plants—Wishon, with 6,670 hp.; Haas, with 82,670 hp.; Balch, with 124,000 hp.; Bear Creek, with 2,600 hp.; Deer Creek No. 1, with 6,670 hp.; Deer Creek No. 2, with 26,670 hp., and Meyer, with 22,670 hp. The major power house of Balch has 45 per cent of the total power capacity of the development. The Wishon power house will divert 400 second-ft. (11.2 cu.m. per second) from Lake Wishon at a head of 235 ft. (72 m.); Haas will divert 400 second-ft. (11.2 cu.m. per second) from Wishon power house at a head of 2,475 ft. (753 m.); Balch will divert 400 second-ft. (11.2 cu.m. per second) from Haas and 200 second-ft. (5.6 cu.m. per second) from Deer Creek No. 2 at a head of 2,500 ft. (762 m.); Bear Creek power house will divert 150 second-ft. (4.2 cu.m. per second) from Bear Creek Lake at a head of 265 ft. (81 m.); Deer Creek No. 1 will divert 50 second-ft. (1.4 cu.m. per second) from Deer Lake at 1,465-ft. (447-m.) head; Deer Creek No. 2 will divert 150 second-ft. from Bear Creek station and 50 second-ft. (1.4 cu.m. per second) from Deer Creek No. 1 at 1,545 ft. (443 m.) head, and Meyer will divert 650 second-ft. (18.2 cu.m. per second) from Balch and the north fork of Kings River at 410-ft. (125-m.) head.

The expenditures necessitated on the Kings River project, not including engineering construction, will be approximately $25,500,000 up to and including the year 1924.

The Great Western Power Company is pushing construction on its Caribou plant, on the Feather River. This plant should be completed by about the first of 1921 and will have a capacity of 40,000 kw. Energy from the plant will be transmitted to the vicinity of San Francisco. The Caribou plant is to operate under head of 1,008 ft. (305 m.). The generators are to be rated at 22,223 kva. and each will be driven by two overhung impulse waterwheels. This plant will have two units installed at the present time with room in the present building for one additional unit, the ultimate capacity being six units of the above noted ratings.

The Pacific Gas & Electric Company is planning to proceed actively with construction work on the Pit River in the northern part of California. Pit River is remarkable for the reason that projects developed on it will not require the construction of storage reservoirs, as the lava beds in the high regions which constitute the source of the stream are themselves storage reservoirs. For this reason the flow of the Pit River continues without extreme variation throughout the year and from year to year. The development on this stream has been postponed in the past owing to its distance from the market and because of the necessity of investing in installation of considerable size at the first.

The Pit River development of the Pacific Gas & Electric Company presents a number of different possibilities in method of development. Surveys are being made at the present time to determine which of these should be developed first, having in mind the time required for construction. One of the larger developments will provide a head of some 940 ft. (284 m.) with a minimum river flow of 2,450 second-ft. (69 cu.m. per second). This will develop 138,000 kw. in this one plant. The transmission lines necessary for this project will be to Sacramento and to San Francisco.

The Yuba Development Company in California is proceeding with the construction of its power and mining project on the Yuba River. It is expected that the dam, which will impound 25,000 acre-ft. (30,000 hectare-m.) of water will be finished in the fall of 1920 and will be utilized primarily for a débris catchment for the hydraulic mining operations farther up stream. It is planned to install a power house below the dam which will be capable of 5,000 hp. output during eight months of the year. Although the initial installation will consist of one 10,000 hp. unit, the full output will not be available continuously.

The Modesto-Turlock Irrigation District has voted bonds for the construction of a power and irrigation project on the Tuolumne River, the dam for which will be constructed in the immediate future. There is sufficient water in this stream to develop 17,000 hp. as a minimum and 45,000 hp. ultimately. The probable immediate development will consist of 30,000 hp.

The Sespe Light & Power Company is planning to

Some Sources of Water Power in the Far West

Upper view, left—Camp Verde, Arizona, dam site. Upper view, right—Sand Springs project in Idaho where joint development of power and irrigation is under way. Lower view, left—Pit River, Cal., where the Pacific Gas & Electric Company is making a large development. Lower view, right—Power-house site on the San Joaquin River, which river will ultimately produce 1,000,000 hp.

install three hydro-electric plants on the Sespe River in Ventura County, each having a capacity of 4,000 kw. or 5,000 kw. This project is as yet only in the development stage, and estimates are being made on the project as a whole. It is now estimated that the project will involve the expenditure of some $4,000,000, which will include works for irrigation.

The Snow Mountain Water & Power Company is going ahead with the construction of a dam in Lake County, California, to impound 73,000 acre-ft. (8,760 hectare-m.) of water. In addition to this, other plans contemplate the addition to their head generating capacity so as to effect a 25 per cent increase in capacity.

The Hetch-Hetchy project of the city of San Francisco is rapidly progressing. The Hetch-Hetchy dam will be the largest structure of its kind in the State of California, being constructed of cyclopean masonry. The completed reservoir will have a capacity of 346,000 acre-ft. (41,500 hectare-m.). The completion of the mountain division will develop 66,000 hp. in the Moccasin Creek power house. The ultimate development on this project will be 250,000 hp., which will include, besides the Moccasin Creek development, one called Early Intake (67,000 hp.), the North Mountain development (50,000 hp.) and a number of miscellaneous developments totaling 61,500 hp. There is already completed and in operation a small power house at Early Intake with a capacity of 4,500 hp., which is utilized for construction work.

In connection with the power development on the Hetch-Hetchy water will be carried by an aqueduct to San Francisco for general use.

Arizona Development.—Two main projects are under contemplation for development in Arizona, one being on the Colorado River at Parker and the other on the Verde River for the irrigation of the Paradise Valley.

The Parker River development will involve a dam which will store sufficient water to permit operation on a minimum flow of 7,500 second-ft. (210 cu.m. per second) the normal minimum flow of the Colorado River at this point being 3,000 second-ft. (84 cu.m. per second). The ultimate development at the Parker site will be 140,000 hp. Power from this plant may be utilized in the copper mines some 240 miles (385 km.) east of Parker. The preliminary work on this project has now been completed, and if the financial arrangements are carried out satisfactorily construction work will start within a period of one year.

The Paradise Verde irrigation project is of interest both from a power and from an irrigation viewpoint. The project contemplates the construction of three main dams and two smaller dams for diversion from two small creeks. The first dam, which will be called the Camp Verde Reservoir, will have a capacity of 440,000 acre-ft. (52,800 hectare-m.). Below this, on the Verde River, is to be constructed the Horse Shoe reservoir, with a capacity of 305,000 acre-ft. (37,000 hectare-m.). From the latter dam water will be taken to a canal and utilized in a 15,000-kw. power house situated above the Paradise Valley. From this point the water will be taken in a canal for the irrigation of the 95,000 acres (38,000 hectares) of the valley, and in those seasons when the utilization of water in the power house is in excess of that required for irrigation the surplus will be stored in a 50,000 acre-ft. (6,000 hectare-m.) reservoir on the New River, later to be returned for irrigation of land lying below the elevation of the latter reservoir. This project is now before the Department of the Interior, and a decision on it is to be rendered by the Secretary by May 1.

Reducing Discrepancies in Coal Weights

Difference That Manifests Itself Between Mine Weights and the Weight of Coal Burned Is the Cause of Inroads on the Revenue of Central Stations—Remedies for Situation Are Discussed

A CONSIDERABLE number of electric lighting and power companies have recently called to the attention of the ELECTRICAL WORLD the losses they are forced to bear on account of discrepancies in coal weights. One central-station executive remarked that in 1919 he had experienced a very wide difference between the weights of coal purchased and the weights of coal burned. His was an Ohio company with 2,000 kw. of generating capacity which used in round figures 10,000 tons of coal a year. His loss from discrepancy in weights in 1919 was about $2,200. Another central-station operator when asked for his experience replied: "During excessively cold weather the discrepancy between mine and delivered weights of fuel purchased by our company have reached as high as 8 per cent, while during the summer months they do not exceed 2½ to 3 per cent. It is my opinion that the average shortage through a period of a full year would be from 4½ per cent to 5 per cent of the total fuel purchased."

These statements and others show that the losses are of a magnitude deserving attention. Therefore in order to throw some light on the problem a letter was addressed to the National Coal Association. This letter outlined the problem and asked what might be done by individual electric light and power companies or by central-station associations to remedy the trouble. To this letter John Callahan, traffic manager for the National Coal Association, replied as follows:

Coal Men Blame Railroads

"There are many reasons why the weights of coal vary between the originating scales and the destination. In the first place, there is tolerance, which is the difference in weights due to variation in scales or weighing which may be permitted without correction of the waybill weight. The allowance made on coal is usually 1 per cent of the lading with a minimum of 1,000 lb. (450 kg.) on coal, although many railroads add 0.5 per cent for evaporation, making the total tolerance 1½ per cent to 2 per cent. Where large volumes of coal are involved it can easily happen that there will be a discrepancy of considerable magnitude because of this variation in scales.

"Secondly, losses of coal occur in transit. One of the principal factors in this connection is the requirement of the railroads that the maximum amount of coal be placed on each car. Coal people are willing to co-operate with the railroads in this matter to a reasonable extent. The railroads, however, have such rigid instructions that it virtually takes a stonemason to build up the top of a car of coal to meet their requirements.

"Then the coal is switched in railroad yards over humps or gravity tracks. During switching operations the coal cars run down the hill at a considerable rate of speed, colliding with other cars standing on the track, with the result that much coal is frequently shaken from the top of the cars. The coal remaining adjusts itself to a new level, and by the time a car gets to its destination it has a very even top. To the eyes of an observer the car has not suffered any loss in transit. Naturally much of this loss is not reported. It frequently occurs during the night, and in such cases the coal is never gathered up. It can be easily understood how 500 lb. (230 kg.) of coal could be lost in such a manner.

"The next large source of loss is the defective equipment of the carriers. This causes small amounts of some kinds of coal and large quantities of mine-run and slack to be lost enroute. Sometimes the car will leak over the entire route. The leak is not large enough to cause a pile of coal to accumulate, but while the car is moving it is constantly losing part of its contents.

"There are also losses due to theft, although that has, in my opinion, been reduced to the minimum except in cases wherein railroad employees are involved and where the coal is taken for cabooses and switchmen's shanties.

"Discrepancies in weight, although no loss exists, often occur in connection with the failure of the railroads to remove iron ore and other material from cars before placing them at coal-mine tipples. This is particularly true at this season of the year, when snows fall on the car between the time it leaves the point at which ore, brick and such other material are unloaded and the time it arrives at the coal mine for loading with coal. This is a prolific source of loss and discrepancy.

"There are other conditions which cause loss of coal in transit, but these are the principal ones. All of these matters have been taken up with the Railroad Administration in an effort to have changes made which will insure the same amount of coal reaching destination that starts from the mines.

What Coal Users Should Do

"The consignee of coal should take active steps to see that the railroads are required to pay for any losses which are indicated when comparison of the scale weights at originating scales and the destination weights is made. That it is the duty of the carrier to furnish proper equipment is unquestionable. Outside of the fact that it is to protect his own property, the shipper has no interest in putting equipment in shape for loading. Carriers will pay claims for loss due to the use of defective equipment, but will not reimburse shippers for repairs made to equipment to place it in proper condition for loading. Nevertheless, many coal producers maintain repair forces for this purpose. Freight Claim Association Rule 64 reads in part as follows: 'Cars shall be inspected by carrier furnishing the equipment before each loading.'

"On page 4,907 of the *Proceedings* of the Freight Claim Association at its twenty-fifth annual convention, held at Chicago, June 19, 20 and 21, 1917, it is recorded that Mr. Baskerville of the Norfolk & Western Railway Company, which is one of the largest coal-loading roads in the country, stated: 'One of the largest items in our loss and damage department is on account of the use of defective equipment. As a usual thing the claims paid are very heavy, and they are claims which could easily have been avoided.'

"Decisions of the Interstate Commerce Commission in regard to the maintenance and furnishing of proper equipment for loading are numerous; for example, Interstate Commerce Commission, 5,924—Wabash Sand & Gravel Company vs. Vandalia Railroad Company et al.; I. C. C., 3,820—Balfour, Guthrie & Company et al. vs. Oregon-Washington Railroad and Navigation Company; I. C. C., 4,829—Southwestern Missouri Millers' Club vs. St. Louis & San Francisco Railroad Company et al. In these three decisions it is clearly established that it is the primary duty of the railroad to furnish equipment that is usable.

"The National Coal Association has endeavored during the past year to have new rules prepared which would insure a better arrangement in connection with freight claims. The real necessity, however, is not for any arrangement which will give remuneration for losses, but to prevent in every way the losses which cause claims to be placed. I maintain that the railroads are far from perfect in their present arrangements for taking care of coal producers and receivers and that anything which is done to make an improvement in present situations should be through common action with the railroads.

"Electrical associations might very well take this matter up with the American Railroad Association and have this body appoint a special committee to co-operate with producers and receivers of coal on this subject."

Mr. Callahan's letter outlines the problem and suggests a practical remedy. That managers of electrical properties and secretaries of live electrical associations will be quick to act on his suggestions seems likely. Any action that will save 8 per cent of the coal or even 2 per cent of the coal used by central stations will be considered work of prime importance.

FOR *ten years there has been little development upon our streams of their power possibilities. And yet there has been increasing demand for power. No other country has such an undeveloped resource, and in no country has there been so great an apparent indifference during the decade to such work. The reason is that the Government itself did not wish to make improvements and private capital would not put itself at the caprice of the Government for building on the basis of revocable permits. Moreover, it was a matter of large expense, great worry and dealing with several departments to secure even such permits. The answer has been found in a bill by which the commission is created composed of the Secretaries of War, Interior and Agriculture, with jurisdiction over navigable waters, public lands, and forest reserves, which may lease such lands for 50 years and reasonable guarantee to the government and the lessees. This measure is now in conference, having passed both Houses of Congress, and will doubtless be a law in a few weeks.*—Franklin K. Lane, *former Secretary of the Interior.*

Analysis of Insulator Practice—III

More Than Forty Transmission Companies Give Their Observations Regarding Failures at Dead-Ends and at Different Positions in String—Effect of Temperature Change and Deposits on Insulators—Methods of Preventing Trouble

PRACTICES of over forty transmission companies in equipping their lines with insulators, together with the nature, frequency, expense and effectiveness of tests and inspection, were discussed in detail in the last two issues of the ELECTRICAL WORLD. In addition a list of observed causes of insulator failure was given, the causes being stated in order of occurrence. In this issue some of the causes will be considered more in detail, and methods of preventing trouble or protecting insulators will be outlined. Space does not permit repeating company names so that key numbers given opposite the companies listed in the March 6 issue are substituted.

Dead-End Failures.—Dead-ends have been considered such vulnerable positions for so many years that data have been collected on whether insulators fail more at dead-end points than at intermediate points, the probable causes, and remedies. Most of the companies report that dead-end positions are more vulnerable and that the cause is either the greater mechanical load carried or the greater exposure to temperature changes. Failure at dead-ends has been reduced considerably by some companies (7, 8, 9, 20, 33) by using porcelain in compression instead of tension, or by employing cushioned joints and units in multiple.

Failure Next to Line Wire.—Since the electrical stress across an ungraded string of insulators is always greatest[16] across the unit next to the line wire, all the companies listed in Table I were asked if disks in this position failed more, and, if not, where greatest failure was noted. It was rather surprising to hear that practically all (except companies 11A and 14) say that this position is no more vulnerable, indicating that electrical stresses have little to do with insulator failure, at least at the operating voltages referred to. Several (11, 21, 34, 38) reported that the disk next to the crossarm fails oftener; some attribute this to greater exposure to sun and rain. Others held that the position had no effect. Company 11 said that the line units fail most often, those next to the support next, and intermediate units least of all.

Alternate Exposure to Heat and Cold.—Practically all of the companies commenting on this subject say that experience proves it to be a serious cause of insulator deterioration. The observed result is that surface cracks form and absorb moisture. The tops of pin insulators also crack off squarely owing to fast contraction of tie wires and cracks appear under the caps of disk insulators. The latter trouble may possibly be relieved by introducing an elastic medium between the metal and the porcelain. Trouble from this cause is experienced principally after a cool or cold night, when the sun strikes the insulators, or when rain falls on insulators that have been subjected to the sun's rays for some time (company 14). One company (40) experiences the highest insulator depreciation in places where the units are alternately exposed to sun and fog several times a day. With pin insulators company 40 has used pipe pins with lead threads with greatly improved results over what were obtained with cemented iron thimbles. Replacing with heavier porcelain is suggested as a remedy by another company. Puncture failures due to cyclic temperature changes seem to be independent of position in string, says company 35. Some companies are quite optimistic, however, saying that they believe the newer types of insulators will better withstand rapid temperature changes.

Exposure to Dust and Ocean Fogs.—Some companies whose line insulators are exposed to smelter fumes, cement dust, ocean fog, or the like, have serious trouble, while others do not. For instance, company 3, which is near the ocean, has no trouble due to fogs, whereas company 35 and others have. A résumé of the experiences reported is given:

(4) Fogs cause trouble but do not interrupt service; pins have to be replaced where flash-over occurs.

(7) Cement dust causes flash-over when wet; frequent cleaning helpful.

(8) Causes surface leakage; not eliminated by cleaning.

(11A) Insulators exposed to acid or alkali washed regularly.

(12) Insulators exposed to chemical fumes cleaned monthly.

(14) Dew hardens cement dust, which must be removed with acid frequently.

(16) Cement dust washed off by frequent rains.

(21) No trouble from sulphur fumes.

(22) Dirt has caused trouble inside; insulators cleaned periodically.

(24) Trouble near gas plants and cooling towers eliminated by extra insulation and weekly cleaning .

(30) Substitute insulation with longer leakage surface.

(32) Trouble avoided by careful inspection.

(33) Clean insulators at railway crossings every six months with oxalic acid; use of three extra disks avoids necessity of cleaning.

(34) Cement dust causes no trouble, but ocean fogs cause temperature effects and salt deposit; wiped twice yearly to prevent pole burning due to surface leakage.

(35) Ocean spray sometimes makes lines inoperative, even several miles inland, by depositing salt on insulators; especially troublesome opposite steep beaches; fogs cause trouble after insulators have become badly coated with dust, salt, etc.; periodic washing and over-insulation helpful. Over-insulation will delay failure by flash-over but not prevent it, for, regardless of degree of over-insulation, fogs in early winter deposit moisture on cool parts and make lines inoperative.

(36) Fogs cause trouble only after insulators have become badly coated with dust, salt or the like; salt deposits also cause excessive leakage after drizzing rain; remedy is substitution of higher voltage insulators and washing periodically at especially affected spots.

(37) Wash insulators exposed to dust.

(38) Crusts of cement dust, salt from ocean fogs and sand cause serious trouble that is alleviated by washing and wiping insulators frequently.

(39) Ocean fog causes flash-over if insulator is dirty, but can be prevented by washing insulators and over-insulating lines where fogs occur.

(40) Cement dust causes excessive surface leakage which may lead to flash-over and must be wiped from insulators, where exposed, about every six weeks. The insulator is then wiped with a thin film of oil to prevent the cement dust setting; this treatment is effective for a limited period of four to six weeks. Where insulators are exposed to ocean fogs they must be wiped at intervals of thirty to a hundred days if flash-overs are to be avoided.

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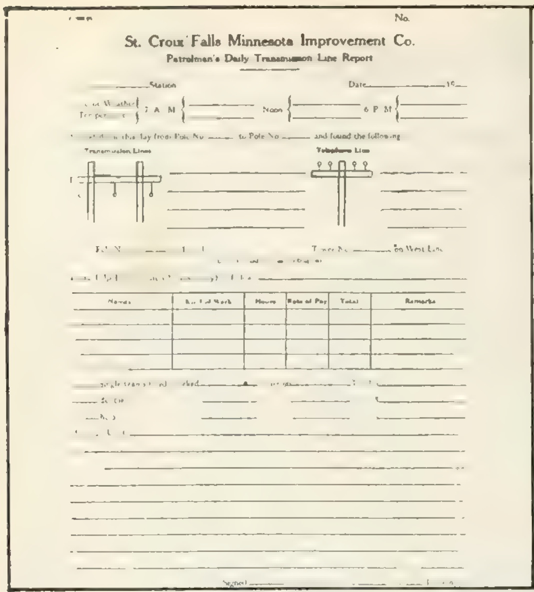
[16] See ELECTRICAL WORLD, Jan. 24, 1920, article by F. W. Peek, Jr.



No.

St. Croix Falls Minnesota Improvement Co.

Patrolman's Daily Transmission Line Report

______Station Date______19__

7 A. M. Noon 6 P. M.

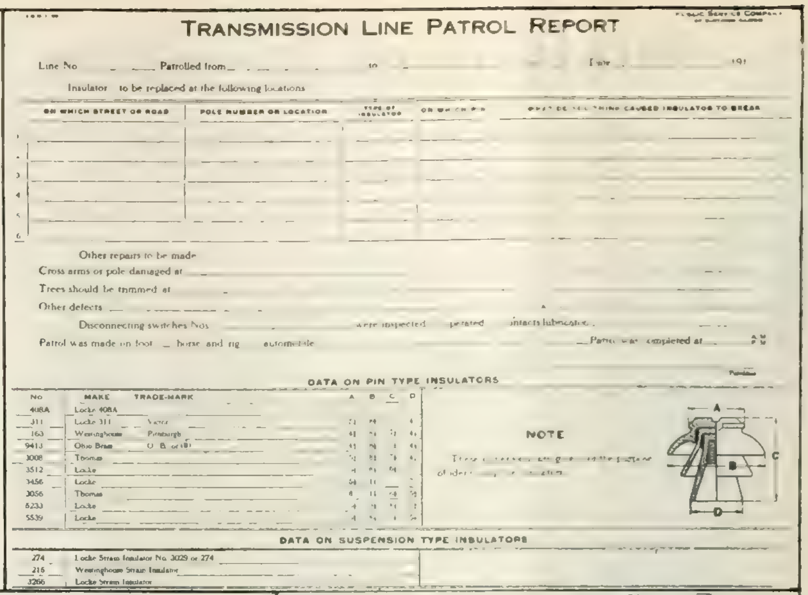
to Pole No ______ and found the following

Transmission Lines
Telephone Line

Tower No ______ on West Line

Names	Kind of Work	Hours	Rate of Pay	Total	Remarks

Signed ______



TRANSMISSION LINE PATROL REPORT

Line No ______ Patrolled from ______ to ______ Date ______ 191

Insulator to be replaced at the following locations

	ON WHICH STREET OR ROAD	POLE NUMBER OR LOCATION	TYPE OF INSULATOR	ON WHICH PIN	WHAT DO YOU THINK CAUSED INSULATOR TO BREAK
1					
2					
3					
4					
5					
6					

Other repairs to be made

Cross arms or pole damaged at ______

Trees should be trimmed at ______

Other defects ______

Disconnecting switches Nos ______ were inspected ______ operated ______ contacts lubricated

Patrol was made on foot ______ horse and rig ______ automobile ______ Patrol was completed at ______ A. M. P. M.

Patrolman

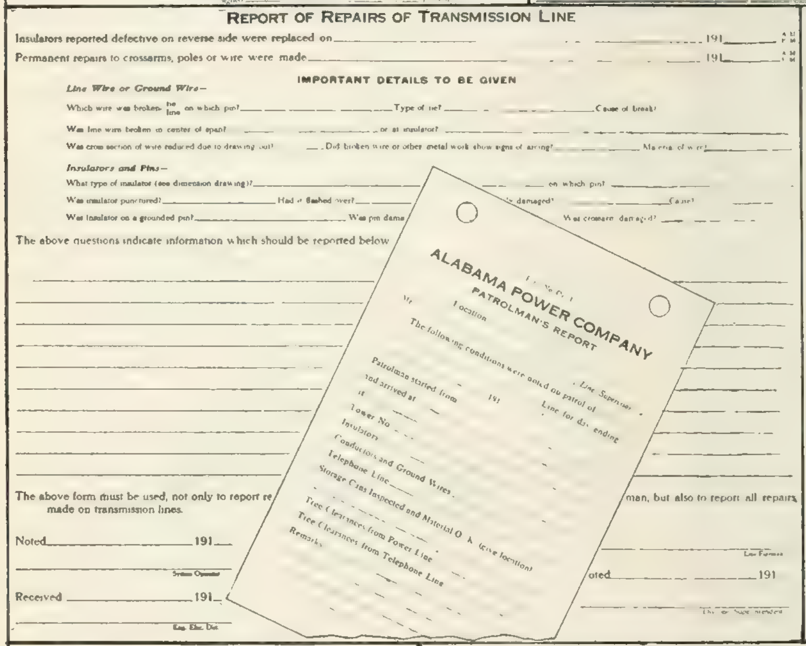
DATA ON PIN TYPE INSULATORS

No	MAKE	TRADE-MARK	A	B	C	D
408A	Locke 408A					
311	Locke 311	Victor	[illegible]	[illegible]		[illegible]
163	Westinghouse	Pittsburgh	[illegible]	[illegible]	[illegible]	[illegible]
9413	Ohio Brass	O. B. or (B)	[illegible]	[illegible]	[illegible]	[illegible]
3008	Thomas		[illegible]	[illegible]	[illegible]	[illegible]
3512	Locke		[illegible]	[illegible]	[illegible]	
3456	Locke		[illegible]	[illegible]		
3056	Thomas		[illegible]	[illegible]	[illegible]	[illegible]
6233	Locke		[illegible]	[illegible]	[illegible]	[illegible]
5539	Locke		[illegible]	[illegible]	[illegible]	[illegible]

NOTE

DATA ON SUSPENSION TYPE INSULATORS

274	Locke Strain Insulator No. 3029 or 274
216	Westinghouse Strain Insulator
3266	Locke Strain Insulator



REPORT OF REPAIRS OF TRANSMISSION LINE

Insulators reported defective on reverse side were replaced on ______ 191___ A. M. P. M.

Permanent repairs to crossarms, poles or wire were made ______ 191___ A. M. P. M.

IMPORTANT DETAILS TO BE GIVEN

Line Wire or Ground Wire—

Which wire was broken—the line on which pin? ______ Type of tie? ______ Cause of break?

Was line wire broken in center of span? ______ or at insulator? ______

Was cross section of wire reduced due to drawing out? ______ Did broken wire or other metal work show signs of arcing? ______ Material of wire? ______

Insulators and Pins—

What type of insulator (see dimension drawing)? ______ on which pin? ______

Was insulator punctured? ______ Had it flashed over? ______ damaged? ______ Cause? ______

Was insulator on a grounded pin? ______ Was pin dama ______ Was crossarm damaged? ______

The above questions indicate information which should be reported below

The above form must be used, not only to report re ______ man, but also to report all repairs made on transmission lines.

Noted ______ 191___

System Operator

Received ______ 191___

Eng. Elec. Dist.

Line Foreman

oted ______ 191

Div. or Supt. Transmission

ALABAMA POWER COMPANY

PATROLMAN'S REPORT

Location

The following conditions were noted on patrol of ______ Line Supervisor ______ Line for day ending

Patrolman started from ______ 191 ______ and arrived at ______ at ______

Tower No ______

Insulators ______

Conductors and Ground Wires ______

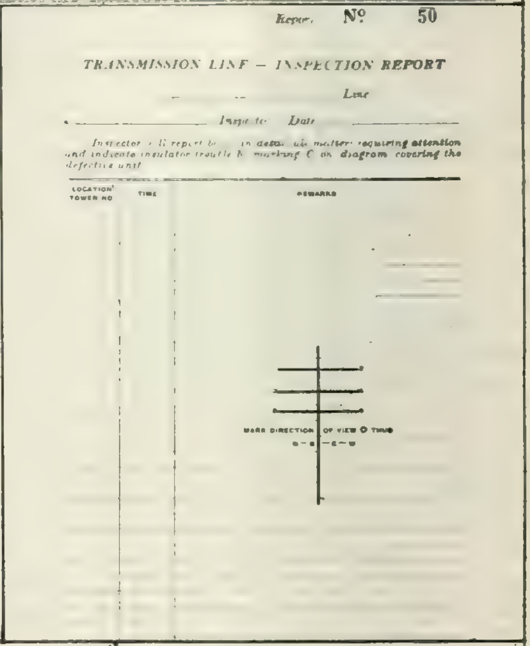
Telephone Line ______

Storage Cans Inspected and Material O. K. (give location)

Tree Clearances from Power Line ______

Tree Clearances from Telephone Line ______

Remarks ______



Report No 50

TRANSMISSION LINE — INSPECTION REPORT

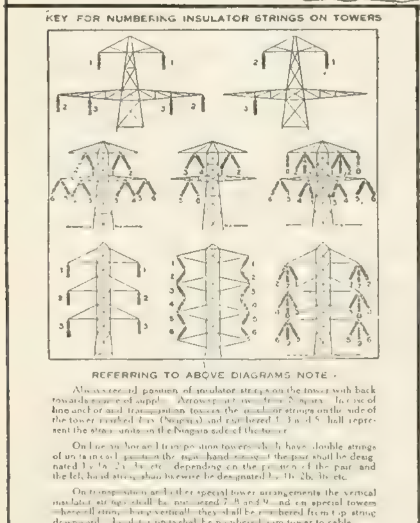
______ Line

______ Inspector Date ______

Inspector will report in detail all matters requiring attention and indicate insulator trouble by marking C on diagram covering the defective unit

LOCATION TOWER NO	TIME	REMARKS

MARK DIRECTION OF VIEW O THUS
N—S—E—W



KEY FOR NUMBERING INSULATOR STRINGS ON TOWERS

REFERRING TO ABOVE DIAGRAMS NOTE:

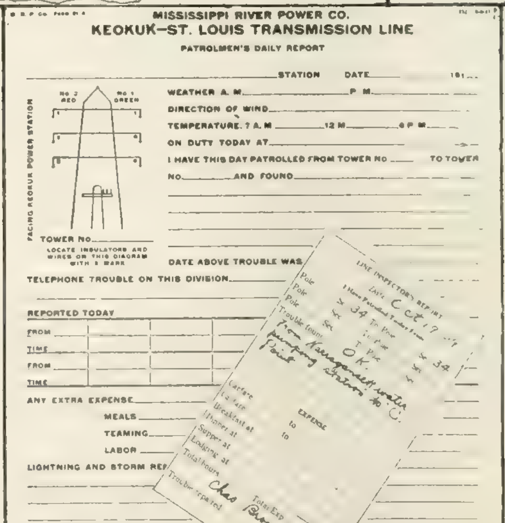
Always record position of insulator strings on the tower with back towards source of supply. Arrows point away from Niagara. In case of line anchor and transposition towers the insulator strings on the side of the tower marked (Niagara) and numbered 1, 3 and 5 shall represent the strain units on the Niagara side of the tower.

On line anchor and transposition towers which have double strings of units in each position the right hand string of the pair shall be designated by 1a, 2a, 3a etc. depending on the position of the pair and the left hand string shall likewise be designated by 1b, 2b, 3b etc.

On transposition and other special tower arrangements the vertical insulator strings shall be numbered 7, 8 and 9, and on special towers where all strings hang vertically they shall be numbered from top string downward. Insulator units shall be numbered from tower to cable.

Key for recording different makes of units used

HERMSDORF CO.	[illegible]	O. B. Standard Type	
LOCKE CO.	[illegible]	O. B. [illegible]	[illegible]
CANADIAN PORCELAIN Strain Type	[illegible]	O. B. Keokuk Type	3
CANADIAN PORCELAIN Susp. Type	[illegible]	O. B. Sanitary	Z



MISSISSIPPI RIVER POWER CO.

KEOKUK—ST. LOUIS TRANSMISSION LINE

PATROLMEN'S DAILY REPORT

______STATION DATE______ 191___

FACING KEOKUK POWER STATION
No. 2 RED
No. 1 GREEN

TOWER NO. ______

LOCATE INSULATORS AND WIRES ON THIS DIAGRAM WITH X MARK

WEATHER A. M. ______ P. M. ______

DIRECTION OF WIND ______

TEMPERATURE, 7 A. M. ______ 12 M. ______ 6 P. M. ______

ON DUTY TODAY AT ______

I HAVE THIS DAY PATROLLED FROM TOWER NO ______ TO TOWER NO. ______ AND FOUND ______

DATE ABOVE TROUBLE WAS

TELEPHONE TROUBLE ON THIS DIVISION ______

REPORTED TODAY

FROM ______

TIME ______

FROM ______

TIME ______

ANY EXTRA EXPENSE ______

MEALS ______

TEAMING ______

LABOR ______

LIGHTNING AND STORM REP

REPAIRS MADE ______

REGULAR PATROL LIMITS

TOWER ______ TO ______

SIGN

ROLMAN NO

LINE INSPECTOR'S REPORT

Date Oct 17

I Have Patrolled Trolley from

Pole ______ St. # 34 To Pole ______

Pole ______ To Pole

Pole ______ St. ______ # 34

Trouble found OK.

from Narragansett water pumping station to C. Point

EXPENSE

Carfare ______ to

Carfare ______ to

Breakfast at

Dinner at

Supper at

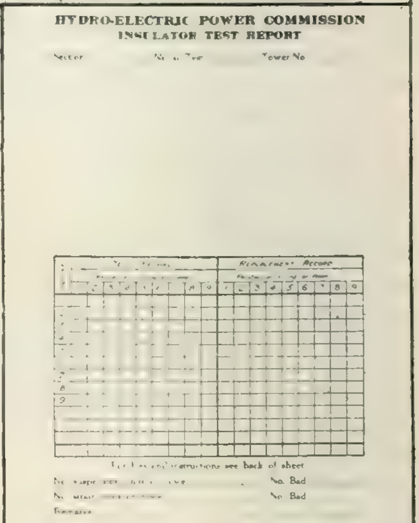
Lodging at

Total hours

Trouble repaired

Total Exp.

by Chas Brown Inspector



HYDRO-ELECTRIC POWER COMMISSION

INSULATOR TEST REPORT

Section ______ Tower No ______

Replacement Record

For key and instructions see back of sheet

No. ______ No. Bad

No. ______ No. Bad

Remarks

Tested by ______ Replaced by ______

Date ______ Date ______

TRANSMISSION LINE REPORT FORMS

Left top—Records for some lines kept on cards, others on form reproduced (Northern States Power Company). Right top and left center—Opposite sides of form used by Public Service Company of Northern Illinois. Superimposed form—Patrolman's report submitted to division office with additional comments directly to line superintendent. (Alabama Power Company). Right center—No report made unless flaw is found (Eastern Massachusetts Electric Company). Left and right bottom—Opposite sides of insulator test report made in duplicate by Hydro-electric Power Commission of Ontario. Center bottom—Patrolman's daily report (Mississippi River Power Company). Superimposed form—Half of double post card, one part of which is mailed to general superintendent and other to chief operator; latter notifies district superintendent, who is held responsible for changes or repairs (Central Maine Power Company.)

(X) Insulators exposed to cement dust wiped every two weeks; extra heavy insulation used.

Preventing Injury from Arc-Overs.—Flash-over of an insulator is really the opening of the safety valve, comparatively speaking; but if it is followed by a power arc, injury often results to the insulator. To avoid trouble from this source many companies (7, 8, 9, 21, 22, 24, 29,[17] 30, 31, 33, 37, 38 and X) provide arcing horns on their insulators.

Company 37 says: "Judging from the fact that no insulators have been damaged by flash-over, the horns are apparently 100 per cent perfect, but it is not certain that flash-overs have occurred." Company 40 has tried arcing horns on suspension insulators to reduce injury to insulators and wire from flash-over, but has not found them very effective. On the other hand, company 38 has found them very effective on 150,000-volt lines. This company's experience with horns on 60,000-volt lines has not been extensive enough to warrant any conclusions yet. Other companies (2 and 12) over-insulate to prevent flash-over, while companies 11, 30 and X interrupt the power after flash-over temporarily by means of a Nicholson arc suppressor or reduce the voltage temporarily to prevent damage. One-half minute is allowed by company 30 after a flash-over on its 110-kv. lines before re-energizing the line to permit the insulator to cool sufficiently. This practice does not interrupt service because duplicate lines are used. Company 11 says that arcing horns are used on 50 per cent of its lines to protect the cables. They have no appreciable effect on the insulators. Heavy insulators that will not be easily damaged by the arc heat are used by company 4 Several companies state that the surface of insulators are blistered by a flash-over and collect moisture and dust more easily, although company 29 says the glaze on the newer insulator is not affected to great extent. Therefore companies 20, 30, 40 and X remove insulators after a flash-over. Extra-long pins are used by company 3 to prevent trouble from flash-over. Companies 10, 11 and 31 say that trouble from this cause is rare.

Very few companies have reached the stage of insulator investigation where they plot the percentage of insulator failures against the years of service. The reports run about as follows, the figure in parentheses being in every case the company number:

(1) Four to 9 per cent fail after fifth year for pin and disk respectively.

(2) Eight years' average life.

(8) Beginning in 1915, two years after completing its 43-mile double-circuit 66,000-volt transmission line, this company tested with a megger about 50 per cent of the 15,696 insulators then installed, classifying them as to position (*i.e.*, dead-end or straight-line) and according to type. Every year since then it has made similar tests, just recently substituting the "buzz-stick" for the megger. Over 30,700 insulators were in service in 1918. In all except two tests out of fourteen the percentage of faulty dead-end units was greater than the defective straight-line units, ranging from thirteen to one to about one to one. No type seemed to have any definite rate of depreciation, the percentage removed each year departing considerably from any average depreciation curve. Two types showed no depreciation after two years of service, whereas one type showed as high as 38 per cent for dead-end positions. The data did indicate very clearly, however, which types were unsuitable and also indicated that such records should be kept permanently. As a result of these tests the use of three types of insulators was discontinued.

(9) Four years' average life for old-type units and six to eight years for new units with cushion between pin and porcelain.

(10) Pin insulators rated at 30,000 volts installed in 1903 gave trouble in 1910 to 1912.

(11) Fifty-one per cent of 22,000 type A insulators failed in nine years. None of 11,000 type B units failed in five years.

(11A) After four years of service about 12 per cent of all insulators tested weak, the next year about 10 per cent, the next year 8 per cent and the seventh year about 5 or 6 per cent. Not much difference was noted between different types.

(20) Pin-type start to fail after two years; no failures in three and one-half years with suspension insulators.

(29) In 1918 less than 2 per cent of 400,000 insulators failed in service or under test, and in 1919 less than 1 per cent; some pin insulators installed in 1907 still in service; some link insulators installed in 1910 still in service; other insulators have shown rapid deterioration; units of last three years show remarkable improvement.

(30) Four and six-tenths per cent showed fault on test and 1 per cent punctured in six years.

(31) Ten to 25 per cent a year fail at end of ten years.

(33) The cap-and-pin disk insulator in strain has an average yearly mortality of 2 to 5 per cent, whereas the same unit in suspension has a mortality of only 0.5 to 2 per cent. Pin insulators are more erratic than disk type. Some 22,000-volt pin insulators have been in service since 1915 with less than 0.5 per cent becoming defective, whereas two lines which have been in service only three years have lost 28 per cent.

(34) Six years in service.

(36) A 75-mile, 60-kw. line was salvaged in 1917 after ten years of service, and the pin insulators (Locke 341) were installed on another line. Except for those units injured in transit, these old units are holding their own with insulators which have been in service a much shorter time. On another line 30 per cent of 75,000 disk insulators installed in 1912 failed after five or six years.

(37) Sixty-thousand-volt line has been in service over sixteen years and insulator failures have been negligible.

(38) Has compiled some elaborate data on percentage of defective insulators found after various lengths of service, but no specific law seems to be followed. For instance, on one of its 150,000-volt lines the percentages of defective insulators found after twenty-eight, thirty-nine, forty-four and seventy-one months of service were 1.6, 2.9, 12 and 1.3 respectively, while on several 60,000-volt lines the percentages of defective insulators found after twenty-eight, thirty-eight, forty-eight, fifty-eight and seventy-two months of service averaged 5.75, 7, 8, 7 and 8.25 respectively. In all cases, however, a higher percentage of dead-end units was found defective than of suspension units—from two to six times greater.

(39) Insulators purchased and installed within the last ten years, made under modern manufacturing conditions and methods, have shown no signs of deterioration. Some insulators which were installed twenty years ago are still giving exceptionally good service. Other insulators of identically the same dimensions and shape have given continued trouble since being installed. All were manufactured before 1905 and many installed with cemented-in metal pins. Signs of electrolytic corrosion have been evident, which has resulted in severe mechanical stresses that may have been the cause of some failures, although inferior porcelain and workmanship was the general cause.

(40) Four-part pin insulators in service about fifteen years show approximately one-third of the insulators with one or more defective parts. In some sections, however, the number of defective parts is not more than 5 per cent of the total number of parts. Suspension insulators made prior to 1914 show about 20 per cent depreciation to date.

(X) Maximum life, twelve years; average life, eight years; 70 per cent of 86,000 units installed in 1913 still in service; much longer life indicated by new units, only 10 per cent of 38,600 installed in 1915 having been found defective so far.

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[17] Used in some cases; effectiveness not known because of other steps taken to prevent trouble, such as use of different insulators and improved testing methods.

Electric Service in Illinois Coal Mine

Typical Installation and Distribution Features of Coal Mine Service Shown in Installation of Union Colliery Company at Dowell, Ill.—Energy Consumption About 4 Kw.-hr. per Ton of Coal Mined

By H. W. EALES

Chief Electrical Engineer Union Electric Light & Power Company, St. Louis, Mo.

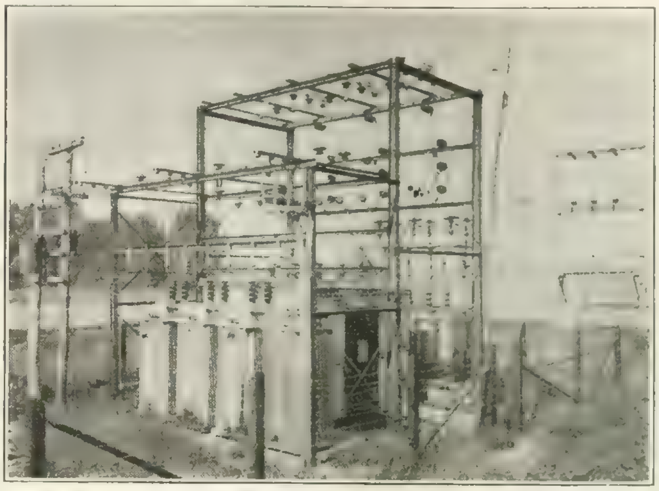


FIG. 1—TYPE OF CONSTRUCTION USED FOR OUTDOOR SUBSTATION SUPPLYING COAL MINE

THE coal-mining industry has certain power requirements which are typified in the service supplied by the Central Illinois Public Service Company to the Union Colliery Company. The capacity of the installation is not the important feature but rather the method of handling the distribution problem of an average-sized mining property supplied by central-station power. It is also of interest to note that the energy consumption of this company has been found to be approximately 4 kw.-hr. per ton of the coal that is mined.

Energy is delivered at 33,000 volts, three-phase, 60 cycles, to a semi-outdoor type of substation. As shown in Fig. 1, a structural steel tower is used for dead-ending the transmission line and to support the various buses, disconnecting switches, etc. The 33,000-volt metering equipment and main oil switch are installed in a small brick house constructed within the base of the tower. Three 333-kva., single-phase, self-cooled transformers, with one additional spare unit, transform the 33,000-volt supply to 2,200 volts. This equipment is protected by a three-phase, 33,000-volt electrolytic lightning arrester. Meters are inserted in the 33,000-volt side by the company supplying power, and each distributing circuit is metered to check the power used in the various operations.

From the outdoor substation bus energy is transmitted at 2,300 volts by No. 4/0 three-conductor lead-covered cables in 3½-in. (8.9-cm.) fiber duct laid in cement to the air shaft, approximately 40 ft. distant, and the main shaft, approximately 400 ft. (122 m.) distant.

Within the air-shaft hoist house the principal distributing switchboard has been installed as shown in Fig. 2. From the line diagram of Fig. 3 it will be seen that from this board are handled four power circuits and a lighting circuit, namely, 2,300-volt circuit to air-shaft hoist motor, 2,300-volt circuit to 200-kw. motor generator set, 2,300-volt circuit to mine bottom, temporary 230-volt circuit to ventilating fan, and a 2,300/230-volt lighting circuit for lighting the town of Dowell.

At the main shaft house power is supplied from the 2,200-volt outdoor substation bus through distributing panels to the motor-generator set for the main hoist and to a 150-kva., 2,300/230-volt, three-phase transformer which supplies power to various motors on the tipple.

In the mine proper there are two distribution systems—an alternating-current system for coal-cutting machines, pumps, lights, etc., and a direct-current system for haulage. The alternating-current energy is transmitted to the mine at 2,300 volts by means of a No. 0 three-conductor steel-armor and lead-covered cable. This cable is carried down the shaft on substantial wooden cleats fastened to 6-in. x 6-in. (15-cm. x 15-cm.) timbers spaced 4 ft. (1.2 m.) apart and terminates in a special high-pressure-type pothead which is compound-tight and capable of withstanding the hydrostatic pressure of the 300-ft. (91.5-m.) head.

This 2,300-volt incoming feeder terminates in the mine substation, which is situated at the bottom of the air shaft. Referring to the line diagram, it will be noted that a distributing bus feeds two outgoing cables, each protected by an automatic oil switch as shown. These cables are also of the steel-armored type, and each is carried buried in a trench in an air course to a transformer vault. In each transformer vault is installed a 150-kva., 2,300/230-volt, three-phase oil-cooled transformer, the secondary of which is connected solid to a local No. 4/0 distribution network for supplying power to the coal faces. This secondary network wiring is run open and supported on thimble insulators mounted on wooden mine props. This wire can readily be taken down and moved to other locations as the working faces move outward. As the working faces progress away from the source of power, the 2,300-volt cables are extended and the transformer moved to a new distributing center. Under

FIG. 2—SWITCHBOARD AND HOIST-CONTROL EQUIPMENT IN AIR-SHAFT HOIST HOUSE; SLIP REGULATOR IS NOT SHOWN BUT IS AT RIGHT OF CONTROL PANEL

present operating conditions the transformers are used to supply a local secondary area of approximately 1,000-ft. (305-m.) radius.

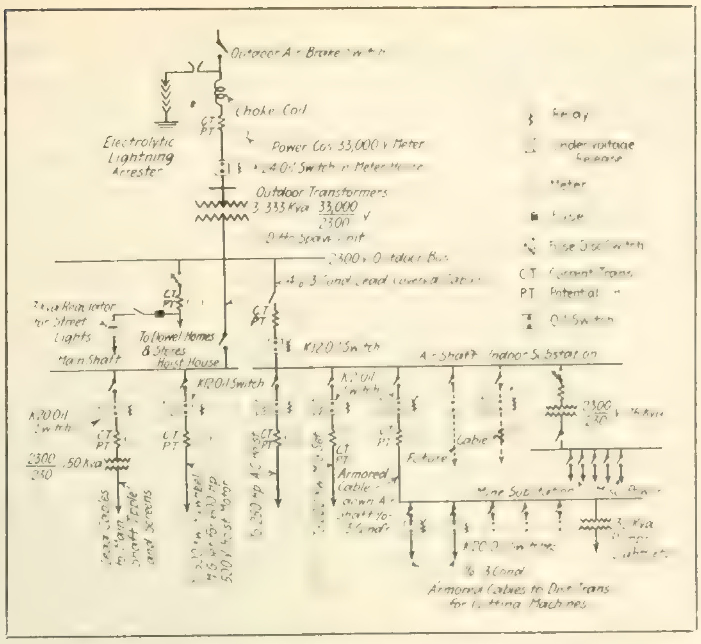

Outdoor Air Brake Switch
Choke Coil
CT PT
Electrolytic Lightning Arrester
Power Co's 33,000 v Meter
Oil Switch in Meter House
Outdoor Transformers 3 333 Kva 33,000/2300 v
2300 v Outdoor Bus
3 Cond. Lead Covered Cable
Regulator for Street Lights
To Dowel Homes & Stores
Main Shaft
Hoist House
K120 Oil Switch
Air Shaft Indoor Substation
K120 Oil Switch
2300/230
50 Kva
Armored Cable down Air Shaft
Future
Cable
Mine Substation
3 Cond.
Armored Cables to Dist. Trans. for Cutting Machines
Relay
Under voltage Release
Meter
Fuse
Fuse Disc. Switch
CT Current Trans.
PT Potential "
Oil Switch

FIG 3.—LINE DIAGRAM OF COAL-MINE POWER DISTRIBUTION

Provision has been made in the mine substation for the addition of a number of such 2,300-volt distribution cables and for one or more incoming feeders from the surface substation.

Direct current for mine locomotives is supplied by a 200-kw., 275-volt motor-generator set in the air-shaft hoist house and is carried to the mine down the air-shaft by 900,000-circ.mil., 500-volt paper-insulated, lead-covered cables, one of the same size being used for the return. This cable also terminates in the mine substation on a bus which supplies two circuits feeding in opposite directions, each circuit being protected with a 400-amp. automatic reclosing-type circuit-breaker. The No. 2/0 trolley system is sectionalized into two groups, each group being protected by one of the reclosing circuit breakers. As the mine develops it is planned to install mine substations with converting equipment operating at 2,300 volts alternating current for supplying direct-current power to the haulage system.

Trolley-type 6-ton, 250-volt locomotives are used in the haulage work although a 15-ton machine is soon to be added. Mining machines are of the short wall type rated at 30 hp. (one hour, 55 deg. C.), operating on 230-volt, three-phase current. Fig. 4 shows one of these machines in operation and will give an idea of the conditions these machines must operate under.

Power requirements on the surface are divided mainly into that required for hoisting and that required for the tipple. Hoisting at the Kathleen mine is done at the main shaft and at the air shaft.

The main shaft hoist, as shown in Fig. 5, is operated by a 600-hp. (40 deg. C. continuous rated), 235-r.p.m., 500-volt shunt-wound, direct-current motor, which is connected to the pinion shaft of the hoist drum through a Francke type flexible coupling. Power for the motor is supplied by a four-bearing, 900-r.p.m. flywheel-type motor-generator set of the following specifications: Motor, 500 hp., 2,300 volts, three-phase, 60-cycle, wound-rotor-type; 20,000-lb. (9,000-kg.) flywheel, 92-in. (2.3-m.) diameter, riveted-steel plate type. The power input to the flywheel set is limited by an automatic liquid slip regulator, which is self-cooling. The flywheel when operated normally has sufficient stored energy to complete any given hoisting operation.

The speed control of the hoist motor is operated on the familiar Ward-Leonard-Ilgner system. The motor speed is changed by varying the voltage of the separately excited generator. Direction of rotation is changed by reversing the field excitation of the generator. All of these operations have been simplified so that the engineer performs them by moving his control lever forward or backward.

The cycle of operation for the 325-ft. (100-m.) depth vertical shaft is as follows: Acceleration, seven seconds; full speed running, fifteen seconds; retarding, five seconds; loading, nine seconds; total, thirty-six seconds.

Operating at this cycle the capacity is 5,000 tons in an eight-hour day.

The air-shaft hoist, which is used mainly for men and materials, is operated by a 250-hp., three-phase, 450-r.p.m. slip-ring induction motor. Speed control is obtained by means of grid resistances connected in the rotor circuit. While the main shaft tipple was being built coal was hoisted through the air shaft. In both of these hoists over-wind devices and track limit switches are in use.

Tipple motors are all of the inclosed ventilated type, galvanized air ducts being piped from the motor to a source of clean air outside the tipple. Power requirements

FIG. 4—SHORT WALL MINING MACHINE IN OPERATION (NOTE SEVERITY OF MOTOR OPERATING CONDITIONS)

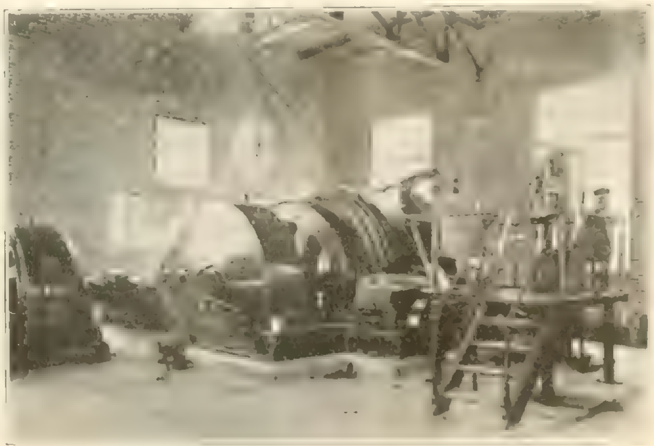


FIG. 5—MAIN SHAFT HOIST USING WARD-LEONARD-ILGNER CONTROL

for tipple work are as follows: One 20-hp., 600-r.p.m. variable-speed feeder motor; one 20-hp., 900-r.p.m. variable-speed shaker screen; one 20-hp., 600-r.p.m. constant-speed picking table; two 10-hp., 600-r.p.m. constant-speed gob conveyors; three 5-hp., 600-r.p.m. constant-speed loading.

The control devices for all motors are installed on a central control platform, where there is also a steel cabinet-type distributing box for handling the incoming 230-volt power supply and distribution. Power for these motors is supplied by a 150-kva., three-phase transformer in the main-shaft hoist house. By closing a push-button circuit at the distribution cabinet on the control platform the tipple operator can open the oil switch on the primary side of the transformer, instantly shutting off power.

The present ventilating requirements necessitate the operation of the fan at slow speed, and a 50-hp. wound rotor motor was installed as suitable for present needs. As the workings are extended and greater ventilation is needed a 250-hp., 2,300-volt motor will be used for the fan drive.

Characteristics of Different Street Lighting Systems

The Constant-Current Series, the Constant-Potential Series and the Constant-Potential Multiple Systems Compared

"SINCE all arc lamps with the exception of the luminous or metallic-flame lamp have been practically superseded by the gas-filled incandescent mazda lamp for street lighting, there is no longer the necessity for the constant-current circuit," said Dr. C. P. Steinmetz, in an address before the three hundred and fifty-seventh meeting of the American Institute of Electrical Engineers in Chicago. "However, the increasing number of incandescent lamps being installed on constant-potential series and multiple systems will still require high voltage distribution.

"Constant-potential circuits, other things being equal, are preferable to constant-current circuits for the operation of tungsten lamps because, unlike the carbon lamp, the tungsten lamp has a positive temperature coefficient. Consequently, with changes in circuit conditions the voltage varies more than the current in tungsten lamps, while the reverse is true in carbon lamps. It follows therefore that the current regulation on a constant-current system must be closer than that of the voltage on a constant-potential system if tungsten lamps are required to give the same life in each case." Dr. Steinmetz then gave a comprehensive discussion of the characteristics of street-lighting systems which is abstracted here.

Danger of Surging Practically Eliminated

The regulation which can be obtained by the use of modern regulators on constant-current systems is amply close for the successful operation of tungsten lamps, and if reasonable care is exercised the danger of surging hardly exists. It is only where tungsten lamps are operated in series with arc lamps that the life of the tungsten lamps may be reduced by surges due to an overloaded circuit or to maladjustments of the arc lamps.

The problem of voltage regulation is eliminated in constant-potential street-lighting systems, where the high-voltage series or multiple systems are supplied from individual transformers. This is because domestic lighting constitutes a large part of the load of the electric supply systems and the voltage regulation required for that service is satisfactory for constant-potential, series or multiple street-lighting systems.

The constant-potential series system is less flexible than the constant-current system in the number of lamps that can be used. However, the full number of lamps on a constant-potential series system can be reduced by the insertion of reactances and by changing transformer taps. The high voltage to ground is another disadvantage of this system. On the other hand, the constant-potential systems have the advantage of high power factor, high efficiency and that they can be operated from a transformer on a pole without special station equipment. Furthermore, with the constant-potential multiple system of distribution, the number of lamps is practically unlimited. When the street lights are tapped on to a general distributing system, however, it is a problem to turn the lamps on and off, and no satisfactory and economical device has been developed for that purpose.

A COMPARISON OF THREE TYPES OF STREET-LIGHTING SYSTEMS—C. P. STEINMETZ

	I Constant-Current Series System	II Constant-Potential Series System	III Constant-Potential Multiple System
1. Type of lamp	Arc lamp or incandescent lamp	Incandescent lamps only	Incandescent lamps only
2. Station apparatus	Constant-current transformer or reactor, etc.	None. Transformer on pole	None
3. Number of station circuits	A separate circuit for every lighting circuit	No special circuits from station	No special circuits from station
4. Number of wires per circuit	Single-wire circuit	Single-wire circuit	Two-wire circuit
5. Accessories at lamp	Film cut-out, or auto-transformer or series transformer	Auto-transformer or series transformer	Constant-potential transformer for one or more lamps
6. Size of circuits	Limited number of lamps per circuit	Limited number of lamps per circuit	Unlimited number of lamps per circuit
7. Flexibility	Great flexibility in number of lamps	Lesser flexibility	Great flexibility in number of lamps
8. Power factor	80 to 85 per cent with incandescent lamps, 70 to 75 per cent with arc lamps	95 to 99 per cent	Practically unity
9. Safety	High voltage at lamp except when using transformer	High voltage at lamp, except when using transformer	Low voltage at lamp
10. Switching	At station	Special	Special

Readers' Views and Comments

Hydro-Electric Nomenclature

To the Editor of the ELECTRICAL WORLD:

SIR: Referring to Mr. Tallant's letter on page 324 of the Feb. 7 issue of the ELECTRICAL WORLD, we agree thoroughly with him as to the desirability of adopting the uniform nomenclature embodied in the generic term "hydraulic turbine" and the subdivisions "impulse turbine" and "reaction turbine." We are heartily in favor of a uniform adoption of these terms as contrasted to the more or less ambiguous term "waterwheel." This latter term conveys an idea quite at variance with the modern design of high-grade units and we believe should be retained as applying more exactly to the small apparatus that Mr. Tallant mentions as well as to the overshot, undershot and breast types of apparatus which are purely waterwheels.

There is another aspect to the situation, however. It would be well to adhere to the first three terms mentioned above, but the fact remains that, according to present popular notions and usage, any rotating device that develops power from water will be automatically considered a waterwheel and undoubtedly will be so designated. This may change in time, but the change could be accomplished only after a considerable period of exclusive use of the other terms by the various interests that have need for them.

We are in accord with Mr. Tallant's views and are sure that practically all the hydraulic turbine builders in the country will take a similar attitude. The Pelton Water Wheel Company might reasonably be expected to be the only authority to object to the three terms in question, and Mr. Tallant's article strikes us as being very commendable. M. H. WHITE,

Manager and Chief Engineer Hydraulic Department,
Allis-Chalmers Manufacturing Company.
Milwaukee, Wis.

Let There Be Light

To the Editor of the ELECTRICAL WORLD:

SIR: Reports from the most recent visitors to Bolshevist Russia are to the effect that the soviet system has broken down and that in its place the ruling powers have partly built and are planning to extend on a nation-wide scale a system of compulsory labor under militaristic discipline. It is doubtless as a part of this system that Lenine is dreaming of the great scheme of hydro-electric development to which editorial allusion was made in your columns a week or two ago. Such a vast undertaking would be utterly impossible under soviet rule, a plan of government suitable only to semi-civilized people—one that might conceivably endure in the interior of China or in Persia or Hindustan, were the natives of those countries to seize upon it as an avenue of escape from political serfdom, but which must wither in any land which Occidental breezes reach.

In the Russia of old an eternal conflict between Europe and Asia was waged, and it used to be held that as long as the peasants wore their shirts outside their trousers Asia would have the better of it. It may be that out of the welter of Bolshevism Europe will emerge the victor—not the autocratic, imperialistic, landlord-ridden Europe of yesterday, but the republican, forward-striving Europe that is slowly being born from the wreck of war. Certainly, if Russia is to be flooded by electric light and fortified with electric power by the efforts not of foreigners but of Russians themselves, shirts all over that land will be tucked inside the trousers. Let it be hoped that simultaneously "proletarian" tyranny will disappear, to be superseded by that system of representative democracy under which all modern political progress and all lasting social amelioration has been accomplished.

Brooklyn, N. Y. FRANK W. CHASE.

Barometric Pressure and the Metric System

To the Editor of the ELECTRICAL WORLD:

SIR: The high atmospheric pressure during the cold period prior to Feb. 7 was noted in the ELECTRICAL WORLD for that date. As we are all living near the bottom of a sea of air and this sea of air does not recognize national boundaries, it is preferable to record meteorological data in the international way, especially if that is the most convenient. The barometer reading given was 30.85 in. or 784 mm. At sea level about New York City the column of mercury rose as high as 790 mm. It will be seen that this manner of recording air pressure (1) requires no fractions of any kind, (2) is an international method, (3) represents a definite measurement, based on the international meter, and hence represents the same thing in all countries.

The British yard standard is a national standard only and renders the British mile, yard, etc., slightly different from the corresponding United States measures, which have been based on the meter since April 5, 1893. The large iron and steel company of China, the Hangyang Iron & Steel Works, has used only the metric weights and measures, and even the old measures of China have been redefined in terms of the metric standards. The Chinese word *ch'ih* officially indicates 32 cm. The *ts'un* indicates 32 mm. These differ from two corresponding measures in Japan and also from our foot and inch. All of these measures, however, in the United States, China and Japan are definitely defined in terms of the international meter. It seems obvious, therefore, that mutual understanding and convenience will be effected by use of the millimeter in recording barometric pressures.

The same advantages may be secured by the use of millimeters in recording the precipitation of rain and snow. During the snowstorm which began on Feb. 4, the precipitation was 4.45 in. or 112 mm., as recorded by the United States Weather Bureau at New York City. Not only is the millimeter a more convenient measure, but the use of such a measure will have a splendid educational value.

The metric weights and measures were legalized by the United States Congress for all transactions in 1866, and the Weather Bureau is at liberty to publish its data in the metric way and will probably be glad to do so.

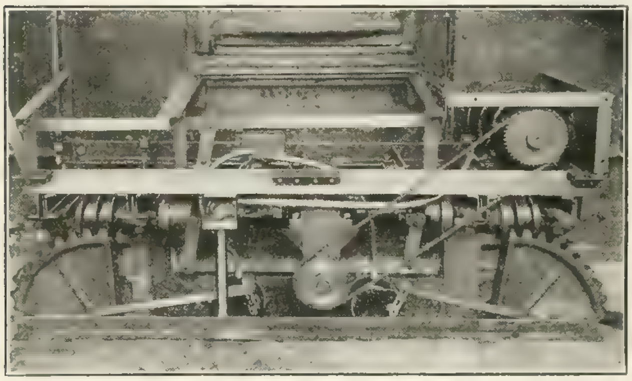
HOWARD RICHARDS, JR.
Secretary American Metric Association.
New York.

Station and Operating Practice

A Department Devoted to Problems of Installation,
Operation and Maintenance of Equipment for Economical Generation and
Distribution of Electrical Energy

Electric Drive Found Satisfactory for Ash Dump

WITH compressed air available only a part of each day and all exhaust steam used to heat boiler make-up, the Buffalo General Electric Company decided that the best method to operate the mechanical dumping mechanism for its Westinghouse twelve-retort stokers was by means of electric motors, chain and worm drive. The mechanism shown in the illustration operates one-half of each stoker, there being duplicate equipment for operating the other halves. Each motor drives a short shaft parallel to it through a chain, this shaft, in turn, driving a cross-shaft through a worm and worm wheel. Two standard jaw clutches enable either the right-hand or left-hand dump section to be operated. This drive contains the usual shearing pin which forms part of the standard stoker, so that in case of binding the pin will prevent excessive stress on the mechanism.


ELECTRIC MOTORS USED FOR OPERATING POWER ASH DUMP

An auxiliary panel is furnished with a double-throw switch for reversing the motor, one direction being for opening the dump and the opposite for closing. Limit switches are provided on each section of the dumping mechanism. **H. L. Rawson.**

Buffalo, N. Y.

Some Pointers for the Construction Crew Foreman

WHEN an electrical construction foreman measures his men by the amount of work they do, in the same manner as a foreman of ditch diggers, it will usually be found that the station operating records will later on show a series of interruptions due to carelessness in construction. Electrical apparatus is often of a delicate nature and considerable adjustments are necessary after the apparatus arrives in the field. For instance, when an electrician is detailed to mount and connect some oil switches, if he knows that the foreman wants a good job done and will not blame him unjustly if the time occupied is longer than expected, he will give the switches internal inspections, make adjustments, solder lugs and connect the operating rods or electrical control in such a manner that the switches will give excellent service for years. On the other hand, if he knows that the foreman will reprimand him for not making fast enough progress, he will not exercise the care that would insure a first-class job.

The present-day successful foreman will study his men and know their weak and strong points. For instance, he may have a man in the crew who has had some experience at blacksmithing and he can use this man for sharpening chisels and doing other jobs at the forge. Then he may have a man who takes pride in his ability to work on live wires, and if this man is intelligent and careful he is the logical man to use for such work. There is often carpenter work in connection with electrical work, and the foreman will usually find a man who is qualified along this line.

When there is rough work to be done and laborers are not available it may be a good idea for the foreman to give each electrician a share of the work. If the same man be kept at a disagreeable task for several days—for example, drilling concrete in cramped quarters in a hot generator pit until his hand becomes blistered—while others are exempt, jealously and accusations of partiality are pretty sure to arise. **L. W. Wyss.**

Iron Mountain, Mich.

Battery Floating Voltage Should Be 2.12 to 2.14 Per Cell

SINCE storage batteries for emergency excitation of generators must perform a very important duty when called into service, every precaution should be taken to have them in readiness. To accomplish this, care in operating and charging is necessary. The first point to consider in operating is to keep the end-cell switch on such a contact as to maintain a voltage of 2.12 to 2.14 across each cell when the battery is "floating" on the exciter line, so that energy does not pass to or from the battery although it is connected across the line in readiness to take up the load should the power supply fail. In such a case when the battery is called into use it should not be allowed to discharge after the voltage has dropped to a certain value. This limiting voltage together with the number of minutes taken to reach this condition for different rates of discharge are shown in the accompanying table for a battery rated at 1,000 amp.-hr. for one hour. These limits should not be exceeded, but in case of extreme emergency the battery may have to operate after they have been passed.

CELL VOLTAGE AND GRAVITY READINGS AT WHICH BATTERY SHOULD BE RELIEVED OF ITS LOAD

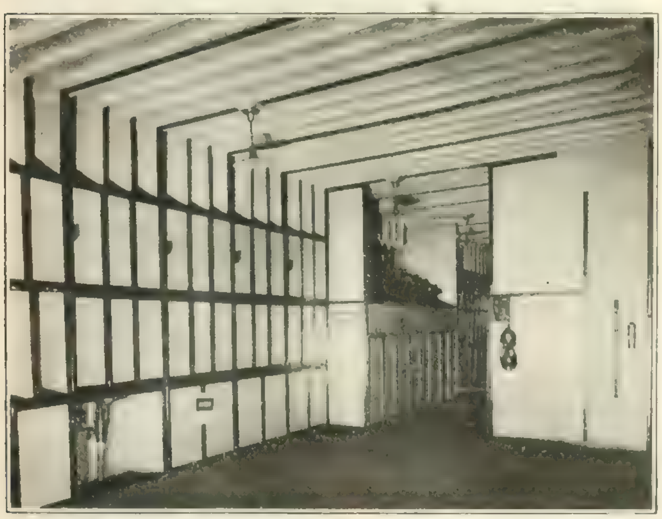
Rate of discharge (amp.)	1,000	1,570	2,000	3,000
Time limit at this rate (min.)	60	30	21	10
Amp.-hr. at this rate	1,000	785	700	500
Voltage per cell falls to	1.60	1.53	1.48	1.31

After a discharge the battery should be charged immediately in the same manner as the periodic weekly charge. In making this charge the normal current (156 amp. for the battery mentioned) is sent through the battery until the voltmeter and the hydrometer readings have been constant for one half-hour. After an over-discharge the readings should be constant for one hour. In case it is required to hasten the charging, it may be done at 130 per cent of normal rate until gasing starts, when the rate should be lowered to normal. If a lower rate must be used, the time of charge after the voltage and gravity are constant should be proportionately increased. Following a discharge, care must be taken in charging the end cells which were not discharging during the entire time. These cells must not be charged as long as the cells which are fully discharged. An indication of completion of charge of these cells is free gasing.

These instructions are extracted from a set of rules for use in the stations of the Pennsylvania Water & Power Company.

Barriers Increase Safety in Electric Station

THE use of more barriers in station construction was recommended to the National Safety Council by Walter C. Wagner of the Philadelphia Electric Company in a paper read before the public utilities section of that body. He pointed out that barriers are superior to warning signs in that they form a physical protection against thoughtless or accidental movements. No hazard is incurred through their deterioration, and equipment is easily inspected and is accessible for repairs and changes. Simplicity of arrangement of conductors and apparatus also serves to increase safety.



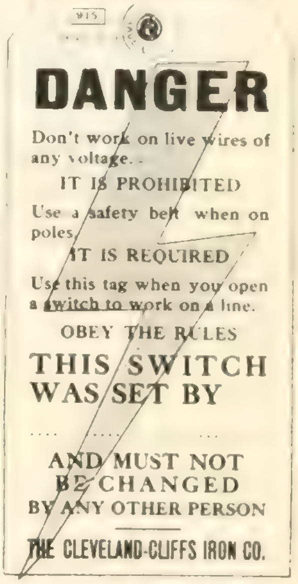
BARRIERS FOR FEEDER AND ARRESTER PARTS

Regarding barriers of concrete construction it must be noted that concrete is not in any sense an insulator, nor is it a good conductor. It serves to isolate live parts which are otherwise insulated, and it supports casings and frames which must be grounded by other means even though the concrete is reinforced with steel. Generally barriers should not support live buses or apparatus subject to stress from electrical disturbances.

The doors to fit in the opening between barriers should be small, light and rugged. They may be made with asbestos panels, clear wire glass in front of disconnecting switches, or heavy screen wire where heat radiation necessitates. A door with a spring-hinged panel is preferable on locked apartments in front of current transformers and oil switches where electrical breakdown might cause a sudden formation of gases.

Safety Measures for Protection of Linemen

IN THE interests of safety, iron and copper mining companies in the upper Michigan peninsula take the control of defective high-tension lines out of the hands of the station operators and place it under the jurisdiction of the linemen who have to make the repairs. Linemen are required to go and see that the main switch is open before they go out on a case of trouble. They must sign a card or tag and attach it to the switch handle. No one else is then allowed to touch the switch without the permission of the man whose name appears on the card. Striking size, color or type makes these cards conspicuous, and such statements as the following are printed on them: "This switch was set by ——— and must not be opened by any other person." "Keep open until notified by — —."



915

DANGER

Don't work on live wires of any voltage.

IT IS PROHIBITED

Use a safety belt when on poles.

IT IS REQUIRED

Use this tag when you open a switch to work on a line.

OBEY THE RULES

THIS SWITCH WAS SET BY

....

AND MUST NOT BE CHANGED BY ANY OTHER PERSON

THE CLEVELAND-CLIFFS IRON CO.

SAFETY CARDS USED IN MINES

The Cleveland Cliffs Iron Company, Ishpeming, Mich., which has more than 80 miles (130 km.) of 30,000-volt transmission line, adheres rigidly to this practice. The Calumet & Hecla Mining Company, Calumet, Mich., goes one step further and insists that its linemen short-circuit and ground a defective line near the power house. This is done by wrapping a chain around the line in addition to the other precautions mentioned. S. N. CLARK.

Chicago, Ill.

Grounding Handle of Air-Break Switch to Prevent Accidents

To protect operators from danger attending the operation of the iron handle on air-break switches and to assure the operator that adequate precautions are taken one company has a ground wire attached directly to each handle so that it is in plain view. In addition to this an insulated platform is provided, since there have been cases where an operator received shocks even with frames and mechanism grounded. This was caused, however, by an unusual gust of wind blowing the arc from the horns onto the frame work. To eliminate this danger some of the latest types of switches have horns of such shape that the arc is broken high enough up on them to prevent its being blown to the frame.

Chicago, Ill. T. N. THOMAS.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

Mirror for Inspecting Inside of Indirect Lighting Fixtures

DUST on the interior parts of lighting fixtures may be easily seen from the floor by using the device shown in the accompanying illustration. The outfit consists of a convex mirror, such as is used on an automobile windshield, arranged to be held above the fixture by means of a collapsible tube about 5 ft. (1.5-m.) long. This tube may be made from the leg of a camera tripod. Experience with this device has proved its worth in a maintenance campaign which was conducted to show industrial plants the amount of dirt that collects on fixtures and the necessity for systematically cleaning and inspection. J. C. STAIR.

MIRROR USED TO INSPECT CONDITION OF LIGHTING FIXTURES

Chicago, Ill.

Automatic Control Speeds Up Printing-Shop Production

AUTOMATIC control apparatus installed in a printing plant in Great Britain has increased its output through eliminating starter trouble caused by "inching" and malpractice. Formerly an ordinary starting switch was employed and trouble was constantly experienced from blowing of fuses and burning of the studs on the switch. The main cause of the trouble was "inching" of the presses, which is a necessity in printing. Attempts were made to force the pressmen to do their inching by hand, but they refused, giving as one reason that they had to wash their hands after turning the flywheel. Another source of trouble was malicious blowing of the fuses by throwing in the line switch with the starter in the running position.

After an investigation a push-button-control panel was put on each machine, and since that time much of the trouble has stopped. The presses can be inched without damage and fuses cannot be intentionally blown.

Glasgow, Scotland. L. E. WOOD.

Electrical Equipment for Coal Mine Operation

BY THE use of electrical equipment through the Moran (Iowa) mine of the Norwood White Company proper operation has been assured so that maximum production can be obtained. In addition, the apparatus can be protected against misuse and can be regulated properly.

For instance the hoist cage, weighing 4,700 lb. (2,100 kg.), is arranged so that the power is automatically cut off and the oil brake is set by a solenoid in case the operator approaches the dumping point at too high a speed or tries to pull the cage through the dump horns. This cage makes an average of two and one-half trips per minute with a 1,500-lb. (680-kg.) car and 4,000 (1,800 kg.) lb. of coal. A herringbone gear and flexible coupling connect the hoist with the motor.

CONNECTED LOAD OF COAL MINE

Name of Apparatus	Capacity	Hp. of Motor	Speed Constant or Variable	Location of Motor
Hoist.	5T. coal per min 330 ft. travel	300	Variable	Hoist house
Ventilating fan, 120 in.	70,000 cu ft. air per min	35	Variable	Air shaft
Crusher.		25	Constant	Tipple
Car hoist .		15	Variable	Shaft bottom
Shaker. ..		10	Variable	Tipple
Pump.	50 gal. per min., 350 ft. head.	10	Constant	Shaft bottom
Shop motors .		10-15		Shop
Lighting circuit.	. . . .			

In the shop an aggregate of 10 hp. to 15 hp. of individual 440-volt, 25-cycle motors drive a forge blower, a power hammer, a drill press, saws, etc.

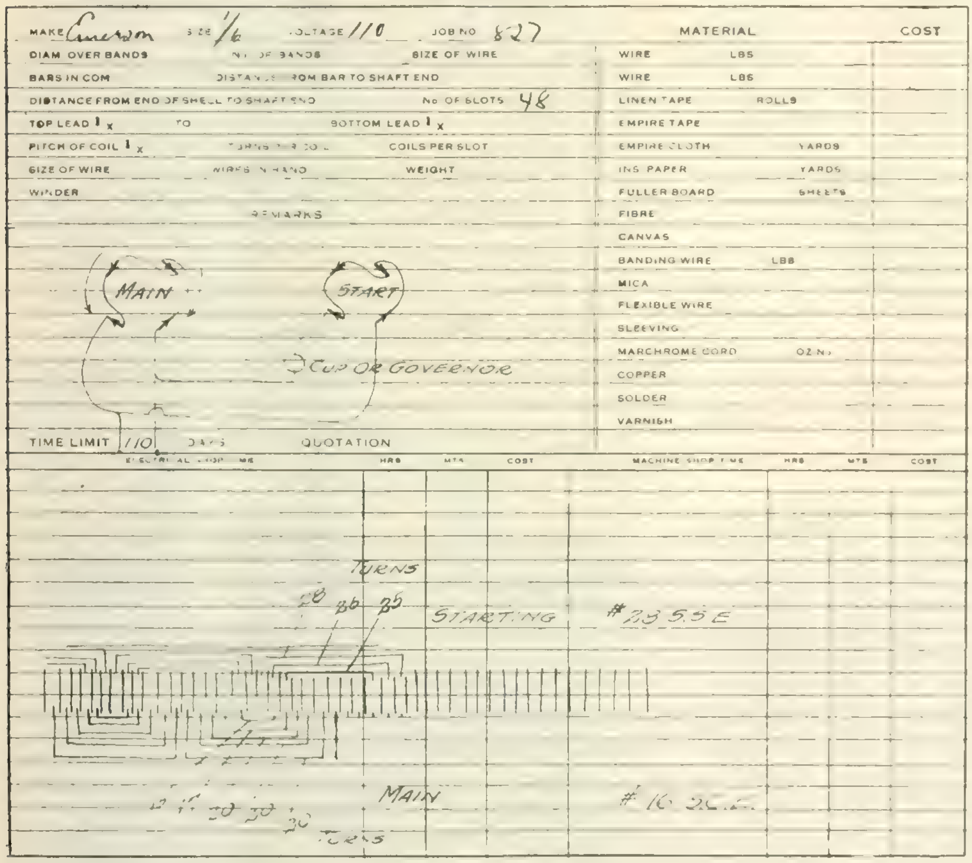
The 22,000-volt line of the Inter Urban Railway Company, Des Moines, which supplies the energy, terminates in a 300-kw. Delta Star substation. The expanded steel tower of this station occupies a ground area of 18 ft. (5.5 m.) by 8.5 ft. (2.6 m.), the height above ground being 25 ft. (7.6 m.) with corner posts set 5 ft. (1.5 m.) in concrete foundations. A guard fence approximately 10 ft. (3 m.) high will completely surround the tower. The three switching and protective units spaced on 6-ft. (1.8 m.) centers consist of a double-break-per-phase switch, a long-turn choke coil, a carbon-tetrachloride fuse and a high-speed sphere-gap graded resistance lightning arrester. The switch elements are mechanically interlocked and can be opened and closed from ground level by means of a lock-type handle. The 22,000-volt energy is transformed to 440 volts by means of three 100-kw. single-phase transformers. Other transformers step-down the current to 110 volts for the lighting circuits. Construction of this plant was in charge of Mr. Kinnard, chief engineer of the Norwood White Company.

Des Moines, Iowa. K. J. Keith.

Cost Data Card Record for Electrical Repair Shop

In the repair shop of the American Electric Service & Maintenance Company, Springfield, Mass., a convenient card record is maintained in order to determine the cost of motor-winding jobs. The cards, which are illustrated herewith, are $8\frac{5}{16}$ in. long by $7\frac{5}{16}$ in wide (21 cm. x 18.5 cm.). They are designed to accommodate all the essential information and dimensions involved in armature, rotor or field winding, with space for all classes of supplies used, cost extensions, labor record in mechanical and electrical shops. On complex work the cards bear diagrams of winding connections. It is customary to show the relation between slots and coils in developed form, as illustrated, with the number of turns of wire of specified insulation concerned in the inter-slot connections. Thus, on the card shown, the typical starting winding and the main or running coils of a ⅙-hp., 110-volt Emerson motor are illustrated.

Springfield, Mass. H. S. Knowles.


MAKE Emerson SIZE 1/6 VOLTAGE 110 JOB NO 827
DIAM OVER BANDS NO OF BANDS SIZE OF WIRE
BARS IN COM DISTANCE FROM BAR TO SHAFT END
DISTANCE FROM END OF SHELL TO SHAFT END No OF SLOTS 48
TOP LEAD 1 x TO BOTTOM LEAD 1 x
PITCH OF COIL 1 x TURNS PER COIL COILS PER SLOT
SIZE OF WIRE WIRES IN HAND WEIGHT
WINDER
REMARKS
TIME LIMIT 110 DAYS QUOTATION

MATERIAL			COST
WIRE	LBS		
WIRE	LBS		
LINEN TAPE	ROLLS		
EMPIRE TAPE			
EMPIRE CLOTH	YARDS		
INS PAPER	YARDS		
FULLER BOARD	SHEETS		
FIBRE			
CANVAS			
BANDING WIRE	LBS		
MICA			
FLEXIBLE WIRE			
SLEEVING			
MARCHROME CORD	OZ NO		
COPPER			
SOLDER			
VARNISH			

ELECTRICAL SHOP TIME	HRS	MTS	COST	MACHINE SHOP TIME	HRS	MTS	COST
STARTING				#23 S.S.E			
MAIN				#16 D.C.C.			

BOTH COST AND WINDING DATA ARE RECORDED ON PRINTED FORM

Method of Installing Armored Cables in Mines

In the installation of heavy armored cables in its shafts the Copper Range Company, Michigan, uses the hoisting engines to do the work of lowering. In the case of a 3,000-ft. (914.6-m.) feeder of three sections the top section was installed first. (All shafts on the properties of this company are inclined shafts, 70 deg. with the horizontal).

The reel was set up at a distance of 500 ft. (152.4 m.) from the shaft house, and the end of the cable was dragged to the shaft by the use of a team and started down the ladder compartment where it was to be installed. When about half of the cable had been fed out and its weight was beginning to overbalance the part that was dragging on the surface, logs were chained to it to give the necessary braking effect and others added as required. The team was used to pull the cable toward the shaft. As the end was approached the entire weight of the cable was sustained by the braking action of the logs. A 1¼-in. (3.2-cm.) block and tackle was used on the cable as a safety feature at the shaft house, hitches being made every 25 ft. (7.5 m.) as the cable advanced. Ropes tied to the end were used to guide it as it passed down the ladder compartment.

The second section was handled in the same way, but was fed down the shaft instead of the compartment in which it was to be finally installed. When 1,000 ft. (304.8 m.) were hanging in the shaft the end was looped through the eye of the hoisting rope and clamped there. The entire 1,000 ft. (304.8 m.) was then slowly lowered by the hoisting engine until the lower ends of the section came to the point where the first section ended. The second section was then started down the ladder compartment into place. The operation was repeated with the third section, except that it was necessary to lower 2,000 ft. (610 m.) before it was swung over and started down the ladder compartment.

As soon as a run was in place it was stapled to the mine timbers with a 2½-in. x 5-in. (6.3-cm. x 12.7-cm.) staple made from ½-in. (12.9-mm.) iron rod by starting from the top and working down.

The method of lowering a section to the place where it is to be worked in does away with having to convey the reels underground. The length of each section is determined entirely by what it is considered feasible to handle.

John E. Rock,
Foreman, Electrical Department.
Painesdale, Mich.

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

Cost of Heating a Five-Room Apartment by Electricity

THE Nason Apartments at Tacoma, Wash., have been successfully heated by electricity. This is an ordinary frame apartment house, three stories high, containing six apartments of four and five rooms each. There is no furnace in the building, but in each apartment there is a Humphrey "radiant gas wire" for emergency use. As yet these have not been used. Cooking and water heating are done by gas.

In each apartment two Hotpoint Electric Heating Company's 220-volt, 18.6-amp., five-heat Model E electric heaters are used, plugged into special circuits by means of baseboard plugs. In the coldest weather these heaters keep the apartments at 70 deg. Fahr. or more. The Municipal Electric Company makes a special rate for heating, which is half a cent a kilowatt-hour. The following figures show actual bills during a season for heating a five-room apartment:

September-November	$4.35	March-April	$5.20
November-December	3.75	April-May	3.40
December-January	6.95	May-June	1.70
January-February	8.40		
February-March	6.65	Total	$40.40

The simplicity and efficiency of this system show what can be done with electric heating when low rates are obtainable.

Electrical Press Service for Pacific Coast Newspapers

WITH a record of 10,000 pages of advertising in a year in California alone, under the stimulus of the campaign being carried out by the publicity committee of the Pacific Coast Section, National Electric Light Association and the California electrical co-operative campaign, it has been realized that the newspaper interest thus aroused should be maintained. The recent introduction of electrical pages into most of the leading newspapers of California has brought with it a corresponding willingness on the part of the press to feature electrical news items. Some of the papers have given word of a definite correspondence between the pages of advertising and the number of column inches of electrical publicity they are willing to give in their reading pages, and all are more cordially receptive to that type of news.

It is not always convenient for the electrical man to furnish the desirable news items from his personal store of information. The local representative of the power company or the contractor-dealers of a small community may not have a wealth of such material on hand. Recognizing the difficulties of local problems as well as the importance of seeing to it that the right type of news alone represents the electrical industry to the public, the publicity committee of the Pacific Coast Section, N. E. L. A., has instituted a regular press service which is furnished to electrical men and to such newspapers as may request it for their own use. This is issued in the form of a newspaper sheet containing news items, a record of important meetings and brief articles of interest taken from the electrical magazines. It is planned to extend the scope of the paper later on, as well as its mailing list.

Central-Station Business Today and Twenty Years Ago in Hartford

IN A SMALL folder entitled "Twenty Years of Progress" the Hartford Electric Light Company, Hartford, Conn., has presented a very interesting review of the company's expansion. It is pointed out that the growth of its business and a reduction of its rates are the result of the continually increasing demand of the public for more electric service. This information is shown in the two curves which are reproduced, one showing the relation between rates and number of customers and the other showing reductions in amount of coal used due to more efficient plant equipment.

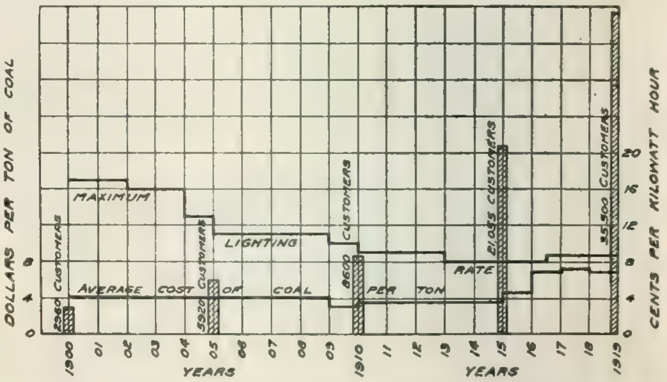


FIG. 1—RELATION BETWEEN RATES AND NUMBER OF CUSTOMERS, TAKING INTO ACCOUNT COST OF COAL

From the table which is also reproduced some interesting data are given by way of comparison between the operating conditions of 1900 and 1919. For

DATA ON GROWTH OF HARTFORD ELECTRIC LIGHT COMPANY

	Dec. 31	
	1900	1919
Generating Plant:		
Pounds coal used per kw.-hr.	7.7	2.01
Tons coal burned yearly	4,285	73,000
Kilowatts capacity in generators	3,550	37,500
Distribution System:		
Miles of overhead wire installed	533	2,036
Miles of underground duct installed	13.5	450
Number of poles installed	4,200	16,942
Kilowatts of transformers installed	3,000	48,500
General:		
Number of customers served	1,960	35,500
Investment per customer	$524.62	$231.60
Number of employees	65	510
Number of meters installed	1,035	32,778
Number of incandescent lamps installed	80,000	698,817

instance, the coal required to generate a kilowatt-hour of electrical energy in 1900 was 7.7 lb., while in the year 1919, under more favorable and efficient operating conditions, the amount was reduced to 2.01 lb. It is also interesting to note that the investment per customer in 1900 was $524.62, while in 1919 it had been reduced to $231.60. Again, while sixty-five employees were required to operate 3,550 kw. capacity in generators and maintain 546.5 miles of distribution system in 1900, twenty years later 510 employees were able to take care of 37,500 kw. of station generators, or more than ten times the capacity in 1900, and 2,486 miles of distribution system, or five times that of 1900.

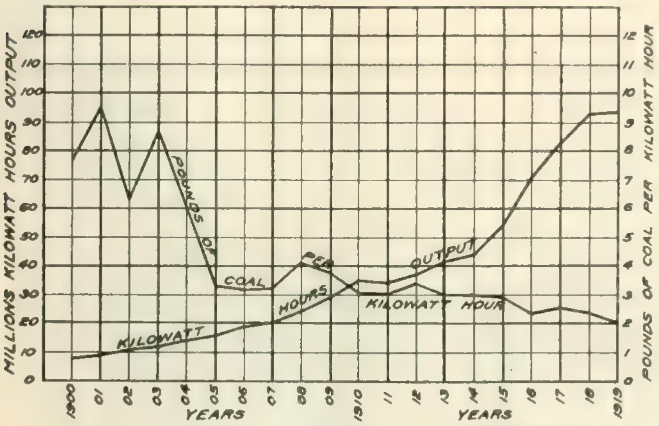


FIG. 2—REDUCTIONS IN AMOUNT OF COAL USED DUE TO INCREASED OUTPUT AND MORE EFFICIENT EQUIPMENT

How Load Center of Mines Changes

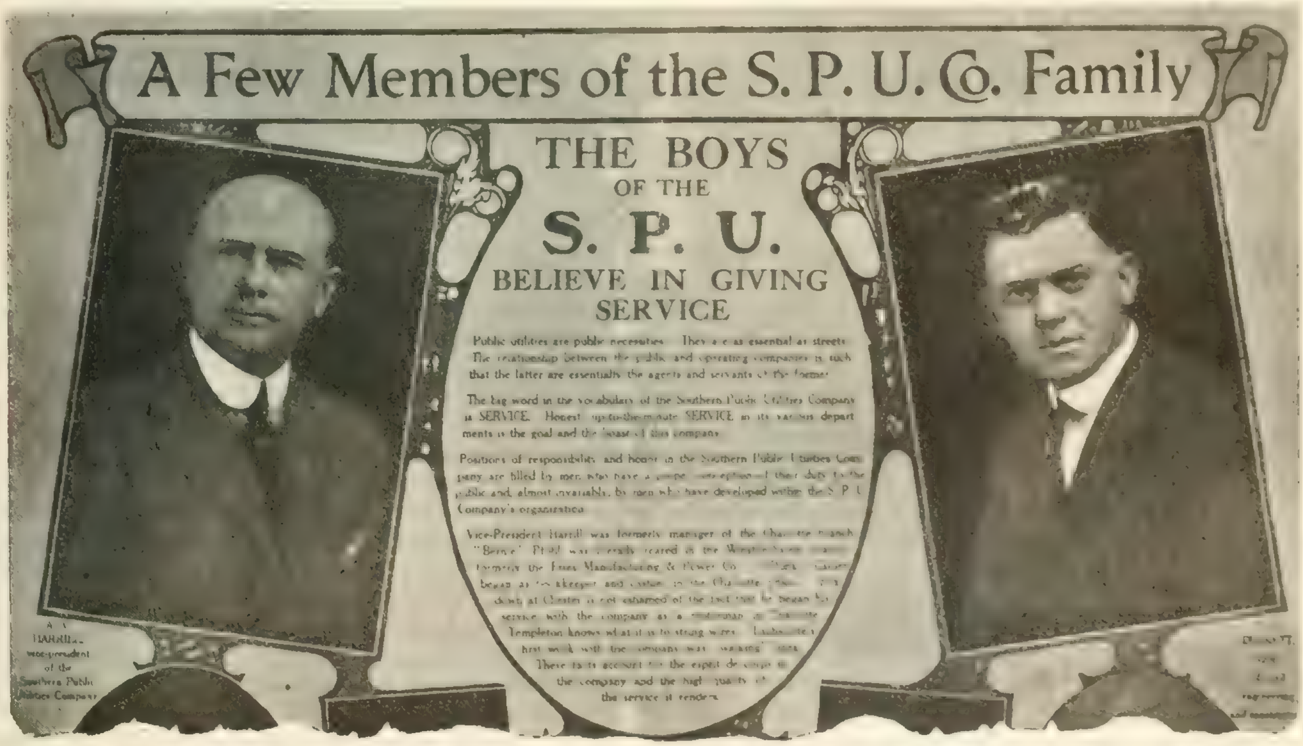
THE Empire District Electric Company of Joplin, Mo., finds that the revenue obtained from its zinc mine loads varies considerably with the market price of zinc ore and the location of the load shifts also. Up to about four years ago the center of the zinc mine load was at Webb City, about 10 miles northeast of Joplin, whereas now the bulk of this load centers around Picher, Okla., which is about 20 miles southwest of Joplin.

Picher, Okla., was an entirely new field, and on Jan. 1, 1915, required only 430 hp. from the central-station lines. However, the load grew rapidly, and in succeeding years it amounted to 3,890 hp., 9,930 hp., 19,555 hp. and 27,582 hp. respectively. The maximum demand of the Picher district is now about 16,000 kw. This includes substations, aggregating 8,500 kw. in capacity, which were moved from Webb City to Picher.

Favorable Publicity for a Southern Public Utility

THE accompanying illustration is part of a full pictorial page which recently appeared in the illustrated section of a Sunday newspaper printed at Charlotte, N. C. The spirit of the message it carries indicates a relationship with local newspapers that is a mighty power in building up public relations.

The Southern Public Utilities Company owns the electric light, gas and street railway properties in Charlotte, N. C., and Greenville, S. C.; the electric light and street railway properties in Winston-Salem, N. C.; similar properties in Anderson, S. C., and the electric light properties in Thomasville, Belmont, Mount Holly, China Grove, Bessemer City, Hickory, Raw Creek, Hoskins and Reidsville, N. C., and Chester, Greer and Fort Lawn, S. C. It operates hydro-electric stations near Anderson, S. C., on the Seneca River, at Portman Shoals on the Savannah River, near Anderson at Gregg Shoals, and on the Yadkin River near Winston-Salem. It also operates steam plants at Anderson, S. C., and Winston-Salem and purchases energy at wholesale from the Southern Power Company.



A Few Members of the S. P. U. Co. Family

THE BOYS
OF THE
S. P. U.
BELIEVE IN GIVING
SERVICE

Public utilities are public necessities. They are as essential as streets. The relationship between the public and operating companies is such that the latter are essentially the agents and servants of the former.

The big word in the vocabulary of the Southern Public Utilities Company is SERVICE. Honest up-to-the-minute SERVICE in its various departments is the goal and the boast of this company.

Positions of responsibility and honor in the Southern Public Utilities Company are filled by men who have a proper conception of their duty to the public and, almost invariably, by men who have developed within the S. P. U. Company's organization.

Vice-President Harrill was formerly manager of the Charlotte branch. "Bernie" [illegible] was [illegible] reared in the [illegible] formerly the [illegible] Manufacturing & Power Co. [illegible] began as bookkeeper and [illegible] in the Charlotte [illegible] at Chester is not ashamed of the fact that he began his service with the company as a [illegible] Templeton knows what it is to string wires. [illegible] first work with the company was [illegible] These facts account for the esprit de corps in the company and the high quality of the service it renders.

A. C. HARRILL, vice-president of the Southern Public Utilities Company

HOW A CHARLOTTE (N. C.) NEWSPAPER IS INTERPRETING THE MEANING OF CENTRAL-STATION SERVICE

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Alternators Rated at 22,000 Kva. for Glomfjord.—J. WENNERBERG.—Two large three-phase generators, built for the Norwegian government's plant at Glomfjord, were recently completed by the Asea works in Vasteras, Sweden. The alternators are rated at 20,000 kva., with a continuous overload capacity of 22,000 kva., and thus are the largest water-turbine-driven generators ever built in Europe. The article exhibits tracings and photographs of these generators, and takes up some details of design. The speed is 300 r.p.m., and the alternators give 15,000 volts at 25 cycles. The rotor is made of several pieces of cast steel and weighs 95 tons. The stator, which weighs 130 tons, is built in four parts, to facilitate transport. When in place it may be rotated one-half turn, to give access, in case of repairs, to the coils in the lower part.—*Teknisk Tidskrift, Elektroteknik,* November, 1919.

Generation, Transmission and Distribution

The New England Power Company.—E. A. DILLARD and H. R. WILSON.—The authors discuss the development of this system, which is a combination of several smaller systems. Operating problems are discussed in detail, and a year's record of disturbances on the line is shown in the illustration.—*General Electric Review,* November, 1919.

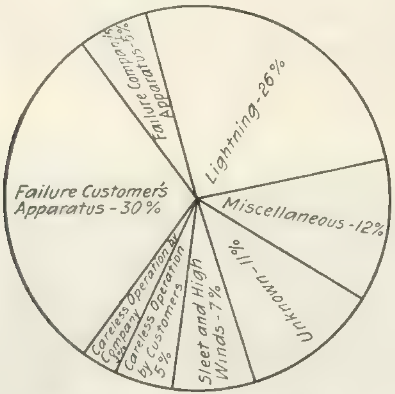


DIAGRAM SHOWING DISTURBANCES ON TRANSMISSION LINE

Industrial Power.—In discussing this subject at the Worcester Section of the American Society of Mechanical Engineers held Dec. 16, 1919, Reginald J. S. Pigott called attention to the considerable advantages of central-station supply compared to those derived from isolated plants. The principal factors to be considered, he said, were the size of the plant, its economy load factor, the cost of fuel, reliability, the space occupied and the cost of the installation per kilowatt installed.—*Power,* Jan. 20, 1920.

Estimating Manhole Costs.—E. E. GEORGE.—In this article equations are derived for use in estimating manhole costs for purposes of valuation. It is said that by this means two men can price with high accuracy, from field notes, 100 manholes per hour.—*Engineering News-Record,* Jan. 20, 1920.

Installations, Systems and Appliances

Coil Versus Magneto Ignition.—A. C. BOOTH.—The writer gives his reason for favoring coil ignition compared with magneto ignition as a result of experience in automobile service.—London *Electrical Review,* Dec. 12, 1920.

Arc Welding.—F. A. ANDERSON.—The writer discusses the effect on the metal of its passage through the arc, the composition of electrodes and other relations between electrodes and current metal.—*Journal of Electricity,* Dec. 15, 1919.

Electric Current Rectifiers.—A brief discussion of the five following types of rectifiers: (1) mercury arc, (2) electrolytic, (3) vibrating tongue or relay, (4) thermionic, (5) mechanical, with rotating parts and commutator.—*Post Office Electrical Engineers' Journal,* October, 1919.

Electrical Cleaning of Gases as Applied to Blast Furnaces.—N. H. GELLERT and K. V. LAIRD.—The article describes the installation of a new type of blast-furnace gas cleaner and the results obtained with it at the furnace of the American Manganese Manufacturing Company of Dunbar, Pa. The cleaner is an adaptation of the Cottrell electrical precipitation process to the blast furnace. This process, while new to the blast furnace, has been in extensive use throughout the country in the cement industry as well as in various metallurgical processes. The cleaning of blast-furnace gases is of importance in obtaining plant efficiency and the lowering of the available heat in the gases. The operation of iron and ferro-alloy furnaces at maximum possible efficiency is now imperative owing to keen domestic competition as well as a constantly rising foreign competition.—*Journal Engineers' Club of Philadelphia,* December, 1919.

The Almissa Power Station in Dalmatia.—H. TANZER.—A 100,000-hp. hydro-electric power station, constructed to utilize the water power of the Cetina River, has recently been put in operation, and in this article a detailed description of it is given. High-pressure 1,800-hp. turbines are installed. The generators are rated at 1,600 kva. and at 4,000 volts, each one being provided with a step-up transformer for a transmission voltage of 56 kv. A considerable proportion of the power is used in electrochemical plants.—*Elektrotechnik und Maschinenbau,* April 27, May 4 and 11, 1919.

Electric-Resistance Furnace of Large Capacity for Zinc Ores.—CHARLES H. FULTON.—The paper includes a description of the furnace and process of using briquettes of zinc ore as resistors for the electric furnace. *Chemical and Metallurgical Engineering,* Jan. 14, 1920.

Electrophysics and Magnetism

Treatment of Harmonics in Alternating-Current Theory by Means of a Harmonic Algebra.—A. PRESS.—The writer states that this monograph will be found to introduce a new mathematical operator, Q_m, which enables one to solve with comparative ease problems in alternating-current circuits which have heretofore been regarded as impossible of solution.—*University of California Publications in Engineering*, Sept. 30, 1919.

Units, Measurements and Instruments

Improved Meter Design.—J. SCHMIDT.—In kilowatt-hour meters of the direct-current-motor type the increasing friction on the commutator, due to wear under the brushes, is usually a serious cause of disturbance. In a design by the Allgemeine Elektrizitäts-Gesellschaft the wear is much diminished by putting the brushes on a lever actuated by an electromagnet in series with the load. The position of the brushes then will vary with the load, and heavy wear due to severe sparking at an occasional overload will therefore not effect the readings of the meter under ordinary load conditions. Friction is also cut down by running both bearings in oil. The upper bearing is inverted, a small fixed shaft projecting down into an oil chamber on top of the motor shaft, while the lower one is a special ball bearing consisting of one highly polished steel ball running on a sapphire. In the later part of this article arrangements are described whereby the meter may be adapted for use in cases where double-rate systems are used. If a special rate prevails during certain hours, the motor gear is automatically meshed with one or the other of two indicating clockworks by means of an electrically driven clock. Where a power limit is prescribed the meter is provided with a differential mechanism so that it goes in operation only when the load exceeds a certain wattage and measures only the surplus consumption.—*Helios*, Aug. 24 and 31, 1919.

Standard Vacuum-Tube Notations in German Literature.—During the war a number of notations for vacuum-tube quantities have come into being and seem to be accepted by most German writers on the subject. To facilitate the reading of a number of articles dealing with recent progress in the theory of electron-discharge tubes whose publication has been delayed by the military censor, but which are now appearing in various magazines, Barkhausen has compiled some of the most satisfactory notations, and, in co-operation with the editors of the *Jahrbuch der Drahtlosen Telegraphie* and the *Archiv für Elektrotechnik*, suggests that these be uniformly accepted as standards. To distinguish between the various circuits indexes are used: *a* for the plate circuit, *g* for the grid-circuit, and *h* for the filament-circuit. $I_g = f(E_g)$ and $I_a = f(E_a)$ are denoted as the grid-current and anode-current curves, while the plate current-grid voltage curve is called the characteristic. The interior resistance is defined as $R_i = \partial E_a/\partial I_a$, but the voltage amplification factor, μ, as usually defined in this country, does not appear. Instead is introduced its reciprocal, $\partial E_g/\partial E_a$ (for constant plate current), which is called D and is a fraction, indicating what percentage of the plate's field acts on the filament through the screening effect of the grid. The mutual conductance $\partial I_a/\partial E_a$ is indicated by S.—*Jahrbuch der drahtlosen Telegraphie*, May, 1919, and *Archiv für Elextrotechnik*, July 15, 1919.

Measurements on Vacuum Tubes.—H. G. MOELLER.—Three-electrode vacuum-tube characteristics may be determined either directly, or by calculation from the direct-current characteristic curves. A number of laboratory methods are outlined in this paper, for the experimental determination, by both these schemes of various amplifying and oscillating properties. A difficulty in obtaining comparative results arises from the indefiniteness due to current inequality at the two ends of the filament. The author therefore suggests that in testing tubes the plate current be adjusted to a prescribed value rather than the filament current. An emission current of 4 milliamperes per watt heating power is said to be usual for small non-coated-filament tubes.—*Archiv für Elektrotechnik*, July 15, 1919.

Telegraphy, Telephony and Signals

German Aircraft Radio-Telegraphy.—E. NIEMANN.—During the war much energy was devoted in Germany to the problem of getting a reliable radio communication with airships of all kinds, and as a result a number of aircraft radio stations were developed and standardized. The various types may be divided into three groups—outfits for ordinary patrol planes and battle planes, for the bigger bombing planes, and for the giant fliers of later years. The article gives a description of a number of airplane stations for various purposes and deals in detail with many practical questions, such as radiation characteristics of airplane and airship antennas, construction of air-screw-driven dynamos, effect of lowered air pressure upon quenched-spark transmitter output, etc.—*Jahrbuch der drahtlosen Telegraphie*, May and July, 1919.

Comparison Between Coil Antenna and Open Antenna for Receiving.—MAX ABRAHAM.—The energy absorption of a coil placed in an electromagnetic radiation field is theoretically investigated, and it is shown that the Rüdenberg theorem holds also for a coil antenna. The maximum detector energy is obtained when the detector resistance is equal to the antenna resistance and is to its value independent of the antenna constants. Inasmuch as the radiation resistance of a coil is very small, optimal conditions are here difficult to realize. The coil antenna, however, is analytically shown to be less susceptible to static disturbances than the open antenna.—*Jahrbuch der drahtlosen Telegraphie*, August 1919.

Recording of Eifel Tower Time Signals for Determination of Clock Error.—L. B. TURNER.—The experiments described in this paper were instigated by a demand for wireless recording apparatus to be used in determinations of longitude for survey work in East Africa. The precise determination of clock error, however, is of importance everywhere. The time signals discussed, besides being timed more precisely than is possible with the ordinary time signal, allow the skilled observer to compare his chronometer with the Eiffel Tower to within a tenth of a second without resort to any apparatus beyond a simple auditive wireless receiver.—London *Electrician*, Nov. 14, 1919.

Some Comparisons of Automatic Exchange Systems.—In this article may be found a comparison of three different systems of automatic telephony which have found considerable use in Great Britain. They are the Siemens, the Western and the Automatic Telephone Company Systems.—*Post Office Electrical Engineers' Journal* (London), January, 1920.

Scientific and Industrial Research

(Printed in the Third Issue of Each Month)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by Prof. Vladimir Karapetoff
Cornell University, Ithaca, N. Y.

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

ARMATURE, DIRECT-CURRENT, FLUX DISTRIBUTION IN AIR.

The purpose of this investigation is to determine the theoretical distribution of magnetic flux and potential around a stationary multi-polar direct-current armature removed from the field structure and entirely surrounded by air. The current is conducted into the armature in the usual way through the brushes so that electromagnetically the armature is equivalent to an excitation by belts of current of alternate polarity. The impetus to this investigation was given by a serious discrepancy between some experimental results which under the above conditions give a "peaked" flux distribution and a "flat" distribution as derived theoretically by E. Arnold under much simplified assumptions in his "Gleichstrommaschine," 1906, Vol. I, pp. 378 and 384. The new theory checks quite closely with the experimental data given in the *Electrician*, Vol. 75 (1915), p. 960. The magnetic field is mapped out by means of conjugate functions.—*James McMahon, Cornell University, Ithaca, N. Y.*

CORONA VOLTMETER.

There has recently been completed a series of precision measureemnts of the crest value of alternating voltages, taken in the high-voltage circuit, using a large air condenser and both kenotrons and commutators for measuring its charging current. This work has been done in connection with an accurate determination of the constants of the corona voltmeter. With these constants the instrument will become a standard of high voltage; that is to say, its calibration or range is inherent in its dimensions. The law of this instrument has been extended over a much wider range than heretofore, and certain new facts have appeared. A paper describing the work is in course of preparation.—*J. B. Whitehead, Johns Hopkins University, Baltimore, Md.*

CORROSION IN CABLES.

A peculiar case of corrosion of lead cable sheaths used by a St. Louis power company was investigated, in which it was found that the difficulty was probably due to a combination of several causes, chief of which was the subjection of the cable system during its first few months' use to very high positive potentials. Subsequently failures gradually developed, due particularly to the elevated temperature at which the cables were operated and to the peculiar type of conduit used.—*Bureau of Standards, Washington, D. C.*

ILLUMINATION IN FACTORIES, EFFECT OF PAINT UPON.

Illumination tests are being made in factories, before and after painting, with a view to discovering the increase in light afforded by the paint. Brightness comparisons (before and after) are also being made with the intention of determining the relative distinctness of dark machinery and light-colored walls and the contrast between the same and the source of light. An attempt is also being made to estimate the effect of surrounding structural surfaces on vertical illumination.—*H. Logan, New York City.*

RADIO DIRECTION FINDER.

A simple coil of wire has been found to form a good receiving device for radio waves, and does away with the necessity of an antenna for a great deal of radio work. The receiving circuit used with such a device is the simplest possible radio circuit, namely, the coil with a condenser in series, with a detecting device connected across the condenser. The great advantage of this method of radio reception is that the direction of propagation of the radio wave is determined by rotating the coil. The received signal disappears when the plane of the coil is perpendicular to the direction of the advancing wave. By rotating the coil the direction can be determined to about one degree. This has been found very advantageous in preventing interference. Thus the coil can be turned in such a direction that waves from a certain source are entirely eliminated while the signal from a different direction is received. The device has also been applied to determining the actual position of a transmitting station by a simple process of triangulation. This has been utilized in finding the positions of ships and airplanes as well as stations on the ground, and it has been of the greatest use in trench warfare. Special apparatus of this sort has been developed for use on ships for determining the position and steering toward a lighthouse during fog. Progress has been made toward the determination not only of the line of direction but also of the absolute direction of propagation of a wave.—*Radio Laboratory, U. S. Bureau of Standards.*

Suggestions for Research

ALLOY, SPECIAL.

An alloy or a metal is required having a very large temperature coefficient of expansion, preferably equal to or greater than that of aluminum; the material must possess a high resistivity, preferably greater than that of German silver and similar alloys, and it must also have a relatively high melting point, preferably greater than that of copper.—*Chester I. Hall, Fort Wayne, Ind*

CONDUCTORS, IRON, AS SURGE PROTECTORS.

Theoretical investigations by H. M. Pleijel, Stockholm, show that transient traveling waves on a transmission line of iron wire are very rapidly damped down, especially at the wave front. This seems to indicate that a mile or so of iron conductor just outside the transformers may be the best and cheapest surge-protecting device to be had, since the dangerous energy is absorbed as skin-effect losses on the line, where no appreciable heating can occur. Apparently there are no experimental data available in the literature, and it would be of great interest to make quantitative tests of an actual line, preferably where high tension is available. A choke coil could be inserted at a point in the line and the maximum drop across the coil measured with sphere gaps, a rectangular high-voltage wave being started by switching on high tension at the home end. A variable length of iron conductor could be inserted just before the choke coil, while suitable means would be provided to avoid reflections and accidental superpositions.—*Edy Velander, Harvard University.*

[This is an expedient which has been brought up many times. It should receive the attention of those in a position to make tests under practical transmission line conditions.—Editor.]

FUSES FOR MEASURING INSTRUMENTS.

A great many movements of electric measuring instruments, especially of the moving-coil type, are burned out each year by accidental overloads. No one seems to have succeeded in developing a simple, reliable and inexpensive fuse, or other protective device, to prevent these burn-outs. Especially in college laboratories, the loss in instruments is quite heavy, and a suitable fuse would be extremely valuable.—*Editorial Suggestion.*

INSULATING MATERIALS FOR USE IN RADIO APPARATUS.

There is need for research covering the following items: (1) Measurement of dielectric constant and phase difference of bakelite and similar phenol materials—porcelain, woods and other dielectrics used in radio apparatus; (2) measurement of properties of liquids used in radio apparatus; (3) effects of moisture and variation of laboratory conditions upon properties of insulating materials; (4) measurement of effects of high voltage on various classes of insulating materials to determine their serviceability in radio generating outfits.—*J. H. Dellinger, U. S. Bureau of Standards.*

INSULATION, OPERATING CONDITIONS OF.

The particular conditions under which electrical apparatus has to work and which require special consideration, as far as insulation is concerned, are as follows: (1) Ordinary service conditions, where neither extremes of heat, dampness or dirt and grit are encountered; (2) where extremes of dirt and grit are encountered; (3) where extreme conditions of heat or room temperatures are encountered; (4) extreme humidity with heat and with or without salty atmosphere; (5) atmosphere with alkali fumes; (6) atmosphere with acid fumes. The insulation for withstanding these conditions should not only be investigated with the view to making apparatus which will stand up for a number of years without a break-down, but should also be studied with the view to preventing leakage or lowering the insulation resistance.—*J. L. Hamilton, St. Louis, Mo.*

INSULATORS, LIFE TEST FOR.

In actual service insulators are subjected to mechanical forces from the following causes: (1) Electrostatic field; (2) weight of conductor, including wind and sleet; (3) temperature differences in the material; (4) volumetric changes in the cement. These forces have in the past shortened the economic life to but a few years. Improvements tending to counterbalance the effect of these forces are continually being made, but their efficacy cannot be absolutely determined for a number of years. In order to estimate the value of such expedients it is desirable to devise comprehensive tests not merely electrical, which will take all the factors into account, and will give at the outset a reliable indication of expected life.—*Editorial Suggestion.*

INSULATORS, PIEZO-ELECTRIC EFFECT IN.

Porcelain is a conglomerate with crystals of quartz and sillimanite ($Al_2O_3SiO_2$) embedded in feldspar glass. It is known that when some crystals are subjected to an electrostatic field mechanical stresses are developed therein. It has been suggested that such stresses might occur in the materials of which porcelain is composed, and it would be of great practical importance to determine whether or not they are of sufficient magnitude to cause physical deterioration which leads to cracking.—*W. A. Hillebrand, Ohio Brass Company.*

TELEPHONE, AUTOMATIC, RELAYS.

A further study and development of automatic relays is recommended, both of the quick-acting and the slow-acting type—their structure and performance. The investigator should first acquaint himself with the normal function of these relays in automatic telephony and then make a mechanical and experimental investigation of their performance and the effect of structure and adjustment upon that performance.—*A. B. Smith, Chicago, Ill.*

WELDING, ELECTRIC.

It is desired to devise a practical and scientific method of testing a welded joint after it has been made. There have been a number of suggestions made for the solution of this problem. They are briefly as follows: (a) Mechanical—by hammering the weld or by chipping at frequent intervals; (b) by means of resistance or voltage drop; (c) magnetic—by means of the permeameter or the change of conditions in the magnetic circuit; (d) X-rays—by means of an exposure on an X-ray plate. At the present time none of these suggested methods have been productive of conclusive results and recourse must be had to crude mechanical methods, such as striking heavy blows on, or adjacent to, the weld, by using a chipping hammer and making intermittent examinations.—*H. A. Horner, A. I. E. E. Proceedings*, 1918, *page* 1192.

News of the Industry

Chronicle of Important Events and General Activities in the
Technical, Commercial and Manufacturing Fields With Announcements and
Reports of Association Meetings and Conventions

Atlantic Seaboard Super-Power System Hearings

HEARINGS on the Boston-Washington super-power system were held this week before the House committee on appropriations. W. S. Murray and Profs. Breckenridge and Jackson appeared before the committee and testified in great detail. Owing to a regulation of the appropriations committee to the effect that testimony before it cannot be released for publication until the entire hearing is released it is not possible to report the testimony this week.

General Electric Leases War Plant of Remington Company

ANNOUNCEMENT has just been made that the General Electric Company has leased, with option to purchase, the forty-acre war plant of the Remington Arms Company at Bridgeport, Conn. This transaction provides the company with 1,500,000 square feet of floor space, available almost immediately, for the production of light rather than heavy apparatus. The plant consists of thirteen identical unit buildings easily accessible and conveniently interconnected. The General Electric Company is not now prepared to state exactly what material will be manufactured there, but it is the company's belief that this new space will be given over to light and smaller apparatus which can easily be adapted to quantity production. According to the present condition of business, the company could utilize this space for virtually any kind of apparatus, the need for space is so great. It is expected that between four and five thousand employees will be required to man the plant.

Kansas Plan of Utility Control Finds Legislative Advocates in East

STATE SENATOR WHITE of New Jersey has introduced a bill into the Legislature that would replace the State Board of Public Utility Commissioners by a Court of Industrial Relations similar to that just installed in Kansas, as recorded in the ELECTRICAL WORLD of March 13. The proposed New Jersey court would handle all utility, transportation and industrial matters and would be made up of three judges to be named by the Governor, with approval of the Senate, the members to serve three years at an annual salary of $5,000 and to give their full time to the work.

A bill has been introduced into the New York State Assembly for the creation of a Court of Industrial Relations to consist of three judges appointed by the Governor, with consent of the Senate, at $10,000 per year, for the purpose of preventing strikes and to exercise other functions of the same nature. The operations of clothing manufacture, mining or production of material in common use as fuel, manufacture and handling of iron and wood products, wearing apparel, fuel or food products, all public utilities and all common carriers are declared subject to state supervision.

Drought Threatens Power Shortage in Idaho and Oregon

JUST as California, aided by recent rains, is apparently surmounting the handicap caused by the long drought, Idaho and Oregon find themselves facing a serious water shortage from the same cause. In the former state, where the electric power companies have a large business from the irrigation districts, an effort will be made to overcome the shortage by shifting the load.

The water conservation board formed in California, as announced in the ELECTRICAL WORLD last week, to reduce the loss from the drought and determine priority of water claims has been made permanent. The San Joaquin Light & Power Corporation has announced to the oil producers that there will be no further curtailment of power.

Some "High Lights" on the Pasadena N. E. L. A. Convention

FINAL details of the program of the forty-third convention of the National Electric Light Association, to be held at Pasadena, Cal., May 18-21, are fast rounding into shape and are expected to be ready for announcement next week. A four-day program replete with interest for all affiliated with the electrical industry has been prepared in such a manner that virtually every phase of development during the past year has been covered. Prospective development during the coming year also is dealt with.

Guests and members of the association who are particularly interested only in the four general sessions and in one or two of the eight sectional sessions will have an unusual opportunity to enjoy scenic trips, golf, tennis, bathing, boating, dancing, etc.

The address of welcome will be delivered by Governor William D. Stephens of California at the opening session of the convention, on the morning following the reception given by President R. H. Ballard.

President Ballard will respond to the Governor's address on behalf of the association and will deliver the president's address. He will be followed by M. H. Aylesworth, executive manager of the association, who will outline the reorganization of the body to date, telling what has already been accomplished and the complete plans for the coming year.

Following these addresses will come the presentation of reports and technical papers and their discussion. General sessions will be held in the mornings, and special sectional sessions in several instances necessar-

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

Because of the sustained heavy demands and the bad transportation conditions, the worst shortage of electrical supplies on record is reported, not even making exception of those that obtained in the height of the war. Prices, however, appear to be steady. Porcelain insulators, cross-arms, locust pins and line hardware are reported up. Copper is still going down, and the metal market is dull.

Carload shipments from the West were received by Boston jobbers at the close of last week, after a tie-up of nearly a month resulting from adverse weather.

The coal crisis appears to have passed its worst stage, as New England central stations see the situation. Recent thaws have begun to increase the hydro-electric power yield, which on one large system ran down to a minimum of 10 per cent of the plant rating during the period of coldest weather.

About 200 contracts for industrial co-operation and research have been placed with the Massachusetts Institute of Technology to date.

The annual convention of the New England Section, N. E. L. A., will be held at Kineo, Me., from Sept. 14 to Sept. 16.

Extensive improvements, to cost not less than $5,000,000, are being planned by various electric companies in Arizona.

Abolition of the national service committee of the Engineering Council, with retention of a "national service representative" at Washington, is advocated in the annual report of the committee named, which covers the year's accomplishments in furthering public movements of especial interest to engineers.

Measures to establish state bodies similar to the Court of Industrial Relations which has superseded the Public Utilities Commission in Kansas have been introduced into the legislatures of New Jersey and New York.

An all-day question box conference was held by the New England Section of the N. E. L. A. at Boston, Mass., on March 18. Members of the Massachusetts State Branch of the National Association of Electrical Contractors and Dealers postponed their regular monthly meeting in order to attend.

A consolidation of the Habirshaw Electric Cable Company, Inc., the Electric Cable Company and the Bare Wire Company, Inc., has taken place, the resulting corporation being known as the Habirshaw Electric Cable Company.

Electric power is to be tried for deep-well drilling in the Oklahoma oil fields in the near future.

Representatives of American industry and of higher education are to be brought together by the Technology Clubs Associated for the purpose of improving the quantity and quality of trained men for management duty.

Plans for the local marketing of public utility securities in territories served by companies under Stone & Webster management are being matured.

Little evidence of a popular demand for state ownership of electric utilities was manifested at a legislative hearing upon bills with that object sponsored by the local branch of the American Federation of Labor.

Substantial increases in the salaries of government electrical engineers are included among the recommendations made by a joint Congressional committee which has investigated the whole question of the pay of federal employees.

A preliminary outline of the program of the N. E. L. A. convention to be held at Pasadena, Cal., May 18-21, has been issued, indicating some of the most important committee reports that are to be presented.

The annual meeting of the Arkansas Utilities Association will be held at Hot Springs, Ark., from April 26 to April 28 inclusive.

Speaking before the Boston Section, N. E. L. A., Dr. E. P. Rosa deplored the handicap put on the work of the Bureau of Standards by inadequate funds.

Delegates to a meeting of the Electric Furnace Association will take part in some of the joint sessions of the A. I. E. E. and the American Electrochemical Society at Boston on April 8-10.

Guy E. Tripp, in a discussion of the production problem, declared his belief that profit sharing is unsound in principle and that, after the provision of a liberal wage, profits and risks should both fall to capital.

Richard H. Rice, manager of the Lynn works of the General Electric Company, declares the works council in that plant an unqualified success.

A. W. Berresford of Milwaukee has been nominated for president of the A. I. E. E. by the board of directors.

What is thought to be a world's record for continuous running of machines of its class was reached by a 45,000-kw. Westinghouse turbogenerator recently shut down at the plant of the Narragansett Electric Lighting Company, Providence, R. I., after steady operation for eighty-four and a half days.

Output and peak load of the Trumbull Public Service Company of Warren, Ohio, are increasing with such rapidity that the company cannot add equipment fast enough to care for the new business.

Protection of rotary converters against flashing was discussed by the A. I. E. E. at its Pittsburgh meeting last week, and two designs for the electric locomotives of the Chicago, Milwaukee & St. Paul Railway were described.

The superdreadnought Maryland, which is the fourth capital ship of the navy to be equipped for electric drive, was launched at Newport News, Va., on March 20.

Applications for the appropriation of water to generate 600,000 hp. have been made in this year in Oregon.

Hearings on the Boston-Washington super-power scheme were held this week before the House committee on appropriations.

Plans for the increased-membership drive of the Illuminating Engineering Society are taking shape.

President Ballard of the N. E. L. A. announces that the electric light division of the Oklahoma Utilities Association has passed a resolution favoring affiliation with the N. E. L. A.

Boston engineers will be addressed by Herbert Hoover at the Engineers' Club on March 24 at a dinner to be given in his honor.

Announcement that the General Electric Company has leased, with option of purchase, the plant of the Remington Arms Company at Bridgeport, Conn., is made.

i‥y paralleling each other will be held in the afternoons. The public policy committee meeting will be held Thursday evening, May 20.

While the program has been arranged tentatively, it is not sufficiently complete in detail to publish in full at this time. Some of the "high lights" of the program, however, follow:

Franklin T. Griffith of the Portland (Ore.) Railway, Light & Power Company will present the report of the committee on water-power development, of which he is chairman. This subject is one of unusual importance and interest at this time in view of the evident present necessity for increasing the production of electrical energy sufficiently to meet the existing and ever-growing demand. By the time his report is presented the national water-power bill will probably have become a law.

"Inductive Interference," at present an absorbing problem, will be dealt with in a report presented by A. E. Silver of the Electric Bond & Share Company, chairman of the inductive interference committee. A summary of the present conditions and problems and recommendations for helpful association activities are contained in the report.

"Electrification of Steam Railroads" will be discussed in the report of a committee on that subject, presented by the chairman, Frank M. Kerr of the Mountain Power Company. Improved practices and the outlook for the electrification of the steam roads of the country are covered.

In the report and subsequent discussion of the committee on electrical resources of the nation, of which M. S. Sloan of the Brooklyn Edison Company, Inc., is chairman, some startling facts are expected to be brought out. This, of course, is really a "key subject" since the extent of future electrical development depends upon these resources and their development.

The numerous phases of electric vehicle activities will be covered in an address by George B. Foster of the Commonwealth Edison Company of Chicago, chairman of the Electric Vehicle Section of the association.

Concrete facts and figures on the value of proper publicity regarding activities and problems of the electrical industry in particular, and of all public utilities in general, will be given in the report of the association committee on public information, of which John F. Gilchrist of the Commonwealth Edison Company, Chicago, is chairman. Under the auspices of this committee and as the result of direct personal activity on the part of the chairman, state committees on public information have been organized in several states.

The importance of the fullest co-operation between all branches of the industry for the mutual benefit of the public and of the industry is given recognition by including in the program a committee report to be presented by Lee H. Newman of the Pacific Gas & Electric Company, San Francisco.

Novel effects in residence and industrial lighting have been developed during the last year, particularly in the use of color. A demonstration of this development, the equipment used and its application will in a large measure fill the vacancy left by the omission of the customary trade exhibit which was made necessary because of distance from trade and manufacturing centers, difficulty of securing prompt and adequate transportation, supply and demand conditions and lack of suitable space for exhibition purposes.

Profit Sharing Unsound in Principle

STIMULATION of production, under a system permitting capital to take the risks and profits after providing a liberal wage which will furnish to the ambitious worker an opportunity to improve his status in the community and to accumulate property, was advocated by Guy E. Tripp, chairman of the board of the Westinghouse Electric & Manufacturing Company, before a meeting on March 12 of the Merchants' Association of New York, held to discuss the problem of increased production.

Nationalization of industry was held by Mr. Tripp to be utterly wrong and impossible of achievement, and its advocacy, he thought contributed to unrest. The restraining influence of labor unions upon the selfish interests of employers, which let alone would tend to a lower wage than the traffic would bear, was felt to be safe. At the same time, complete unionization of labor would reduce production, reduce the standard of living and practically destroy the opportunities for the ambitious man with ability. The solution of the problem, the speaker stated, lay in the maintenance of a proper equilibrium between the self-interest of capital on the one hand and the self-interest of labor on the other.

"If this can be accomplished at all," Mr. Tripp said, "it will only be done by permitting a healthy play of natural forces. A man should be entirely free to belong to a labor union or not, as he pleases, and in this right he should have the full protection of the law. Likewise an employer should be entirely free to run an open shop or a closed shop, as he pleases, and he should be protected in that right."

The right to organize was not questioned, but Mr. Tripp did deny "the justice and propriety of the use of force and lawlessness and improper use of government" to accomplish the workmen's ends. While the speaker believed that every sound effort to improve the human relationship between employer and employee should be encouraged, he said that he believed profit sharing to be unsound in principle.

While no remedy was suggested, Mr. Tripp proposed that there be a general recognition that the problem of production and prosperity is an economic one, and not a sentimental one, and that unrest will not be overcome so long as a considerable portion of the people believe that it is possible to abolish the wage system in this country. "There is almost nothing," Mr. Tripp concluded, "so impossible as that. My industrial creed is a simple one. It is only this—a fair field for diligence, enterprise and intelligence."

Works Council in General Electric Factory Declared Success

AFTER eighteen months' trial the works council system in the Lynn (Mass.) works of the General Electric Company has proved an unqualified success, it was declared by Richard H. Rice, manager of the works, at Boston, this week. The council has without the aid of trade unionism maintained just relations between the management and the employees, said Mr. Rice, not one case in the period named having been appealed from the committee to the manager. Mr. Rice also announced his belief that a forty-eight-hour week is inadequate world production, which this year are 50 per cent greater than in 1914.

Electric Furnace Men to Participate in Electrochemical Meeting

COINCIDENT with the meeting of the American Institute of Electrical Engineers and the American Electrochemical Society, there will be a meeting of the Electric Furnace Association in Boston from April 8 to April 10. The annual election and business meeting will be held on April 8. On one other day there will be a session on the proper training of electric furnace operators. The association will meet with the other two societies during their discussions on "Electrically Produced Alloys" and "Power for Electrochemical Purposes."

Indications are, it is stated, that there will be a considerable attendance of electric furnace men at these sessions.

To Try Out Electric Power on Deep-Oil-Well Drilling

AN EXPERIMENT with electric power for deep-well drilling is to be tried in the Oklahoma oil fields in the near future. The Marland Oil & Refining Company, Tonka City, Okla., will replace a steam outfit on one of the deep wells with electric power. The fact that these wells are drilled to depths of 3,900 ft. and 4,000 ft. made it seem doubtful whether electric power could stand the strain.

It is claimed that the cost of operation and installation of electric power is about one-third the cost of the steam equipment for steam power. The Tonka field is already wired for alternating current from the refinery power house.

In an effort to determine as far as possible the adaptability of electric power for deep-well drilling the production department has installed 35-hp. motors in three of the deep wells already producing. These wells will be pumped for a period to determine the ability of electric power to carry the big loads. One of these motors has been pumping from 50 barrels to 100 barrels daily from Burt Well No. 5 and has been used successfully for pulling rods and cleaning out.

Stone & Webster to Push Sale of Utility Securities Locally

PLANS for marketing securities in territories served by public utility companies under Stone & Webster management are being matured in Boston, and C. W. Kellogg, formerly manager of the Mississippi Power Company, and for the past year in charge of the Stone & Webster investigation and report on the New York Railways and Interborough Rapid Transit properties, has been placed in charge of the work. Mr. Kellogg will make headquarters at the Boston office of Stone & Webster. To a representative of the ELECTRICAL WORLD he stated that the local sale of securities is being pushed because of the belief of Stone & Webster that the market for utility stocks, bonds and notes has greatly broadened of late and that increased local ownership in companies serving communities is sound policy and worth cultivating, especially in view of its beneficial effect on the understanding of conditions which local companies face. The pioneer work of the Pacific Gas & Electric Company and many other utilities in the field of customer ownership has been noted, and some of the Stone & Webster companies—notably at New London, Conn. (before the sale of the Connecticut Power Company to the Hartford Electric Light Company), Pawtucket, R. I., Brockton, Mass., and Pensacola, Fla.—have sold securities locally to advantage. Newspaper publicity will form the backbone of the sales methods.

More Pay for Government Electrical Engineers

AFTER the most thorough investigation ever made of salary classification in the government service, a joint Congressional committee has submitted to Congress a detailed report recommending substantial increases in pay for nearly every class of government worker. Salaries for technical service were found to be strikingly out of line with those paid in private employment. Senator Jones of New Mexico is the chairman of the committee.

Standardization of compensation for electrical and radio engineering are recommended by the committee as follows: Electrical engineering draftsman and electrical engineering aid, from $1,200 to $1,800 annually; junior electrical engineer, $1,800 to $2,160 annually; assistant electrical engineer, $2,400 to $3,000 annually; associate electrical engineer, $3,240 to $3,840 annually; electrical engineer, $4,140 to $5,040 annually; senior electrical engineer, to be determined by Congress upon recommendation by the Civil Service Commission based upon a full appraisal of the duties and responsibilities of the position and its relation to positions in similar classes; assistant radio engineer, $2,400 to $3,000 annually; associate radio engineer, $3,240 to $3,840 annually radio engineer, $4,140 to $5,040 annually.

Berresford Nominated for President of the A. I. E. E.

A. W. BERRESFORD

AT THE meeting of the board of directors of the American Institute of Electrical Engineers held in Pittsburgh on March 12, the report of the committee of tellers on its canvass of the nomination ballots cast for candidates for the Institute offices falling vacant July 31 next was presented.

As required by the constitution of the Institute, the board then selected by ballot its list of "directors' nominees," with the following result: For president—A. W. Berresford, Milwaukee. For vice-presidents—C. S. Ruffner, New York; E. H. Martindale, Cleveland; Charles Robbins, Pittsburgh; C. E. Magnusson, Seattle; C. S. McDowell, U. S. N.; L. T. Robinson, Schenectady.

For managers—E. B. Craft, New York; Harold B. Smith, Worcester, Mass.; James F. Lincoln, Cleveland.

For treasurer—George A. Hamilton, Elizabeth, N. J.

The ballots will be mailed to the membership prior to April 1.

I. E. S. Membership Drive Plans Shaping Up

PLANS for the increased membership drive of the Illuminating Engineering Society, mentioned in these columns two weeks ago, are going forward. At the council meeting last week it was decided to double the membership at large. During the drive, which is to be handled by a general committee now being made up, it is proposed that initiation fees shall be waived and half-yearly dues to Oct. 1, 1920, accepted. In order to keep the present members interested and active and to provide for reasonable growth, sections and proposed local chapters are to be given every opportunity to govern their own finances and activities, under a proposed "declaration of applied ethics," to be set forth by the council. The drive is to be started when the council has agreed to recommend changes in the constitution providing a sufficient degree of financial autonomy to sections and proposed chapters and will be for the duration of three weeks, one an intensive week.

It is proposed to popularize the drive by calling the intensive week "National Lighting Week," or some similar name. A committee of one hundred or more is to be appointed to take care of arrangements and publicity. The general committee is to consist of nationally known men identified with or interested in illumination and to include the publicity committee of the society. With each state chairman will be associated a staff of vice-chairmen, each representing one of the several interested branches of the industry and interested professions.

Consolidation of Habirshaw Interests

TO OBTAIN required working capital as well as to effect economy in their operations the Habirshaw Electric Cable Company, Inc., the Electric Cable Company and the Bare Wire Company, Inc., have been consolidated to form a new corporation, the Habirshaw Electric Cable Company.

The combined gross sales of the constituent companies have grown from $3,597,786 in 1916 to $7,413,652 in 1919, and orders on hand indicate that the 1920 business will be considerably greater than that for 1919. Primarily it was to finance the expansion of the last two years that consolidation was effected.

The Habirshaw Electric Cable Company, Inc., is the outgrowth of a company started in the early eighties by Dr. William F. Habirshaw and known as the India Rubbia & Gutta Percha Insulating Company. It has specialized largely on power and light cables and wires and submarine cables. The Electric Cable Company is the successor to the Clark Wire Company of Boston, organized at about the same time, and has since specialized on telephone wires. Early in 1916 the Electric Cable Company acquired control of the Habirshaw company, and in the same year the two companies organized the Bare Wire Company, Inc., which built a factory for the manufacture of bare copper wire.

The new company has sold $2,000,000 of 7 per cent sinking-fund convertible gold debenture bonds, due 1935, and 40,000 shares of common stock without par value. There are outstanding in addition 95,000 shares of common stock and $1,340,700 of 8 per cent cumulative preferred stock.

Electric Traction Subjects Discussed at Pittsburgh Meeting of A. I. E. E.

CONSIDERABLE information, including test data, regarding the protection of 60-cycle synchronous converters was brought out at the three hundred and eighty-fifth meeting of the American Institute of Electrical Engineers, held in Pittsburgh on March 12. Papers on the automatic operation of railway converter substations indicated the increasing tendency toward their use for heavy service. At the evening session two designs of electric locomotives for use on the Chicago, Milwaukee & St. Paul Railway electrification were described. The meeting was thus largely devoted to electric railway problems.

One paper, presented by C. M. Davis in the absence of its author, J. J. Linebaugh, General Electric Company, entitled "Short-Circuit Protection for Direct-Current Substations," gave the opinion of the author that flash barriers with arc coolers and a new form of high-speed breaker with current-limiting resistance provided complete protection from a "dead" short circuit. It was said that this new type of breaker had been applied to the new gearless locomotives for the Chicago, Milwaukee & St. Paul Railway. On the other hand, Marvin W. Smith, Westinghouse Electric & Manufacturing Company, in his paper, "Flashing of 60-Cycle Synchronous Converters and Some Suggested Remedies," showed the results of extensive investigations on a 500-kw., 600-volt, six-phase, 60-cycle, 1,200-r.p.m. converter. These indicated that full protection on the alternating-current side may be obtained with a flash suppressor, and Mr. Smith maintained that flash guards increase the tendency of a machine to flash over after they have become carbonized. Furthermore, flashing does not appear to be entirely dependent upon the point or value at which this current is interrupted. Tests with both the low-speed and high-speed breaker indicated that a machine rarely flashes over until the direct-current breaker has opened. For this reason, Mr. Smith said, a moderately high-speed breaker is no better than an ordinary slow-speed breaker. Experiments are now being made on the flash suppressor, consisting of a high-speed switch actuated by the short-circuit current, which short-circuits either all or a part of the collector rings, in the hope of solving this problem completely.

In commenting on these two papers, F. D. Newbury of the Westinghouse Electric & Manufacturing Company reiterated the statements of Mr. Smith to the effect that the moderately high-speed circuit breaker may cause more trouble than the slow-speed breaker. Flashing continues and increases, he said, after the circuit-breaker action has stopped. In regard to the use of flash barriers, Mr. Newbury thought that, although they may be the final solution, they are undesirable from the standpoint of accessibility.

Speaking from the viewpoint of the operating man, C. H. Jones, engineer of the Chicago, North Shore & Milwaukee Railway, stated that the flash barriers had proved successful on his company's 25-cycle converters. Although the converters "squeaked" occasionally from heavy overload current, there had been no flashing.

In his paper, "Automatic Railway Substations," Frank W. Peters, General Electric Company, reviewed the history of this type of station and told of the advantages of automatic operation. These advantages were set forth by the speaker as follows: Saving of labor, saving of energy, saving at light loads on account of the automatic shutting down of the machines, elimination of building heating with the consequent saving of fuel, simplicity of design, allowing lower initial cost; better load factor, reduction of feeder copper necessary on account of the closer spacing of substations, and reduction of electrolysis losses due to smaller return current.

Heretofore the automatic substation has been confined almost exclusively to small interurban systems, said R. J. Wensley, Westinghouse Electric & Manufacturing Company, in his paper, entitled "Automatic Substations for Heavy City Service," but now it has been shown that automatic operation can be successfully applied for heavy city service. The speaker's figures on such a system showed a total substation cost of $82,693 with a net operating credit of $47,960.

At the evening session, when papers were presented by N. W. Storer, Westinghouse Electric & Manufacturing Company, and S. T. Dodd, General Electric Company, on the two designs of electric passenger locomotives for the Chicago, Milwaukee & St. Paul Railway, it was shown how two entirely different pieces of equipment could be designed to comply with the same specifications. Calvert Townley, Westinghouse Electric & Manufacturing Company and president of the A. I. E. E., sounded the keynote of the discussion when he said that it should be kept in mind that every electrification of steam railroads made thus far has been absolutely successful.

E. H. Sniffin, Westinghouse Electric & Manufacturing Company; A. W. Thompson, president of the Duquesne Light & Power Company, and President Townley welcomed the members in after-dinner speeches in behalf of the manufacturers, the operating companies and the Institute respectively.

In the morning the visitors made an inspection trip through the Westinghouse plant to see the new St. Paul locomotives and the automatic substation equipment. It is said that the attendance was more than 400.

During the morning the board of directors of the A. I. E. E. held a meeting at which, in addition to the consideration of other matters, President Townley was authorized to appoint, after conference with W. S. Murray, a committee for the specific purpose of studying and reporting on the super-power scheme of the Northeastern Atlantic seaboard.

Electrical Safeguards for Pennsylvania Coal Mines

CONFERENCES of state and federal officials, coal operators and manufacturers of electrical equipment have been held recently in Harrisburg, Pa., to discuss changes in the direction of greater safety in electrical equipment in coal mines and the adoption of a code of rules further to safeguard employees and to keep pace with the increasing use of electrically operated machinery in coal mines.

Manufacturers of storage-battery locomotives have agreed to changes in design of their machines to conform to the requirements of the state and federal authorities, and the operators have expressed their willingness to add the safety features to the locomotives already in use. There are now about 300 of this type of locomotive in operation, and it will cost from $400 to $600 each to add the necessary safety features. The chief of the State Department of Mines stated that while the obligation rested on the department to safeguard the miners, there was no intention to be arbitrary or unduly to restrict operators during the period of changeover.

The unfortunate feature of the matter, it is learned from the State Department of Mines, is the deficiency in the mine laws of the state regulating electrical equipment. In the anthracite region the act of 1891 is still operative, and it contains no mention of electricity. The bituminous mine code, passed in 1911, was prepared with much care and effort and at the time was sufficient to meet the demands, but as electricity has so generally replaced steam equipment the bituminous code is also now far behind the requirements. This being the case, certain rules, according to the State Department of Mines, must be adopted to tide over the interim between the present time and a time when a new electrical code can be enacted.

Bureau of Standards Handicapped by Lack of Funds

DR. E. B. BOSA, chief physicist United States Bureau of Standards, addressed the Boston Section of the American Institute of Electrical Engineers on March 2 upon the work of the bureau in the war and after, emphasizing the economic value of research and pointing out that at a conservative estimate every dollar expended for research adds $100 directly or indirectly to the nation's wealth. At present the cost of maintaining the varied and important work of the bureau amounts to about 1 cent per year per capita population of the United States, and if this could be doubled or trebled, the results would be of extraordinary benefit to the people at large and to private industries. The bureau is handicapped by lack of the funds needed to enable it to carry forward its numerous researches upon an adequate scale, and the opportunities before it are almost beyond appreciation, given adequate financial support.

Chicago Electrification Not to Start for Two or Three Years

MANUFACTURERS and trade representatives who are anticipating business to develop from the proposed electrification of the Illinois Central in Chicago will be interested to learn that it will perhaps be two or three years before active construction on overhead or third-rail distribution system and substations can be begun. The reasons which make it necessary to delay starting until this time are that a great deal of track work, building and other changes in physical property must be well under way before the electrification can be started. At the same time purchase of motor cars and other electrified equipment will be begun.

Erroneous ideas as to the date for starting this work have spread among the trade largely because the company is considering at the present time the purchase of a few steel trailer cars which will be later used in the electrified suburban service. Long before the actual railroad electrification is started the job of wiring the new terminal building and other similar buildings will occupy the center of the stage.

Applications to Appropriate 600,000 Hp. in Oregon

AN INDICATION of the great amount of water-power development being contemplated in the immediate future in the West is found in the report of the State Engineer of Oregon, who has received this year twenty-one applications to appropriate water to generate 600,000 hp., or more than three and one-half times as much power as has already been developed. Among applications is one covering the Five Mile Project, to reclaim 100,000 acres in Franklin and Walla Walla Counties and to develop 30,000 hp.

Fourth Electric Battleship Launched

THE superdreadnought Maryland, the fourth capital ship of the navy to be equipped for electric drive, was launched at Newport News, Va., on March 20. The Maryland is sister ship to the California, launched in November at the Mare Island Navy Yard, California. Her electrical propulsion equipment, which is of General Electric Company manufacture, consists of two turbo-generator units rated at 11,000 kw. each, one control board, four 7,000-hp. propeller motors of the induction type and six 300-kw. exciter sets. The capacity of the complete power plant for propulsion is 28,000 hp. In most respects the Maryland's propulsion equipment follows that of her predecessors, the California and the New Mexico. She is the first vessel to mount 16-in. guns, being supplied with a battery of eight and thus possessing a range greater than any other American warship. She is 624 ft. (188 m.) long, displaces 32,000 tons and is equipped to operate at full speed up to 21½ knots (58 km.) per hour.

A Plan for Co-operation Between Industry and Colleges

THE Technology Clubs Associated, composed of fifty-eight local clubs of technical men, propose to bring together representatives of American industry and of higher education for the purpose of improving the quantity and quality of trained men for management duty.

According to this plan, it is proposed: (1) That representatives of industry shall specify in as definite terms as possible what types of college men are most needed by industry, what character and training industry requires of these men, how many will be needed and what their opportunities in any particular business are; (2) that a specific statement shall be made by representatives of the colleges giving the extent to which the colleges can meet the demands of industry, that is, telling what courses are now given or can be given to meet these demands; (3) that a joint conference between industry and the colleges shall be held for the discussion of these problems at Philadelphia, March 26 and 27; (4) that a permanent record shall be made in book form of the results obtained; (5) that a permanent plan shall be adopted to provide for the continuance of profitable co-operation between industry and education.

At the annual meeting of representatives of the schools and of the industries each of the co-operators from industry is to give one day of an executive's time to presenting information necessary for the prosecution of the work and each industry taking part in this program is to subscribe $2,500 toward the cost of carrying out the plan. The total sum subscribed will be administered by a financial committee made up of Col. Henry Waite, Lester Gardner and Dr. Hollis Godfrey, who is also president of the Technology Clubs Associated.

First Train Over Newly Electrified Pacific Coast Section of C., M. & St. P. Railway

THE GENERAL ELECTRIC GEARLESS PASSENGER LOCOMOTIVE WHICH IS SHOWN DRAWING THE TRAIN OVER THE CASCADE MOUNTAINS ON MARCH 5 IS OPERATED AT 3,000 VOLTS DIRECT CURRENT. OTHER PARTICULARS OF THE ENTERPRISE WERE GIVEN IN LAST WEEK'S "ELECTRICAL WORLD"

Socialization of Public Utilities Opposed in Massachusetts

UNDER a suggested investigation to be made by the Massachusetts Department of Public Utilities into the possibilities of interconnection and development by the state of all electric generating and distributing facilities, established and potential, it was recently proposed in a bill sponsored by the local branch of the American Federation of Labor to abandon the policy of private ownership and operation of electric utilities and to socialize the entire electric light, heat and power service of the Bay State. Two hearings were given by the legislative committee on public lighting at Boston, but little evidence of any popular demand for state ownership of electric service was forthcoming. L. W. E. Kimball of Boston appeared on behalf of the bill as its principal advocate, and F. G. R. Gordon, Haverhill, Mass., and E. W. Burdett, counsel for the Massachusetts Gas and Electric Association, spoke in opposition.

The bill, which is looked upon in electrical circles as one of the most radical measures of the present session, provides an appropriation not exceeding $300,000 for the inquiry, with a report by January, 1922, embracing a plan for unified ownership, operation and maintenance by the state of all electric plants and systems within its borders, both private and municipal. On behalf of the measure, Mr. Kimball claimed that existing companies are not developing the field efficiently, that prices are unduly high, and that public ownership and development would increase facilities and reduce costs. In a long argument he endeavored to prove that experience with government ownership and operation shows it to conduce to economy. Chairman Nason stated that he had no question as to the desirability of unifying the systems of energy supply, but that when it came to the question of a publicly controlled system, government inefficiency in the operation of utilities during the war had led to a revulsion of feeling on his part, and he was no longer an advocate of public ownership.

Mr. Gordon, secretary of the American Anti-Socialist League and a well-known speaker against government ownership, addressed the committee at length upon the failures of the public operation of utilities in many parts of the world. He pointed out that the tendency toward public ownership is confined to the radically thinking population, but that the disastrous results of government operation of utilities during the war, from the standpoint of service and finance, have convinced innumerable people that private management and ownership are vastly to be preferred. H. O. Garman, chief engineer of the Indiana Public Service Commission, recently stated that the poorest managed utilities in the state are municipally owned, and that the cause is partisan politics. Mr. Gordon admitted that occasionally a successful gas or electric light plant can be found under municipal management, but said that, by and large, 95 per cent of all the socialized industries throughout the world are a monumental failure from every standpoint.

For the central-station interests Mr. Burdett denounced the bill as an unadulterated plan for state socialism on a gigantic scale, not to be tolerated by the citizens of the commonwealth. The speaker pointed out that its passage would lead the way toward overturning all previous conceptions of the proper functions of state government. The centralization of generating and supply systems demanded by the times is going forward effectively under private ownership, under the ordinary laws of business and trade. The government's assistance is not needed. Mr. Burdett said that difference between generating cost and selling price to the small consumer is forced by the cost of service beyond the generating station and the unfavorable demand conditions. He held that the greatest profit is made on low-rate power.

Activities of Engineering Council's National Service Committee

THAT the name of the Washington office of the Engineering Council should be changed to "National Service Department" and that the Washington representative should be designated "national service representative" is recommended in the annual report for 1920 of the national service committee of the council, issued last week. The abolition of the committee is included in this recommended change, the chairman, M. O. Leighton, finding that as at present constituted it serves no purpose, conditions constantly forcing the chairman to act on his own responsibility. There exists also a need to make clear whether the chief function of the council is to offer engineering service to the nation or to offer national service to the engineer.

Among important matters undertaken during the year were (1) bringing about a permanent Board of Surveys and Maps to which the supervision of all government mapping has been given; (2) urging upon the President the appointment of engineers on the International Joint Commission and the Interstate Commerce Commission, such appointment to the latter body having been made but refused by the appointee; (3) advocacy of increased compensation for railway professional engineers; (4) getting into closer relations with Congress; (5) propaganda for the proposed National Public Works Department.

Since the December meeting of the Engineering Council work along the lines just mentioned has been continued, follow-up work on the proposed Boston-Washington super-power investigation has been carried on, adequate maintenance for the Signal Corps of the army has been advocated before the House committee on military affairs, bills for the improvement of the Patent Office have been actively supported, and co-operation with the engineering societies of the capital has been successfully sought. The general work of the office has increased at about the same rate as previously.

Signal Corps Organization Approved by House

ONE of the few sections of the army reorganization bill which was passed over by the House of Representatives without discusson was that pertaining to the Signal Corps. No amendment was offered to this section, which reads as follows:

"The Signal Corps shall consist of one Chief Signal Officer with the rank of brigadier general, 290 officers in grades from colonel to second lieutenant inclusive, and 5,000 enlisted men, such part of whom as the President may direct being formed into tactical units organized as he may prescribe; provided, that during the tenure of office of the present Chief Signal Officer he shall have the rank of major-general."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Pennsylvania Safety Congress.—A safety congress under the auspices of the Department of Labor and Industry of Pennsylvania is to be held from March 22 to March 25 in the State Capitol at Harrisburg. On Tuesday, March 23, there will be a symposium on "The Public Utility and Its Hazard."

Endowment for Worcester Polytechnic.—Twenty-two scholarship foundations of $10,000 each were pledged by local manufacturing concerns recently to the Worcester (Mass.) Polytechnic Institute in the course of a "drive" now under way to endow this noted engineering school with $2,000,000.

M. I. T. Professors to Receive Bonus.—The executive committee of the corporation of the Massachusetts Institute of Technology has voted to appropriate $100,000 as a bonus to the instructing staff, covering the remainder of the academic year. In the fall a new schedule of salaries will be established in view of the success of the recent campaign for an endowment fund of $8,000,000.

Ice and Sand Hinder Operation.—So severe did the weather conditions at the Port Clinton power plant of the Northwestern Ohio Railway & Power Company become during the long cold spell that it was found necessary to blast a channel through ice and sand bars to get relief. Steady winds from the southwest had lowered the water of Lake Erie several feet in front of the company's plant.

Growth of Georgia Company's Testing Laboratory.—The testing laboratory of the Georgia Railway & Power Company, which two years ago was manned by two men whose most important work was the testing of meters, is now equipped to make almost every known electrical test. To it fell the acceptance tests of the 60,000-kw. hydro-electric plant at Tallulah Falls, where the sixth 13,300-kw. turbine is now being installed.

Metropolitan Edison Has Banner Year.—The Metropolitan Edison Company's new-business department reports that 1919 was a banner year, 15,442 hp. being added to the company's load. Two contracts with other public utilities—one the York Haven (Pa.) Water & Power Company, the other the Pottsville (Pa.) company—are not included in these figures. Under an arrangement for interchange of power with the former company 5,000 kw. may sometimes be called for, while the latter company will take from 2,000 kw. to 4,500 kw.

California College Changes Name.—By unanimous action of the board of trustees, taken last month, the name of the Throop College of Technology, Pasadena, Cal., has been changed to California Institute of Technology.

Standardizing Map Making.—President Wilson has created a board of surveys and maps "in order to coordinate the activities of the various map-making agencies of the executive departments of the government, to standardize results and to avoid unnecessary duplication of work." The board is directed to perfect a permanent organization and to hold meetings at stated intervals, to which representatives of the map-making public shall be invited for the purpose of conference and advice.

Lowellville, Ohio, to Have Larger Power House.—The Pennsylvania-Ohio Electric Company, successor to the Mahoning & Shenango Valley Railway & Light Company, is to build a large addition to its power house at Lowellville, Ohio. The improvement, which will cause an expenditure of more than $1,000,000, will involve the installation of a 20,000-hp. turbo-generator of the latest type, increasing the total rating of the plant to 80,000 hp. and affording additional power facilities to the rapidly expanding districts of Youngstown, New Castle and Sharon.

Teaching Safety to Engineering Students.—With the idea of interesting educators in engineering colleges still further in a plan to impart to their students a knowledge of modern safety methods, the National Safety Council recently arranged a conference with prominent engineers and instructors, at which addresses were made by several members of the council. Their suggestions were commented on by Frank J. Sprague, Dean Cooley, Prof. C. A. Adams, Dr. E. B. Rosa and others, who discussed the safety movement from the standpoint of economy and engineering efficiency and also in its human and altruistic aspects.

Utilizing Waste Natural Gas.—The San Joaquin Light & Power Company is preparing to begin work upon a new generating plant in the oil field west of Bakersfield. This plant is planned primarily for the use of natural gas produced in the oil fields and now going to waste because of the lack of facilities for transporting it to the distant market of Bakersfield and Los Angeles. According to A. D. Balch, vice-president of the company, the plans for the plant are about completed. Stirling boilers will be used, equipped with duplicate sets of furnaces so that either natural gas or oil may be burned. The first electrical unit will be a 12,500-kw. generator feeding into the 110,000-volt transmission line. It is planned to install ultimately three other units of the same rating in this plant, making a total of 50,000 kw. Construction will be in charge of E. A. Quinn, general superintendent. The first installation will require approximately $1,000,000, and it is hoped to have the plant in operation this year.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. and S. E. E., Philadelphia Section.—"Welding, Electric Versus Gas," will be the topic presented by James E. Wilson, electrical engineer for the Treadwell Engineering Company, Easton, Pa., before this section on Saturday, April 3.

Pennsylvania Electric Association.—The Eastern Geographic Section of the Pennsylvania Electric Association will meet at Philadelphia on March 25, when "Grounding Secondaries" and "Customers' Appliance Repairs" will be the subjects of discussion.

Engineers' Club of Philadelphia.—"The Progress of the Engineering Council's Work" will be discussed by Alfred D. Flinn at the Tuesday luncheon address of the club on March 30. Next week P. H. W. Ross will talk upon "Merchant Marine Developments."

A. I. and S. E. E., Pittsburgh Section.—Coming meetings of the Pittsburgh Iron and Steel engineers are that of April 17, when Robert B. Treat, electrical engineer, General Electric Company, Schenectady, will present a paper on "Grounded Neutral," and that of June 12, when R. H. Keil, power engineer, Jones & Laughlin Steel Company, Pittsburgh, will discuss "Current Limit Reactance."

Wisconsin Electrical Association.—C. A. Butcher of the switchboard engineering department of the Westinghouse Electric & Manufacturing Company will present the paper on "The Development of Automatic Substation Equipment" which was unassigned in the program published in this column on March 6 for the Milwaukee meeting of this association to be held next Wednesday and Thursday.

A. I. E. E., Boston Section.—On April 9 a meeting of the Institute under the auspices of the Boston Section and the committee on electrochemistry and electrometallurgy will be held at Boston jointly with the American Electrochemical Society. At 9:30 a.m. a symposium on "Electrically Produced Alloys" will be given at a joint session of the two societies. In the afternoon an inspection trip will be made to the laboratories of the General Electric Company at Lynn, where talks on research work will be delivered by Prof. Elihu Thomson and others. At 6:30 p.m. a subscription dinner will be served at the Copley Plaza. At 8:30 p.m. the evening session will be held at the Copley Plaza, where a symposium will be given on "Power for Electrochemical Purposes."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Exercise of Police Power by the State in Changing Rates.—The Supreme Court of Oregon, in a decision just handed down, in City of Hillsboro vs. Oregon Public Service Commission and North Coast Power Company, has ruled that when a city enters into a franchise agreement with a public utility which involves rates for the service rendered the law reads into the contract the stipulation by the city that the state may at any time exercise its police power to change such rates.

Duty of Commission in Fixing of Maximum Rate.—In City of Cleveland vs. Public Utilities Commission, it was held by the Supreme Court of Ohio that when the commission, on the complaint of an illuminating company, set aside as unjust a municipal ordinance fixing a maximum rate of 3 cents a kilowatt-hour for electrical energy and merely fixed as a maximum rate 10 cents—a price concededly too high for an actual uniform operating rate—it was in error and that it was its duty to fix a just and reasonable rate. (125 N. E. 864.)

Contributory Negligence in Case of Death from Fallen Wire.—Whether a man who was killed from contact with electric wires attached to a fallen pole alleged to have been unsafely erected in stock yards where he had duties was warned of the danger, heard the warning if given, or was in a position to hear another deliver a message that the wires were down, and similar questions, with the general question of contributory negligence, were held by the Supreme Court of Iowa, in Eason vs. Des Moines Electric Company, to be questions for the jury. (175 N. W. 945.)

Damages Claimed Because of Dam Erected in 1902.—The Supreme Court of Georgia has held that a non-suit was properly granted in Roberts vs. Georgia Railway & Power Company, a suit for damages because of alleged injury due to a dam built in 1902 below petitioner's property and creating a large reservoir. The court found that there was no evidence to show that the dam was improperly constructed, operated or maintained, that no negligence was charged either against first operator or the defendant, a successor, and that there was nothing to support allegations of foul odors constituting a nuisance and menace to health. (101 S. E. 813.)

Verdict as to Negligence of Several Defendants Conclusive on Appeal.—In a suit brought jointly against a construction company, a telephone company and an electric light and power company for the death of plaintiff's husband it appeared that he was employed by the construction company, which in the progress of work upon a reservoir was responsible for the breaking of a telephone wire that subsequently came into contact with the wire of the power company and thus led to the fatal accident. The trial court found against the construction company and in favor of the two other defendants, and the Supreme Court of Missouri has held that this verdict is conclusive on appeal. (317 S. W. 831.)

Where a Contract Is Unambiguous, Circumstances and Intent Are Immaterial.—The Supreme Court of Montana has held, in Helena Light & Railway Company vs. Northern Pacific Railway Company, that a contract to furnish the defendant with all the electrical energy it required at its pumping station and other places was not broken because of the abandonment of the pumping station, although the inducing cause that led the electric company to make the contract was the use of its poduct at the pumping station. The contract at issue was for five years with option of renewal, but, on the ground that renewal of a part only of the contract was sought, the electric company held that the rate should be increased to that of its regular schedule. (186 P. 702.)

Interstate and Intrastate Commerce in Electricity.—In Mill Creek Coal & Coke Company vs. the Public Service Commission of West Virginia, the Supreme Court of Appeals of that state laid down these among other principles governing the importation and sale of electrical energy: (1) The transmission of electricity from state to state is commerce between the states; (2) in determining when commerce ceases to be interstate and becomes intrastate the essential character or unity of the movement is decisive; (3) the transmission of electrical energy direct from the seller in one state to the consumer in another for immediate or virtually immediate use, subject only to a temporary stop en route for the purpose of reducing the voltage, remains interstate commerce until the commodity has reached its goal unless theretofore sold to independent distributing companies, in the state importing the energy, for resale to local consumers; (4) the regulation of the rates at which electrical energy transmitted from one state to another shall be sold in the latter state is, so long as the rate fixed is not confiscatory or discriminatory against citizens of another state, a matter essentially local in its nature and not of such national importance as to require a general system and uniformity of regulation; (5) reasonable rates for electrical energy prescribed by a state in the exercise of its police power, through the instrumentality of the Public Service Commission, are not repugnant to the contract or due-process-of-law clauses of the United States Constitution. (100 S. E. 557.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Invalidity of Oral Contract.—In the matter of an alleged oral contract for fan service entered into with the predecessor of the Richland Public Service Company and refused recognition by the latter company, the Ohio Public Service Commission decided that it was without power to compel the fulfillment of the agreement asserted to exist inasmuch as to do so would be ordering the defendant company to commit a discrimination, which the law forbids.

What Constitutes Going Value.—The Indiana Public Service Commission has asserted its belief that the logical and equitable basis for an allowance for going value is the unrequited losses and the cost of establishing the business. No substantial allowance for going value is justified where there is no showing of early or unrequited losses or of any capital expenditures for establishing and attaching the business other than those which have been paid as operating expenses without loss or impairment of dividends.

Commission's Policy on Consolidation.—The North Dakota Board of Railroad Commissioners, in passing on an application made by the Dakota Light, Heat & Power Company, has declared itself not to be opposed to the consolidation and merger of public utilities where increased efficiency in administration and operation may be derived therefrom. It holds, however, that no value for purposes of capitalization should be attached to increased efficiency and decreased operating costs resulting from such consolidation.

Power to Compel Consolidation.—The Railroad Commission of Wisconsin has held that it is without authority to compel the consolidation of competing telephone exchanges in a municipality, even though such consolidation would result in economy of operation and lower rates for subscribers. The Ettrick Telephone Company and the Western Wisconsin Telephone Company each operate telephone exchanges in both Ettrick and Galesville. The Railroad Commission recommended a scheme of consolidation which would eliminate one of the extra exchanges in each village. The Western Wisconsin Company agreed to this, but the Ettrick company refused. Ninety per cent of the latter company's subscribers are stockholders, and at the annual meeting they voted unanimously to pay higher rates rather than consolidate. The commission has, therefore, authorized an increase in rates from $12 to $15 a year and established a charge of $6 per year for extension telephones.

F. W. Brownell has been appointed general auditor of the Stone & Webster companies in the Puget Sound district, succeeding F. P. Dexter, who has been transferred to the Boston office.

W. Wayne Everett, who has held the position of assistant sales manager for the last year and a half with the Wisconsin Gas & Electric Company at Kenosha, Wis., and previous to that held the position of sales manager for four years, has resigned to become advertising manager for the *Wisconsin Agriculturist*.

Edward M. Burd and **William C. Giffels** have recently opened an office in Grand Rapids, Mich. Both are University of Michigan graduates and have since had about ten years' experience in power development work, largely in connection with the design and construction of the steam and water-power plants and transmission lines of the Consumers' Power Company system in Michigan. During the war Mr. Burd was a captain of heavy artillery, while Mr. Giffels was first lieutenant of engineers and served more than a year on the firing line in North Russia. Since that time both men have been back with the Consumers' Power Company.

S. W. McCune, Jr., who was for some two years electrical mechanical engineer of the Newport Company, Carrollville, Wis., was recently appointed chief engineer of the company. After graudation from Armour Institute, Chicago, with the degree of electrical engineer in 1910, Mr. McCune entered the test department of the General Electric Company at Schenectady, N. Y. In 1912 he was transferred to the Chicago office of the General Electric Company as sales manager, leaving this post about five years later and becoming connected with the Newport Company. As chief engineer of that company, Mr. McCune is responsible for all new construction and for the maintenance and operation of its electrical and mechanical equipment.

N. J. Neall has re-established offices as consulting electrical engineer at 12 Pearl Street, Boston, Mass., where he is prepared to render special assistance to executives of electrical and industrial properties on plant design, the purchase and operation of equipment, negotiation of power contracts, plant economies and improvements. Mr. Neall closed his offices at Boston in April, 1918, following the completion of his work as consulting electrical engineer at the Camp Devens (Mass.) cantonment. Entering the service with a major's commission, he was ordered to report for duty at Washington, where he was made advisory electrical engineer for the construction division of the army. Later he was made chairman of the committee on the standardization of War Department apparatus and supplies, and his service led to his appointment as chief of the standardization section of the engineering and standardization branch of the purchase, storage and traffic division of the General Staff.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

William States Lee, who is vice-president and chief engineer of the Southern Power Company, with headquarters at Charlotte, N. C., and responsible for the design and construction of the entire system of that company, has built up a consulting practice which has called for the establishing of an engineering office at 511 Fifth Avenue, New York City, to handle a part of his consulting work. He will still retain his relationship as heretofore with the company and maintain his engineering staff in Charlotte which will work in conjunction with the New York office. Mr. Lee will divide his time between these two offices. Some of the high points in Mr. Lee's engineering career are outlined on page 644. He was born Jan. 28, 1872, at Lancaster, S. C., and was graduated from the South Carolina Military Academy in 1894. His first work was with the Pickens Railway Company as resident engineer. That position he gave up to take charge of the construction of the Portman Shoals hydro-electric plant on the Seneca River as resident engineer for the Anderson (S. C.) Water, Light & Power Company. There he placed in service in 1898 the first 11,000-volt generator to be installed in America. After completing this plant Mr. Lee spent some time in construction work for the United States government coast-defense plans for the Charleston and Port Royal harbors. In October 1898 he was employed by the Columbus (Ga.) Power Company as resident engineer on the construction of a dam on the Chattahoochee River at Columbus. This dam was partly swept away by a severe flood in 1900. Its redesign and reconstruction, together with the building of transmission lines and substations, were then placed under his direction and supervision as chief engineer for the company. He modified the design and raised the height of the dam, completing it in the spring of 1902. This was the first large dam built in the South and was constructed under most unfavorable conditions due to quickly rising floods. About this time Dr. W. Gill Wylie, the organizer of the Catawba Power Company, was having trouble in building a dam at India Hook Shoals, near Rockhill, S. C., on the Catawba River, and Mr. Lee was engaged as chief engineer to take up the work that three contractors were unable to complete. In spite of persistent floods he completed the dam in the spring of 1904, together with 47 miles of transmission lines from the plant to Rockhill, Charlotte and Clover. Upon the formation of the Southern Power Company in 1905, which took over the Catawba Power Company and purchased larger power rights on the Catawba and Broad Rivers, Mr. Lee was made chief engineer and in addition served in the executive capacity of vice-president. This position he has ever since held, and with the financial assistance of J. B. Duke, as president of the Southern Power Company, he has designed and constructed the generating stations of that company in the following order: Catawba, 6,600 kva., in 1904; Great Falls, 30,000 kva., in 1907; Rocky Creek, 30,000 kva., in 1909; Ninety-nine Islands, 22,500 kva., in 1910; Lookout Shoals, 22,500 kva., in 1915; Fishing Creek, 37,500 kva., in 1916; Bridgewater, 25,000 kva., in 1919, and Wateree, 70,000 kva., in 1919. Four auxiliary steam stations have also been built, with a total rating of 36,500 kva., making the combined generator rating of all plants 280,900 kva. These stations serve 2,050 miles of high-voltage transmission lines and through outdoor substations with a combined rating of 443,500 kva. furnish electric energy to one-fourth of the number of spindles in the cotton mills of the South. Under Mr. Lee's direction also 130 miles of high-speed electric railway, operated at 1,500 volts direct current from the Southern Power Company's system was built and placed in operation in 1911 for general freight and passenger traffic. The standards devised by Mr Lee through experiences in pioneer design and installation of steel tower transmission lines, outdoor switching and transformer stations, line insulation and protection and the design of dams of concrete and earth construction to resist unusual stream flow, have been widely reflected in the practices of other large companies. Mr. Lee is a fellow of the A. I. E. E. and a member of the A. S. M. E., A. S. C. E., Engineering Institute of Canada, and Southern Manufacturers' Club. He is also a member of the Industrial Committee of North Carolina and during the war served on the North Carolina State Council of National Defense.

Obituary

Henry Smith Carhart, celebrated physicist and noted authority on electrical subjects, died at his home in Pasadena, Cal., on Feb. 12. Dr. Carhart was born at Coeymans, N. Y., March 27, 1844. He was graduated from Wesleyan University with the class of 1869 and then took up graduate study at Yale and Harvard and also in Berlin. In 1893 he was a member of the International Electrical Congress which standardized the Clark cell. From 1872 to 1886 he was professor of physics at Northwestern University, leaving in 1886 to become professor of physics at the University of Michigan, where in 1889 he started the College of Electrical Engineering.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies -Notes on Industrial Activities and Business Methods

Unfilled Orders of Somewhat Uncertain Value

ORDINARILY a volume of unfilled orders is an indication of strength. The greater the amount the better the manufacturer feels. If such were an unerring rule for confidence, then conditions today would be the best ever known.

Electrical manufacturers of standard lines and of specialties, of wiring supplies and of appliances, of motors and of fixtures, all along the line are producing all that they can and in most instances only to find that unfilled orders continue to pile up. Furthermore, these goods are being absorbed by the ultimate consumer as fast as they can be delivered. Satisfactory stocks in a majority of electrical lines are virtually unknown in a large part of the country. There are sections, of course, like the copper-mining regions that are purchasing very little; but these sections only serve as exceptions to prove the rule.

Apparently, therefore, the present situation in the electrical market is decidedly favorable. Still, there is an undertone in the market that is unmistakable. Where six months ago one would say jokingly, "This can't keep up forever," today market students are counseling watchfulness. Cancellations of orders are expected. It is well known that a substantial part of the present volume of unfilled orders represents protection. In fact, in some raw-material markets no secret is made of this fact. Buyers feel that in placing orders today they have nothing to lose and everything to gain. They feel no obligation to accept delivery. If conditions change so that instead of there being a shortage the supply will equal or be greater than the demand, then they expect to cancel.

When such a situation exists the volume of unfilled orders naturally cannot be considered so favorable. In fact, electrical manufacturers are finding this volume of such uncertain value in their assets sheet that they are hesitating to engage in any plan for expansion. There is no doubt that under ordinary conditions the demand and shortage of supply would warrant almost any electrical manufacturer in materially increasing production facilities. To-day, however, caution is being urged.

Delivery Conditions Prevailing in the Motor Field

DELIVERIES of motors at present are running around ten to twelve weeks from the factory on direct-current motors in a representative case; from twelve to twenty-six weeks on alternating-current motors up to 20 hp., and from fourteen to twenty weeks on large motors, say of 50 hp. and up. Factory stocks are confined to motors in process and long since mortgaged by purchasers or else awaiting shipment immediately that transportation becomes available. The delays in raw-material shipments and in factory deliveries due to adverse weather conditions are still very trying, but these are temporary in character and less serious than the lessened production resulting from unsatisfactory labor conditions. Unwillingness to work steadily and well for a full weekly schedule is proving a great hindrance to motor output, and in some winding rooms only four days work per week is being obtained. The labor turnover is also disquieting, and the pressure for higher wages is continuous, notwithstanding the unprecedented compensation now widely in vogue. These conditions are naturally putting a premium on the development of labor and time-saving machinery for motor production, and the advances of the past two or three years in this direction are little short of a revelation to an outsider permitted to visit a large-scale motor factory.

It seems probable that no protracted shut-downs will be necessary to motor manufacturers on account of the non-arrival of materials, and that if the industry reaches the close of this month safely, the rest of the year can be utilized with little fear of curtailment. The stability of the present price level seems assured, at least for several months. Within the past few weeks motor prices have advanced or been readjusted on the order of 5 to 10 per cent, and some of these new lists were sent out only after the utmost effort was made to hold to the former schedules. Large buyers of electrical machinery have expressed appreciation of the fact that since 1914 price advances have been of the order of 65 per cent compared with increases of 85 to 315 per cent in many other manufactured commodities. If labor can be induced to "play the game" fairly and squarely in the coming months and years, either by persuasion or by the stern teaching of economic adversity, the effect on motor production will be most salutary, and in any case the use of automatic machinery will be encouraged considerably.

Better Business Methods Bring Added Discounts to Lamp Agents

DISTRIBUTION through consignment of stock to agents always presents many problems largely of a psychological or human nature. The human being is so constituted, unfortunately, that he is prone to think that because he has no money invested in a stock there is little necessity for selling that stock on what is generally recognized as a good business basis.

For some years the bulk of the incandescent lamps made in the United States have been distributed on a consignment basis. In the trade there is the jobber or B agent and the dealer or A agent, who is served on consginment by the B agent. Now this B agent serves customers direct as well.

One of the well-recognized functions of a jobber is to warehouse stocks. In fact, in most lines a large proportion of his discount compensation is made for this reason. However, there have been electrical jobbers, many of them in fact, who, feeling the burden of warehousing charges, made use of manufacturers' local stocks. The jobber would secure an order and have the order shipped to the customer from the manufacturer's stocks.

This situation when brought home to jobbers who performed their rightful function of warehousing showed them conclusively that they were being placed at a disadvantage.

The lamp manufacturers, on the other hand, easily saw that they were being called on to do what they were expecting the jobber to do. The manufacturer found that it was costing him more to do this shipping of small lots.

To penalize a jobber for billing from manufacturer's stock by lessening his discount was not felt to be advisable. Another and more generous method was conceived and has been made a part of the 1920 Mazda lamp agent contracts. Now a jobber is allowed an extra 2 per cent on the list value of the lamps which he distributes from his own stocks. The added profit to be derived gives the jobber a greater incentive to warehouse lamps.

A greater evil in the distribution of lamps, however, is that of slowness of turnover. On consigned stocks naturally there is not the incentive to increase turnover that there is on sold stocks. In the lamp situation there is the added complication of the jobber consigning stocks to the retailer.

Consequently, the manufacturers in their 1920 contracts gave the jobber the definite responsibility of seeing that the dealer turned his lamp stocks over at what was felt to be a reasonable rate. The retailer's stocks are actually in the custody of the jobber. Under the old contracts the jobber received a flat 5 per cent on the list value of the retailers' (A agents') sales. Under the new contract, as originally drawn up, the jobber or B agent was to receive instead 3 per cent with an additional 1 per cent if the A agents showed a turnover of five times a year, and an additional 2 per cent if the A agents showed a turnover of six times a year.

While the manufacturers feel that such a rate of turnover is reasonable and practicable, there have been a number of jobbers who were not so convinced. Rather than force these terms on the jobbers, almost, as it were, without warning, the lamp manufacturers in a statement to the ELECTRICAL WORLD said that for the current calendar year they had decided to pay the full 5 per cent, regardless of the turnover rider, with the distinct understanding, however, that they were convinced of the fairness of the principle and were definitely going to put it in force on some equitable basis in next year's contracts.

The manufacturers of lamps have now out on consignment millions of dollars worth of lamps. This investment is bringing in no return. It is not unreasonable to suppose, therefore, that if this huge unproductive investment can be materially reduced by increasing turnover the distributer who aids in this matter will find the manufacturer more inclined to better his discount.

The manufacturers state that they are firm in their decision to make stocks move faster. It was for that reason that they decided to make the discounts such that the jobber will have a real incentive.

Pole-Line Material Prices Are Materially Higher

AN INCREASING demand is felt for pole-line material with the approach of the spring construction season. Generally speaking, stocks are in fair shape—much better, in fact, than stocks on other electrical materials.

Prices have advanced on almost all line material except wire. White cedar poles are up 10 per cent, cross-arms 8 per cent, insulators 10 per cent, hardware 10 per cent, and locust pins 25 per cent.

Cross-arms appear to be short east of the Rockies. It is reported that the Pacific Coast yards are piled high with cross-arms, but owing to a local shortage of rolling stock it takes from three to six weeks to make a shipment.

Sales Efforts in Industrial Heating Intensified

IN ORDER to take fuller advantage of the opportunities presented in the industrial heating field, at least two large manufacturing companies have recently intensified their efforts in that direction. It was only in January that the Cutler-Hammer Manufacturing Company announced the discontinuance of its domestic heating line to permit it to apply all its energy of that nature to developments of the industrial heating field.

The New York office of the General Electric Company has just organized a "process section," composed of men specializing in equipment such as is used in electrothermal and electrochemical operations, to centralize the handling of equipment for special processes wherein electricity or electrical heat is the active agent. This has apparently been done in view of the situation prevailing in the metropolitan district, where headquarters of many of the large manufacturing, mining and reduction companies may be found, companies which are or could be large users of this kind of energy.

Reducing Lamp Shrinkage by Means of Bonus

IN THE manufacture of incandescent lamps the reduction of shrinkage is perhaps the most serious problem encountered, and lamp makers are concentrating attention upon this matter. The percentage of spoiled or rejected lamps in process expresses in some cases the difference between commercial success and failure, and in the past a number of companies have gone on the rocks because of excessive losses of this kind. Of late, the paying of a bonus dependent upon the reduction in shrinkage percentage has come into favor in certain lamp factories, and the results appear to justify the practice. The lower the shrinkage the more the employee earns, and the application of what might be called profit-sharing methods to the pursuit of a shrinkage "bogie" is cutting down spoilage and waste.

What such profit-sharing means is illustrated in the case of automatic exhausting, where a typical operator is paid $4.25 for exhausting 5,000 lamps with a shrinkage of 3.1 per cent and $5 if a shrinkage of 1 per cent is obtained. To make headway in approaching or attaining a shrinkage bogie, inspection must be maintained at maximum efficiency and poor work must not be allowed to be passed along to the next operation to add to the shrinkage of the succeeding process. The ability of lamp manufacturers to meet the growing demands of the trade is intimately bound up in these important problems of production efficiency.

Lightning-Arrester Deliveries Good

MANUFACTURERS are better able to deliver lightning arresters than almost any other kind of equipment. Although sales have been fairly heavy, greatly increased production has enabled manufacturers to get some stock ahead. This, however, it is expected, will be swallowed up by the first rush of orders. As the heavy buying of the year takes place during the spring months, production of arresters is being pushed to the limit in an attempt to keep ahead of orders placed.

Distribution lightning arresters, both of the compression-chamber multi-gap type and of the aluminum-cell type for 2,300-volt service, are in fair demand. Ample stocks of each kind are held ready for shipment. In the larger sizes of compression-chamber multi-gap arresters deliveries are four, eight and ten weeks respectively on voltages of 5,000, 7,500 and 15,000. Arresters of special design require four to six weeks additional.

In the high-voltage transmission field deliveries on both aluminum-cell and oxide-film arresters range from two to eight weeks, depending upon size and type.

Prices have not changed since last fall with the exception of a small increase on compression-type arresters. The oxide-film arresters, however, have been decreased in price, on an average 5 per cent. According to the manufacturer, the decrease was made because of greater production and increased sales.

More Interest Being Shown in Grounding Device Sales

SALES of grounding devices for a year past have been rather spotty among various manufacturers. Where labor conditions have permitted operators to work their plants at full capacity an increase in business has been shown for the year. Where labor conditions hindered production inquiries received by the manufacturers indicate that the business of the year just closed would otherwise have been above that of the year previous. Ability to furnish the grounds has been a big factor in the sale, in addition to more settled conditions and more liberal buying in this country and, particularly, the demand that has been growing abroad.

Current sales show an increase. Since the time to manufacture these devices is small, shipments can be made promptly, or up to three weeks. In some cases, however, labor conditions are drawing out this time considerably.

So far as can be learned, prices have not changed recently and there is no prospect for any change in the near future. The outlook is bright because of the quantity of inquiries and the amount of unfilled orders. There is an increasing interest in the problem of proper grounding, and considerable attention is being directed toward adequate capacity, durability and dependability of the apparatus.

As spring advances and frost conditions disappear considerable development in this field can undoubtedly be expected both for new developments and rehabilitation work.

Wood-Pole Market Improving

WOOD-pole sales are improving. Business is encouraging and as soon as the railroads recover from the effects of the storm conditions over the country, deliveries will be much better than for some months past.

Although cutting operations have been difficult during the present season, the work is pretty well along, and were it possible to get transportation at the present time, the distributing yards of the different pole companies would be full to overflowing. As it is the poles have been cut and are on the ground waiting to be shipped. Car shortage is the greatest menace, although in some instances pole interests have built their own flat cars for moving poles to the main line of the railroads. Some stocks already have been received, and a large amount of poles are now loaded or en route.

Prices on red cedar poles have not advanced since the first of the year, but white cedar prices have just increased ten per cent. There is a large demand in the East and South for both Northern and Western red cedar and also for Northern white cedar. In the West the greatest demand is for Western red cedar, which is cut in the off season and is in reality a local product obtainable on short notice at almost any time of the year.

Chestnut poles have not advanced since last year, but an increase is now looked for and may be announced at any time. Some of the best grades grown in parts of Virginia and Pennsylvania have been destroyed by blight although there is a considerable supply south of these districts which will be available.

Metal Market Situation

A CONTINUED dullness in metals was evidenced this week. Copper is still going down, being an eighth of a cent lower than last week. London prices continue to toboggan. Copper consumers from all reports seem to be fully covered until the first of May. Current sales are small and are for the most part resales. Producers, it is stated, are not interested in present prices, claiming that they are too low. Producers are holding prompt to third-quarter copper, it is reported, at 18½ cents, which is slightly in advance of open-market quotations.

Seamless-copper tubing is quoted at 32 cents and seamless high-brass tubing at 30½ cents. Copper sheets are quoted at 29½ cents and round rods at 26¾ cents.

Old metals showed little change over last week.

NEW YORK METAL MARKET PRICES

	March 16	March 8
Copper	£	£ s d
London, standard spot	107 00	121 0 0
	Cents per Pound	Cents per Pound
Prime Lake	18.50 to 18 75	18 75
Electrolytic	18 12½	18 25
Casting	17.87½	18.00
Wire base	22.25	22.25
Lead, trust price	9 25	9 25
Antimony	11.00	11.37½
Nickel, ingot	43 00	43 00
Sheet zinc, f.o.b. smelter	12 00	12 50
Spelter, spot	8 85 to 8.95	8 85
Tin	62.00	61 50
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15 50 to 16.00	16 50 to 17 00
Brass, heavy	10 00 to 10 25	9 50 to 10 00
Brass, light	8 50 to 9 00	8 75 to 9 00
Lead, heavy	7 75 to 8 00	7 75 to 8 00
Zinc, old scrap	5 00 to 5.25	5 00 to 5 25

THE WEEK
IN TRADE

SUSTAINED heavy demands and unusually slow transportation have combined to produce the worst shortage of electrical supplies on record. Local conditions are apparently worse today than during the height of the war. Total absence of a growing list of items is reported from more than one locality.

Prices seem to be steady, however, porcelain insulators, cross-arms, locust pins and line hardware are reported up.

Collections are slowing down here and there, but apparently this condition will right itself very shortly. At any rate, it is causing no concern in those localities yet.

NEW YORK

The past week has shown considerable improvement in shipments over previous weeks. A good many carloads of material were received only to be rebilled and sent out to dealers. With the exception of some seasonable goods, jobbers are rebilling virtually everything they receive; hence the amount of goods sent out is smaller in volume than is usual. Parcels post is being used to a great extent, and materials such as porcelains, etc., are reported as coming through in good shape.

Jobbers, not to be caught short of heating appliances for the Christmas trade, are placing orders for both 1920 and 1921 requirements.

Lack of labor and of raw material, with an added car shortage, is holding up rigid conduit and armored flexible conductor. One manufacturer reports that he has not made any of the latter for five weeks as the raw material is still en route.

Wire.—Deliveries are much better in this line than on many other products. The demand is brisk and stocks are moving rapidly. Rubber-covered No. 14 is quoted at $11.50 per 1,000 ft. in 5,000-ft. to 1,000-ft. lots. One large manufacturer on a 26-cent base has revised discounts which increases prices approximately 5 per cent.

Flexible Armored Conductor.—Shortages are reported everywhere. Prospects are for a continued shortage. Manufacturers announce that they cannot get steel strip although many carloads are en route. The price of No. 14 double-strip is $97 to $99 in 1,000-ft. lots.

Sockets.—Prices vary slightly with the demand fairly heavy. Pull sockets during the early part of the week were 47 cents net, keys 28 cents and keyless 26 cents.

Heating Appliances.—Several cars were received the first of the week on old orders. Factory conditions are improving slightly.

Friction Tapes.—Stocks are spotty. The ¾-in. black is 48 cents a pound for lots of 50 lb. or more, 48 cents for from 25 lb. to 50 lb. and 50 cents for quantities less than 25 lb.

Ironing Machines.—Poor shipments are the rule. Manufacturers are now four to eight weeks behind in deliveries. The large demand has been a surprise to jobbers, who are now buying in carload lots.

Schedule Material.—This is coming in stronger with prospects of having sufficient to take care of most of the remodeling work being done. New construction work may have to wait, although there is not so much of it as yet.

Rigid Conduit.—The situation is unimproved and seems to be growing more serious. Considerable relief is expected within three months according to reports, but by that time new construction work and remodeling will take every available foot and still leave a large shortage.

Fans.—These are coming in at a fair rate. Several jobbers report a carload or two, which a month from now should last probably three days to a week. In view of the raw-material situation, the demand for fans this summer is expected to be unprecedented. Some jobbers already have doubled their orders to be sure of getting at least half of them.

Transformers.—One of the largest manufacturers has advanced prices on all transformers approximately 10 per cent, on account of increased costs of raw material. Deliveries for distribution type, range from delivery out of stock up to four weeks. High-tension transformer deliveries are quoted from ten to twenty weeks.

CHICAGO

Market conditions here remain as for some time in the past, with a great volume of orders pouring in, back orders steadily increasing and prices trending upward. Deliveries are apparently as bad as ever, and the list of items on which jobbers are accepting orders for shipment at manufacturer's convenience and at prices prevailing at time of shipment only is steadily growing.

The motor situation is probably the worst in the entire line. Factories have for some time been congested with orders and troubled by transportation difficulties, and now the acute shortage of magnet wire further complicates matters. One large manufacturer reports now on order more than 50,000 motors above fractional size, and the number of fractional size needed will run well toward the million mark.

Although the holiday season has passed, factories are not rapidly catching up on shipments as was expected. Jobbers report that deliveries are about negligible, and many dealers who in the past have carried but one line are being compelled by pressure of retail demand to take any make they can secure. Jobbers are booking orders on an open-price basis only.

Bare Copper Wire.—This is one of the few items on which deliveries are anything like normal. Dealers are quoting for immediate delivery on a 23-cent base.

Magnet Wire.—Stocks have ceased to exist. No changes have as yet been recorded in price, but orders are being booked only at price ruling on date of shipment. Deliveries range from four months up, with no signs of betterment. A large jobbing concern reports orders totaling nearly $1,000,000 on which delivery ranges from six months to a year.

Snap Switches.—Jobbers report a heavy demand for stock and for current needs. No recent price changes are recorded. Deliveries are slowing up, a month being average at present.

Motors.—Price increases which have been expected became effective this week on certain types and styles of General Electric motors. The raise of approximately 5 per cent is such as to bring into line those items on which the price was below the existing scale.

Batteries.—New list on Hot Shot batteries, on which a raise was announced last week, is as follows: Nos. 1461 and 1462, $2.70 each; No. 1561, $3.25 each; No. 3462, $7.40 each. There has been no change on dealers' discounts.

Poles.—The increase reported a week ago affected Northern white cedar only. Western red cedar prices remain as formerly. Current list on this grade is: For 6-in. poles, 30-ft., $7.90; 35-ft., $11.45; for 7-in. poles, 30-ft., $10.10; 35-ft., $13.25.

Cross-Arms.—An advance averaging 8 per cent became effective on cross-arms last week. Price on 6-ft. Washington-fir six-pin arms, 3¼-in. x 4¼-in., is now $123.90. Dealers are able to make immediate delivery on reasonably sized orders.

Insulators.—An increase of about 10 per cent is announced on all grades and sizes of porcelain insulators, but actual figures on the new lists are not yet available. There has been no change noted on glass or composition. Deliveries are fairly prompt.

Locust Pins.—At least one large manufacturer has just announced an increase of about 25 per cent. Only those who are protected by contract are able to maintain stock.

Line Hardware.—All items in this line have just been subject to an advance of approximately 10 per cent. Current list on hot-galvanized cross-arm bolts, ⅜-in. x 4½-in., less than 500, $3.78 per 100; over 500, 3.36 per 100; on ½-in. x 7-in., less than 500, $7.28 per 100; large quantities, $6.47 per 100. Hot-galvanized flat cross-arm braces, $1\frac{3}{16}$-in. x $\frac{3}{16}$-in. x 28-in., less than 500, $163.80; over 500, $145.60; 1¼-in. x ¼-in. x 28-in., less than 500, $201; larger quantities, $178.66.

Fans.—Wholesalers report about 90 per cent of their anticipated 1920 stock already on order, at prices approximating 20 per cent over last season. Current list on 12-in. fans is $28; 16-in., $33.

BOSTON

Orders continue to flood New England jobbing houses. Transportation conditions have improved somewhat, and some jobbers report receipt of carload shipments from the Middle West. Others state that material and supplies shipped three months ago are still en route. The shortage of materials resulting from bad weather has begun to hamper collections from some of the electrical contractors, as much construction work has been temporarily suspended. Prices hold fairly firm. Stocks are very spotty and are badly hit in regard to non-metallic flexible conduit, porcelain and motors up to 50 hp. Rigid conduit is very scarce. New building programs are still going forward actively as regards the placing of contracts. Deliveries show little real improvement, but present famine conditions in various lines are expected to yield to better weather. The Lowell (Mass.) Electric Light Corporation will add a 12,500-kva. turbo-alternator with boiler-plant equipment to its facilities.

Electric Coal Loaders.—The Conant Machine Company has increased prices 10 per cent.

Wire.—Weatherproof in smaller sizes is reported short in some agency circles, but jobbers are reasonably well supplied. Quotations are firmer, running around 32.75 cents per pound for triple-braid, No. 10. Bare wire is easier, at 22.25 cents base, and rubber-covered No. 14 is steady at $11.50 per 1,000 ft. in lots of 5,000 ft. and over.

Non-Metallic Flexible Conduit.—The market is almost cleaned out, so far as quantity sales go. Prices are steady at $37 per 1,000 ft. for $\frac{7}{32}$-in. and $40 for ¼-in. loom.

Metallic Flexible Conduit.—Prices are quoted with 10 to 15 per cent off, when any of this material can be had.

Flexible Armored Conductor.—Stocks are very low. A nominal quotation Monday was $100 per 1,000 ft. on single-strip No. 14 in coil lots.

Knobs and Tubes.—Nail-it knobs are extremely scarce, but are quoted around $28 per 1,000 for estimating purposes. Three-inch tubes bring 93 cents per 100 in standard packages. A few can be picked up.

Rigid Conduit.—Shipments are far below normal, and stocks are hoarded to the limit for old customers. One jobber reports receiving two or three carloads in the past six weeks. Black pipe, ½-in., brings $85.43 per 1,000 ft., and the same size galvanized $90.53. Fittings are coming through a little better, on about three months' delivery.

Sockets.—Conditions are decidedly better, notwithstanding heavy orders. Manufacturers are not obliged to work nights to any great extent as yet. Prices are steady, with pulls 47.5 cents, keys 28 cents, and keyless sockets 26 cents net, in case lots.

Washers.—Deliveries out of stock are still being made by leading distributers, but only as a result of far-sighted ordering. Prices are firm, a leading make retailing at $150 in galvanized and $165 in the copper-lined tank.

Radio Apparatus.—Sales are very brisk in both amateur and commercial products. Mail-order business is an important factor in current radio supplies.

Meters.—Jobbers' stocks are low in size, but now and then meters can be delivered at once in moderate quantities. By and large, there is a general shortage.

Lamps.—Strict control of deliveries is being practiced. Business is still very active.

ATLANTA

In spite of the street railway strike in Atlanta just ended, jobbers report that there is no slackening in demand for electrical construction material. Outside of Atlanta proper brisk demands are being registered in all lines of electrical material and apparatus. Building permits continue to be taken out in large quantities and rural districts report considerable activities with the opening of the spring season. Complaints of inability to obtain material are becoming more pronounced. Jobbers report collections not quite so good as in former weeks, but even so, accounts are being liquidated with reasonable promptness.

Wire.—Stocks continue to shrink, especially in the popular sizes, Nos. 6, 8 and 10, No. 14 being especially hard to obtain in quantities. Demand on the larger sizes is reported as somewhat easier. Prices are steady, with rubber-covered on 28-cent and weatherproof on 29-cent base.

Conduit.—There are no stocks of 1-in. and ¾-in. rigid in the territory, while the amount of the other sizes is very small. Car shortage is contributing to the difficulty of obtaining shipments, some pipe having been recently received in refrigerator cars.

Cross-Arms.—The brisk spring demand for line material is badly depleting stocks. For the first time in several years, one of the largest jobbers reports no 6-ft., six-pin arms in stock, while the demand for other popular sizes is in excess of the supply. Prices in Rainier Washington fir, 4-ft., four-pin, less than 1,000 linear feet, $1.03; six-pin, 6-ft., $1.60; pine, four-pin, 4-ft., $0.72; six-pin, 6-ft., $1.10.

Non-Metallic Flexible Conduit.—The scarcity is still acute with no hope for betterment in the face of the brisk demand and very poor deliveries. Prices, however, remain steady; 7/32-in., lots of 250 ft. to 1,000 ft., $3.80; 5/16-in., $4.14.

Panelboards.—Demand is active, while shipments are reported poorer.

Schedule Material.—Local stocks are becoming badly depleted. There is a keen shortage of sockets. Back orders for such have absorbed all shipments recently received. Porcelain is still very scarce, there being practically no knobs or tubes in the territory. An average price advance of 20 per cent is to be noted in this line.

Safety Switches.—Demand is excellent, and, contrary to the general rule, stocks are reported in fair condition. Prices on 30-amp., two-wire, less than one-fifth standard package, $2.20; 30-amp., three-wire, in excess of one-fifth standard package, $2.70.

Oil Switches.—Industrial-plant activity is causing a very brisk demand for the 220, 440, 550 and 2,300-volt, three-pole, single-throw types. Deliveries are slow, particularly on the automatic type, shipments being quoted at from four to six weeks. A price of $76 is quoted on 100-amp. and 200-amp., three-pole, single-throw full automatics.

SEATTLE—PORTLAND

Never have stocks been in the condition that they are today. There are shortages along all lines. There is a particularily good demand, and replenishments appear to be out of the question, orders must be placed from a month to eight months ahead, and then delivery is not assured. The shortage is felt more keenly in house-wiring devices, domestic appliances, schedule material, small motors and porcelain. Apparently there is no relief in sight. In Seattle and Puget Sound cities, the demand for electrical materials for new construction continues increasingly strong, both in the cities and in the smaller suburban towns. Demand for labor-saving devices also is far in excess of available supply, and this condition is true from curling irons to ranges. Jobbers are further harassed by an extreme shortage of competent help, particularly office assistants, salesmen and warehousemen. Owing to the closing down of steel shipyards, there is an over supply of both skilled mechanics and common labor. The spring exodus of labor from the cities to the woods and farms is well under way, and the present surplus will shortly be absorbed. Canneries, sawmills and like industrial plants all expect 1920 to be their biggest year and are making plans accordingly.

The Portland district reports that jobbing and manufacturing interests speak of materially decreasing sales. This may be partly due to the difficulty in obtaining many items. The retail electrical business, however, is in splendid shape, running 50 per cent greater than it did a year ago at this time. As an indication of the movement in labor-saving devices, the Pacific Power & Light Company sold more than 200 washing machines in a campaign conducted during February. A great deal of interest is being developed throughout Oregon in the matter of improved lighting conditions.

Porcelain.—In the face of daily increasing demand, stocks are run down to nothing and no deliveries.

Lamp Cord.—If present demand continues, and there is every indication that it will, stocks will be entirely depleted within a very short time. Shipments are very indefinite. Prices during the past few months have fluctuated.

Flexible Metal Conduit.—Demand is showing a constant increase and stocks are diminishing. Prices are steady. A delayed shipment recently received relieved the local situation temporarily.

Washing Machines.—There is an unprecedented demand and a chronically inadequate supply. Stocks of 32-volt motors for electric washing machines, are completely exhausted.

SAN FRANCISCO

Building permits fell off about 30 per cent during February but are increasing during March. They cover dwellings principally, with here and there a larger job. Rains continue and are spaced so that the year promises well after all. It is predicted that $5,000,000 worth of electrical appliances will be sold in 1920 along the Pacific Coast.

Cross-Arms.—Stocks and sales are improving. The following prices may be considered as representative for delivery from jobbers warehouses: 3¼-in. x 4¼-in. x 5-ft. four-pin light power arms, $1.20 each; 3¾-in. x 4¾-in. x 5-ft. four-pin heavy-power arms, $1.50 each; 2¾-in. x 3¾-in. x 5-ft. six-pin telephone arms, 92 cents each. In lots of several hundred for one delivery these prices may be bettered about 5 per cent. They represent, however, an increase of about 20 per cent over the first of the year.

Fixtures.—Fixtures of the Brascolite ceiling type are in excellent demand because of the redesigning of stores and the improving of residence lighting. Stocks are poor.

Portables.—Fixture dealers report a remarkable increase in the call for stand portables. Comparatively few of the old suspension type, such as were used over dining-room tables, are being sold. There is a decreasing demand for small table brackets and portables except of the very ornate sort. There has been a 20 per cent increase in the Pacific Coast prices of several standard makes of brackets.

Hospital Systems.—This business now seems stagnant after the war activities. There are one or two prospects for railroad hopsitals on foot, but only for a limited number of stations. No Pacific Coast stocks are carried except for maintenance, and sixty days' delivery is promised. The discount on the Bryant type has decreased from 20 per cent to 10 per cent Coast delivery.

Switches.—The best-selling schedule device now is the push switch and plate. One local manufacturer's representative reports that he is 30,000 to 40,000 pieces behind in delivery. Another representative who recently received a shipment of 40,000 push plates sold them within a few days. The call for snap switches is gradually receding.

Flush Receptacle.—The next most popular schedule device is the flush receptacle, which from present indications will outsell even the push switch by the end of the year. A local agent reports that he is about 30,000 behind and is quoting on a basis of from three to four months' delivery.

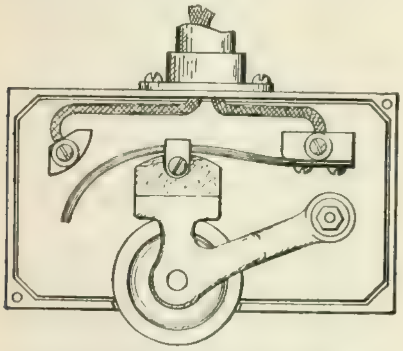
Sewing-Machine Motors.—During the past month or so a great increase in the sale of special bracket motors is noticeable.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Elevator Door Contact

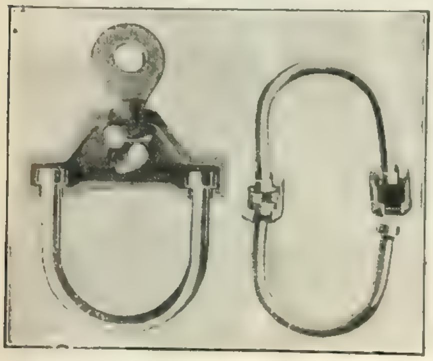
An elevator contact to prevent starting the elevator when any shaft door is open has been developed by Coote & Lawrence, 27 Warren Street, New York City. The device consists of a swinging arm carrying a laminated copper contact which closes when a wheel projecting from the base of the device is pushed inward by the door. The swinging arm is made heavy as it operates by gravity when opening the circuit. The closing operation gives a wiping contact to insure clean surfaces.



CLOSING ELEVATOR DOOR CLOSES CONTROL CIRCUIT

Connector for Link-Type Insulators

A new form of metal connecting link which may be used to join Hewlett strain insulators into strings has been developed by the R. Thomas & Sons Company, East Liverpool, Ohio. The U-shaped member of this connector which is passed through the hole in the insulator has enlarged cylindrical ends with square shoulders which take the strain of the pull on the insulator. Two of these members are used to link two insulators together. After they are placed in the insulator holes their ends are abutted and a coupling piece is slipped over the ends. The ends are then separated about $\frac{1}{4}$ in. and a locking spring is inserted which prevents them from coming out of the coupling piece. For connecting the top insulator a clamp (one design of which is shown in the illustration) with an eye for attaching to the cross-arm holds the metal link.



MEMBERS CANNOT SEPARATE WHEN LOCK SPRING IS INSERTED

Slip-on Reed Shades for Portable Lamps

Hatheway & Knott, Inc., of 120 Liberty Street, New York City, agents for the Rattan Manufacturing Company of New Haven, Conn., announce the addition of a new feature to their line of "Rattan" portable lamps, in the slip-on reed shades. These reed shades are detachable and can be used on other portables and over different silk shades. They are made in a number of styles and shapes, with both open and closed top. The finishes are numerous.

Linemen's Safety Blanket

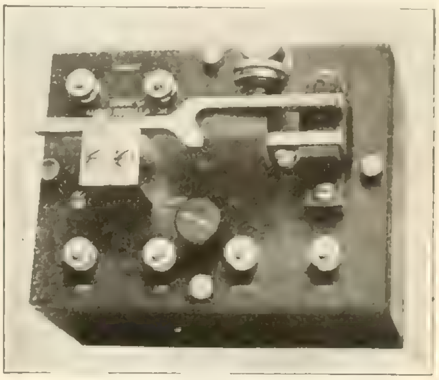
An insulating blanket designed to protect linemen and others from coming in contact with adjacent live lines and terminals has been put on the market by the F. A. Hardy & Company of Chicago and is known as the "Harco linemen's Blanket." It is composed of two thicknesses of steam-cured rubber between which a piece of fabric is inserted. All are vulcanized together in one solid sheet 36 in square, with heavy beaded edges. The total thickness of the blanket is $\frac{1}{16}$ in., and it is made to withstand a test of 25,000 volts. The blanket is to be placed over transformer terminals or live wires with which workmen might inadvertently come in contact. It can be held on a line by the use of regular clothes-pin clips. This protector has been approved by the National Electric Light Association and by the Bureau of Safety of Chicago.

Wall-Type Pull Switch

A pull-switch designed to be mounted on the wall has been perfected by the General Electric Company, Schenectady, N. Y. The mechanism, the makers state, is especially designed for the switch and is not merely an "adapted" snap-switch movement. All the parts are constructed to withstand the abuse of every-day service. The operating mechanism is primarily an eight-tooth ratchet actuated by a pulley whose shaft is parallel to the base to allow a straight pull.

Constant-Frequency Radio Oscillator

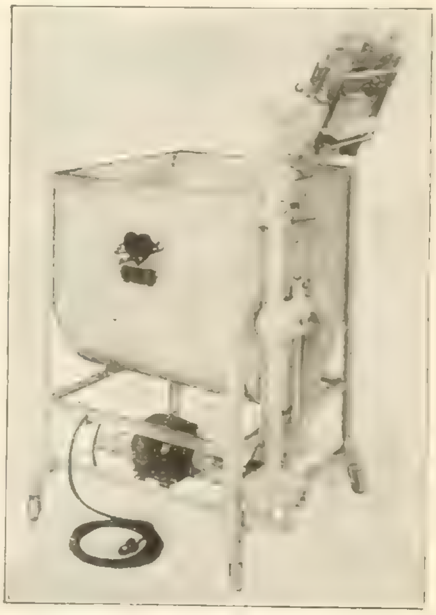
A radio oscillator designed to give a wave form free from harmonics and a constant frequency of 1,000 cycles has been developed by the General Radio Company, Cambridge, Mass. A vibrating fork magnetized with a field coil is used to keep the frequency constant. The output of the oscillator is said to be 0.06 watt. External posts are arranged to give three voltages, 0.5 volt, 1.5 volts and 5 volts. For higher voltages an inductance and capacitance are connected in series across the terminals. The input current at 4 volts to 8 volts averages 0.13 amp.



FORK USED TO KEEP FREQUENCY AT 1,000 CYCLES

Off-Center Cylinder Washing Machine

An offset octagon wooden-slat cylinder is incorporated in the design of the "Berkshire" electric washer made by the Pittsfield Machine & Tool Company, Pittsfield, Mass. The cylinder is rotated around an off-center axis continuously in one direction. The swinging wringer may be tilted while operating so that clothes dropped on its rolls will be drawn in.



HAS PUMP FOR DRAINING

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

CHARLES B. YONTS, who has been well known in the central-station industry in the Middle West, has been appointed manager of the Kansas City branch of the Bluebird Appliance Company, which will handle the retail sales of the Bluebird products. In 1906 Mr. Yonts entered the central-station field with the Illinois Traction System of Peoria. In 1912 he resigned to become connected with the Insull properties as commercial manager, operating in some of the cities served in northern Illinois. In 1918 he became manager of the La Crosse division of the Wisconsin-Minnesota Light & Power Company, which position he held until he became connected with the Bluebird company.

C. B. YONTS

THE DAY BAKER COMPANY, INC., of 110 Arlington Street, Boston, has been assigned the New England agency for the Oneida Motor Truck Company, Green Bay, Wis., manufacturer of both gasoline and electric road trucks.

EDWARD C. RILEY has been transferred from Boston to the Chicago office of the Edison Storage Battery Company, of which he will have charge. His successor in charge of the New England territory is F. I. Starbuck, formerly of the New Haven office of the company.

THE WESTINGHOUSE LAMP COMPANY'S Franklin branch, at Middletown, Conn., will shortly be converted into a plant for the manufacture of miniature incandescent lamps, with a capacity of about 80,000 lamps per day. The working force will be increased from a present total of 250 to 500.

THE JAMES LEFFEL & COMPANY, Springfield, Ohio, manufacturer of turbine waterwheels, on March 15, will move its Boston offices from 79 Milk Street, where it has been for several years, to 161 Devonshire Street. This office will be in charge of A. S. Addison, who for several years was connected with the Boston offices of this firm, but who for the last year has been at the main offices and factories in Springfield, Ohio.

THE HYGRADE LAMP COMPANY, Salem, Mass., will add 20,000 sq.ft. of floor space to its Bridge Street storehouse, to meet the demand for additional stocking facilities and to allow sufficient room for a modern cafeteria, as well as a general assembly room. Mill construction will be used, with wooden walls and asbestos shingles. The storage capacity will be 1,500,000 finished, boxed lamps. Since 1915 the floor space of the Hygrade factory has increased from 14,000 sq.ft. at the old Danvers plant to a total of 80,000 sq.ft., including the 1920 enlargement.

JOHN A. STEVENS, engineer, 8 Merrick Street, Lowell, Mass., has established a branch office at 502-4 Frederick Building, Cleveland, Ohio. Mr. Stevens is prepared to render consulting engineering services for the analysis, design, construction and management of power plants. This office is in charge of Marcus K. Bryan.

THE BROWN INSTRUMENT COMPANY, Wayne and Windrim Streets, Philadelphia, Pa., is making arrangements for extensions to its plant, including the erection of a two-story concrete factory, 44 ft. x 126 ft., and a two-story plant unit, 37 ft. x 72 ft., to be located at Wayne and Roberts Streets. The company manufactures pyrometers and other scientific instruments.

THE ELECTRIC FURNACE COMPANY, Alliance, Ohio, has just opened a Middle Western office at 301 Frisco Building, St. Louis, Mo., in charge of W. E. Prosser. The increasing demand for Baily electric furnaces for melting non-ferrous metals made this step necessary, inasmuch as there are at present sixty units of this type in operation within a radius of 500 mlies of St. Louis alone.

THE GEORGE CUTTER COMPANY of South Bend, Ind., announces the acquisition by the Westinghouse Electric & Manufacturing Company of a financial interest in it. The management and the commercial policies will remain unchanged, but advantage will be taken of the Westinghouse engineering and other facilities to expand the Cutter company's activities and develop its lines to enable it to serve more effectively its customers and the industry. The Westinghouse company will operate as sole distributer for the Cutter company's products.

THE BRYANT ELECTRIC COMPANY of Bridgeport, Conn., for a number of years has made two-outlet sockets as a part of its New Wrinkle line. The demand for this device has so materially increased that it has been decided to handle the production and packing of it as a separate complete article and to identify the device by the name "Bryant Dubl-Duty" socket. Each socket is being packed in a three-color carton, which not only facilitates handling but serves to enhance shelf and counter display. In addition a unique counter or window display box is provided for the use of dealers. One of these display boxes, with two dummy containers and a special cradle, is included with each standard package of twenty sockets.

THE FORMICA INSULATION COMPANY of Cincinnati, Ohio, is preparing to remove its plant from 3240 Spring Grove Avenue to 4614 Spring Grove Avenue, where it will have a floor space of approximately 30,000 sq.ft. The change of location will be made sometime in May. The company manufactures high-dielectric moisture-proof permanent electric insulation in sheets, tubes, rods, special shapes and machine parts.

BALDWIN & WELCOMER, general contractors, who have been maintaining offices at Jersey City, N. J., Union City, Pa., and Niles, Ohio, have opened an office at Warren, Ohio, in the Western Reserve Building, which will be known as the main office to take care of their various contracts in the Mahoning Valley. The company does a general construction business, including buildings, industrial and utility plants and systems.

THE A. & W. ELECTRIC COMPANY of Cleveland, Ohio, recently suffered a loss by fire which almost totally destroyed its plant.

THE WHITE LILY MANUFACTURING COMPANY of Davenport, Iowa, has increased its capital stock from $60,000 to $600,000.

JAMES DIXON, formerly with the Crocker-Wheeler Company of Ampere, N. J., has become production manager of the Reliance Electric & Engineering Company of Cleveland, Ohio.

THE YOUNG AMERICA ELECTRIC MACHINE COMPANY of Young America, near West Bend, Wis., has had plans prepared for the construction of a new two-story plant, 44 ft. x 122 ft.

THE WELLINGTON GLASS COMPANY of Cumberland, Md., manufacturer of lighting fixtures, suffered a loss by fire of about $350,000 on Feb. 29. The plant of the company was practically destroyed.

A. L. WILKINSON has resigned as vice-president of the Ohio Brass Company of Mansfield, Ohio. He has been with the company since 1894 and during the twenty-five years since that date has served as salesman, general sales manager, secretary and vice-president, having been elected to the latter office in February, 1919. He contemplates a complete rest for the benefit of his health.

THE MODERN FARM UTILITIES COMPANY has moved into its new quarters at 324 South Nineteenth Street, where it has much more floor space. The company has the agency for the Kewanee products, farm-lighting plants, water system, etc., and carries a line of electrical appliances for the farm. A. L. Green is president of the company and Frank C. Bestor is vice-president and sales manager.

THE TRIUMPH ELECTRIC COMPANY is the name of a new firm of jobbers and engineers at 211 South Third Street, Minneapolis, Minn. H. H. Henley is president of this new organization and with him are associated W. H. Vilett, former president of the Sterling Electric Company, and D. E. Ford. The organization consists largely of the personnel of the former Sterling Electric Company, which has discontinued its electrical jobbing business. The new Triumph Company is carrying a complete stock for a general jobbing business and in addition has organized an extraordinarily active department for building high-tension transmission lines into rural communities. The company expects to go into this branch of the business very extensively.

HOOVER OPENS CANADIAN FACTORY.—A celebration which marked the beginning of active operations in Canada by the Hoover Suction Sweeper Company was staged at Hamilton, Ont., on Feb. 12, by Thomas F. Kelly, Candian sales manager of the company. Mr. Kelly was formerly sales manager of the Dayton (Ohio) Power & Light Company. The photograph shows the first "made in Canada" machine and the department heads of the Canadian company. Mr. Kelly stands directly behind the brush, and W. G. Vogt, office manager, stands directly behind the junction of the bag and the machine.

CANADIAN STAFF OF HOOVER SUCTION SWEEPER COMPANY

THE STEEL DUCT COMPANY, Dollar Bank Building, Youngstown, Ohio, has been recently organized. It expects by April to have on the market a complete line of enameled and galvanized conduit. William B. Curtis, formerly with the Youngstown Sheet & Tube Company, is president.

THE EUREKA VACUUM CLEANER COMPANY of Detroit was awarded the Grand Prix for its vacuum cleaners at the Hygienic Exhibition held in Brussels, Belgium, recently. This is the second time that Eureka vacuum cleaners have won the highest honors. These machines also secured the Grand Prize at the Panama-Pacific Exposition at San Francisco.

THE ELECTROLABS COMPANY, manufacturer of oxygen and hydrogen generating plants, in order to obtain closer co-operation between the factory and the sales department, has decided to consolidate all its offices at 2635 Penn Avenue, Pittsburgh, Pa. The company requests that all correspondence be addressed to its Pittsburgh office. A branch office will be maintained by the company at 30 Church Street. The company also announces that its new catalog is about ready for distribution.

THE H-G MANUFACTURING COMPANY, 1215 Pine Street, St. Louis, Mo., recently organized, will manufacture a line of electrical specialties, including fractional-horsepower motors for operating motor-driven washing machines, etc. Work will be started immediately on the production of small motors. The officers are: J. F. Galvin, president, and A. M. Harrelson, vice-president and treasurer. Mr. Galvin was formerly manager of the St. Louis branch of the Robbins & Myers Company, and Mr. Harrelson was chief engineer of the Emerson Electric Manufacturing Company.

THE ELECTRIC STORAGE BATTERY COMPANY of Philadelphia has arranged for the purchase of 40 acres in Crescentville, in the northeastern part of Philadelphia, on which it will erect a plant to meet the increasing demand for its products. The new buildings, it is reported, are to be used for the manufacture of the products now made by the company, and no venture into new fields is being considered. The company, it is understood, will finance the construction of the proposed new plant out of earnings, as has been its policy in the past. The new plant will be located 4 miles from its present plant at Nineteenth Street and Allegheny Avenue.

THE ENGINEERING & APPRAISAL COMPANY, INC, with offices at 103 Park Avenue, New York, N. Y., has been organized by J. C. Henriques and M. A. Stone, Jr. The company proposes to design and construct mills, factories, power plants and chemical works, to design and develop special machinery and undertake formulation of commercial propositions on which the formation of new manufacturing corporations may be based and also to design and construct industrial plants for every purpose. Mr. Henriques, who is a member of the American Institute of Electrical Engineers, has been engaged for nearly twenty years in the installation, operation and testing of large electrical central stations and distribution systems, as well as in the appraisal and valuation of large works. Mr. Stone is a mechanical engineering graduate of both Yale and Columbia. His special experience has been in the design and construction of buildings and plants for the manufacture of chemical products, oil refining and the production of special gases.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has contracted with Westinghouse, Church, Kerr & Company to build four new buildings at South Philadelphia, Pa. The expansion is intended to take care of the immediate needs incidental to the removal of the machine works (formerly the Westinghouse Machine Company) from East Pittsburgh, Pa. The four buildings will be made of terra cotta and steel, similar in construction and design to the present buildings, and will include a light machine shop, one story, 500 ft. x 130 ft. This building will be used for building small turbines for operating pumps and generators. Machine shop No. 3 will be a duplicate of the present machine shop No. 1, with dimensions of 750 ft. x 130 ft. Very large land and sea steam turbines will be machined in this building. The erecting shop will be extended 300 ft. and will join the new shop No. 3 as it does Nos. 1 and 2. A three-story building, 600 ft. x 50 ft., will be constructed to provide warehouse facilities. The third floor of the building will be used for manufacturing purposes. Nearly all of the machinery necessary for production purposes will be transferred from the Machine Works, East Pittsburgh, and will be directly driven by motors.

THE SYRACUSE WASHING MACHINE CORPORATION, which consists of the reorganized Easy Vacuum Electric Washing Machine Company, is now erecting a new modern fireproof plant on a 25-acre tract of land at Syracuse, N. Y. The factory of the building will be of one-story fireproof construction with the second floor for administrative and executive offices, including a fully equipped cafeteria covering 10,000 sq.ft. of floor space, an auditorium for instruction of workingmen in the different phases of the industry and an experimental department and museum. The officers of the new corporation are: President, J. N. Derschug; vice-president, G. C. Wilkinson; treasurer, H. L. Babcock; secretary, W. A. MacKenzie; assistant secretary and treasurer, S. Stivers, New York. Directors: James M. Gilbert, president Syracuse Trust Company; Walter H. Lippincott, Philadelphia; Frank Ford of Ford, Bacon & Davis, 115 Broadway, New York; W. J. Zuill, W. A. MacKenzie, J. N. Derschug, G. C. Wilkinson, H. L. Babcock. The executive committee consists of Mr. Derschug, Mr. Wilkinson and Mr. Ford.

THE BLACK & DECKER MANUFACTURING COMPANY, Towson Heights, Baltimore, Md., will discontinue the special machinery business and devote all of its energies to an endeavor to keep up with the demand for "lectroflaters," portable electric drills and electric valve grinders, and a new product, the "loadometer," a device for indicating on the dash the amount of load or overload a truck is carrying. A road type loadometer for the use of the State police in detecting violators of the road overloading laws is also to be manufactured. Already plans are under way for erecting another plant building, the same size as the one just completed; new products are in process of development, new manufacturing methods are being perfected, a cafeteria is planned, and plans are being drawn for twenty-five more new houses for employees. The Baltimore plant of the company, at 105 to 115 South Calvert Street, has been sold complete to the Dieffenbach-Westendorf Manufacturing Company, which is composed principally of the older members of the city plant organization. O. W. Dieffenbach, president, was formerly manager of the Baltimore plant; William Westendorf, vice-president and general manager, was superintendent; George M. Kimberly, treasurer, has been treasurer of the Black & Decker Company for a number of years, which position he still holds; John Sonnenleiter, secretary of the new company, was foreman of the milling machine department. The plant of the new company is completely equipped for the manufacture of high-class special machinery and is at present operating two shifts. It is now devoting quite a large portion of its capacity to the overflow from the Towson plant of the Black & Decker Company, which, although recently more than doubled in size, is already contemplating further extensions.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A co-operative supply company in the Netherlands (No. 32,197) desires to secure quotations for the purchase of 5,000 to 10,000 high-tension porcelain supporting insulators for overhead transmission, and request is made for design and description of insulators offered. Correspondence may be in English.

A commercial agent in Italy (No. 32,179) desires to secure an agency for the sale of electrical apparatus, machinery, heating and illuminating apparatus for gas and electricity, motors, automobiles and accessories and food products. Correspondence should be in Italian or French

An American firm maintaining offices in Mexico, Brazil, Argentina, Berlin and Paris (No. 32,185) desires to secure agencies for the sale of machinery, electrical supplies, automobiles, motor trucks, tractors, railroad equipment, iron and steel, textiles, agricultural implements, chemicals, etc.

W. G. Watson, managing director of W. G. Watson & Company, Ltd., electrical engineers and merchants of Sydney, Australia, will be in the United States shortly, arriving at San Francisco, Cal., on his way to England. Mr. Watson expects to be a few weeks in the United States working his way across the continent

Trade Publications

ASH CONVEYORS. — The American Steam Conveyor Corporation, 326 West Madison Street, Chicago, Ill., has issued a folder on steam jet ash conveyors.

ELECTRIC SUCTION CLEANERS.—The Apex Electrical Distributing Company, Cleveland, Ohio., has issued a "sales guide" for Apex dealers and salesmen.

CARBON BRUSHES.—The United States Graphite Company, Saginaw, Mich., manufacturer of carbon brushes, is distributing a new catalog, B-2, describing its motor and generator brushes.

OIL CIRCUIT BREAKERS.—Bulletin No. 47,450 of the General Electric Company, Schenectady, N. Y., describes circuit breakers for circuits up to 15,000 volts of moderate capacity.

STREET-LIGHTING FIXTURES.—The General Electric Company, Schenectady, N. Y., has printed a booklet on "Novalux" pendent and bracket street lighting units for series tungsten lamps.

OIL CIRCUIT BREAKERS.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 47,445, describing oil circuit breakers for circuits up to 7,500 volts and currents up to 800 amp.

DIRECT-CURRENT GENERATING SETS.—Engberg's Electric & Mechanical Works, St. Joseph, Mich., have issued catalog No. 103, describing engine-driven direct-current generators of 1-kw. to 50-kw. rating.

New Incorporations

THE SCOTTSVILLE (KY.) UTILITIES COMPANY has been incorporated by Thurman Dixon, A. J. Oliver and W. D. Gilman. The company is capitalized at $40,000.

THE ROSE HILL LIGHT COMPANY of Greenwood, S. C., has been incorporated with a capital stock of $1,500. The officers are: G. Allen Banks, president; T. B. Coleman, secretary, and T. P. McKellar, manager.

THE HARLAN (KY.) ELECTRIC & MACHINE WORKS have been incorporated by G. H. Black, A. C. Jones and F. C. Tarvin to manufacture electrical and mechanical equipment. The company is capitalized at $75,000.

THE STAMPS (ARK.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $20,000. The officers are: J. M. Hudgens, president; L. A. Baker, vice-president, and R. C. Stewart, secretary and treasurer.

THE MANHATTAN INSULATED WIRE & CABLE COMPANY of New York, N. Y., has been chartered with a capital stock of $50,000 by S. A. Morrissey, R. H. Cherry and C. Kurzon, 155 East Houston Street, New York City.

THE RIVERSIDE ENGINEERING COMPANY of Paterson, N. J., has been incorporated by George R. D. Decnyf and George W. Kent. The company is capitalized at $50,000 and proposes to manufacture electrical products.

THE GEORGE F. UHLMAN COMPANY of Binghamton, N. Y., has been incorporated with a capital stock of $25,000 by George F. Uhlman, W. L. Chittenden and W. G. Phelps, Jr. The company proposes to manufacture electric signs.

THE CROTHERSVILLE (IND.) WATER & ELECTRIC COMPANY has been incorporated by W. P. Rider, C. W. Keach and H. B. White. The company is capitalized at $50,000 and proposes to furnish light, heat and power in Crothersville.

THE NON-VACUUM ELECTRODE COMPANY of New York, N. Y., has been incorporated by H. J. Sondheim, M. B. and H. A. Conem, 51 Chambers Street, New York, N. Y. The company is capitalized at $50,000 and proposes to manufacture electrodes.

THE MODERN ELECTRIC WELDING COMPANY, 915 South Ann Street, Baltimore, Md., has been incorporated by Daniel J. Lynch, John M. Hoffman and Milton Roberts. The company is capitalized at $100,000 and proposes to do a general electric welding business.

New England States

HINSDALE, N. H.—The Connecticut River Power Company, 35 Harvard Street, Worcester, Mass., contemplates the enlargement of its hydro-station at Hinsdale, including the installation of four additional units. C. A. Harris, Brattleboro, Vt., is president.

MANCHESTER, N. H. — Preliminary steps have been taken by the Amoskeag Manufacturing Company toward the construction of a new dam and power house on the Merrimac River. The equipment will include two waterwheels of 7,500 hp. each. The estimated cost is $500,000.

PLAISTOW, N. H.—The Plaistow Electric Light & Power Company is considering plans for the construction of a street-lighting system.

JOHNSON, VT.—The installation of a generator and switchboard in the municipal electric light plant is under consideration.

CONCORD, MASS.—Extensive improvements are contemplated to the municipal electric plant, including complete renewal of boiler plant, piping and accessories.

NORTHAMPTON, MASS.—In connection with the construction of the new hospital for which the Lathrop Home, 236 South Street, will soon award contracts considerable electrical equipment will be required. The cost is estimated at about $250,000. G. F. Newton, 6 Beacon Street, Boston, is architect.

SPRINGFIELD, MASS.—The construction of a new three-story, 44-ft. x 80-ft. substation is contemplated by the United Electric Light Company, 73 State Street. W. L. Mulligan is manager.

WORCESTER, MASS.—The Worcester Electric Light Company contemplates the installation of three additional 1,250-hp. Bigelow-Hornsby boilers in its Webster Street power plant. This project, with other improvements, will involve an expenditure of several thousand dollars. R. W. Rollins is the general manager.

PROVIDENCE, R. I.—The Narragansett Electric Light Company, 800 Turk's Head Building, is preparing to construct an addition to its power house on South Street and will install eight new boilers and generators. The project will cost approximately $700,000.

WESTBROOK, CONN.—Complete electrical equipment will be required in connection with the with the new suspender factory that Knothe Brothers Company, 124 Fifth Avenue, New York, N. Y., plan to build in Westbrook at an approximate cost of $120,000. Fletcher-Thompson, Inc., 1089 Broad Street, Bridgeport, are architects.

Middle Atlantic States

ADDISON, N. Y.—The Addison Electric Light & Power Company plans to install a new steam unit. M. G. Hubbs is secretary.

BUFFALO, N. Y.—The Buffalo General Electric Company, Electric Building, plans to extend its transmission system. R. McMillan is statistician.

BUFFALO, N. Y.—Bids will be received until March 29 by the Commissioner of Parks and Public Buildings, Municipal Building, for sundry electrical equipment, including wire, conduits and switchboards, to be used by the Fire Department staff in the wiring of thirty-nine fire houses in Buffalo. The cost will be about $17,000.

CALEDONIA, N. Y.—The Livingston-Niagara Power Company of Avon contemplates the construction of a street lighting system for the village of Caledonia. D. M. Lewis is secretary.

CENTRAL ISLIP, N. Y.—Bids will be received April 7 by the State Hospital Commission, E. S. Elwood secretary, Capitol, Albany, for construction of a fire-alarm system in Central Islip State Hospital, at an approximate cost of $10,000. Specifications may be obtained from L. F. Pilcher, state architect, Capitol, Albany.

ELMIRA, N. Y.—The Elmira Water, Light & Railroad Company contemplates the installation of a 6,000-kw. turbine and a 786-hp. boiler, as well as transmission-line extensions. F. H. Hill is manager.

JAMAICA, N. Y.—Steps have been taken by the Jamaica Board of Trade to establish an ornamental lighting system on the principal streets.

NORWICH, N. Y.—The New York State Gas & Electric Corporation is considering the installation of a new generating unit, and a three-phase, 10-mile transmission line extension. B. Diamond is superintendent.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

RICHMOND, N. Y.—Bids will be received until March 26 by C. B. J. Snyder, superintendent of School Buildings, Municipal Building, Manhattan, for installation of electrical equipment in new Public School 11, Dongan Hills, Borough of Richmond.

SCHENECTADY, N. Y.—The General Electric Company, River Road, contemplates the construction of a completely equipped punch-press shop to cost about $700,000.

SOUTH RIVER, N. J.—Bids will be received by the Board of Public Works until April 12 for design and construction of an addition to the generating station, including machinery and equipment. Goss, Bryce & Johnson, 55 Liberty Street, New York, N. Y., are engineers. E. B. Hedden is superintendent. For details see Searchlight Section.

TRENTON, N. J.—Considerable electrical equipment will be required in connection with proposed theater to be erected in Perry Street by W. J. Vernon, St. Regis Building, to cost about $500,000. W. W. Slack & Son, St. Regis Building, are architects.

DOVER, DEL.—Bids will be received until March 24 by the City Council for improvements and extension to the municipal light plant, to cost about $89,000.

PHILADELPHIA, PA.—The Queens-Brooks Company, American and Diamond Streets, contemplates the erection of a five-story underwear factory at Fifth Street and Huntington Place, to cost about $100,000. Considerable electrical equipment will be required. W. E. S. Dyer, Land Title Building, is architect and engineer.

PITTSTON, PA.—The Pennsylvania Coal Company of Pittston plans to build an electric power plant, 30 ft. high, to cost about $200,000, in connection with the construction of its new coal breaker.

ST. MARYS, PA.—The St. Marys Electric Light Company plans to build 10 miles of 22,000-volt transmission line. W. H. Brown is superintendent.

WILKES-BARRE, PA. — The Vulcan Iron Works, 730 South Main Street, contemplate building a locomotive shop on Hazel Avenue, at an estimated cost of $130,000. Motors and other electrical equipment will be required. E. D. Rineheimer, Carlisle Street, is engineer.

SPARROW'S POINT, MD.—A new power plant is included in the proposed additions to the local plant of the Bethlehem Steel Corporation. The cost of the work is estimated at about $1,000,000.

North Central States

DETROIT, MICH.—Considerable electrical equipment will be required by B. B. Jacobs, Penobscot Building, in connection with the construction of a ten-story hotel addition at Park Boulevard and Elizabeth Street, to cost about $1,000,000.

DETROIT, MICH.—The Superior Machine & Engine Company, 51 East Fort Street, will require motors for power and other electrical equipment in connection with the construction of a proposed three-story factory at East Larned and St. Aubin Streets, to cost about $100,000. Brown & Preston, 406 Empire Building, are architects.

FLINT, MICH.—Van Leyen, Schilling, Keough & Reynolds, architects and engineers, Union Trust Building, Detroit, representing owners (name withheld), are preparing plans for a new theater building on Detroit Street, to cost about $100,000. The project calls for considerable electrical equipment.

HAMTRAMCK, MICH.—Complete electric lighting equipment will be required for the two-story municipal hospital to be erected by the village of Hamtramck, at a cost of about $150,000. A. E. Harley, 435 Woodward Avenue, Detroit, is architect.

OXFORD, MICH.—Plans are under consideration to rebuild the municipal electric distribution system. E. A. Detwiler is clerk.

SAGINAW, MICH.—The Board of Education is having plans prepared by Cowles & Mutscheller, 10 Chase Block, for the erection of a two-story junior high school, requiring considerable electrical equipment. The cost is estimated at $1,000,000.

SAGINAW, MICH.—The Modart Corset Company, 309 Lapeer Avenue, contemplates the erection of a four-story mercantile building on Lapeer Avenue, to cost about $300,000. Equipment for electric lighting and elevator control will be required. Cooper & Beckbissinger, 114 South Jefferson Avenue, are architects.

YALE, MICH.—The installation of an additional 75-kw. unit generator in the municipal electric light and water plant is under consideration. A. T. Kent is superintendent.

CINCINNATI, OHIO.—The installation of one new 33,000-kva. unit and the construction of approximately three miles of 13,200-volt eight-duct underground conduit, as well as one 6,000-kw. outdoor substation and about 20 miles of 33,000-volt, three-phase transmission line to Milford and Loveland, is contemplated by the Union Gas & Electric Company. W. W. Freeman is president.

CLEVELAND, OHIO. — Considerable electrical equipment will be required by the Beckman Company, 3167 Fulton Road, in connection with the two-story weaving factory it plans to build on Fulton Road and West Thirty-third Street, at a cost of approximately $400,000. Lockwood-Gowen & Company are engineers and arichtects.

CLEVELAND, OHIO — The Cleveland Railway Company is having plans prepared for the construction of a new one-story substation at East 139th Street and Woodland Avenue, to cost about $75,000. D. W. Morrow, 4500 Euclid Avenue is architect.

CLEVELAND, OHIO.—The Hubbell Tire & Rubber Company, 6545 Carnegie Avenue, is in the market for a 10-kw. motor-generator set, including a four-pole, compound-wound 220-volt, direct-current, 900-r.p.m. generator, to connect with a 15-hp., three-phase, 60-cycle, 400-volt, 900-r.p.m. induction motor, with starting device and flexible coupling between motor and generator.

CLEVELAND, OHIO.—Bids will be received until March 22 by the Gordon Square Company, M. Eyerdam manager, West Sixty-fifth Street and Detroit Avenue, for construction of commercial building, including theatre and market, for which electrical motors, wiring and elevator equipment will be required; also the installation of boilers and refrigerating system. The approximate cost is estimated at $300,000. B. H. Prack, Keystone Building, is engineer.

EAST PALESTINE, OHIO.—The installation of a 300-hp. water-tube boiler in the municipal electric plant is contemplated. J. Ashman is president.

JACKSON, OHIO.—The Wellston Iron Furnace Company is in the market for 100-hp., direct-current, 250-volt motor.

NEWARK, OHIO.—Newark Telephone Company contemplates the erection of six telephone substations on various sites at a total cost of about $48,000. M. Peterman, 321 East Gay Street, Columbus, is architect.

SABINA, OHIO.—Transformers to furnish 230-volt three-phase service will probably be installed in the municipal water and light plant. J. C. Phelps is the superintendent.

WADSWORTH, OHIO.—The installation of one 400-kva. General Electric generator and Skinner engine in the municipal light, water and ice plant is under consideration. Carl Stauffer is superintendent.

WHITEHOUSE, OHIO.—The Whitehouse Electric Company contemplates extending its electrical service into the outlying districts. L. A. Harris is manager.

GEORGETOWN, KY.—Bonds to the amount of $100,000 have been authorized for improvements to the city electric light and power plant and waterworks. W. H. Weiss, City Hall, is consulting engineer and C. L. Sebree is city clerk.

SOUTH BEND, IND.—The Indiana & Michigan Electric Company of South Bend has increased its capital stock from $5,000,000 to $11,500,000.

BLOOMINGTON, ILL.—Bids will be received until April 2 at the office of the supervising architect, Washington, D. C., for rewiring, etc. in the United States post office at Bloomington, Ill. Specifications may be obtained from this office or from the office of the custodian, Bloomington, Ill. For details see Searchlight Section.

AMHERST, WIS.—The Amherst Electric Service Company contemplates the installation of a 100-kva. generator and a 50 hp. or 75-hp. oil engine. B. E. Dwinnel is the manager.

MEDFORD, WIS.—The Medford Light & Heating Company plans to install a new generator. W. Ungrodt is superintendent.

ROME, WIS.—The Bark River Electric Service Company contemplates erecting a 20-mile transmission line. A. N. Becker is president.

SOLDIERS' GROVE, WIS.—The Soldiers' Grove Electric Company is planning to change its system from direct-current to alternating current. T. Sime is manager.

REINBECK, IOWA.—Charles C. Camp, owner of the electric light plant, contemplates the installation of about sixty ornamental single-lamp standards in the business district.

WEST BRANCH, IOWA.—The Board of Education, T. A. Moore, secretary, plans to build a three-story school at a cost of about $125,000. A separate contract will be awarded for electrical equipment, to include wiring, switches, fuses, etc. Proudfoot, Bird & Rawson, 810 Hubbell Building, Des Moines, are architects.

KANSAS CITY, MO.—The Kansas City Power & Light Company has acquired a site south of Kansas City terminal tracks on Summit Street, on which it will erect a new warehouse building, garage, etc., to cost about $250,000.

LEADWOOD, MO.—Contract for a new 5,000-kw. steam-driven electric power plant with complete electrical and mechanical equipment, including jet condenser with auxiliaries, two boilers, 12-ft. x 200-ft. brick stack, pulverized-coal equipment, conveyors, piping, etc., has been awarded the Stone & Webster Engineering Corporation, 147 Milk Street, Boston, Mass., by the St. Joseph Lead Company. The project will cost about $800,000.

SARCOXIE, MO.—The Southwest Electric Light & Milling Company contemplates the installation of one 112½-kva. generator and a transformer. A. Adams is president.

GARRISON, N. D.—The Garrison Light & Power Company is considering the installation of a 150-hp. boiler and a 100-kw. direct-connected generator. J. A. Kunkel is the secretary.

LARIMORE, N. D.—Improvements are contemplated to the municipal electric light and power plant, including the installation of a three-phase, 60-cycle, 2,300-volt generator and an entire new distribution system. The system will be changed from direct to alternating current.

MICHIGAN, N. D.—The Municipal Electric Light Company contemplates increasing the generating capacity of its plant. H. J. Harrison is superintendent.

WALLHALLA, N. D.—The owners of the local electric light plant contemplate extending their lines into the farming district. W. A. Andrews is in charge.

WILLISTON, N. D.—The installation of a fifty-lamp series street-lighting system, including a switching station, is under consideration by the Water and Light Department.

ARMOUR, S. D.—The South Dakota Light & Power Company contemplates the installation of one 500-hp. oil engine, of either Diesel or semi-Diesel type, and one 300-hp. producer. G. W. Welch is superintendent.

FLANDREAU, S. D.—The Dakota Light & Power Company is considering several rural extensions to its transmission lines. A. H. Bushman is superintendent.

HIGHMORE, S. D.—Plans are under consideration to change the municipal electric light system from direct to alternating current.

IROQUOIS, S. D.—The Iroquois Electric Light Company contemplates the installation of a 50-hp. engine directly connected to a 42-kva., 2,300-volt, three-phase, 60-cycle generator. W. H. Jordan is president.

MILBANK, S. D.—The Milbank Power Company is considering the installation of a 100-hp. Rathbun engine and generator. F. A. Barnard is the manager.

MINDEN, NEB.—Bids will be received until March 20 by J. M. Markussen, city clerk, for extensions to municipal water and light plant to cost about $37,000.

Southern States

BELMONT, N. C.—Large quantities of electric equipment, including motors for individual drive, it is understood, will be required in connection with the proposed new plant of the Stowe Spinning Company.

BAMBERG, S. C.—Preparations are being made to equip the local mills of the Santu Cotton Mills Company for electrical operation.

CHESTERFIELD, S. C.—The Teal Light & Power Company contemplates the installation of an additional generating unit. D. T. Teal is manager.

WALTERBORO, S. C.—The Waterboro Water, Light & Power Company contemplates the installation of a 75-kva. generator and engine directly connected. C. Binns is manager.

CARTHAGE, TENN.—The Smith County Electric Company contemplates the construction of an 11-mile transmission line to Monoville, Riddleton and Dixon Springs. R. S. Seese is manager.

COAL CREEK, TENN.—The Black Diamond Collieries contemplates the installation of a 225-kva. or 325-kva., three-phase, 60-cycle, 2,300-volt generator directly connected to engine.

DICKSON, TENN.—The installation of a complete new generating unit in the municipal electric light plant is under consideration. E. S. Payne is superintendent.

MONTEREY, TENN. — The Monterey Light & Power Company contemplates the installation of a 60-hp. engine and a generator; also a number of short extensions to its distribution system. L. C. Parks is manager.

FRIARS POINT, MISS. — The Friars Point Light, Water & Ice Company contemplate the installation of a power plant in connection with a new building. The cost of the machinery is estimated at $180,000. Minor C. Lyon is proprietor.

IOTA, LA.—Bonds to the amount of $44,000 have been voted for the construction of electric light plant and waterworks system.

ALTUS, OKLA.—The installation of an additional 700-kva. engine and high-pressure boilers in the municipal water and light plant is contemplated. C. A. Welch is superintendent.

CARMEN, OKLA.—The construction of a ten-mile transmission line to Helena is contemplated by the Electric Light & Water Department. H. A. Kenderson is superintendent.

ENID, OKLA.—Plans are under consideration by city officials for the installation of a municipal electric lighting system, including a power house, to cost about $500,000. Black & Veatch, Interstate Building, Kansas City, Mo., are consulting engineers.

LEVERNE, OKLA.—The City Light Department contemplates the installation of 2,400-volt alternators in the municipal electric plant and of transformers in the transmission system. C. H. Arbuthnot is superintendent.

MARLOW, OKLA.—The City Council is considering the installation of an ornamental street-lighting system. S. A. Anthony is superintendent.

MIAMI, OKLA.—The installation of an additional Diesel engine-driven unit in the municipal electric light and water plant is under consideration.

PRAGUE, OKLA.—The erection of additional 33,000-volt transmission lines is contemplated in connection with the municipal electric light and water plant. O. Vaught is superintendent.

WEATHERFORD, OKLA. — The erection of a 9-mile transmission line with transformer in connection with the municipal electric plant under consideration. G. A. Griechfield is manager.

ABILENE, TEX.—Abilene Gas & Electric Company plans the construction of a new 2,500 kw. generating plant. J. W. Dawley is manager.

BASTROP, TEX.—The Bastrop Water Light & Ice Company is considering the installation of one 150-kva. generator. J. E. Haines is the superintendent.

CISCO, TEX.—The Cisco Gas & Electric Company will build a transmission line to Abilene. P. W. Campbell is manager.

GORDON, TEX.—The Gordon Mingus Light Company is considering the installation of a 50-hp. generating unit. S. W. Daws is the manager.

HENDERSON, TEX.—The Henderson Cotton Oil & Gin Company is planning the construction of a complete new generating plant. O. E. Morris is manager.

LOMETA, TEX.—Lometa Light & Power Compay is considering the installation of an additional oil engine and generating unit. M. D. Melear is manager.

MARSHALL, TEX.—The Marshall Electric Company contemplates the installation of one 1,500-kw. turbo-generator. W. Campbell is manager.

PALACIOS, TEX.—The installation of one 75-kva. unit in the municipal generating plant is under consideration. M. Lipscomb is superintendent.

SAN BENITO, TEX. — The Commonwealth Water & Electric Company contemplates the installation of a 200-hp. generating unit. A. L. Harris is manager.

PERRYTOWN, TEX. — The Perrytown Public Utilities Company, recently incorporated with a capital stock of $25,000, contemplates the erection of an electric light plant. C. E. Whippe and others are the incorporators.

SNYDER, TEX.—The Snyder Utilities Company, recently organized with a capital stock of $50,000, will take over the Snyder electric light plant. Plans for enlargement and improvement are under way. D. P. Yoder and others are incorporators.

Pacific and Mountain States

CLARKSTON, WASH. — The Idaho-Washington Light & Power Company, 825 Trent Street, Spokane, contemplates extending its transmission lines to Culdesac a distance of 9 miles. F. J. Keys is the manager.

DAYTON, WASH.—Steps have been taken by the City Council and the Commercial Club to secure establishment of a steam auxiliary electric generating plant on a local site, or to obtain transfer of plant now operating at Kennewick.

VANCOUVER, WASH.—The Spirit Lake Railway & Power Company, recently incorporated, contemplates the construction of a power house with a capacity of 44,000 hp. at Spirit Lake, about 40 miles east of this city. The estimated cost is $2,000,000. The construction of an electric railroad from Vancouver to Puget Sound, with branches running into Portland, Grays Harbor and Willapa Harbor is also under consideration. Dr. J. Roan of this city is one of the trustees.

WENATCHEE, WASH.—The installation of a pumping system, including one or more 25,000-gal per-minute pumps, with 470 ft. lifting capacity, to cost about $10,000 is contemplated by the Okanogan Valley Irrigation Project. D. C. Heney, Spaulding Building, Portland, Ore., is consulting engineer. J. S. Peterson of Omak is representative of property holders.

ENTERPRISE, ORE.—A. J. McInturff & Son have filed application with P. A. Cupper, state engineer, for permission to appropriate 100 second-feet of water from the Wallowa River. The plans provide for a development of 682 hp. and include dam, wasteway, headgate, tunnel pipe, etc., to cost about $57,700.

GRANT'S PASS, ORE. — The Grant's Pass Irrigation District has had plans approved by P. A. Cupper, state engineer, Salem, for the installation of a temporary pumping plant, to cost about $106,000.

PORTLAND, ORE.—C. J. Schnabel representing owner, Chamber of Commerce Building, has filed application with P. A. Cupper, state engineer, to appropriate 600 second-feet of water from the Santiam River. The plans provide for construction of a manufacturing and lighting plant, to include the development of 6,511 hp. and the erection of a dam, headgate, canal and steel pipe lines, to cost about $800,000.

HAYWARD, CAL.—The Water Department is making tentative plans for the purchase of the Hayward Water Company's system. Improvements, to include the replacing of steam pumping plant with electric pumping system are contemplated. The cost will be approximately $100,000.

LOS ANGELES, CAL.—Bids will be received by the Public Service Commission until April 6, for furnishing hydraulic equipment, generators and auxiliary electrical equipment, to cost about $175,000. E. F. Scattergood, 645 South Olive Street is the engineer.

MODESTO, CAL.—Bonds to the amount of $2,000,000 will be issued for the Modesto Irrigation District's share in the construction of the Don Pedro reservoir, power plant and transmission and distribution system and the enlargement of the present canal.

HARRISON, IDAHO — Bonds to the amount of $10,000 have been voted for a new lighting system.

MYTON, UTAH.—The Utah Power & Light Company contemplates the construction of a new power plant and transmission lines to connect with six small towns. J. H. Colthorp is the manager.

BUTTE, MONT.—The Department of Public Works plans to extend the street-lighting system. E. J. Strasburger is the commissioner.

GILLETTE, WYO.—The installation of an engine and a 166-kva. generator in the municipal light plant is under consideration. M. L. Thomas is manager.

Canada

EDMONTON, ALTA.—An expenditure of $750,000 for power plant extensions is recommended by the City Commissioners.

LADYSMITH, B. C.—The installation of a 50-kw., 220-volt, 60-cycle, three-phase generator and a Diesel engine in the municipal electric plant is under consideration. M. A. Morrison is city clerk.

SHOAL LAKE, MAN.—The installation of an additional generating unit in the municipal electric plant is contemplated. A. R. Ibbotson is engineer

CAMPBELLFORD, ONT.—In order to supply 600 hp. additional, the transmission voltage in the municipal electric plant is to be raised to 6,600 volts. J. Carr is engineer.

ISLINGTON, ONT.—Plans are being prepared by E. A. James Company, engineers, 31 Toronto Street, Toronto, for a complete new waterworks system, including electrically operated centrifugal pumps, to cost about $85,000

LISTOWEL, ONT.—The Public Utilities Commission plans to install new street-lighting equipment. W. R. Reynolds is superintendent.

MANOTICK, ONT.—The Hydro-Electric Power Commission of Ontario will be asked to supply electricity in the entire district around Manotick.

ORILLIA, ONT.—The Water, Light & Power Commission contemplates the rebuilding of two 22,000-volt transmission lines. S. H. Starr is engineer.

STRATFORD, ONT.—Kindel Brothers Company, Ontario Street, plan to build a boiler house, with complete electrical equipment, including one 250-hp. horizontal return tubular boiler with feed-pump, water heater, etc. J. Russell, Downie Street, architect. The cost is estimated at $18,000.

SUTTON, ONT.—The question of securing electricity from the Hydro-electric Power Commission of Ontario in the town of Sutton is under consideration.

TORONTO, ONT.—Bids will be received until April 20 by R. C. Harris, city engineer, City Hall, for the installation of an electrically operated centrifugal pump to be used in the sewerage system.

WALKERVILLE, ONT. — The Hydro-Electric Commission contemplates an additional power feeder of 2,000 kva. capacity and a lighting feeder of 7,500 kva. for the local transmission system. M. T. McHenry is manager.

DRUMMONDVILLE, QUE.—The Jenckes Spinning Company of Pawtucket R. I., is erecting a tire-fabric plant in Drummondville, to cost about $1,000,000. The Loomis Daekin Engineering Company of Sherbrooke is contractor. The proposed plant will give employment to approximately 1,000. Through mistake this item appeared under Montreal in the isue of Feb. 14.

MOOSEJAW, SASK.—The installation of water-tube boilers in the municipal light and power plant is under consideration. J. D. Peters is manager.

Record of Electrical Patents

Notes on United States Patents

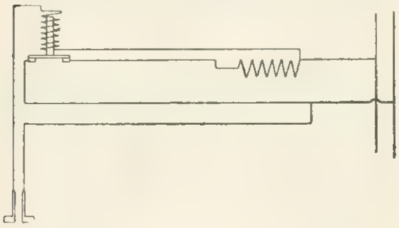
(Issued March 2, 1920)

1,332,208. Measured-Service Telephone System; John Erickson, Chicago, Ill. App. filed Feb. 11, 1918. Coin-collecting device used with party line.

1,332,221. Electric Cooker; James E. Lappen, Winona, Minn. App. filed Feb. 20, 1917. Also serves as table.

1,332,222. Automatic Telephone System; Alben E. Lundell, New York. App. filed April 13, 1918. Quick-acting switches in exchange of large capacity.

1,332,226. Common-Battery Automatic Telephone System; Talbot G. Martin, Chicago, Ill. App. filed Jan. 4, 1906. Improved repeater makes trunk-line connection between exchanges.



No. 1,332,696—Alternating-Current Circuit Breaker for Motors

1,332,241. Electrode Holder for Use in Electric Arc Welding or Cutting; Charles B. Waters, New York, N. Y. App. filed July 18, 1918. For several sizes of electrodes.

1,332,275. Telephone System; Hans Steidle, Munich, Germany. App. filed Oct. 5, 1914. Simplifies mechanism provided for branch exchanges with restricted service.

1,332,307. Method for Coating with Tin and Tin Alloys Articles Made of Aluminum or Aluminum Alloys; Michele N. Salvati, Turbin, Italy. App. filed Nov. 15, 1918. First coats aluminum articles with iron layer by electrolytic method.

1,332,312. Electrical Position Indicator; Harry L. Tanner, Brooklyn, N. Y. App. filed June 5, 1915. Indicates range of distant object.

1,332,322. Signaling Device; Frederick W. Cole, Newton Highlands, Mass. App. filed Jan. 12, 1917. Motor-driven vibratory diaphragm for out-of-door use.

1,332,379. Circuit Connector; Carl Bramming, Chicago, Ill. App. filed Feb. 19, 1917. Plug-and-socket type.

1,332,394. Method of Electric Welding; Louis Gruber, Dayton, Ohio. App. filed March 14, 1918. Dowel pin subjected to welding heat.

1,332,403. Car-Control Mechanism; John S. McWhirter, New York, N. Y. App. filed Feb. 18, 1919. Manual control for safety cars.

1,332,414. Synchronizer; Melvin L. Severy, Arlington Heights, Mass. App. filed March 8, 1913. Controls speed of pulsation-producing devices in musical instruments.

1,332,422. Process for the Manufacture of Cements and Similar Products; Maurice L. Boillot and Jean Daudignac, Moutiers, France. App. filed June 28, 1918. Integral fusion in electric furnace.

1,332,434. Electric Power Table; Samuel Desure, New York, N. Y. App. filed March 6, 1919. For sewing machines, etc.

1,332,463. Variable Inductance; Harold P. Donle, Meriden, Conn. App. filed Dec. 15, 1917. Adjusted throughout wide range.

1,332,464. Electricity Meter; Jesse Harris, Lafayette, Ind. App. filed Nov. 14, 1918. Motor-driven counting trains, damping magnets and disks.

1,332,482. Battery-Terminal Connector; Charles J. Baker, Elkhart, Ind. App. filed March 10, 1919. For flashlights.

1,332,483. Sea-Water Battery for Vessels; Arthur Bridge, Washington, D. C. App. filed May 29, 1919. Primary battery suitable for submarine boats.

1,332,526. Electric Table Heater; John K. Soden, Portland, Ore. App. filed June 21, 1918. Grid type with closed chamber at base containing water to conserve heat.

1,332,555. Switch Cabinet; Arthur T. Hunt, Chicago, Ill. App. filed Jan. 5, 1918. For industrial-plant lighting circuits.

1,332,563. Method of Electric Welding and Product Thereof; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed Nov. 25, 1919. Welds metal inner tube to metal outer tube.

1,332,564. Telephone-Locking Device; Trevor G. Murton, Detroit, Mich. App. filed March 19, 1919. Prevents unauthorized use.

1,332,610. Electric System; John L. Creveling, White Plains, N. Y. App. filed Aug. 28, 1916. Auxiliary battery operates translating device when current fails.

1,332,631. Submarine-Propulsion System; Robert V. Morse, Ithaca, N. Y. App. filed Feb. 5, 1916. Increases cruising radius.

1,332,652. Magneto Generator; Richard Varley, Englewood, N. J. App. filed April 26, 1919. Shifts field poles.

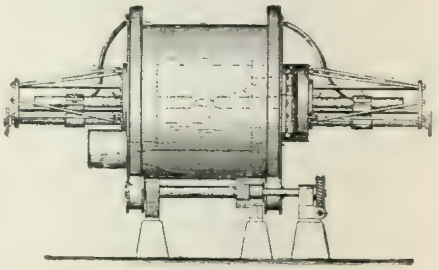
1,332,658. Electric Heating and Bending Device; George E. Barstow, Lynn, Mass. App. filed Aug. 20, 1918. Bending cutting edges of rotary cutters for trimming heels in shoe manufacture.

1,332,670. Method of Plugging Holes in Metal Plates; Maurice Lachman, New York, N. Y. App. filed Oct. 19, 1918. Rivet forms part of secondary.

1,332,688. Intermediate Conductor for Electric Metal-Working Apparatus; Adolph F. Rietzel, Charleston, R. I. App. filed Oct. 3, 1918. Connection transmits heavy currents and permits free movement of jaws.

1,332,696. Automatic Circuit Breaker for Motors; Arthur C. Tabbot, Atlanta, Ga. App. filed April 29, 1918. Breaker acts when armature bearings become worn.

1,332,707. Electrical Generating System; William W. Bucher, Chicago, Ill. App. filed June 2, 1916. Both low and high voltage through single armature with brushes operating on separate commutators.



No. 1,332,795—Electric Furnace

1,332,757. Induction Coil; Rudolf Rosner, Chicago, Ill. App. filed Feb. 23, 1918. Annular core of thin, flat soft-iron strips.

1,332,795. Electric Furnace; William K. Booth, Chicago, Ill. App. filed Feb. 3, 1919. Revolving type.

1,332,810. Combined Air-Speed Meter and Angle of Incidence and Side-Slip Indicator, with Dial Therefor; Oscar A. Danielson, New York, N. Y. App. filed Feb. 3, 1917. Indicating altitudes of aeroplane with relation to currents through which it passes.

1,332,844. Automatic Timing Device; Charles L. Kasson, Mattapan, Mass. App. filed Sept. 11, 1918. Measures time settings of relays.

1,332,852. Electrical Heating Element; Henri G. Levy, San Francisco, Cal. App. filed Sept. 18, 1917. For hair dryers.

1,332,860. Coumarone-Resin Insulating Material; Alfred A. Wells, Caldwell, N. J. App. filed April 9, 1917. Molded insulator.

1,332,862. Alternating-Current Rectifier; Frank W. Adsit, Minneapolis, Minn. App. filed Oct. 22, 1915. Pulsating wave taken from direct-current side symmetrical in each half cycle.

1,332,867. Electric Lamp Socket; Gustave Frankel, New York, N. Y. App. filed Jan. 13, 1919. Double outlet type.

1,332,868. Flashlight; Gustave Frankel, New York, N. Y. App. filed May 12, 1919. Continuous or intermittent light.

1,332,873. Telephone Transmitter; Peter L. Jensen, San Francisco, Cal. App. filed Jan. 2, 1918. For aeroplane use.

Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 75 New York, Saturday, March 27, 1920 *Number* 13

Distribution Losses

FUEL costs and plant limitations alike demand fresh attacks upon preventable line and equipment losses. Loads are shifting and increasing, and the adequacy of mains and feeders is no less important because new lamp designs, for instance, may be relieving the burdens of extremely close regulation of voltage. "Do it now" could never be applied with greater force in connection with the head for studies of all distribution losses than at present.

Revenue from Junk

ELSEWHERE will be found a brief account of the substantial savings made by a Pacific Coast company through the simple method of examining systematically, with a view to salvage, all material on its way to the junkman. There is money in the scrap heap along with all its other varied contents, and to distill it from the detritus needs no alchemy, only common sense, the business instinct and the capacity to take pains and see that subordinates do likewise.

Lighting-Fixture Styles

DESIGNS of home-lighting fixtures follow some of the eccentricities of changes in furniture styles. For 1920 the candelabra design predominates, and with it, of course, will come the use of bare round frosted-bulb lamps. These light sources in the line of vision are the rocks upon which the utilitarian engineer and the designer of artistic temperament have split. It is obvious that for 1920 at least the contentions of the artist have held more weight with the home-lighting fixture manufacturer than have the opinions of the engineer. Probably the engineer is to blame, because the artist has worked his way into the confidence of the manufacturer as one who can foresee the public's tastes. This is unfortunate even for the public, but the situation will be likely to remain unchanged until more engineers appreciate the value of learning how to sell an engineering idea.

Control of Credit

THE present period of business expansion could be suddenly turned into a panic if the banks were to curtail commercial credit. Speculative credit on the stock exchange has been curtailed, but commercial loans have been steadily increasing in spite of the warnings which have been issued in the guise of advances in the discount rates. This traditional method of controlling credit has not proved effective under present abnormal conditions because the profits have been large enough to do more than cover the higher interest charges. However, this period of inflation with its rising prices must give way to deflation with reductions in price levels. There are representative electrical manufacturers and bankers who believe that no appreciable slowing down of business is probable under the most adverse conditions for a considerable period, at least a year or more. However, every business man should observe all reasonable precautions and should be very sparing in the use of his credit privileges. The last annual report of the Federal Reserve Bank indicates that the board intends to check further expansion and to reduce inflation as rapidly as practicable. However, no drastic or precipitate action by the Federal Reserve Board seems imminent. Certainly the country at large has the right to expect this great credit agency of the government to display sufficient wisdom and foresight to bring financial conditions back to normal without any undue demoralization, non-employment or misery.

Competition in Service

THE oversold condition of many electrical markets by no means points to the enforced abdication of the salesman. Never is the opportunity to render customers valuable service greater than when a sellers' market rules the industry. Selection of goods and materials, scrutiny of specifications, influencing toward standardization, forecasting needs and outputs, intensive studies of performance of equipment and supplies—these and other lines of activity may be followed to mutual advantage. Competition in service supersedes rivalry for orders and establishes the foundation of long business friendships and profitable transactions.

Power Control by Commission

THE shortage of power in California due to unusual drought has brought out a very interesting situation. Seventeen utility companies have voluntarily met with the Railroad Commission of that state and pledged themselves to obey all rules, regulations and orders of the commission concerning diminution or extension of service and the interchange of power between the several companies. Another interesting sidelight has been furnished by farmers and power users who protest against a large block of power being transmitted from the northern section of the state to the central section, claiming that they should have first call upon the power generated in the district whence it originates. Thus the shortage of rainfall brings with it an unexpected compensation in the West, for it has caused a closer coöperative helpfulness in serving the public, a keener appreciation of the necessity for extending reservoirs to meet future emergencies, and, on the part of a grateful public, a full realization of the immense service that electrical energy is able to give in an exceedingly dry year to a rural community wholly dependent for its existence upon irrigation and electrical pumping.

Power-Plant Maintenance

MAINTENANCE of power-house apparatus is a prerequisite to successful operation. It really implies far more than casual repairs, for it ought to mean that, save for unusual contingencies, the plant is actually kept up to its initial condition with respect to efficiency and good service. It means more than keeping a plant merely in running condition, a conception of maintenance which has not infrequently led to disaster. Elsewhere in this issue A. B. Stitzer gives an admirably sound discussion of maintenance problems, particularly as to the orderly arrangement of affairs whereby proper inspection and the subsequent necessary upkeep can be successfully carried on. Of all things unfortunate in plant operation that which he refers to as deferred maintenance is most highly objectionable. In plain and uncompromising English, deferred maintenance means letting a plant run as long as possible before executing repairs long overdue. Those familiar with the development of the electrical art have no difficulty in remembering the unhappy effects of "deferred maintenance" in many early and some later electric railway systems, the results frequently being a large issue of capital stock for "improvements and extensions."

The only way to hold a power plant in condition and to give thoroughly first-class service is to keep looking after the details of the equipment all the time and to make at once any repairs or replacements that are found to be necessary. Orderly systematic inspection, with immediate reports of anything gone wrong, and prompt remedial action are imperative if service is to be maintained in the way that both the stockholders and the public have the right to expect. Perhaps the matter cannot be reduced wholly to standard methods, although Mr. Stitzer gives some very useful suggestions to this end. The chief thing is that inspection should be the immediate business of somebody with an orderly plan for reporting what has to be done and seeing to its prompt execution. One too often finds a fairly good system of outside inspection and a tendency to let things slide along in the station as long as may be convenient.

Self-Excited, Self-Starting Synchronous Motors

THE recognized advantage of the synchronous alternating-current motor over the induction motor is its good power factor. As a running machine the synchronous motor has qualities in this respect that are commendable in the eyes of central-station managers. The weak points of the synchronous motor are in starting or in accidental falling out of step. The starting torque of the synchronous motor is relatively small and has to be obtained at the expense of relatively excessive starting current. On the other hand, the induction motor can be designed to give excellent starting torque, and, if any momentary failure of voltage occurs in the supply system, it can easily regain full speed. Its power factor when running is apt to be low.

J. K. Kostko, in an article in this week's issue, advocates a synchronous motor with induction-motor characteristics. The machine recommended has no salient poles and resembles in its structure an induction motor with a somewhat wide air gap. The rotor is provided with a minor direct-current exciter winding, in addition to the main alternating-current motor winding.

The vector diagrams involved in the discussion of the properties of this advocated motor are interesting from a geometrical standpoint, in the fact that they are nearly all circular loci. The modern tendency of alternating-current motor theory has been to reveal the presence of circular vector loci in many directions previously unsuspected. The geometrical philosophy of these associated circular diagrams has in part been explained; but a complete and comprehensive exposition of the subject yet remains to be brought forth.

Hydro-Electric Developments in the West

PROGRESS in the development of plants in the Far West, as outlined in last week's issue, embodies elements of brilliant success and of discouraging obstacles. The growth of transmission systems began almost simultaneously in California and Colorado, the former furnishing light and power for miscellaneous purposes, the latter chiefly devoted to the general work of the mining camps. As time has gone on these regions have developed to no inconsiderable degree along the same lines. Fortunately there has been added the normal steady growth of prosperous communities and no inconsiderable call for power for irrigation as the farming country has developed. Unhappily some five years ago irrigation projects obtained a preferred rate, sound enough, perhaps, at the beginning, but now burdensome on account of the heavy increase in costs of operation and development. While some of the power companies through this region are not called upon to increase generating capacity at any considerable rate, there are others, in Montana and Idaho, for instance, where the proposed developments now under consideration aggregate more than 500,000 hp.

In California also there are bright prospects for the immediate future, owing to the rapid development of the industrial and agricultural sections of the state, of whose resources much that is claimed by the Californian is true. The brilliant success of the great networks of the Southern California Edison Company, the Pacific Gas & Electric Company and others stands out as the most remarkable development of power transmission in the world. California, too, has wisely given its power companies a square deal by allowing rates that encourage the investment of capital and the utilization of natural resources. These rates are not high, but fair, and they have resulted in putting transmitted power into every corner of the state. There are now under consideration several groups of high-head developments which will run close to 1,000,000 kw., and when one considers the territory of fertile lands to be irrigated and the other resources of the state, this great reserve of power will soon be needed.

The third group of hydro-electric activities are those in the far Northwest, Oregon and Washington. Here there has been a cessation of some great war activities which demanded large quantities of power, and there is a less favorable situation with respect to rate control. Existing plants do not lack in prosperity, but they are not now in a position to undertake large increases on account of the financial and rate situations. At the present time, with the very great increase in construction costs and operating costs as well, it does not require an ultra-conservative control of rates to put the brakes on activity. Several big projects are under way, but they may be slow of final realization. These considerations point very plainly the moral that the upbuilding of the hydro-electric resources of any region depends on a reasonably generous policy toward the investor. The situation has changed radically in the last five years. Even the big and successful companies have to pay high for the capital they need for necessary improvements. All the costs have increased at a startling rate, and unless they are met by a modest rise in the price of the product sold progress must necessarily be checked.

Short-Circuit Currents in Networks

IN THE early days of electric light and power transmission the problem before the designers and constructors was to furnish the generators which could supply the load called for. In recent times, however, the amount of power that can be furnished by a large central station is so great that some safeguard has to be established against accidental short circuits in the system. If no check were established, a severe short circuit might not only develop an enormous amount of energy locally liberated but the mechanical stresses upon the generators and plant might easily become excessive. Sound generators have occasionally been wrecked from mechanical injuries due to stresses from a short circuit.

The protective devices which have been installed during recent years—permanent reactors, overload switches and time relays—are capable of checking the rush of current and energy into a short circuit when the conditions can be assigned in a simple and definite way. In the case, however, of a complex network of high-voltage conductors, such as exists in many large cities, the conditions under which a short circuit can occur are so complicated that it may be very difficult to predetermine whether the safeguards installed are adequate.

An interesting experimental method of ascertaining the electrical severity of a short circuit at any point of a given high-voltage system, supplied by any number of generators in parallel, is described this week by W. R. Woodward. It virtually consists in constructing an artificial line or system on an experimental switchboard supplied with a 110-volt generator. The switchboard artificial system can be short-circuited at any desired point, and the currents in the system or at the generators can be measured by inserting an ammeter at the corresponding points. A current of 1 amp. on the model may mean a current of 1,000 amp. in the actual system, the ratio being determined partly by the voltage supplied to the model and partly by the scale of resistances used in its construction.

An interesting feature of the artificial-line system is that, in the ordinary method of its use, resistances in the model represent reactances in the actual system. The resistance distribution in the actual system is ignored in the model. Consequently, if a short-circuit on the model involves a certain amount of current and power, with reactance only inserted, the added effects of resistance will tend to reduce somewhat the currents in the actual systems. The currents in the model are to that extent limiting currents. This procedure greatly simplifies the construction of the model, because if the latter had to be supplied with both resistance and reactance to match the actual system in all parts, the construction would become much more expensive, while the increased precision would ordinarily be of little service from a practical standpoint.

The switchboard artificial system also has the advantage that it lends itself to the modeling of any given city system with relatively little delay.

Another Stride in Railroad Electrification

THE 207 miles between Tacoma and Othello, Wash., added to the 440 miles previously electrified between Avery, Idaho, and Harlow, Mont., makes 647 miles of track belonging to the Chicago, Milwaukee & St. Paul Railway over which trains are now propelled by electricity. When the connecting link of 212 miles from Othello to Avery shall have been electrified, a straight run of 859 miles will be in operation. Here are both fulfillment and prophecy—fulfillment of a notable undertaking and prophecy of the day when water-power development will cause electric energy to supersede steam for traction purposes in many states—or even of the time when with the onward march of electricity locomotion by this means will be nation-wide.

Pond-Level Control Very Important in Low-head Plants

IRREGULAR flow has always been a problem confronting the hydraulic engineer, and particularly along the Atlantic seaboard, where the run-off is apt to be rapid and the available heads relatively small enough to make variation of pond level a serious factor. In the Rockies and on the Pacific Coast, where several hundred feet of head is the rule, the pond level as such causes very little variation of head and the main problem is to retain all the water possible. In the eastern part of the country, however, the hydraulic works must be so managed as to keep the level on the whole as high as possible, with due provision for taking care sometimes of enormous amounts of surplus water which cannot be saved in the area impounded and is likely to do much damage unless discharged into the stream. In last week's issue Earl Stafford analyzed the various schemes for accomplishing these ends, beginning with the old-fashioned flashboard and proceeding to the recent types of automatic swinging gates.

The flashboard is, of course, able to change the level by only a structurally fixed amount of a very few feet. Discharge of water in time of flood is accomplished by removing the flashboard; but the control of head thus obtained is very imperfect, for, with the original form of flashboard, it is merely a case of a dam with or without the boards. These work passably well, however, in big storage areas with small variations in head. The hinged flashboards pivoted on the lower edge and held up by props which can be removed readily when necessary form a further step in design but still represent only the crudest sort of regulation of the pond level. One step further along comes the sliding gate, effective but requiring hand regulation and in cold climates likely to get blocked by ice. Various forms of pivoted gates show some improvement over the sliding device, being more easily managed and less easily put out of action. Of late there has been a strong tendency to install swinging-leaf automatic gates hinged and counterbalanced so that the water pressure itself determines the angle at which the gate stands. These are now used up to large sizes, 8 feet or 10 feet (2.4 m. or 3 m.) high and 50 feet (15 m.) or more long, and when carefully balanced they seem to be exceptionally successful in holding a steady level in normal circumstances and meeting flood conditions successfully. Something of the detail of the installation costs and practical operation in saving water with these gates is given in Mr. Stafford's paper. Incidentally he deals with the methods for meeting ever-present ice problems in Northern plants.

Benjamin G. Lamme

An originator of methods for calculating designs of electrical machines, a leader in electric traction development and a prolific inventor

ALTHOUGH a graduate in mechanical engineering, Benjamin G. Lamme is one of our best known electrical engineers and has always devoted his attention to electrical problems. It was the late Albert Schmid who discovered Mr. Lamme's genius in the Westinghouse test room, where he began work on May 1, 1889. Although methods for calculating the performance of electric motors were then unknown, Mr. Lamme devised a means whereby the saturation curves of existing machines could be checked up from test data. In January, 1890, just eight months after taking up electrical work, he prepared specifications from calculations for a double-reduction railway motor which was built and placed on the market as a commercial machine. Then from his calculations in the fall of 1890 came the four-pole, single-reduction-gear railway motor with slotted armature, machine-wound coils and a wave or two-circuit winding—the design still standard in railway work. He has been a prolific inventor. Most of the early rotary-converter patents were in his name, and he alone is the father of the 60-cycle converter. The single-phase railway motor which was once said to be impossible also stands to his credit. To turbo-generator design and all Westinghouse alternating-current apparatus he has contributed much. Mr. Lamme has denied himself many honors owing to an extremely retiring disposition. His genius, however, has been widely recognized. Two years ago he was selected as chairman of the inventions committee of the Naval Consulting Board, and in June, 1919, the Edison medal was awarded to him by the A. I. E. E. for inventions and development of electrical machinery. His greatest reward, however, is the regard in which he is held by his engineering associates, many of whom he has discovered and promoted to high positions during the seventeen years he has been chief engineer of the Westinghouse Electric & Manufacturing Company.

Short-Circuit Currents in Networks

A Miniature Network Is Readily Set Up by Means of a Flexible Switchboard and Approximate Currents Are Measured—Typical Examples Are Worked Out

By W. R. WOODWARD
Electrical Engineer Westinghouse Electric & Manufacturing Company

THE interconnection of transmission and distribution systems in the last few years has resulted in networks of a very complicated form. This complication has increased the operating difficulties and has made necessary a more accurate knowledge of the happenings in the system as a whole when a disturbance occurs in any portion. Short circuits on such large power systems not only impose heavy duty on the oil circuit breakers but result in heavy mechanical strains in the apparatus in the circuit, such as transformers and busbars. It is, therefore, of the utmost importance to be able to calculate the currents that may flow in such a system during short circuit, in order to select the proper circuit breakers, to provide adequate mechanical strength in the various parts of the circuit and to adjust selective relays, so that the portion of the system in trouble may be cut free from the rest of the system with the minimum disturbance.

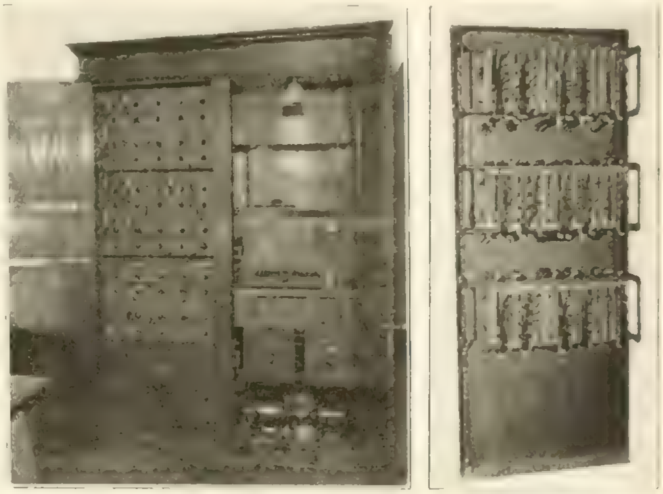
While it is possible to calculate the short-circuit current in most cases by the application of Kirchoff's laws, the process is often very laborious and the necessary time is not available, so that some means of lessening the labor is essential.

MINIATURE NETWORK IS READILY SET UP

This has been accomplished for a number of years, in the case of extremely complicated problems, by setting up a miniature of the networks, using uniform resistance wire, whose length is proportional to the reactances of the various circuits, and then measuring the resultant current in the various paths when a moderate voltage is applied. However, such a "set-up" is expensive and requires much time and labor. The problem can be greatly reduced, however, by arranging a set of permanent adjustable resistors in convenient form so that they may be connected into a miniature of any network. This set-up may be quickly made and the desired results obtained at very little expense and in a short time. Such a network involving only resistance when substituted for impedance or reactance, while not giving exact results, is adequate for most cases, and allowances can be made in almost any problem for the errors that are introduced by the neglect of the other elements.

This method can be justified as follows: In general, synchronous machines, transformers and aërial lines have similar impedance characteristics—that is, the reactance value is relatively large with respect to the resistance value. If these impedances have exactly the same power factor—*i.e.*, ratio of resistance to reactance—it is obvious that if resistance be substituted for impedance and direct voltage applied, the current flowing will be exactly proportional to the symmetrical alternating current which would flow in the case of short circuit. If they are not the same, some error is introduced. Usually the worst case of error is where underground three-conductor cables are used, in which case the reactance value is low in proportion to the resistance, particularly in 25-cycle systems. The network, however, can usually be checked quickly to determine whether an incorrect impedance in these lines would merely change the total current or would change the distribution of the current in the network. In the latter case it might lead to considerable error, but in general the effect of the cable impedance is rather small in those short-circuit conditions which are the determining factors in apparatus application.

For the calculation of regulation a device using resistance only can seldom be applied without more resultant error than can be allowed. In this work it is usually necessary to obtain results within a small limit of error, whereas greater limits are permissible in estimating short-circuit values of currents. Also, in the case of transmission lines, the value of capacity must be considered in calculating regulation, as it has a marked effect on regulation but a much less effect on short-circuit currents; for when a short-circuit occurs the voltage between wires or from wires to ground is much reduced.


FIGS. 1 AND 2 FRONT AND REAR VIEW OF CALCULATING BOARD

HOW THE SWITCHBOARD IS ARRANGED

On a calculating board recently developed for this work there are thirty adjustable resistors mounted on a panel of three frames with ten units per frame. Each resistor of 1,100 ohms is made in two parts, each part connected to an eleven-point dial. The first dial gives resistance values of 50, 100, 200, 300, etc., to 1,000 ohms, and is connected in series with a second dial which is adjustable from 0 ohm to 100 ohms in steps of ten. By the use of these two dials any resistance from 50 ohms to 1,100 ohms can be obtained in steps of ten ohms.

As shown in the accompanying illustrations, the units are mounted in two horizontal rows of five units each. A bus bar is provided at the top and bottom of the top row and at the top only of the bottom row. Each resistor ends in a terminal block which may be connected to the bus by means of a tapered plug. Several tapered

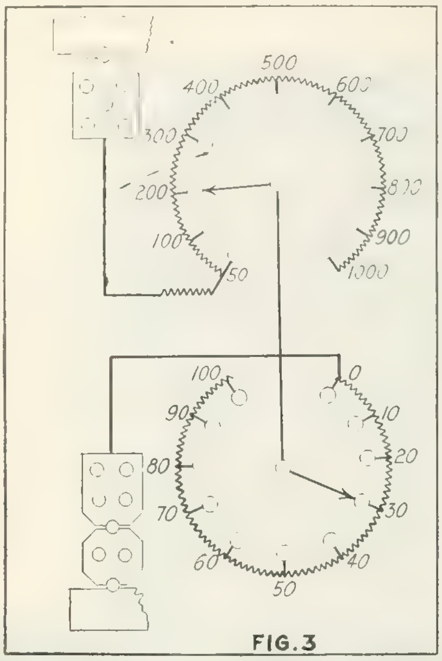
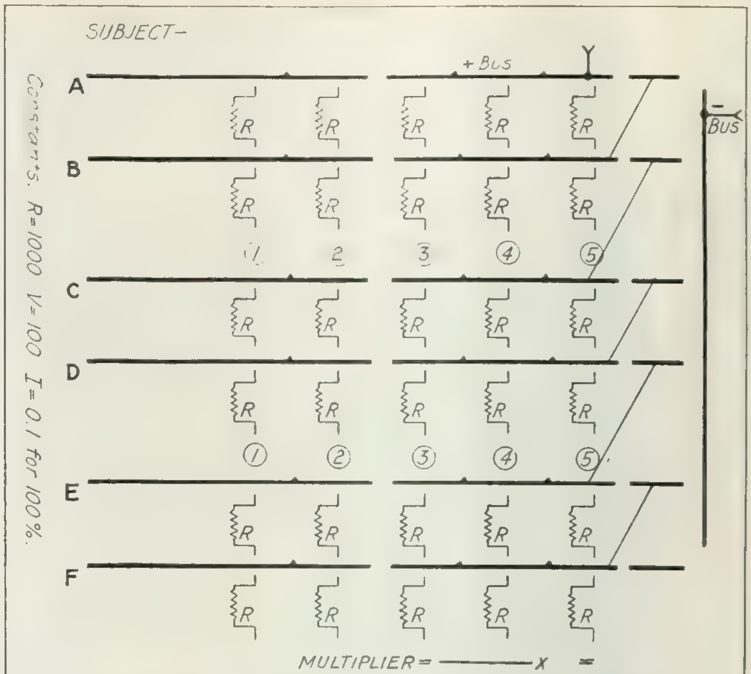


FIG. 3



Location	D.C. Volts	D.C. Amps	A.C. Amps	Location	D.C. Volts	D.C. Amps	A.C. Amps

FIG. 4

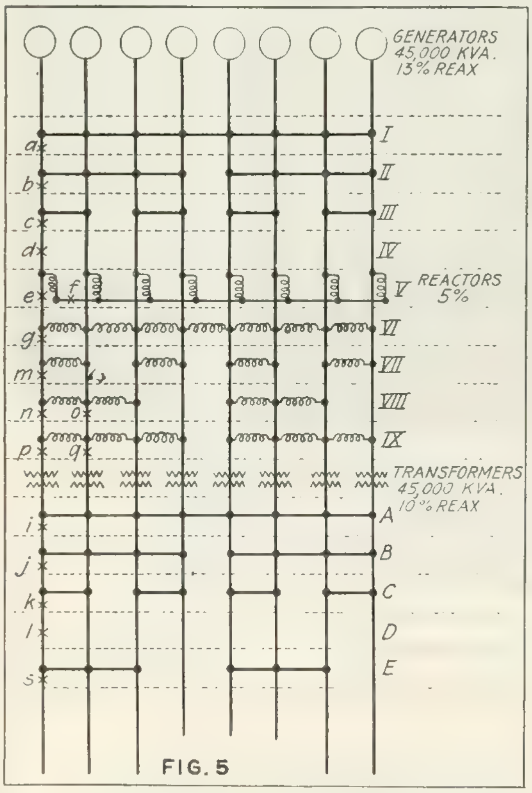


FIG. 5

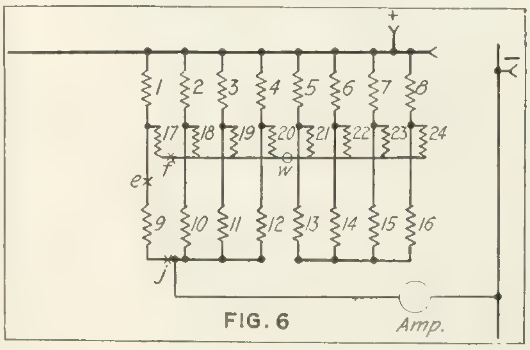
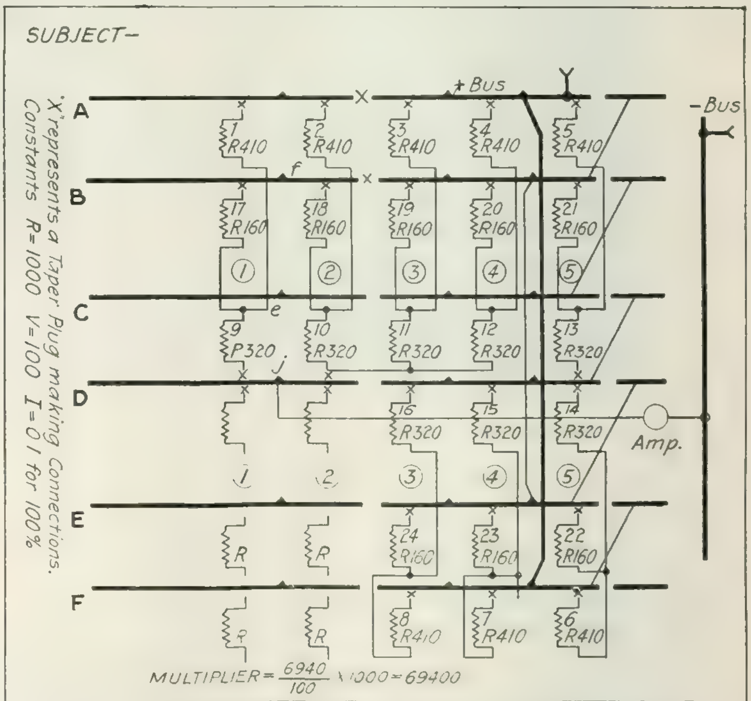


FIG. 6



Location	D.C. Volts	D.C. Amps	A.C. Amps	Location	D.C. Volts	D.C. Amps	A.C. Amps
				j	100	0.692	48,000
				e	100	0.784	54,400
				f	100	1.4	97,000

FIG. 7

FIGS. 3 TO 7—WORKING OUT THE SHORT-CIRCUIT CURRENT IN A NETWORK BY CALCULATING BOARD

Fig. 3—Diagram of one resistor on panel.
Fig. 4—Form used for laying out miniature circuits.
Fig. 5—High-voltage and low-voltage operating connections considered in problem.
Fig. 6—Simplified diagram of combination in Fig. 5 with short circuit at j.
Fig. 7—Set-up of panel for problem, Figs. 5 and 6.

TABLE GIVING TOTAL INSTANTANEOUS SYMMETRICAL SHORT-CIRCUIT CURRENT ON LOW-VOLTAGE SIDE.
BASIS 12,000 VOLTS

L.V. H.V.	I All in parallel	II Two groups, four in parallel	III Four groups, two in parallel	IV Separate	V Reactance Synchronizing Bus	VI Reactance Main Bus	VII Four groups, two in parallel, Reactance Main Bus	VIII Two groups, three in parallel, Reactance Main Bus	IX Two groups, four in parallel, Reactance Main Bus
A All in parallel	a 135,000	b 92,500	c 59,500	d 33,400	e 56,000 f 97,000	g 51,800 h 66,500	* 48,400	x 58,000	x 62,000
B Two groups, four in parallel		b 68,500	c 48,000	d 29,400	e 54,400 f 97,000	g 45,000 h 64,000	* 39,200	x 47,000	x 49,300
C Four groups, two in parallel			c 34,200	d 26,300	e 51,300 f 97,000	g 39,700 h 59,000	m 29,500	n 36,200 o 44,800	p 37,900 q 47,500
D Separate				d 17,200	e 46,500 f 97,000	g 37,200 h 56,400			

HIGH-VOLTAGE SIDE. BASIS, 12,000 VOLTS

A All in parallel	i 75,500	i 75,500	i 75,500	i 75,500	i 75,500	i 75,500	i 75,500	i 75,500	i 75,500
B—two groups, four in parallel	j 54,500	j 38,400	j 38,400	j 38,400	j 48,000	j 44,000	j 37,600	j 37,600	j 37,600
C—four groups, two in parallel	k 32,800	k 26,600	k 19,300	k 19,100	k 48,000	k 24,000 k_2 27,000	k 18,800	k 21,100	k 23,200
D—separate	l 18,700	l 16,400	l 13,300	l 9,350	l 15,000	l 14,000 l_4 16,000			
E—Two groups, three in parallel.							s 32,100	s 28,300	s 36,800

* Maximum short-circuit current on low-voltage side.

holes are also provided in each terminal and busbar for the insertion of jumper plugs. Each busbar is divided into two parts which may be connected by a tapered plug, and two adjacent busbars may also be connected by the insertion of a plug. One section of the top bar is permanently connected to the positive generator lead, and the negative lead of the generator is connected to the negative bus, which for convenience is placed at one side and extends from the top to the bottom of the board.

Energy for this outfit is supplied from a 500-watt, 120-volt motor-generator adjustable so as to produce voltages of 50, 100 or 120 with current up to 5 amp. A low-reading ammeter is arranged with flexible leads, so that it may be readily connected in series with any resistor. For this purpose the lower terminal of each resistor is split into two parts and connected by a tapered plug around which the ammeter may be shunted. Owing to the high resistance of the units the contact and ammeter resistances are negligible. The complete panel is mounted in a wooden cabinet for protection, the motor-generator and field resistance boxes being mounted under the instrument table.

HOW TO OPERATE THE BOARD

In Fig. 3 the connections of an individual resistor unit are shown. The resistance cannot be adjusted to less than 50 ohms in order that there shall be no danger of over-loading the generator. The diagrams of the board as shown in Fig. 4 are used in working out any individual problem.

It is necessary to draw a single-line diagram of the network and reduce the impedance of every circuit to ohms on a common voltage basis. On a three-phase circuit the impedance is taken as the equivalent from line to neutral. The following indicates how these impedances are calculated.

For example, assume a 10,000-kva., 11,000-volt, three-phase generator having 12 per cent reactance. The full load current is $10{,}000 \div (11 \times 1.73) = 526$ amp. The reactance drop $= (0.12 \times 11{,}000) \div 1.73 = 762$ volts. The impedance $= 762 \div 526 = 1.45$ ohms.

If apparatus of some other voltage is connected to the network by transformers, its impedance may be calculated as above just as though it were really rated at 11,000 volts. If for any reason its actual value in ohms is known, as for instance in the case of a transmission line, it may be reduced to the proper voltage basis by multiplying by the square of the ratio of the desired to the actual voltage. Thus a 33,000-volt transmission line has 12 ohms reactance. Its equivalent reactance on the basis of 11,000 volts is $(11/33)^2 \times 12 = 1.33$ ohms.

For convenience, the values in ohms are multiplied by a factor (M) to obtain values in the range of 50 to 1,100, which are the limits of actual values of the resistors. For example, suppose the actual reactance ohms range from 0.34 to 3.9 ohms; multiplying by 200 we get values from 68 to 780.

The individual impedances are numbered on the single-line diagram of the network and the connections shown on the form, each resistor being numbered and its value recorded. The set-up on the panel is then made exactly as shown on the sketch to facilitate checking.

By applying a direct-current voltage and measuring the current to the various branches a value proportional to the alternating current is obtained. This value multiplied by a factor (K) gives the value of symmetrical alternating current, where $K =$ (alternating-current volts to neutral $\times$ M) $\div$ direct-current volts.

SOLUTION OF A SPECIFIC PROBLEM

A good example of the usefulness of this equipment is the problem and results shown in Figs. 5, 6, 7 and 8. This involves a new project which will ultimately contain eight generators, each rated at 45,000 kva., 13 per cent inherent reactance. The transformers of the same rating have 10 per cent inherent reactance, while the bus reactors were assumed as 5 per cent on the basis of the rating of one machine. The problem was to ascertain the best scheme of operating such a station. Fig. 5 shows the various high-voltage and low-voltage operating connections considered, while Fig. 6 is a simplified diagram of combination in Fig. 5 with short circuit at point *j*. The generators are numbered 1 to 8, the transformers 9 to 16 and the synchronizing reactors 17 to 24. The actual impedances of the apparatus are: Generators, 0.415 ohm; transformers, 0.32 ohm; reactors, 0.16 ohm. These were multiplied by $M = 1{,}000$, giving values of 415, 320 and 160 respectively.

Since all generators tend to feed into a short circuit, they are connected to the "plus" bus and the point of short circuit connected to the "minus" bus. An ammeter in the negative bus connection shows the total short-circuit current at j. If desired, the ammeter can be connected at some other point, such as w, to find how much certain machines are contributing to the total current.

Fig. 7 shows the connections drawn on the form Fig. 4, with the impedances numbered as in Fig. 6 and impedance values given.

The tabulation shows the various values of short-circuit currents corresponding to the various connections and places of short circuit. From this table the effect of the various connections on bus structure and circuit breaker rupturing capacity can be thoroughly analyzed.

Standard Maintenance in Power Plants[*]

Deferred Maintenance Shown to Be an "Expensive" Economy—Systematic Inspection and Repair Program Is Suggested—Relation Existing Between Maintenance and Reserve Capacity Is Pointed Out

By A. B. STITZER
Chief Engineer Republic Engineers, Inc.

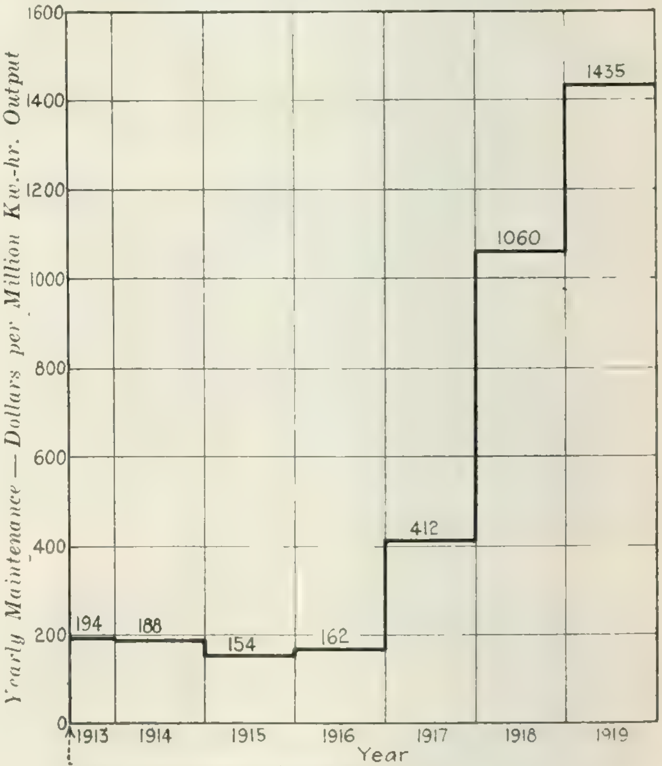
SOME engineers have always believed that maintenance of the highest character justified the expense involved, but the majority have looked upon it as a necessary evil attendant upon operation. The latter group do only a sufficient amount of maintenance work to keep the plant in operating condition and rely upon reserve capacity to care for the unforeseen outrages and emergency use. Higher standards of maintenance are conducive to the elimination or reduction of losses from a number of sources.

Authorities differ on what really constitutes maintenance, but it is usually referred to as the expense of keeping a plant in running condition over and above the cost of attendance. It includes the cost of up-keep replacement and precautionary measures. This latter item includes renewal of working parts, painting of perishable or exposed material and replacement of worn-out and defective equipment.

DEFERRED MAINTENANCE IS COSTLY

Deferred maintenance is the real "bugbear" of power plants and is represented by the cost of putting the plant in the best practical working order at any given time. A new plant may be kept running for several years with comparatively little maintenance, but during that time deferred charges are accumulating that must eventually be met. Repairs and renewals must then be made simultaneously on a large amount of equipment, thus impairing service and sending the cost of maintenance suddenly skyward. A striking example of the effect of deferred maintenance is shown graphically in Fig. 1, the data being taken from actual cost records. The plant from which this data was taken began operation in 1913, and for the succeeding four years only sufficient maintenance was applied to keep it running. In 1918, or the fifth year, however, it became necessary to begin overhauling the entire plant, and the maintenance charges jumped to 260 per cent of those for the preceding year and were more than six and one-half times the charges for 1916. There are few engineers who do not concede the fallacy of deferred-maintenance practice, and yet, strange to relate, there are also few who have had the courage to eliminate the evil.

The extreme limit of maintenance, of course, would be to keep the plant continuously in a new state, but since such a condition could only exist in theory, some practical limit must be established by investigation and experience. Even then, however, maintenance is not to be applied indiscriminately; to become a real economy it should be efficiently standardized.



Plant began operation May, 1913

FIG. 1—EFFECT OF DEFERRED MAINTENANCE IN A MODERN POWER PLANT

There are two distinct divisions of such work, the first being a combination of inspection and record keeping, the second consisting of repairs and renewals.

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[*] Presented before station operating committee, Ohio Electric Light Association.

There can be little doubt that many costly failures have been directly attributable to improper or insufficient inspection. A specific instance which occurs to the writer was one in which the field circuit of a 150-hp. direct-current motor was accidentally opened, allowing the motor to run away. In the ensuing wreck a piece of flying débris struck and killed a station attendant, while another piece cut through some brass pipe carrying three-phase, high-voltage cables. A severe "short" occurred, starting surges which shut down the entire system at an important hour of the day. This disastrous accident could, in all probability, have been avoided by proper inspection, since an investigation disclosed the fact that a field wire had been gradually "chafing" through because of excessive vibration.

Systematized, efficient inspection and records should be the basis of maintenance, and the elaborateness of the work should agree with the size and importance of the plant.

The following scheme, modified to suit local conditions, represents one way in which the matter could be handled. The first essential is *periodic* inspections, the frequency of which will vary according to the type of apparatus and the purpose for which it is used. All equipment in any given power plant would be divided into groups corresponding with the name of the apparatus, and then further classified according to the approximate number of inspections necessary during any definite period of time. This is practically dependent upon the amount of use the apparatus is likely to have during the selected period, and the final classification will be under daily, weekly, semi-monthly, monthly, bi-monthly, semi-annual and annual inspections. Experience will perhaps show that it is advantageous to make occasional changes in the classifications.

In order to facilitate inspection and at the same time to eliminate the probability of omitting some apparatus or important part thereof printed forms can be used advantageously and kept as permanent records. These forms may consist of a series of questions, which, if carefully answered by a simple yes or no, will necessitate a most rigid and thorough inspection. While paper forms are cheaper, the card file system is preferable, and the ease with which the latter may be kept should compensate for the additional first cost. A form can be made for each piece of apparatus or part of station equipment. Ordinarily a card would cover the inspection of a single piece of apparatus, but where the form is exceedingly short or several pieces of apparatus are closely related two or more forms could be combined on a card. Space can be left on each card for "Remarks," under which heading a detailed description of any trouble or defects may be noted and recommendations made for the elimination of the trouble or for repairs and renewals.

Consecutive numbers could be assigned to all apparatus scheduled to be inspected at any given time—say, for instance, the monthly inspection—and cards covering the inspection numbered accordingly. This consecutive numbering would be a further precaution against omitting some apparatus. It would also be advisable in numbering the apparatus to pay particular attention to the actual physical location in the station, making the numbers progressive from one part of the station to another instead of proceeding at random.

As soon as trouble is discovered the inspector should immediately turn in the card covering the case to the man in charge of the station or of maintenance. Then so long as the trouble is uncorrected the card should remain in a special file prominently displayed. When the defect has been remedied the card can be transferred to the regular file containing records of apparatus in good condition. The man in charge of maintenance can arrange the cards in the special file in the sequence in which it is most advisable to make repairs or renewals, since it is obvious that, owing to questions of expense, service or inability to obtain material, it is not always possible to make immediate corrections. Small repairs are nearly always allotted to Sundays or hours of "off peak." Occasionally the recommendations of the inspector may be changed or deemed unnecessary, in which case the card is so marked by the responsible party.

The fact must not be lost sight of that with many types of apparatus the periods of inspection may be shortened as the apparatus grows older. Many good systems of periodic inspection have been put in the discard because of this oversight.

It is obvious that no schedule can be made for emergency repairs, neither can any maintenance schedule be made which can be followed in detail just as laid out. Emergency conditions must be met as they arise with as little interruption to the actual schedule as possible. Likewise, slight repairs to equipment which should be made but which are not considered as emergency conditions may be made at periods of light load when such apparatus can be taken off the line without interfering with the necessary capacity required for carrying the load.

When emergency repairs are made good judgment must be used at the next regular period for inspection as to how nearly the repairs constituted a complete overhauling; otherwise the purpose of the schedule will be defeated, for it is highly probable that in most cases the inspection could be omitted.

Inspection periods being based entirely on estimated average use, the contention may arise that periodic inspection does not adequately provide for the fact that the actual hours' use of some apparatus varies continuously over a wide range. Again, it is possible that through unforeseen conditions some equipment might either be driven much above rating or else remain idle for an undue length of time between inspection dates. To offset this apparent disadvantage, it is suggested that charts be used in all special cases, showing continuously the numbers of hours' use of *rated* capacity. These charts will have the additional advantage of showing at a glance all apparatus nearing the time of inspection. If too much equipment is apparently coming due at the same time, the operator has the opportunity of slowing up or hastening some of it so that the minimum amount of apparatus will be out of service simultaneously.

However, it really makes little difference whether inspections are determined by definite periods or by hours' use, so long as a standard system is used.

Operating men should always be on the lookout for small deficiencies of apparatus and report them promptly so that if possible they can be put on a work list for that piece of apparatus when it comes out of service. This is a sort of double insurance that nothing will be overlooked in the regular inspection. Co-operation between the operating and maintenance departments is very desirable in the working out of a maintenance schedule and also in carrying out the schedule after it is in effect.

REPAIRS AND RENEWALS

It is an extremely difficult matter to prescribe a definite set of rules governing the exact amount of wear or deterioration which should take place before renewals are made; also the amount of elaborateness of repairs necessary at any given time. These things are in most cases a matter of judgment for the inspector, who should always be a carefully trained and experienced man.

The observation of inspection records, however, should furnish a satisfactory approximate guide in recommending renewals and repairs. If the records are complete, they will show the condition of any given piece of apparatus and its parts at each inspection; also the repairs and renewals made either at times of inspection or in emergency cases. Knowledge of this character covering a number of inspections should usually prove sufficient to determine the advisability of making immediate renewals or of postponing them until a subsequent inspection.

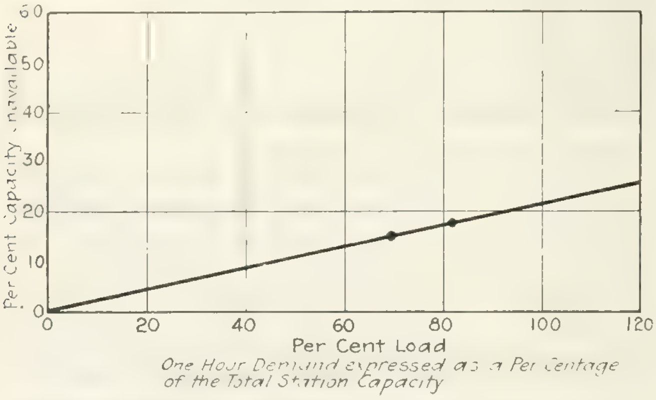

FIG. 2—VARIATION OF UNAVAILABLE APPARATUS WITH LOAD ON STATION

The foregoing suggestion, if conscientiously carried out, will automatically fix the point of best economy, which lies somewhere between the theoretical upper limit of maintaining everything in a new condition and the lower limit of allowing apparatus or parts thereof to fail before making repairs and renewals.

It very often happens that necessary maintenance work is neglected or postponed because of overloaded plant conditions or through a false idea of economy, but in either case a resulting failure is likely to cost a good deal more in loss of service as well as money than the cost of proper maintenance. A typical instance of an attempt to economize on necessary repairs and renewals which had serious results was one in which the boilers of a certain plant were permitted to reach such a bad condition that the slightest forcing caused excessive foaming. Quantities of scale and sediment and slugs of water were sent over into the turbine, and the inevitable shutdown occurred with much damage to the turbine and considerable loss of service.

In regard to the authorization of expenditure as well as a proper accounting for maintenance, the work-order system appears to be both simple and efficient. Under this plan a work order should be applied for two or three days prior to the regular overhaul period for any given piece of apparatus, but before making application the foreman in charge should check up the availability of the machine and also ascertain whether all necessary material for the work is on hand.

The great diversity of conditions affecting maintenance in the various power plants precludes any accurate estimate of the cost. An approximate idea may be had, however, from the fact that in a plant of 100,000 kw. capacity, where the maintenance is highly standardized, the charges for 1919 were 15 per cent of the total operating cost. These charges included inspection, record keeping, repairs and renewals.

RELATION OF MAINTENANCE TO RESERVE CAPACITY

Reserve capacity in a power station is very often overlooked as a factor connected with maintenance of station equipment, the common idea being to consider reserve capacity as just so much insurance against interruptions to service during periods of emergency breakdown. Contrary to this belief, standardized maintenance does have a certain definite relation to reserve capacity.

The curve shown in Fig. 2 was determined from actual data collected during four years in several stations of a prominent company, and it shows the percentage of capacity unavailable under varying load conditions. The unavailable capacity represents that portion of the equipment necessarily out of service for emergency repairs and for the purpose of carrying out a system of standardized maintenance. The per cent load is the one-hour demand expressed as a percentage of the total rated capacity of the station. This ratio is sometimes known as "plant factor." Referring to the curve, it will be seen that, at 70 per cent load, 15 per cent of the capacity is unavailable owing to maintenance conditions, leaving 15 per cent reserve capacity. Two important facts are brought out by this curve—first, that maintenance varies directly with the rate at which the station is driven, and, second, that the maximum load possible would be about 82 per cent of the rated capacity of the station, the unavailable capacity at this load being 18 per cent.

The number of units in a station has an important bearing on standardized maintenance—a large number of small units being better for this purpose than a small number of large units. The general economy of the latter arrangement, however, makes it the most used, and for this reason perodic inspection becomes considerably more difficult to put into practice. In most cases the taking of a large unit out of service for inspection will seriously reduce or even eliminate reserve capacity.

It has often been said that more reserve capacity will be required with a system of standardized maintenance than without it. This, however, is an arbitrary viewpoint, since for any given factor of safety against interruptions to service it is evident that proper maintenance will reduce the necessary reserve capacity.

In the second part of this article a number of systems of maintenance used by representative companies will be given.

Measurement of Power Factor for Rates

Average Power Factor May Be Obtained Over Period of Time by Using Standard Watt-Hour Meters Connected to Register Energy and Reactive Components of Load

By C. E. BROWN

Commonwealth Edison Company, Chicago

THE desire on the part of central stations to incorporate power-factor clauses in rate schedules has directed a great deal of attention to the problem of measuring the power factor of customers' loads. There appears to be no generally accepted practice of making and recording power-factor measurements on three-phase loads over a period of time, and some of the methods commonly used are not accurate on unbalanced loads. A method has been developed, however, which has been found to make accurate measurements on customers' loads under various conditions met with in service.

This method was described in part by Willard S. Wilder on page 239 of the Aug. 2 issue of the ELECTRICAL WORLD. It requires no special equipment and is generally not difficult to apply. The method consists in the measurement of the reactive component of the load and the calculation of the power factor from the relation of this component to the energy as measured by the service meter. The scheme has been used by the Commonwealth Edison Company, Chicago, for the past year on three-phase loads of all degrees of unbalance to the extreme conditions where the load consists at times of a single-phase load across the two phases of the three-phase line. The results obtained have been uniformly accurate throughout, under balanced voltage conditions on the line.

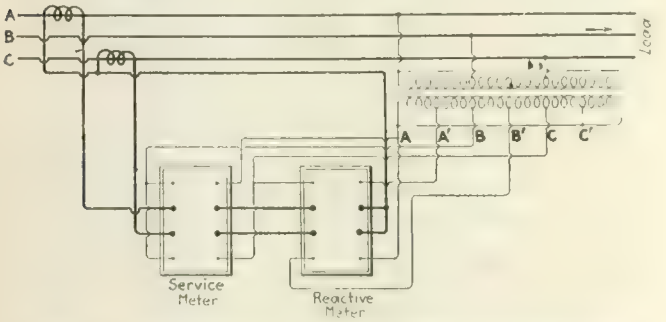

FIG. 1—POWER FACTOR OBTAINED FROM SERVICE METERS

Commonwealth Edison Company, Chicago

. Standard three-phase watt-hour meters connected to indicate energy and reactive components of load with delta-connected potential transformers.

A standard polyphase service meter with cross-phase connection of its potential coils will register $2EI \sin \phi$, or 115.5 per cent of the reactive component of a balanced three-phase load. Such a connection, however, does not give the reactive component accurately on unbalanced loads, which are of equal importance.

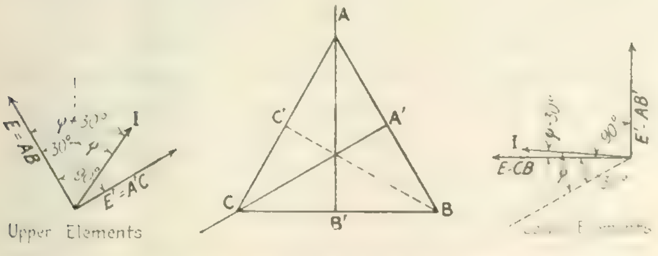

FIG. 2—VECTOR DIAGRAMS OF VOLTAGE RELATIONS IN SERVICE AND REACTIVE METERS (FIG. 1)

AB and *CB* (*E*) are the voltages across the elements of the service meter, and *A'C* and *AB'* (*E'*) are the potentials on the reactive meter.

In the ELECTRICAL WORLD, Vol. 71, page 140, E. S. Borrington describes a method for determining the power factor on balanced loads. It is believed, however, that the method used by the Commonwealth Edison Company for the past year offers greater advantages and has a wider sphere of application.

In this method a standard polyphase service-type meter is used to register the reactive component of the load. The meter is connected with its current coils in series with the corresponding current coils of the service watt-hour meter, and its potential coils from one phase to the middle or half tap on the secondary of the potential transformer connected across the other two phases. This connection is made in such order that the potential on the reactive component meter is 90 deg. behind the phase of the corresponding element of the service meter, as shown in the diagram of connections (Fig. 1). An inspection of the vector diagrams in Fig. 2 will show that the voltage on the reactive component meter is 86.6 per cent of the voltage across the potential transformer and the registration is $1.5EI \sin \phi$, or 86.6 per cent of the reactive component. This may be demonstrated in the case of balanced loads as follows:

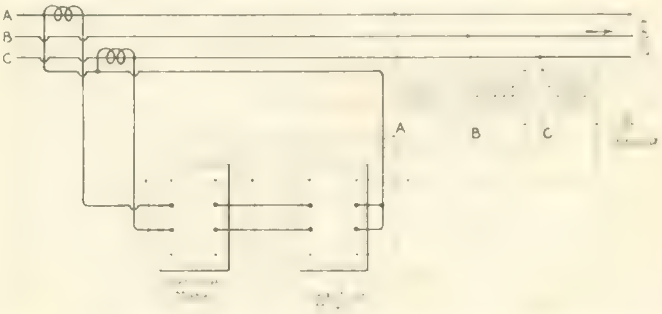

FIG. 3—MODIFICATION OF FIG. 1 FOR USE WITH Y-CONNECTED POTENTIAL TRANSFORMERS

With meters connected as in Figs. 1 and 3 the sum of the energy (*P*) and reactive (*X*) components of different loads make the same triangle (*OLM*, Fig. 4) as if all the service were supplied through one meter.

Let E' = the potential from A' to C = $0.866E$,
also E' = the potential from A to B' = $0.866E$,
I = current per phase;

then, for the upper element of the meter:

$$\text{Reg.} = E'I \sin(\phi + 30^\circ) = 0.866EI \sin(\phi + 30^\circ),$$

and for the lower element:

$$\text{Reg.} = E'I \sin(\phi - 30^\circ) = 0.866EI \sin(\phi - 30^\circ),$$

and for the meter as a whole:

$$\begin{aligned}\text{Reg.} &= 0.866EI\,[\sin(\phi + 30^\circ) + \sin(\phi - 30^\circ)] \\ &= 0.866EI\,(2 \sin\phi \cos 30^\circ) \\ &= 1.5EI \sin\phi.\end{aligned}$$

The accuracy of these meter registrations on unbalanced loads can be demonstrated mathematically, but the following analysis will answer equally well: Referring to Fig. 2, it is evident that any three-phase load may be considered as made up of three single-phase loads connected from *A* to *B*, *A* to *C*, and *B* to *C*, respectively, and that these single-phase loads will be equal or unequal according as to whether the three-phase load and power factor is balanced or unbalanced.

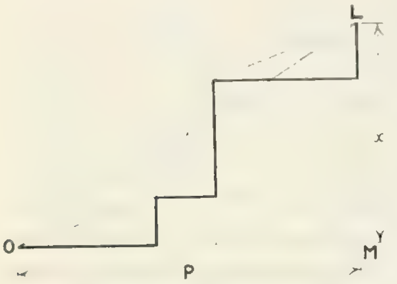

FIG. 4—RESULTANT POWER FACTOR OF TWO OR MORE LOADS

The reactive component of any single-phase load can be measured by connecting the current coil of a meter in series with it and the potential coil to a potential 90 deg. out of phase with the potential to which the load is connected. Applying this principle then and dividing by the factor 0.866, the single-phase current taken from *AB* will pass through the upper element of the meter and its reactive component will be correctly registered as the potential of this element is *A′C*, which is 90 deg. out of phase with *AB*. The single-phase current taken from *BC* will pass through the lower element and its reactive component will be correctly registered as the potential on this element is *AB′*, which is 90 deg. out of phase with *BC*. The single-phase current taken from *AC* will pass through both elements of the meter and its reactive component will be correctly registered since the resultant of the two potentials acting is equivalent to the potential *BC′*. which is 90 deg. out of phase with *AC*.

No assumption of equality of relative values of current or power factor has been made, but the voltage triangle must remain symmetrical. This means that the method is correct for any degree of current or power-factor unbalance but not for unbalance in potential. But the unbalance in the potential on commercial lines is very much less than the unbalance in current may be and will not generally cause any appreciable error. The fact that two of these currents are usually acting on each element at the same time does not, of course, invalidate these conclusions.

CALIBRATING AND CONNECTING THE METERS

The reactive component meter is calibrated on 86.6 per cent of normal voltage and can be adjusted with a disk constant of 86.6 per cent of normal so that it will register the reactive component without correction. The meter is left in circuit for a week or more, as may be required, or it can be connected up permanently if continuous records are needed. When it is desired to know the power factor at the time of the maximum demand or for other short periods of time printometers are connected to the reactive meter and to the service meter in the same manner and at the same time. This permits the determination of the power factor at any hour of the day, under any conditions of load, and permits plotting a continuous power-factor curve.

The power factor is calculated from the registration of the two meters in the following manner:

$$\frac{\text{Reactive kva.-hr.}}{\text{kw.-hr.}} = \frac{\sin}{\cos} = \tan \phi.$$

The power factor is the cosine of the angle whose tangent is obtained by dividing the registration of the reactive component meter by the registration of the service meter.

The connecting up of the standard service meters as suggested is not difficult under practically any condition met with in practice. The potential transformers used on high-potential metering are all provided with middle taps on the secondary, and the only extra wiring required is that necessary to connect these taps to the meter panel. Where no potential transformers are used a middle tap can be taken from any double-coil power transformer without great difficulty. Where potential transformers are connected Y, or where no potential transformers are used and power transformers are connected Y, the reactive meter can be connected according to diagram shown in Fig. 3. The potential on the meter will then be that of the secondary of the transformer, and the registration will be 57.7 per cent of the reactive component. This method is available for the measurements of power factor on single-phase loads taken from three-phase circuits, the single-phase reactive meter being connected with its current coil in series with that of the service meter and its potential coil 90 deg. behind. The potential on the reactive meter is 86.6 per cent of normal, and its registration is 86.6 per cent of the reactive component.

The power factor of single-phase loads taken from three-phase circuits can be obtained by connecting the potential coils of a test meter to one of the other phases in cases where the middle tap is not available. A standard single-phase service-type meter is used and is connected with its current coil in series with the current coil of the service meter, and its potential coil to the phase having a potential 60 deg. behind that of the service meter. This will give a forward rotation on lagging currents, and the ratio of the test-meter registration to that of the service meter will vary with the power factor as shown in Fig. 5. This is essentially the Borrington method applied to single-phase circuits, and the accuracy of results obtained is not materially different from those obtained with a 90-deg. connection. As this test meter is only 60 deg. out of phase with the service meter, it does not record reactive component; but if the reactive component is required it can be obtained by multiplying the registration of the service meter by the tangent of the angle whose cosine is the power factor already obtained.

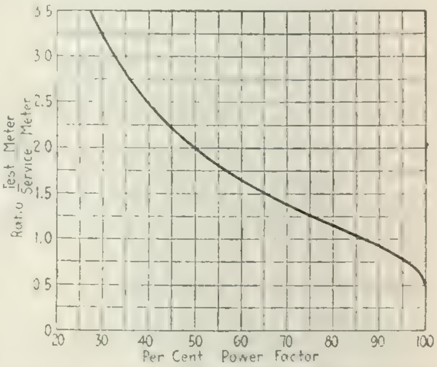

FIG. 5—CURVE FOR DETERMINING POWER FACTOR FROM TWO WATT-HOUR METERS CONNECTED 60 DEG. OUT OF PHASE

When the mean power factor of the load measured on several meters is required the several energy components are added and the several reactive components, and from these combined results the power factor is calculated in the same way as for a single meter. This gives a vector power factor as shown in Fig. 4, and the results are the same as if all loads were combined and measured on one meter.

Self-Exciting Synchronous Motor

Synchronous Motor with Polyphase Type of Field Winding May Be Designed for Self-Starting—Author Shows How Characteristics of This Motor Are Improved by Automatically Increasing Excitation with Load—Suitable for Industrial Applications

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IT IS generally admitted that the field of application of synchronous motors is limited mainly by their poor starting characteristics and the necessity of direct-current excitation. Much attention has been given to the design of the amortisseur windings of the salient-pole type, with a view of improving the starting performance, but in the opinion of the writer, the problem of satisfying the conflicting requirements of a high-resistance rotor for starting and a low-resistance rotor for pulling into synchronism can be most satisfactorily solved by the use of a non-salient-pole structure, with a field winding of the polyphase type, adapted to be connected to an external resistance at starting and to a source of direct current at synchronism (Danielson motor). Structurally the motor is similar to an induction motor with a wide air gap and requires only such mechanical parts as are standard in the manufacture of induction and direct-current motors. At constant excitation the synchronous performance of such a motor is somewhat inferior to the salient-pole type, because its armature reaction is higher, and a sufficiently high maximum torque can be obtained only by the use of a strong excitation, which lowers the efficiency and increases the heating at light loads. Much better results are obtained if the excitation, instead of being kept constant, is made to increase with the load.[*]

The field circuit is usually a three-phase star-connected winding, and the direct-current exciting voltage is applied between one slip ring and the other two connected together, so that one phase carries full exciting current and each of the other two one-half of it. In a motor of normal proportions it will always be found that even if this winding is designed for the maximum permissible voltage between slip rings at starting, the number of turns in series is so small that the direct-current exciting current is very large and the exciting voltage extremely low, requiring an exciter of somewhat abnormal proportions.

EXCITER IS WOUND ON REVOLVING ARMATURE

When the alternating-current supply voltage and the capacity of the motor permit of disposing the armature winding on the rotating member, a non-salient pole motor can be improved in many respects by constructing it as a self-exciting machine, deriving its excitation from a small direct-current type winding superposed on the main alternating-current winding and connected to a commutator. An automatic increase of the excitation with the load can then be obtained by the simple expedient of setting the brushes at a suitable angle with respect to the armature field, which is stationary relative to the field member. The necessity of disposing the armature winding on the revolving member limits the application of this arrangement to low-voltage, moderate-power motors, where the insulation of the revolving winding and the transmission of the line current by means of slip rings offer no difficulty. But when this construction is applicable it has still another advantage: a stationary field winding can be made reconnectable for different number of turns, so as to satisfy the condition of a low induced voltage at starting and a reasonably low exciting current during synchronous operation. However, even in this case the exciting armature winding must be proportioned for a comparatively low voltage, so that sparking is not likely to occur even if no special precautions are taken against the effect of short-circuiting armature coils in a magnetic field.

The field winding is designed for a very small slip, to facilitate the pulling into synchronism; the impedance of the exciting armature being very small relative to the field winding, it can be left in circuit during the starting period. The synchronizing is entirely automatic, without any rush of current or mechanical stress, because the excitation builds up gradually and, naturally, always with the "right" polarity. No difficulty need be anticipated from the absence of the "locking into synchronism" effect of the salient poles, this absence being more than compensated by the rapidity of building up of the field, due to the completely laminated magnetic circuit.

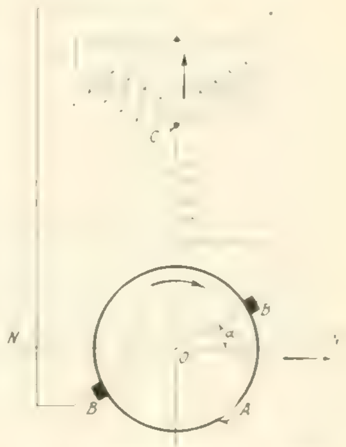

FIG. 1 ARRANGEMENT OF EXCITER AND FIELD WINDING

The object of this article is to study the synchronous performance of a non-salient pole, self-exciting motor, as influenced by the brush displacement and by the selection of the constants of the exciting circuit.

Fig. 1 shows the exciting circuit connected for the synchronous operation. It consists of the armature A, brushes B and field C, the latter shown as a three-phase star connected winding. For the sake of simplicity, the main alternating-current armature winding connected to the slip rings, and all auxiliary apparatus, resistances, etc., used at starting, are not shown in the figure. In what follows the saturation of iron will be considered as negligible, which is usually the case in a non-salient pole structure; but it will be shown how to find the limit beyond which the theory ceases to be applicable on account of the saturation.

The direct-current emf. induced in the exciting armature winding is proportional to the component of the flux normal to the line of brushes BB; the flux set up by the field winding C is proportional to this emf.; therefore, there is a constant ratio a between these two fluxes. Neglecting the weak direct-current reaction of the exciting armature A, the action of the exciting circuit during the synchronous operation is fully determined by this constant a and by the angle (BON) $= \alpha$ between the line of brushes BB and the neutral axis NN.

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[*] On the subject of non-salient-pole-type synchronous motors see Dr. Steinmetz, "Theory and Calculations of Electrical Apparatus," p. 57; C. J. Fechheimer, "Self-starting Synchronous Motors." *Transactions* A. I. E. E., 1912, Vol. 31, p. 529 (discussion); Dr E. Rosenberg, "Self-synchronizing Machines," *Journal I. E. E.* (London), June, 1913.

The alternating-current armature flux can be considered as the resultant of a longitudinal flux F_e, coaxial with that produced by the exciting winding C and set up by the reactive component of the current (with respect to the back-emf. induced by the field of the exciting winding C), and a transversal flux F_t, directed along NN and due to the active component of the current. As various fluxes will figure in the same analytical expressions, it is convenient to select positive directions of their axes, for instance as shown by the arrows, and consider a flux as positive or negative, according as it acts in the positive or negative direction of its axis. With this convention the constant a will be positive in a self-exciting machine.

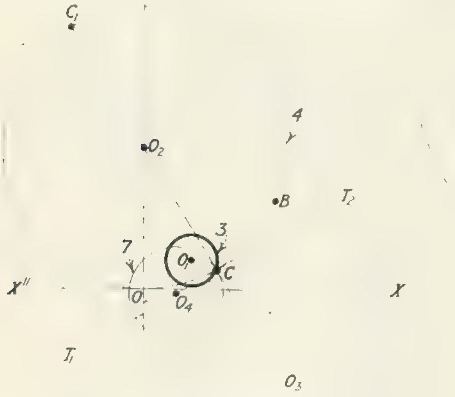

FIG. 2—DIAGRAM FOR DETERMINATION OF EXCITER BRUSH POSITION

Let F be the total longitudinal flux, equal to the algebraic sum of F_e and flux F_f set up by the field winding. The flux normal to the line of brushes is $F \cos \alpha - F_t \sin \alpha$; therefore:

$$F_f = \frac{F \cos \alpha - F_t \sin \alpha}{a} = \frac{(F_l + F_f) \cos \alpha - F_t \sin \alpha}{a}$$

This equation gives

$$F_f = \frac{F_l \cos \alpha - F_t \sin \alpha}{a - \cos \alpha}$$

If α is considered as positive or negative, according as the brushes are displaced against rotation or with rotation, all expressions hold good for any position of the brushes; but the case $\alpha < O$ is of no interest, because, in a motor, it corresponds to the weakening of the main field by the armature reaction; the condition $\alpha > \pi/2$ also need not be considered, because in this case the flux, which is set up by the exciting winding through the action of the flux F on the exciting armature is opposed to F; this will prevent the motor from falling into step. For all practical purposes it is sufficient to consider the case $O < \alpha < \pi/2$.

Let r be the resistance per phase of the main alternating-current winding, $x =$ the leakage reactance, and $X =$ the total synchronous reactance, *i.e.*, $X = x + 1/b$, where b is the exciting susceptance, which can be calculated as for an induction motor. The reactance of armature reaction is $X - x$; it should be made low by a suitable selection of the air gap, which can be made fairly wide without affecting the starting performance to any extent.

Fig. 4 is the vector diagram of the motor. OI' is the current I'; $OA' = rI'$, $A'B' = xI'$, $B'C' = (X - x)\ I'$. The emf. of armature reaction $B'C'$ is itself the sum of two components, E_t and E_l, at right angles to one another, due to the fluxes F_t and F_l respectively. Since the flux F_f is coaxial with F_l, the back-emf. due to F_f has in the diagram the same direction as E_l (although, of course, not necessarily the same sense), and the value E_f of this back-emf. is

$$E_f = E_l \cdot \frac{F_f}{F_l} = E_l \frac{1}{a - \cos \alpha} (\cos \alpha - \frac{F_t}{F_l} \sin \alpha).$$

But in Fig. 2, $F_t/F_l = E_t/E_l = \tan\omega$ and $E_l = B'C' \cos\omega = (X - x)\ I' \cos\omega$; therefore $E_f = (X - x)$

$$I' \cos\omega \times \frac{\cos\alpha - \tan\omega \sin\alpha}{a - \cos\alpha} = \frac{(X - x)\ I'}{a - \cos\alpha} \cos(\omega + \alpha) \quad (1)$$

The vector $C'E' = E_f$ represents this emf. The applied voltage V' is then represented by the vector $E'O$.

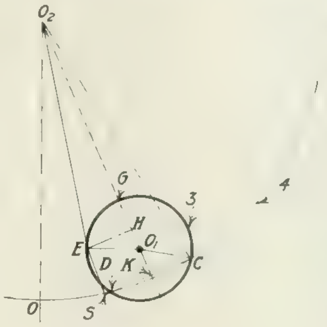

FIG. 3—DIAGRAM FOR INVESTIGATION OF TORQUE CHARACTERISTICS

If the machine is supplied with a constant current I', the points A', B' and C' are fixed, and the locus of point E' is a curve represented in polar co-ordinates by the equation (1), in which E_f is considered as the radius-vector and ω as the vectorial angle, with pole C' and polar axis $A'X'$. This equation is that of a circle 1 of radius $(X - x)\ I'/2\ (-\cos \alpha)$ having its center O' on the line $C'O'$, which makes an angle equal to α with $A'X'$. If $a > \cos \alpha$, the center is to the right of C' and above $A'X'$; if $a < \cos \alpha$, it is to the left of C' and above $A'X'$. C' is the short-circuit point, the back-emf., E_f, being zero at this point. The point D', in which this emf. $= C'D'$ is at right angles to the current, is the no-load point. Below $C'D'$ the machine delivers mechanical energy; above $C'D'$ it consumes it.

The vector $E'O$ represents the variable applied voltage V' corresponding to the constant current I'; at the given constant voltage V the current would be $I = I' \times (V/E'O)$. Let $E'O$ be produced to E'' selected so that $OE'' = I = I' \times (V/E'O)$. If the axis OY is considered as the direction of the applied voltage, the vector OE'' can represent the current I, except that it shows a lead when the current is lagging, and vice versa. To obtain the correct phase relation it is only necessary to replace OE'' by the vector OE, symmetrical to OE'' with respect to OY.

The relation $OE'' \times E'O = I'V$ shows that the point E'' is the inverse of the point E' with respect to the point O, the constant of inversion being $I' \times V$. The locus of $E'' =$ the inverse of the locus of E'—*i.e.*, of the circle 1—is also a circle 2, and the true current locus at constant applied voltage is a circle 3, symmetrical to the circle 2.† The points D and C, corresponding to D' and C', are the no-load point and the short-circuit point respectively. Above CD the machine operates as a motor; below CD it consumes mechanical energy and may act as a generator if the circle 3 has points below $X''X$.

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†On the principle of inversion as applied to alternating-current problems see Arnold, *Wechselstromtechnik*, Vol. 1, second edition, p. 70.

It may be pointed out here that, for the sake of clearness, the diagram of Fig. 2 has been drawn so as to show the circles 1, 2 and 3 separate from each other, corresponding to an extremely poor, underexcited ($a > \cos\alpha$) motor. A good, strongly excited ($a < \cos\alpha$), leading-power-factor motor would have the center of its circle 1 above $X'X'$, with the origin O inside of it. The circles 1, 2, 3, would then overlap on one another, but all conclusions would be the same as for non-overlapping circles.

The study of the exciting circuit in its relation to the synchronous performance can now be more particularly defined as an investigation of the relations between the elements of the circle 3 and the constants a and α.

Values of a and α Giving a Desired Current Locus.—In this case the first step is to express the desired performance in the form of a current locus. The relation between various performance data and the circle 3 can be found as follows:

The points B', C' and D' lie on the line $X'X'$. Their inverse points lie on the inverse of $X'X'$, which is a circle 4, having its center O_2 on OY. Its diameter is $\frac{V \times I'}{OA'} = \frac{V \times I'}{rI'} = \frac{V}{r}$, and the radius $OO_2 = \frac{V}{2r}$. When the constants a and α vary, the no-load point D'' moves on this circle, but the points B'' and C'' are fixed and determined by the relations

$$\tan X''OB'' = \frac{OA'}{A'B'} = \frac{rI'}{xI'} = \frac{r}{x},$$

$$\tan X''OC'' = \frac{OA'}{A'C'} = \frac{rI'}{XI'} = \frac{r}{X},$$

$$OB'' = \frac{V \times I'}{OB'} = \frac{V \times I'}{zI'} = \frac{V}{z},$$

$$OC'' = \frac{V \times I'}{OC'} = \frac{V \times I'}{ZI'} = \frac{V}{Z},$$

with $z = \sqrt{r^2 + x^2}$ and $Z = \sqrt{r^2 + X^2}$.

The triangle OO_2E gives: $OO_2^2 - O_2E^2 = 2 \times OO_2 \times OE \times \cos\varphi - OE^2$.

But $OO_2 = V/2r$; $OE = I$, therefore $OO_2^2 - O_2E^2 = (V \times I/r) \times \cos\varphi - I^2$; hence

$r\,(OO_2^2 - O_2E^2) = V \times I\cos\varphi - I^2r =$ input — ohmic loss = torque (per phase) in synchronous watts (including iron, friction and exciting losses) (2)

Since OO_2 is constant, this expression shows that the torque at a point E depends only on the distance O_2E of this point from the fixed point O_2; therefore a circle concentric with the circle 4 is a locus of points of equal torque, *i.e.*, of equal power. By means of the expression (2) (with OO_2 and O_2E in amperes) the radius OO_2 can be graduated in terms of the torque, and the latter can then be determined at any point E by describing an arc of circle 5 passing through E. For a given current locus 3 the maximum torque corresponds to a circle 6 tangent to 3 at G. The maximum possible torque of the motor occurs when $O_2E = O$, and is equal to $r \times OO_2^2 = V^2/4r$, as in every synchronous motor.

The triangles $OC'E'$ and $OC''E''$ are similar because $OC' \times OC'' = V \times I' = OE' \times OE''$, *i.e.*, $OC'/OE = OE''/OC''$, and $\angle C'OE' = \angle C''OE''$; therefore $C'E'/C''E'' = OC'/OE'' = ZI'/I$. Let E_f be, in the constant potential (c.p.) operation, the back-emf. due to F_f; in the constant current (c.c.) diagram it is represented by $C'E'$; therefore

$$E_f = C'E' \times (I/I') = C''E'' \times (ZI'/I) \times (I/I')$$
$$= C''E'' \times Z = CE \times Z, \qquad (3)$$

which shows that the segment CE, expressed in amperes and multiplied by Z, gives the back-emf. E_f. This emf, in turn gives the flux F_f, because the alternating-current armature winding is known. Since, for a given structure, the distribution and the weight of copper of the exciting winding may also be assumed as known, the ohmic loss in the exciting circuit is determined by the value of F_f and is proportional to the square of it. Thus, in the diagram, the exciting current loss is proportional to the square of the segment CE.

Let E_r be, in the c.p. operation, the emf. generated by the total flux common to the stator and the rotor, *i.e.*, by the resultant of F and F_f. In the c.c. diagram this emf. is represented by the vector $B'E'$. By the same reasoning as above the emf. E_r can be determined from the similar triangles $OB'E'$ and $OB''E''$, and is found to be

$$E_r = BE \times z. \qquad (4)$$

From the emf. E_r and the armature winding data the resultant common flux can be calculated. This flux is the measure of the iron losses and, which is perhaps more important, of the degree of saturation of the magnetic circuit. Let E_{rs} be the value of E_r corresponding to the flux at which the iron begins to become saturated. A circle described with center B and radius E_{rs}/z will contain all points of current loci to which the theory is applicable. For points outside of this circle it is only roughly approximate.

Thus, at any point E, the input, the torque, the power-factor $\cos\varphi$, and all the losses can be determined; and any performance, compatible with the fundamental characteristics of this type of motors can be expressed in the form of a circular-current locus passing through the point C. It remains only to find the values of the constants a and α which correspond to a given locus.

The circle 1 and the line $A'X'$ cut at C' at an angle equal to the angle of their normals $N'C'O' = \pi/2 - \alpha$. It is well known that the normals to the inverse curves 2 (3) and 4 make the same angle with each other at the corresponding point C'' (C); if O_1 is the center of the desired locus, then

$$O_1CO_2 = \frac{\pi}{2} - \alpha \qquad (5)$$

Let E_{fo} and E_{ro} be the values of the emfs. E_f and E_r at n load, *i.e.*, for $\omega = O$. Fig. 2 gives: $E_{fo} = C'D' = \frac{X - x}{a - \cos\alpha} I'\cos\alpha$; $E_{ro} = B'D' = B'C' + C'D' = (X - x)I' + \frac{X - x}{a - \cos\alpha} I'\cos\alpha = \frac{X - x}{a - \cos\alpha} \times aI'$; therefore $\frac{E_{ro}}{E_{fo}} = \frac{a}{\cos\alpha}$. But $E_{ro} = BD \times z$; $E_{fo} = CD \times Z$, therefore $\frac{a}{\cos\alpha} = \frac{z}{Z}\frac{BD}{CD}$. Let R be the radius of the locus 3 and $d =$ the distance of its center O_1 from the fixed line O_2C; then $\sin\left(\frac{\pi}{2} - \alpha\right) = \cos\alpha = \sin O_1CO_2 = d/R$, and

$$a = \frac{z}{Z}\frac{d}{R}\frac{BD}{CD} \qquad (6)$$

By means of the expressions (5) and (6) the constants a and α can be determined from the drawing of the specified current locus.

When a varies from O to $\cos\alpha$, $C'D' = \frac{X - x}{a - \cos\alpha} I'\cos\alpha$ varies from $-(X - x)I' = C'B'$ to $-\infty$. When

a varies from cos α to $+\infty$, $C'D'$ varies from $+\infty$ to O. In other words, with the adopted limits for a and $\alpha (a > O, (\pi/2) > \alpha > 0)$, the no-load point D' can occupy any position on $X'X'$ with the exception of the segment $B'C'$. In the c.p. diagram the point D may fall on any point of the circle 4 except the (shorter) arc CB.

The useful range of the values of α being O to $\pi/2$, the relation (5) shows that the center of the current locus must fall within the angles T_1CO_2 or T_2CO_3 (Fig. 2) which the tangent T_1T_2 to the circle 4 makes with the normal O_2O_3. Let C_1 be the point of the circle 4 diametrically opposite to C; if D falls on the shorter arc BC_1, the perpendicular bisector of the segment CD obviously has points within both angles T_1CO_2 and T_2CO_3, and the centers of the loci passing through D can lie within either of these angles. If D lies on the arc COC_1, the perpendicular bisector of CD has no points in T_2CO_3, and the center of the current locus must be in the angle T_1CO_2. With normal proportions of the circle 4 the case of the no-load point D on the arc BC_1 is of no practical importance, and it may be stated quite generally that (subject to the check of the saturation, as described above) constants a and α, comprised within their useful range, exist for any desired current locus passing through the point C and having its center within the angle T_1CO_2 and its no-load point on the arc COC_1.

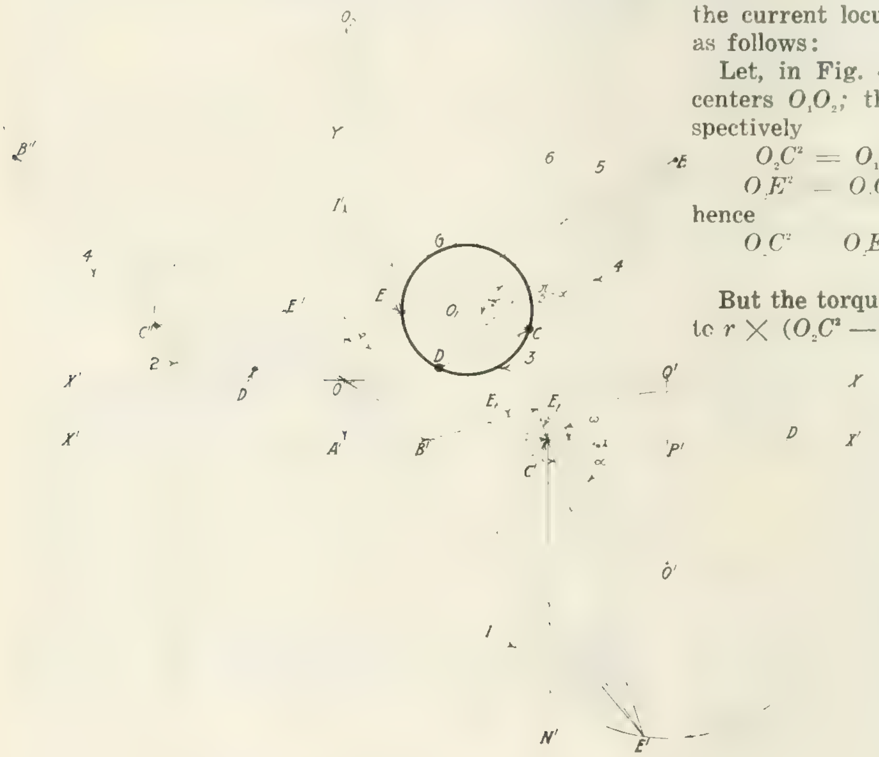


FIG. 4—PERFORMANCE DIAGRAM OF SELF-EXCITED MOTOR

The performance of the motor with the brushes on the neutral ($\alpha = O$) is represented by a circle 7 having its center O_4 on the tangent CT_1. The excitation, which is proportional to CE, decreases rapidly with the load, and, unless the exciting current is made excessively strong at no-load, the power factor is poor and the overload capacity low, which explains why such motors have met with very little success in the past.

The inverse problem of constructing the current locus corresponding to given values of a and α can be solved by considering the center O_1 as the intersection of the line CO_1, Fig. 4, determined by the value of α, with the radius vector OO_1 (not shown in the figure), inclined to $X''X$ at the same angle as the radius vector OO' This angle is determined by the relation

$$\tan O_1OX = \tan O'OX = \frac{O'Q'}{O\,Q'} = \frac{O'P + P'Q'}{A'C' + C'P'} =$$

$$\left[\frac{X + x}{2\,(a - \cos\alpha)}\,I\sin\alpha - rI\right] : \left[XI - \frac{X - x}{2(a - \cos\alpha)}\,I\cos\alpha\right] =$$

$$\frac{(X + x)\sin\alpha - 2r\,(a - \cos\alpha)}{2aX - (X + x)\cos\alpha}.$$

The comparative study of the torque conditions of various current loci can be made by means of circles 5; but in a given locus it is easier to follow the variation of the torque by considering it as represented by the distance ES (Fig. 3) of the point E from the line joining the no-load and the short-circuit points. This is the general property of c.p. diagrams in which the current locus is a circle. It can be demonstrated as follows:

Let, in Fig. 4, EH be perpendicular to the line of centers O_1O_2; the triangles O_1CO_2 and O_1EO_2 give respectively

$$O_2C^2 = O_1O_2^2 + O_1C^2 + 2 \times O_1O_2 \times O_1K,$$
$$O_2E^2 = O_1O_2^2 + O_1E^2 - 2 \times O_1O_2 \times O_1H;$$

hence

$$O_2C^2 - O_2E^2 = 2 \times O_1O_2 \times (O_1K + O_1H)$$
$$= 2 \times O_1O_2 \times ES.$$

But the torque has been previously found to be equal to $r \times (O_2C^2 - O_2E^2)$; therefore

Torque in synchronous watts $= 2r \times O_1O_2 \times ES$, where $2r \times O_1O_2$ is constant for a given current locus. The operation is stable between D and G, and unstable between G and C.

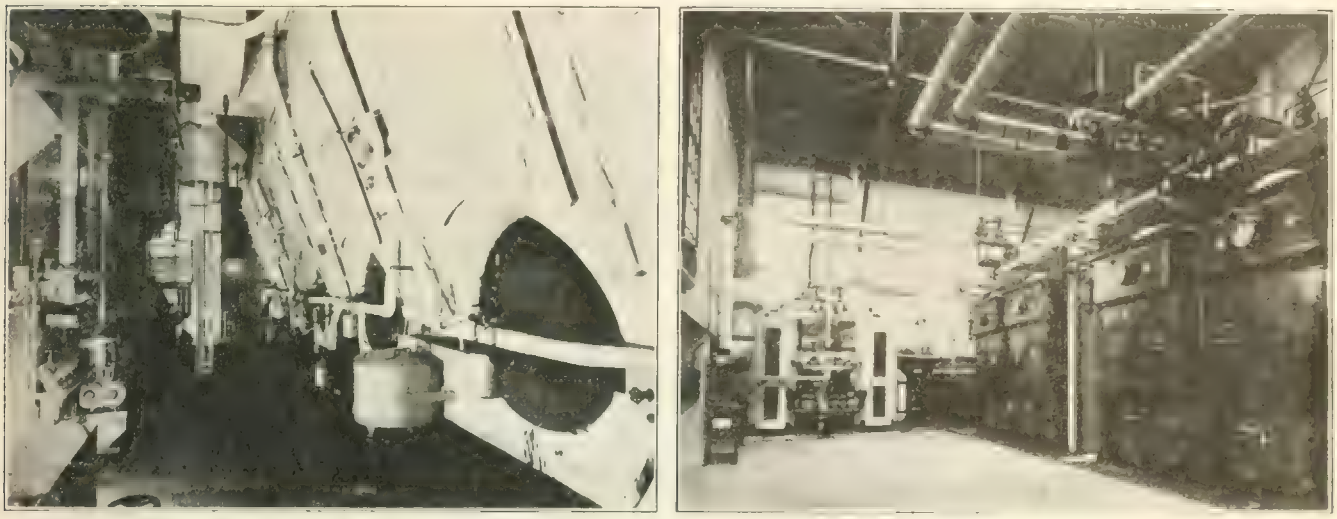
It is interesting to note that the current locus is the case of the constant separate excitation—*i.e.*, constant back-emf. E_f, can be represented in the diagram of Fig. 4 by a circle described from C as a center with E_f/Z as a radius, all other elements of the diagram, such as constant torque circles 5, the line BE representing the resultant emf. E_r, etc., having the same meaning as for a self-exciting motor. This can be seen by reference to Blondel's bipolar diagram, or it may be considered as following directly from the relation (3), which, as well as relation (4) and the properties of circles 5, has been established generally for any point E, without reference to the locus to which it belongs. This relation shows that if E_f is constant the point E describes a circle having C for the center. The self-exciting motor, in which not only the radius but also the center of the current locus can be selected at will, has the advantage of a greater flexibility, but the performance of one type cannot be reproduced by the other, the point C being a point of the locus in one case, and its center in the other.

"IT IS *the duty of the government to do business honestly and intelligently, to elevate and not to degrade the standards of business integrity, and to make it easy for business men to know whether they are complying with specifications, and to assist them where they need help most. In other words, it is the duty of the government to make it easy to do right in business and hard to do wrong.*"—DR. E. B. ROSA.

Burning Oil with Mechanical Atomizers

May Eventually Be as Extensively Used in Stationary Plants as Steam Atomizer — Best Operating Pressures and Temperatures, Some Advantages and Disadvantages

By ROBERT SIBLEY and C. H. DELANY



OIL-FIRED BOILERS EQUIPPED WITH MECHANICAL ATOMIZERS

At left, fire-room arrangement showing Bethlehem oil-burning system using a mechanical atomizer, installed on a 12,000-ton freighter fitted with Howden forced draft. This type of mechanical atomizer is already installed aboard vessels aggregating over 2,500,000 i.hp. At right, a typical installation for mechanical atomization on land. The view shown is that of the San Francisco Hospital, in which four 250-hp. water-tube boilers are equipped to burn either coal or oil.

While steam atomizing oil burners are used almost exclusively in stationary power-plant work at the present time, the mechanical atomizing oil burner has found great favor in marine work and is the standard method of firing oil-burning marine boilers at the present time. Much interest is shown concerning the use of the mechanical atomizing burner in stationary plants, and it is possible that it may eventually be as extensively used in this field as the steam atomizing burner or may entirely displace it.

The mechanical atomizing burner, sometimes called a pressure-jet burner, is made in a number of different forms all of which operate on the same principle. It consists essentially of a nozzle containing a small conical orifice through which the oil is forced at high pressure, the oil being first heated to a temperature approaching its flash point. Inside the nozzle means are provided to give the oil a whirling motion of sufficient intensity to make it fly into a spray on account of the centrifugal force as soon as it leaves the nozzle. The burners are placed in the boiler front, and each burner is provided with an air-regulating device which admits the air around the burner, at the same time regulating the quantity of air to suit the combustion requirements. In some makes of mechanical burners the air receives a twisting motion as well as the oil, which adds to the effectiveness of the mixing of air and oil for combustion. Where the boilers are to be operated at high capacities the air is supplied by means of forced draft.

The operation of these burners varies with both the pressure and temperature of the oil. The pressure must be at least 60 lb. (4.2 kg.) in order to produce good atomization, and it may be increased up to 200 lb. (14 kg.) Pressures higher than 200 lb. are not required and only cause unnecessary stress of the oil piping. The quantity of oil being burned is regulated by varying the pressure from 60 lb. up to 200 lb. If more oil is required than can be obtained at the higher pressure, it is necessary to change the nozzles, using tips with larger orifices. If less oil is needed than passes through the burners at 60 lb. pressure, it is necessary to shut off some of the burners.

A temperature of at least 150 deg. F. (66 deg. C.) is required to atomize the oil properly. The atomization is improved by increasing the temperature up to about 200 deg. Above this temperature no change is made in the atomization but the flame becomes shorter and the combustion occurs closer to the burner as the oil is heated to a higher temperature. As the oil is heated the first effect is to reduce its viscosity resulting in a greater quantity of oil passing through the burner. At the higher temperatures, however, the increased temperature has little effect on the viscosity but owing to the increased volume of the oil the capacity of the burner is reduced.

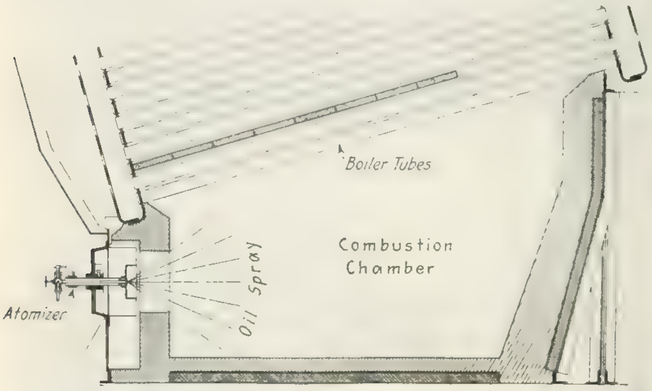
The following table gives the quantity of oil that will flow through a burner having a $\frac{1}{16}$-in. (1.6-mm.) diameter orifice at a pressure of 200 lb. (14 kg.), the oil having a gravity of 20 deg. Bé. and a flash point of 220 deg. F. (105 deg. C.):

Temperature (deg. Fahr.)	Pounds Oil Per Hour	Remarks
60	340	No atomization.
110	440	Bad sparking.
153	375	Atomization good.
210	330	Flame white and short.
260	300	Flame shorter.
304	273	Flame 2 ft. long.

The principal advantage of the mechanical atomizing system is that a large quantity of oil can be burned in a furnace of a given volume.

The steam atomizing burner as applied to stationary boilers produces a flat flame and the combustion occurs on the upper and lower surfaces of this flame, with the result that a considerable proportion of the volume of the furnace is not made use of.

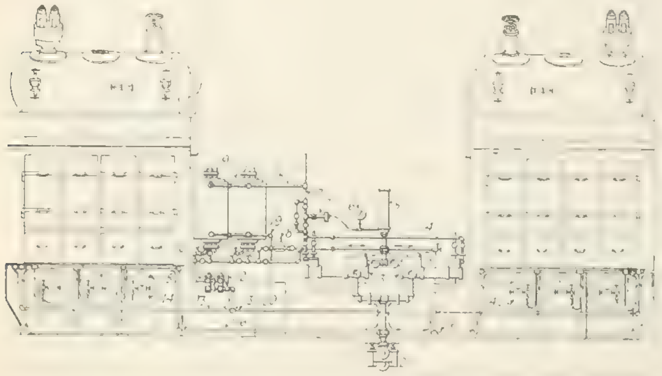
With the mechanical atomizing burner, on the other hand, there is what may be called volume combustion, the mixture of air and gases occurring throughout the entire furnace. It is, therefore, possible to completely burn more oil in a given size of furnace by this method than by the steam atomizing method, or if the same quantity of oil is burned in both cases the combustion with the mechanical atomizing system will be more complete in the furnace proper, so that the flame will not travel so far among the boiler tubes and the entire efficiency of the boiler will be greater.



OIL-BURNING FRONT FOR WATER-TUBE BOILERS, SHOWING CONICAL-SHAPED FLAME OBTAINED WITH MECHANICAL ATOMIZATION

The cooling of the gases by their contact with the boiler tubes before the combustion is completed is one of the principal causes of low efficiency in boilers that are forced up to high capacities, and any method of combustion that prevents this tends to improve the efficiency of the boiler.

The mechanical atomizing system also saves the steam that is used in the steam atomizing system, which often amounts to 3 per cent or 4 per cent of the total steam generated. While some steam is required in the mechanical system for heating the oil up to the higher temperature and for pumping it to the higher pressure, the condensation or exhaust from this steam returns to the feed-water heater so that the quantity utilized is not great. The loss of the steam used by the steam atomizing burner is of much greater importance for marine boilers than for stationary boilers, because it means a loss of fresh water as well as a loss of steam. It is for this reason that mechanical atomizing burners have already largely displaced steam atomizing burners on board ship.



ARRANGEMENT OF MOORE SHIPBUILDING COMPANY'S OIL-BURNING SYSTEM FOR WATER-TUBE BOILERS, SHOWING TYPICAL LAYOUT AND ACCESSORIES INVOLVED IN MECHANICAL ATOMIZATION

The principal disadvantage of the mechanical atomizing burner is that there is always a tendency for the small orifice in the burner to choke up. This is due sometimes to grit and other solids in the oil which pass through the strainers and sometimes to carbonization on account of the flame occurring close to the nozzle. To overcome this difficulty it is necessary in some cases merely to slacken back the feed screw of the burner and then readjust it and in some cases to turn off the oil altogether and blow steam through the burner. Whenever the fire is burning one-sided sparking on one side or showing black streaks it is a sign that the burner needs cleaning. As the number of burners required for mechanical atomization is much greater than for steam atomization, this difficulty means a good deal of careful attention on the part of the operator. With steam atomizing three burners are sufficient to operate a large 800-hp. boiler, whereas a boiler of the same size would require ten or twelve mechanical atomizing burners.

Another objection to mechanical atomizing burners for stationary power-plant work is the fact that the air supply for each burner must be adjusted separately every time there is a change in the quantity of oil burned. This is not objectionable where there is a steady load, as on board ship, but in a stationary power plant where the load is changing continuously a continual adjustment of the air supply would mean constant attention on the part of the fireman.

Notwithstanding these objections, it seems probable that the mechanical atomizing system will be introduced to some extent in stationary work, especially where it is essential to operate the boilers to very high capacities.

Prompt Payment Discount Eliminated

INSTEAD of giving its customers a discount for paying their bills promptly, the Springfield (Mo.) Gas & Electric Company tells them that they become delinquent if the bill is not paid within ten days. This policy, which was inaugurated about a year ago, has proved profitable to the company and appears to be satisfactory to its customers. The company has saved the discount and reduced the amount of its bad debts.

No prompt-payment discount was given during the greater part of 1919, and in that year the bad debts which had to be written off the company's books amounted to 0.44 per cent of the gross revenue. This was less than half the loss sustained in the best year in which a discount was allowed. In 1916 the bad debts amounted to 1.5 per cent, in 1917 to 1.81 per cent, and in 1918 to 1.03 per cent. A discount was allowed during each of these three years.

The change was made at a time when the people had plenty of money, and now the new system is so firmly established that no future difficulties are anticipated. If a customer does not pay his bill a notice is sent out at the end of fifteen days. If necessary, two other notices are sent at intervals of two or three days, after which the service is cut off.

Protect Workmen by Inclosing Switches

Records Show That Exposed Switches Have Been Responsible for Many Accidents—Features of Typical Inclosed Switches Discussed—Rules Regulating Use of Switches Show Wide Variation

By A. WALDSCHMIDT
Assistant Physicist Bureau of Standards

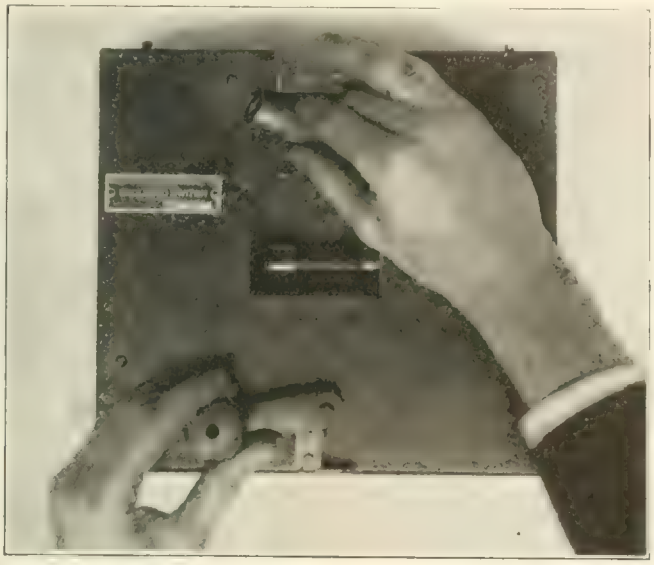
RECORDS show that exposed parts of switches have been responsible for many accidents. The reasons are clear since the greatest number of exposed parts are to be found at switches, and switches are handled more by the unqualified employees than any other type of apparatus having unprotected parts. There are also to be considered fuses and fuse terminals, usually found combined with switches, but sometimes separated therefrom, which are frequently handled by unqualified persons in renewing blown fuses.

Some far-seeing managers of industrial plants who believe in efficiency, maximum production and the welfare of employees provided the necessary safeguards for their equipment long before any mandatory rules required safeguarding. Manufacturers of safety inclosed switches are to be commended for their efforts in developing safety switches to meet the increasing demand and varying conditions of service.

The conditions under which switches and fuses are used have suggested three types of persons to be protected. First there is the ordinary worker, second the authorized operator, and third the qualified attendant. Conditions under which switches are installed vary greatly, and the type of protection to provide depends largely on these conditions. In a small industrial plant the authorized and qualified workers may be predominant in numbers, while in many occupations the ordinary worker may predominate. It is therefore clear that service conditions should dictate what type of protection is proper.

The ordinary worker has to be protected from contact with live parts in passing by a switch. He must also be protected against short-circuiting the switch with metal bars or pipes which he may be carrying. This may be accomplished by the ordinary inclosure without necessarily employing the externally operable feature. The cabinets must be kept locked to exclude the ordinary worker. Where such employees are expected to operate switches at times and also to renew fuses one of the higher degrees of protection is necessary.

For the authorized operator protection should be provided against contact with live parts during ordinary operation of the switch and also against contact with live parts in renewing fuses. Both external operation and automatic disconnection of fuses should be provided in this case. Qualified operators are supposed to be familiar with the hazards involved and with the construction and operation of the apparatus, so that a less degree of protection is necessary. Frequently all three classes of workers are involved in operating one installation, in which case the higher degrees of protection are desirable.


WITH HIGH-PRICED LABOR PROTECTION HAS BECOME A SOUND ECONOMIC POLICY

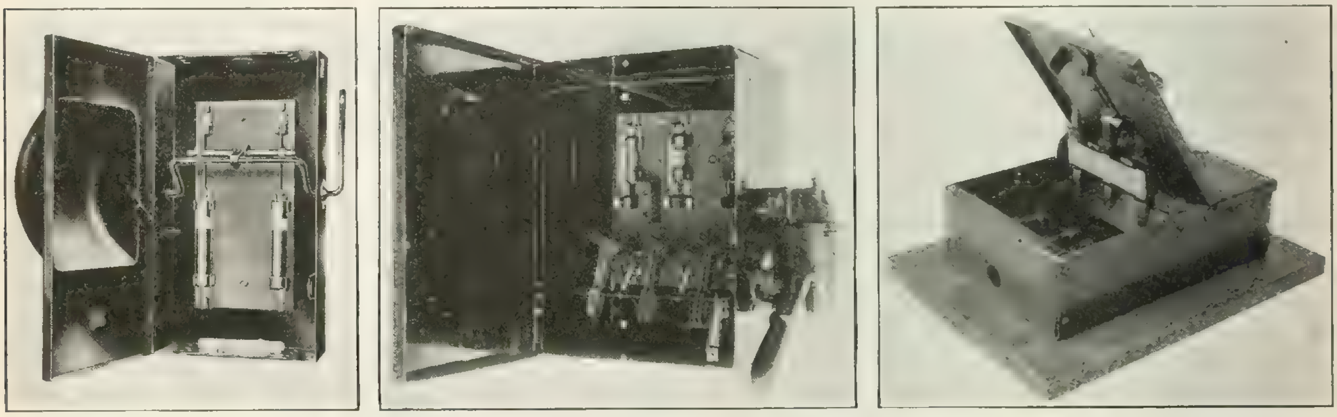
The knife switch remained unprotected until the absolute necessity for protection created a demand on the manufacturer for the development of different types to meet various conditions of service. There are at present available several distinct types of inclosed switches embodying different degrees of protection. The first but most meager type of protection is that characterizing the ordinary knife switch, either fused or unfused, inclosed in an iron or steel cabinet. Protection against short circuits and fire caused by accidental contact with conducting materials handled in the vicinity is afforded by this type of inclosure. The operator, however, is not protected against shock or burns due to coming in contact with live parts of the switch and the grounded metal of the cabinet. The presence of live parts of an ordinary knife switch in a grounded metal cabinet is a greater hazard as regards shock than inheres in those parts not inclosed in a metal cabinet.

The second type of protected knife switch may be referred to as the externally operated type. It is inclosed in an iron or steel cabinet having a handle on the outside of the case by which the switch may be operated without opening the case. This kind of switch is not only protected against accidental short circuits caused by bars of metal and similar material handled in the vicinity but it also protects the operator from contact with live parts. A commendable degree of protection is afforded by this type, especially where kept locked so as to exclude ordinary workers.

A third type is also externally operated but is combined with fuses and provided with an interlocking arrangement which does not permit opening the door of the inclosure when the switch is in the "on" position or closing the switch when its door is open. If properly connected so that the fuses are dead when the switch is in the "off" position a certain degree of protection is afforded to the person renewing fuses. But in this type of fused switch there are some parts alive with which the person may accidentally come in contact. The probability of this is, however, somewhat remote, though the switch is not absolutely foolproof.

The fourth type of switch affords a greater degree of safety than the previous one, and it is always fused. It is capable of external operation and is so interlocked that fuses are dead before they can be handled, and, moreover, there are absolutely no live parts exposed to the operator or the person renewing fuses. It is more nearly foolproof than the previous types and more desirable in places where fuse renewals are made by the ordinary or unqualified employee.

In all of the above-mentioned switches wrong connections are possible. If the wireman does not connect the switch properly, the fuses will be alive at all times and therefore the most important element of safety—namely, safety to persons renewing fuses—is lost. A fifth type which may be mentioned is really foolproof. It is capable of external operation and is so interlocked that fuses are dead before they can be handled, and there are no live parts exposed to the operator or the person renewing fuses; nor can it be wrongly connected as can the previous types so that some parts will be alive.



TYPICAL EXAMPLE OF DEVELOPMENTS IN SAFETY SWITCHES

The selection of a type is dependent on operating conditions. Where only qualified operators have access to the switches and fuses very little protection is required because they recognize the hazard. In the case of ordinary workers changing fuses, however, a type in which fuses are "dead" and no live parts exposed is a desirable feature.

Some administrative and inspection authorities have advocated rules requiring the inclosure of live parts of switches and cut-outs. However, a consideration of these rules has indicated a lack of uniformity. It would seem that uniform rules could be formulated that would be equally applicable in all States and municipalities. A review of several of these existing rules, compared with the equivalent rules contained in the National Electrical Safety Code promulgated by the Bureau of Standards, might suggest improvements in the matter of uniformity. Below is indicated the substance of these rules as advanced by various administrative or inspection departments in what might be termed representative territories:

City of Detroit.—All knife switches except on approved switchboards under constant supervision of a competent electrican must be approved safety inclosed type designed to be operated from the outside of the inclosure and can be locked in the open position.

Safety inclosed switches must be so marked as to indicate without opening the inclosure whether switches are closed or open.

All distribution panels with switches must be approved safety design so constructed and installed that no live metal will be exposed and that the fuses, if fuses are used, will not be alive when switches are open; except in double-throw switches for alternating-current motor starting and running, switches must be so constructed and installed that the blades will not be alive when in the open position.

City of Chicago (in effect Jan. 1, 1920).—Knife switches, except on panelboards and switchboards, must be of the safety inclosed type. Safety inclosed switches must be of an approved design and arranged to be operated from the outside of the inclosure. They shall be so marked as to indicate without opening the inclosure whether the switch is in the "on" or "off" position. They shall be so constructed that fuses, if used, will be dead when the switch is open; and except in the case of double-throw switches and alternating-current motor starting switches designed for running and starting positions, they must be so constructed and installed that the blades of switch will be dead when the switch is in the open position. If in order to comply with the above the incoming wires must be connected to certain terminals, such terminals must be marked "line."

California Industrial Accident Commission.—All manual switches shall have suitable casings or guards protecting the operator from danger of contact with current-carrying parts, effective during ordinary operation,, except for switches or circuits not exceeding 150 volts to ground which are not located in permanently damp places or where local conditions entail a particular hazard.

Pennsylvania Department of Labor and Industry.—Exactly the same as the National Electrical Safety Code to be discussed below.

Wisconsin Industrial Accident Commission.—Recommends same provisions as National Electrical Safety Code.

Hydro-Electric Power Commission, Ontario.—All live parts of service equipment, including cut-outs, switches and meters, must be so protected that accidental contact therewith will be effectually prevented.

Great Britain, Home Office Regulations for Factories and Workshops.—Every switch, switch fuse, circuit breaker, and isolating link shall be: (a) so constructed, placed or protected as to prevent danger; (b) so constructed and adjusted as accurately to make and maintain good contact; (c) provided with an efficient handle or other means of working, insulated from the system, and so arranged that the hand cannot inadvertently touch live metal; (d) so constructed or arranged that it cannot accidentally fall or move into contact when left out of contact.

The problem of guarding current-carrying parts presents itself in two aspects, and any proposed rulings should be considered from this point of view. In the first place, persons are to be protected during the operation of turning switches on and off; in the second place, they are to be protected during the act of removing fuses. In other words, in the first case switches only are involved, and in the second combined switches and fuses. The National Electrical Safety Code covers the subject in the following quoted rules:

327a.—All manual switches, except switches under 150 volts to ground and limited by cut-outs to 60 amp., shall have suitable casings or guards protecting the operator from danger of contact with current-carrying parts, or shall be provided with insulating handles and suitable insulating guard disks or shields so arranged between the handles and live parts as to prevent the hand from slipping into contact with live parts or being burned by arcing at the switches.

b.—Current carrying parts of switches or automatic cut-outs operating at over 150 volts to ground shall be provided with inclosing guards, effective during ordinary operation if accessible to other than properly qualified persons.

c.—Where switches or cut-outs above 150 volts to ground are not guarded during ordinary operation suitable insulating floor mats or platforms shall be provided on which the operator must stand while operating the switches or adjusting automatic cut-outs, and (unless operators invariably wear suitable insulating gloves while handling the switches) any conducting walls or machine frames within 3.5 ft. shall be provided with suitable insulating guards.

d.—Switches shall, if practicable, be so connected as to have no live blades exposed to contact when a switch is open.

324a.—Fusible cut-outs in circuits operating at over 150 volts to ground shall, if practicable, where accessible to others than qualified electrical attendants, be so arranged that the ungrounded current-carrying parts cannot be touched by persons re-fusing the cut-out until such parts are disconnected from all sources of electrical energy. Where the circuit voltage exceeds 300 to ground, this arrangement shall always be made. It is recommended that this protection also be provided for fusible cut-outs operating below 150 volts to ground.

An analysis of the above Safety Code rules would indicate that the open switch, while ordinarily undesirable, is still permissible on circuits up to 150 volts to ground; but whenever the switches are fused above 60 amp., guard disks or other shields should be provided to protect the operator from burns and from contact with live parts. On voltages above 150 to ground it has been found proper to provide externally operable switches where otherwise accessible to ordinary persons.

When, however, switches above 150 volts are accessible only to a qualified attendant and others are excluded, they need not be externally operable but may be placed in ordinary locked cabinets. But at the same time any conducting floors should be provided with insulating platforms or mats. In general it is to be noted that the Safety Code rules permit of alternatives, recognize different degrees of hazard, and also differentiate between operating the switch and renewing fuses, both of which have some hazards in common, but for which different types of protection are required.

There is a strong sentiment in favor of including in the National Electrical (Fire) Code a rule requiring that in all future installations service switches be of externally operated type. The desirability of also including a similar rule to cover other types of control switches has been indicated.

Many industrial plants have installed at least some one of the five types of protection mentioned. Where 110 volts is used as the distribution voltage, the first type of protection—namely, mere inclosure of the ordinary knife switch in a metal cabinet—is provided in many industrial plants. While this type of protection prevents accidental contact by passers-by and short circuits from bars of metal handled in the vicinity, it does not protect the operator from shock and possible burns. However, the danger from shock on the lower voltages is not extremely great. But where voltages such as 220 or 440 are concerned the mere inclosure of knife switches in grounded metal cabinets is an extreme hazard that should not go unchallenged. The second type of protection—namely, an externally operated switch—offers a commendable degree of protection where the doors of the cabinets are kept locked to exclude unauthorized or unqualified persons. Locking of doors so as to exclude certain persons from replacing fuses or tampering with the switches has worked out well in actual practice. The third and fourth degrees of protection are provided in many industrial plants, even on the lower voltages, and these permit of the fuses being renewed by an ordinary employee as all current-carrying parts are dead when handled by such persons. Many electric service companies are providing service switches embodying this fourth type of protection. It not only protects their customers from shock and therefore the company from litigation, but it also prevents the theft of energy and therefore a loss of revenue to the company. In some of the larger cities of this country each and every service switch and fuse is of such type.

There are other minor safety features which are sometimes included in the inclosed switches now available. Many are provided with quick-break mechanism, thus preventing arcing, and this is specially desirable where the switch cannot be inspected in the closed position. Another safety feature is the providing of a grounding lug on the metal inclosures. This encourages grounding of the cases, which is particularly desirable where the switches are used on circuits above 150 volts to ground. Locking arrangements are also desirable and necessary and are usually provided by the manufacturer. The marking of the "on" and "off" positions is important and is almost always provided. For motor-starting switches no-voltage trips are sometimes embodied in the switches.

Estimated Cost of 2,500-Kw. Hydro-Electric Development

A TOTAL cost of $181 per kilowatt was estimated for a New England hydro-electric plant now under construction having two 1,250-kw., 13,200-volt, three-phase, 60-cycle generators directly connected to two 1,500-hp. water wheels. The design includes provision in the building for a third similar unit to be installed later. The dam consists of a concrete core wall and earth fill, with concrete spillway and headworks, water being taken to the power house through a 78-in. (198-cm.) wood-stave pipe line about 8,000 ft. (2.4 km.) long. The approximate head on the wheels is 175 ft. (53.5 m.) In building the plant the size of generating unit was slightly modified and the plant location was changed by a few hundred feet on account of reservoir location difficulties, but the itemized estimate for the original design shown herewith is indicative of the present costs.

ESTIMATED COST OF DEVELOPING 2,500-KW HYDRO-ELECTRIC SITE

Dam, headgates, racks, etc.	$127,500
Penstock, 78-in. wooden	120,000
Power-station building and fixtures (brick and concrete)	30,000
Waterwheels with governors and relief valves	36,000
Generators and exciters	24,000
Switchboard and wiring	9,000
Transformers	10,000
Transmission line connections	1,000
Total	$357,500
Contingencies, 10 per cent	35,750
Total structural cost	$393,250
Interest during construction, organization, legal expenses, taxes and insurance during construction; 15 per cent	59,987
Total ($181 per kw.)	$453,237

Readers' Views and Comments

Field Testing of Instrument Transformers

To the Editor of the ELECTRICAL WORLD:

SIR: In the first part of the article on "Field Testing of Instrument Transformers," which appeared in the ELECTRICAL WORLD for Feb. 7, I described a method of calibrating standard current transformers and referred to it as new. At the time of publication I believed it to have originated at the standards laboratory of the University of Wisconsin in August, 1917, but within the last week my attention has been called to a previous publication. As a result I wish to make a correction.

In 1916 Otto A. Knopp proposed substantially this same method. His method is the same in that the current transformer ratio is reduced to unity and two watt-hour meters are used to compare primary and secondary currents. It differs in that he suggests the use of two service watt-hour meters in which the speeds have been specially adjusted and which have been provided with a mirror system for counting revolutions, instead of the more usual Agnew arrangement in which two standard watt-hour meters are used. Mr. Knopp's proposal appeared in the ELECTRICAL WORLD, Vol. 67, page 92 (1916), and in the *N. E. L. A. Bulletin* for November, 1916.

Madison, Wis. H. M. CROTHERS.

State Lines and Power Supply

To the Editor of the ELECTRICAL WORLD:

SIR: There is no economic reason why the mere existence of a state boundary line should limit the supply of energy in either direction. The policy of non-exportation may be as great a mistake as sweeping inhibitions upon bringing energy into a state by an independent system. There is little doubt, for instance, that without permitting power exportation the State of Vermont would be unable to secure its present energy supply at anything like the present figures. Through the sale of energy generated locally for distant markets, standards of production and distribution have become established which make for minimum power cost within the localities in Vermont in electrical touch with the exporting plant. It would be well for the people of Maine to ponder this.

The Connecticut case outlined in the March 6 issue of the ELECTRICAL WORLD, page 568, whereby an industrial concern was denied permission by the commission to build a transmission line to the state border for power importation will probably be appealed. The decision reinforces the right of a local company (the central station covering the district) to retain its hold upon the field, and so long as community power requirements are properly met by an established company there is much to be said on its side. If, however, a local central station, as in the celebrated Fitchburg and Worcester cases against the New England Power Company before the Massachusetts commission, is not at a given time ready to undertake to supply so-called large power customers, either directly or through purchase and resale of energy from outside, the situation becomes, or may become, acute. It is of the utmost importance that a suitable working arrangement be entered into if possible, with profit to all the utilities concerned. The mere existence of the state line, as was stated above, should have no significance in the ultimate satisfactory supply of energy to a territory at the lowest cost to its residents and business establishments consistent with a fair return upon the total expense of supply. It may be pointed out also that the immediate clarification of local resources is of pressing importance with hydro-electric energy knocking at the northern door of the state.

Boston, Mass. H. S. CLARK.

Position of the Small Manufacturer

To the Editor of the ELECTRICAL WORLD:

SIR: I have read the interesting article in the ELECTRICAL WORLD for March 13, page 630, on the unequal price level. I agree with you in your views regarding the situation except that I have my doubts about the wholesale cancellations. As long as the demand continues the stress of business will continue, and the demand will continue as long as the working people keep buying.

The workers, especially the skilled workers, are making more money than they ever have made, and they are spending it. You will notice them buying silk shirts, high-priced shoes, pianos, victrolas. Their wives and daughters are wearing furs and expensive hats and so on. Until the skilled worker reaches the point where he has had enough of luxury the demand will continue, and, as you know, this demand runs in a circle and so is felt finally in the electrical industry. Personally, I feel that the drop will be slow and gradual. Prices will decline slowly and wages still more slowly. This is just my own view, of course.

There seems to me to be another reason besides the one suggested why the larger motor industries did not advance their prices. During the war they increased their capacity for production to anywhere from two to twelve times that of the pre-war period. Right after the close of the war business dropped off, causing a considerable reduction in production. With the present increased production it has taken the larger companies with their increased facilities a longer time to load up to their maximum production than it has the smaller concerns.

Since the great war, during which he proved his worth and came into his own, the smaller manufacturer is more respected, is better known and has shown the buyers that his apparatus is equal to and in many cases better than that of the bigger concerns. With this improved prestige he can and does meet his larger competitor on an equal basis of price and can obtain the same interest from the buyer.

The buyers now realize that the smaller manufacturer fitted into an emergency during the period of war profits when the larger companies threw them over, and now with the rush of business the buyers are giving him the same opportunity as he had during the war. Whether they will remember the smaller concerns as the ones which helped them out and will continue to let them meet the big competitor on an equal basis when normal business conditions return remains to be seen.

E. F. LE NOIR,
Union Electric Manufacturing Company, Milwaukee.

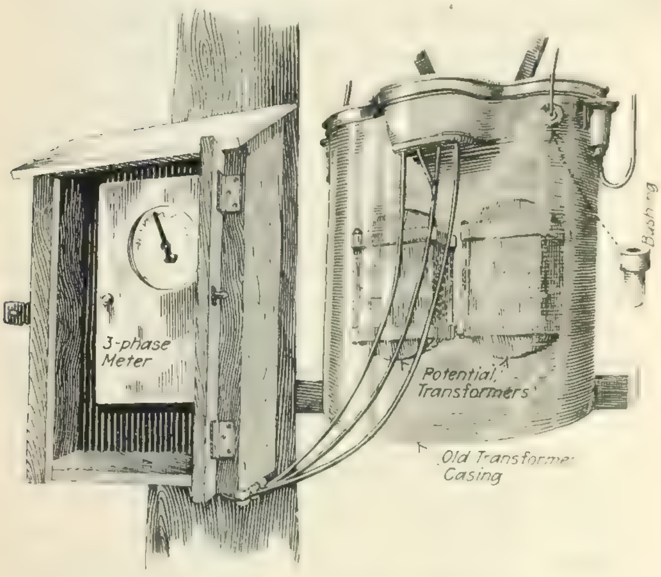
Station and Operating Practice

A Department Devoted to Problems of Installation,
Operation and Maintenance of Equipment for Economical Generation and
Distribution of Electrical Energy

Instrument Transformers Mounted in Old Transformer Case

INSTRUMENT transformers are protected from the weather and accidental contact with high-voltage leads is guarded against in outdoor substations built by a company in Pennsylvania by mounting the instrument transformers in a discarded distribution transformer case. The case is hung from a cross-arm so arranged that the low-potential leads can be connected directly to the meter mounted in a wooden box next to the transformer. The meter was mounted outdoors to be near the electric furnace load and several nearby industrial plants which this substation serves. L. H. RAWSON.

Pittsburgh, Pa.



TRANSFORMER CASE HUNG FROM CROSS-ARM ON POLE PROTECTS INSTRUMENT TRANSFORMERS

Breakage Offsets Saving on Lamps Operated Below Rating

WITH a low energy cost it may be economical to burn lamps below normal rating in order to save renewal costs through the added life of the lamp. However, in some cases another element—that of accidental breakage—may greatly offset the saving. Such was the experience of the Department of Electricity, Chicago. The cost of energy generated by the Sanitary District for this department is very low—0.44 cent per kilowatt-hour in 1918—therefore on certain street-lighting circuits it was decided to operate a 900-cp. lamp at 10 amp., which will give about 600 cp. when so operated, in place of a 600-cp., 10-amp. lamp operated normally. By exterpolating the life curve of the 900-cp. lamp a life of 7,000 hours was expected against a 2,200-hour life with the normally operated lamp. However, the actual life obtained averaged only 3,000 hours. The cause of this was a much greater amount of breakage than was thought to exist. These circuits pass through outlying districts of the city near railroad tracks and rock piles where missiles are handy for small boys to throw. It was found that five and six and even more replacements per year were made in some sections. In the worst sections it was necessary to replace the diffusing globes with steel screens of 0.094-in. (2.4-mm.) wire with 1-in. (2.5-cm.) meshes. These have practically stopped breakage where they were installed.

Another cause of breakage is lowering the lamps for cleaning. The lowering apparatus employed was that formerly used for arc lamps which have been replaced by the incandescent lamps. Although the apparatus is of the best available design, it sometimes sticks. The cleaner, who is often careless and who must clean fifty lamps a day, jerks the fixture and often breaks the filament. As many as twenty or thirty lamps have been found broken on a circuit after a careless cleaner has been over it. The apparatus is being discarded as rapidly as possible and the posts are being stepped. It was found that a workman cleaned a lamp in nine minutes by climbing the pole, which compares with seven minutes when lowering apparatus is used, provided that the apparatus does not stick. In some cases lamps have been left uncleaned on account of persistent sticking.

Henry Nixon, Deputy Commissioner of Gas and Electricity, Chicago, presented the foregoing facts before a recent meeting of the Chicago (Ill.) Section of the Illuminating Engineering Society.

Compact Kit for Testing a Wide Range of Relays

FOR testing alternating-current relays with ratings ranging up to 125 amp. on 60 cycles or 25 cycles, a compact, portable kit has been developed by the testing department of the Commonwealth Edison Company, Chicago. The entire apparatus exclusive of a cycle counter is contained in a box about 30 in. (75 cm.) long, 12 in. (40 cm.) wide and 24 in. (60 cm.) high. A switch panel is mounted at the top of the box, where all meter connections are made and switching is done. A hinged cover fits over this panel so that when open it serves as a holder for an ammeter and a cycle counter. The box is fitted with casters and has a handle on each end. There are two drawers in one side of the box for carrying small tools, notebooks, etc.

In each end at the bottom of the box is a revolving reel which holds 100 ft. (30 m.) of No. 12 lamp cord for leads to the source of supply and 50 ft. (15 m.) of connections for the relay being tested. A detachable crank carried in the drawers is used for reeling in the wire leads. Hinged doors cover the holes through which these wires are led.

A Thordarsen transformer about 9 in. by 11 in. by 10 in. (23 cm. by 28 cm. by 25 cm.) in size steps down the supply voltage from 120 volts or 240 volts to 60 volts on open circuit. The current through the relay is regulated by a specially wound reactance coil. Resistance units were formerly used for this purpose, but for the wide range of current they were necessarily very bulky. The laminated core for this reactance is U-shaped, 5½ in. (14 cm.) deep and 3½ in. (9 cm.) wide with a 1-in. (25-mm.) square cross-section at any point. Four coils of 120 turns each of No. 14 (2 sq.mm.) double-cotton-covered wire are mounted on a wooden frame so that they may slide over one arm of the core. A wooden block is fixed as an extension of this arm so that the coils may be removed from the core. The coils are taken on or off by means of a screw operated from the outside of the box with the same iron crank used on the reels. By means of switches (2) and (3) these coils may be connected in series, series-parallel or parallel, and they may be put on either the primary or the secondary side of the transformer by switch (4).

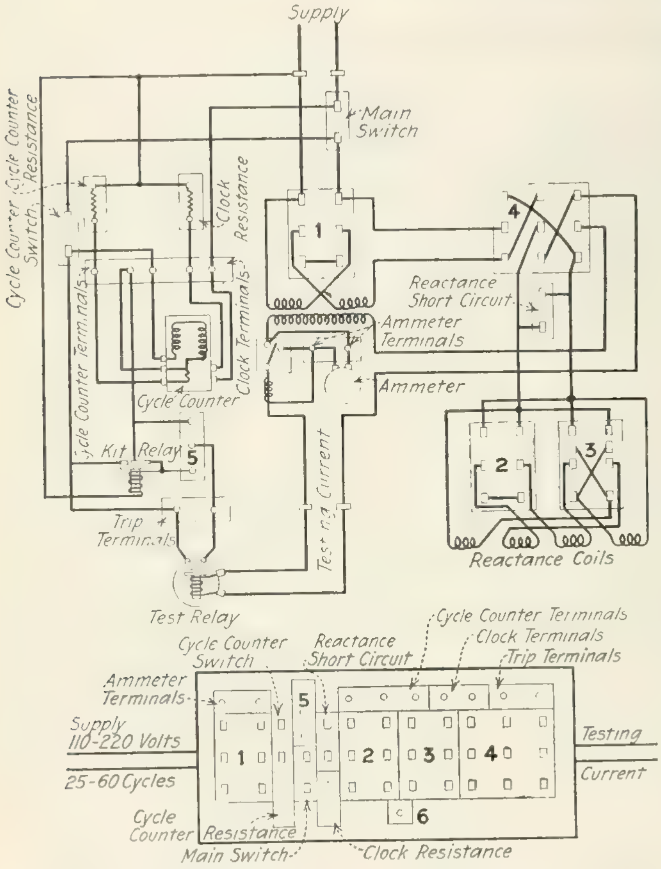


DIAGRAM OF SWITCH PANEL AND CONNECTIONS OF RELAY TEST KIT

Directions for changing connections: One up transformer coil in parallel; one down transformer coil in series; two and three down reactance coils in series; two up and three down reactance coils in series-parallel; two and three up reactance coils in parallel; four up reactance in primary; four down reactance in secondary; five up test relay stops cycle-counter directly; five down test relay operates kit relay; six up ammeter reads direct, and for six down multiply ammeter reading by 5. When using 220-volt supply remove links shorting cycle counter and clock resistances.

For measuring the current a 25-amp. meter is used. Above currents of 25 amp. a small current transformer (6) may be connected in the circuit, short-circuited when the meter is read directly. The ammeter is carried in a pocket at one end of the top of the box.

The Westinghouse cycle counter which is used to time the relays is connected to terminals on the panel. Resistances in series with the cycle counter for use with 240-volt circuits are short-circuited with removable links for 120-volt operation. The dial is calibrated to read directly in fractions of a second.

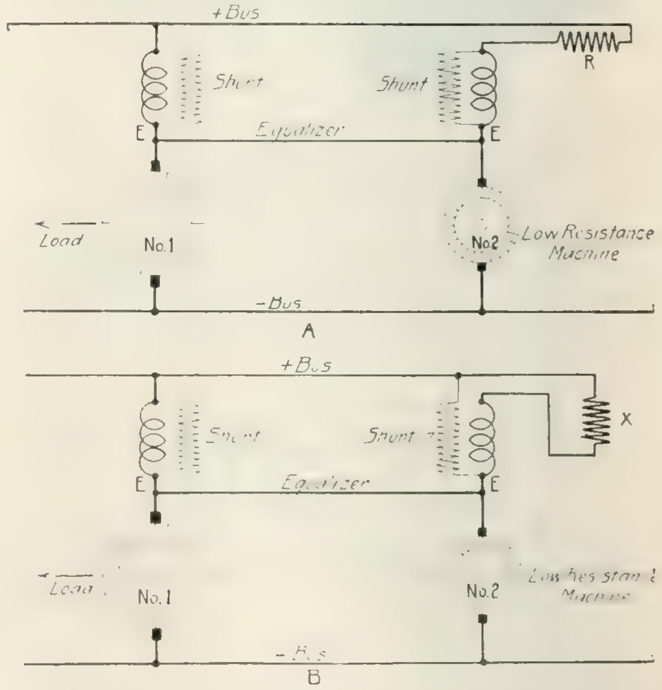
If the cycle-counter switch is in circuit, the counter begins to record when the main switch is closed and stops when the tested relay reaches the tripping point. Some relays, although they will trip an oil switch, do not maintain contact steady enough to short-circuit the cycle counter completely. Then the auxiliary kit relay must be connected in the circuit. This relay operates very rapidly (in less than one cycle) and holds itself in the tripping position after its plunger has once been raised.

All of this apparatus, excepting the two reels, is mounted on an iron frame, and the whole may be removed from the box intact for repair purposes.

Chicago, Ill. A. L. BROWNLEE.

Arrangement for Paralleling Dissimilar Direct-Current Generators

CONSIDERABLE difficulty was experienced in a certain plant in paralleling a 300-kw. turbine-driven direct-current generator running at 1,400 r.p.m. with three 300-kw. engine-type machines running about 120 r.p.m. Although the turbine unit was adjusted by a shunt to give flat compounding, when operated in parallel with the other machines it tended to seize all the load, and when the load dropped off the turbine-driven unit would drop all its load first and run as a motor. An investigation showed that the trouble was due to the fact that the series field of this unit was very much lower in resistance than the series field of the low-speed machines, and consequently a great deal of their current went to the board through the turbo-generator series field. Measurements showed that the resistance of the series copper alone was 0.0005 ohm for the turbine type and 0.002 ohm for the engine type.



TWO METHODS TO SECURE PARALLEL OPERATION OF DISSIMILAR GENERATORS

To cure this trouble either of two methods could be used. A resistance could be placed at *R* (diagram A) in series with the positive lead of the turbo-generator having such a value that the resistance from *E* to the positive bus would be equal for each unit, or a resistance could be placed in series with the series winding alone and the field shunt changed to the proper value. It was decided to use the latter method so a resistance of 0.0015 ohm was connected in series with the series field at *X* (diagram B), thus making the series resistance the same as that of the other units. Across the series field and the resistance *X* a shunt was installed of the same size as the shunts on the other machines. After this change very satisfactory parallel operation was obtained.

This problem will be met in cases where small high-speed machines of large output are parallel with large machines, and may arise also with motor-generators paralleled with engine-type machines. In any case, to correct the trouble, the resistance of the series circuits to the switchboard must be made inversely proportional to the ampere rating of the machines. For instance, if No. 1 machine is rated at 1,000 amp. and No. 2 at 250 amp., then the series field resistance of No. 2 must be four times that of No. 1. JAMES DIXON.

East Orange, N. J.

Periodic Inspection Saves Company $6,000 Per Year

PREVENTING breakdown of equipment by periodic inspection instead of repairing it is a practice that has saved one central-station company as much as $6,000 in one year. In the inspection systems of this country and others discussed at a recent meeting of the Empire State Gas & Electric Association the period between tests for transformer oil averages about six months. E. P. Peck, electrical engineer of the Utica Gas & Electric Company, when he was superintendent of operation, maintenance and tests with the Georgia Railway & Power Company, tested the oil in 110,000-volt transformers every three months, 66,000-volt to 11,000-volt transformers every six months and station transformers with voltages below 11,000 every year. W. C. Blackwood, electrical engineer of the New York & Queens Electric Light & Power Company, said that on account of poor ventilation the vault type of distribution transformers is sometimes tested yearly, although this is not necessary with the pole type of transformer. On taking the transformers from stock the bushings are tested and the windings are meggered in order to ascertain that the insulation has not deteriorated. Oil-switch contacts are inspected every three months by the Syracuse Lighting Company, according to D. C. Cox, while D. B. Taylor said that the Troy Gas & Electric Company inspects high-voltage switches for damaged contacts and excessive temperature every two weeks. Generators and rotaries which have been lying idle are customarily tested with a megger before starting. Mr. Peck said that he meggers reserve turbo-generators before placing in operation every two weeks even when they are operating. He also emphasized the necessity for an auxiliary trip for a steam turbine which operates in parallel with water-wheel generators, the purpose of this trip being to prevent overspeeding of the steam turbine when the waterwheels run above synchronism.

V. Poston pointed out the necessity for regularly testing generator and converter speed-limit relays and said that weekly tests were the practice of the New York & Queens Electric Light & Power Company. It is the practice of some companies, A. M. Perry of the ELECTRICAL WORLD said, to obtain from the manufacturers the maximum allowable hot-spot temperature of their equipment and, by means of temperature indicators connected to thermocouples therein, to limit the load on the machines according to actual temperature indicated rather than by nameplate rating. In examining rotary converters Mr. Peck thought particular attention should be paid to the nuts holding the squirrel cage. In the Georgia plants, of which he formerly had charge, the end shields of generators were removed for inspection every three months. The temperature of turbine bearings is noted hourly during operation, according to H. W. Morreall, Utica Gas & Electric Company.

To facilitate inspection Mr. Taylor recommended the truck-type switchboard. He stated that in a Pittsburgh company, where a 30,000-kw. board of this type is installed, an 11,000-volt panel can be changed in one and a half minutes. A different opinion was held by W. C. Pearce, superintendent Syracuse Lighting Company, who said he did not see the advantage of the truck-type board when a spare permanent board can be easily provided. Sydney Alling said that the Rochester Railway & Light Company has an arrangement for connecting feeders outside the station when feeder apparatus inside is to be inspected, so that a truck-type board would not add any advantages. Mr. Blackwood stated that this type of board is used by his company for high-tension customers' substations to permit standardization and provide safety.

Precaution Taken to Avoid Outage of Emergency-Circuit Lamps

ON THE ceiling above each emergency lamp in the power plant of the Louisville (Ky.) Gas & Electric Company is painted a red circle. This indicates that the fixture below it is on the emergency lighting circuits and reminds observers that outages must be remedied immediately.

Losses in 33,000-Volt Transmission Network

IN A 25-CYCLE transmission system in Missouri which includes 175 miles (105 km.) of 33,000-volt transmission lines and two transformations, the losses over a period of two years averaged about 9 per cent. The energy in this system is generated at 6,600 volts, stepped up to 33,000 volts through transformers aggregating 42,800 kva. and sold partly at this voltage and partly at 2,300 volts, the 33,000/2,300-volt transformers aggregating 27,500 kva. About 80 per cent of the transmission lines are of No. 0 (53.5 sq.mm.) hard-drawn copper, and the remainder are practically all of No. 4 (21.1 sq.mm.) hard-drawn. The losses of this company, the Empire District Electric Company, Joplin, Mo., between the 66,000-volt side of the step-up transformers and the delivery point are shown here for the two years:

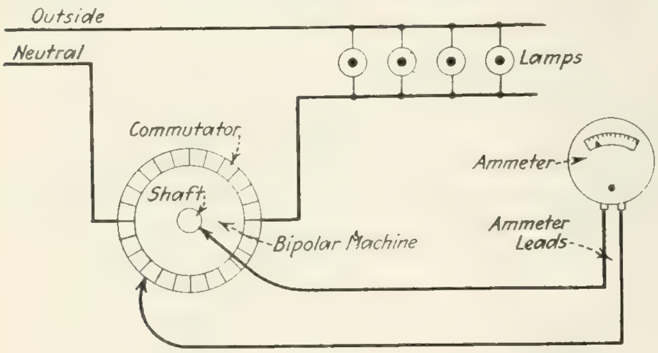
Annual Maximum Demand	Annual Load Factor	Average Loss, Per Cent	Lowest Monthly Loss, Per Cent	Highest Monthly Loss, Per Cent
23,500	57.5	8.56	6.84	10.12
24,300	51.5	9.53	7.56	11.48
Average— 23,900	54.5	9.05	7.20	10.80

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

Grounds on Direct-Current Machines Located with Ammeter

For locating grounds in the armature of direct-current machines without lifting the commutator leads a Long Island repair shop employs an ammeter in conjunction with current from a lighting circuit. Flexible leads as shown in the diagram are attached to the commutator with a bank of lamps in series with the leads and on the live leg of the direct-current system. If the bank is connected to the neutral wire, there is danger of short circuit should the rotor touch a grounded object. These leads are placed the same distance apart as adjacent brushes of the machine are normally spaced. Then one lead of an ammeter of sufficient size to carry the full lamp lead is attached to the motor shaft while the other lead is moved around the commutator. When the ammeter reading is lowest the lead is on the commutator bar to which the grounded coil is attached. In case the lowest reading occurs at two different points, the leads from the lamp bank must be shifted and more readings are then taken with the ammeter.



TESTING FOR GROUND WITH LAMP BANK AND AMMETER

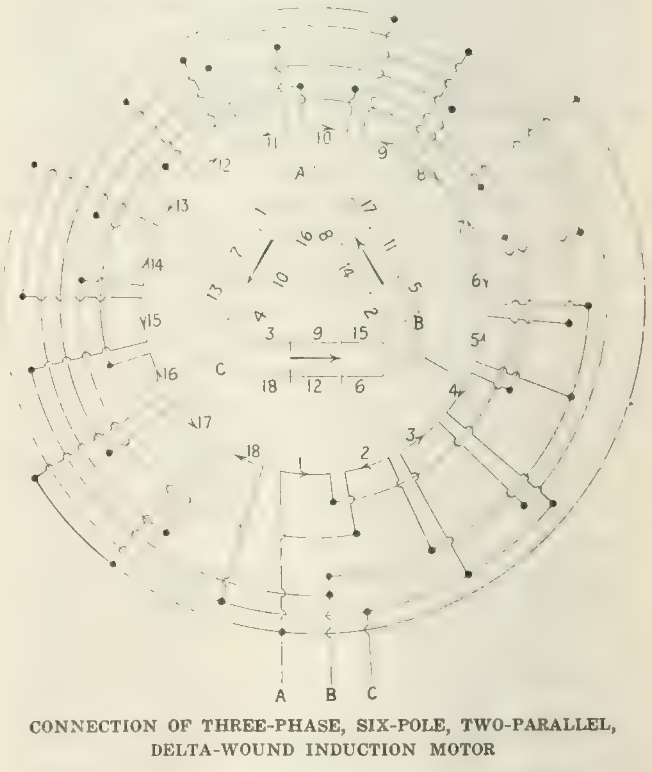
New York City, N. Y. **Theo. C. Katsigris.**

Rewinding 220-Volt Induction Motor for 110 Volts

A 25-HP., 220-volt, six-pole induction motor was recently sent to a New York repair shop for rewinding to operate on 110 volts. By changing the stator winding and the coil throw this was accomplished without altering the rotor. The machine was originally built to run 1,200 r.p.m. on three-phase, 60-cycle energy. There were seventy-two coils of five turns of 0.18-in. x 0.11-in. (4.6-mm x 2.8-mm.) single cotton-covered ribbon, laid with a pitch of one to twelve in the seventy-two slots and connected as shown in the diagram in two-parallel delta.

In rewinding for 110 volts the number of turns per phase should be reduced by one-half, provided that the same pitch was used, but as one-half of five gives two and one-half turns, an impossible condition, the number of turns had to be taken as either two or three. The latter value, three turns per coil, was chosen, and the chord factor was diminished by decreasing the pitch in order to make the voltage approximately 110 volts. To determine the correct pitch the formula $(5 \times 0.9914)/(3 \times P) = 220/110$ was used, in which 0.9914 is the chord factor for the five-turn coil, giving 220 volts, and P is the chord factor for the three-turn coil, giving 110 volts.

Solving this equation, it is found that $P = 0.8262$, which is the sine of about 55.5 deg., or 111/2 deg. But full pitch equals $72/6 = 12$, and the angle between slots is 180/12 deg., or 15 deg. Therefore $113/15 = 7.4$ slots is the proper span for 110 volts. The coils were consequently laid with a pitch of No. 1 to No. 8, spanning seven slots, which gives a chord factor of sine $(7 \times 15)/2$ deg. $= 0.793$, and a voltage of 105 volts. As this voltage is only about 5 per cent below normal and as modern motors are designed to operate with 10 per cent voltage variation, it was thought that the motor would operate satisfactorily if rewound with this pitch. Accordingly, it was wound with a pitch of one to eight with seventy-two coils of three turns of 0.18-in. x 0.2-in. (4.6-mm. x 5.1-mm.) double-cotton-covered ribbon and connected two-parallel delta as before.



CONNECTION OF THREE-PHASE, SIX-POLE, TWO-PARALLEL, DELTA-WOUND INDUCTION MOTOR

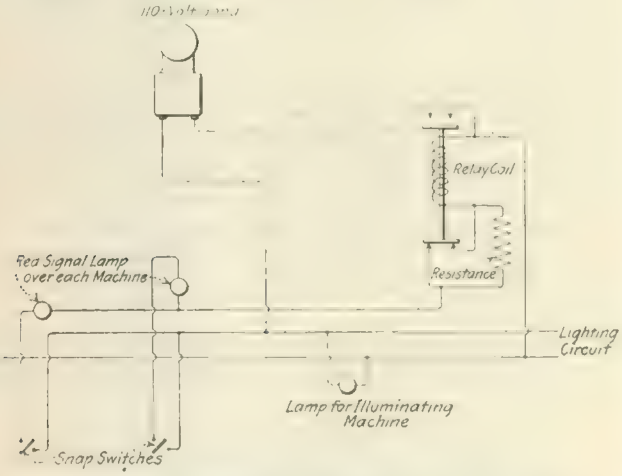
Diagram applies to motor wound for 220 volts and also to motor rewound for 110 volts. Number of turns per coil was decreased from five to three, pitch was decreased and wire size was doubled.

After reassembling, the motor was given a ten-hour load test and was found to run in a perfect manner.

New York City. **C. A. Johnson.**

Signal Lamp to Call Machinist in Composing Room

USUALLY when a linotype machine in a printing establishment is out of order the operator waits for the machinist to come past his machine rather than attempt to find him. This wastes time and tends to reduce shop production. A printing concern in the East has, therefore, installed a signaling system by which the linotype operator may give the machinist notice of a breakdown by simply pressing a switch button on the linotype. This rings a bell indicating that some machine is in need of attention, and it also closes the circuit to a red lamp mounted on the machine frame to indicate which machine is out of service.


110-Volt
Relay Coil
Red Signal Lamp over each Machine
Resistance
Lighting Circuit
Lamp for Illuminating Machine
Snap Switches

WHEN CIRCUIT IS CLOSED BELL RINGS AND SIGNAL SHOWS WHICH MACHINE NEEDS REPAIR

This installation was made at a very slight cost as the main illuminating circuit wires were utilized, thus necessitating only one additional wire for the signal lamps. The simultaneous operation of the bell and lamp is obtained in an interesting manner as shown in the diagram. When the switch is closed the lamp lights, but at the same time the relay is actuated so as to close the bell circuit. When the bell circuit is closed a resistance is automatically inserted in the relay coil circuit to prevent its overheating. L. C. HEFTNER.

New York, N. Y.

Residual Magnetism Causes Relay Armature to Stick

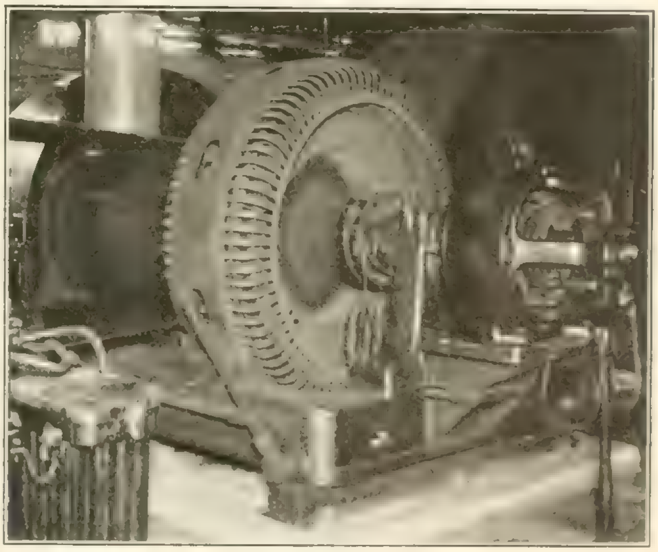
RESIDUAL magnetism holding the armature of a relay against the force of gravity was responsible for much trouble in the operation of an air compressor in North Carolina where the starting and stopping of the compressor was controlled by the reservoir pressure. This relay is the starting relay for a 25-hp. slip-ring induction motor which drives the compressor. The motor voltage is 2,200 volts and that of the control panel is 220 volts. By means of a pressure gage connected to the relay when the pressure rises to 40 lb. (2.8 kg.) the relay is energized and the armature is raised, thereby opening the control circuit and stopping the motor. The armature is held in this position until the pressure falls to 20 lb. (1.4 kg.) when the operation of the pressure gage breaks the circuit through the relay so that the armature should drop to start the motor again.

After a few weeks of operation of the plant it was found that sometimes the motor failed to start when the pressure fell below 20 lb. and the relay had to be tripped by hand. In attempting to remedy the trouble a new pressure gage was put in, but this did not improve the operation. After a bell had been connected to the gage so that it would ring when the pressure decreased below the limit, it was found that the gage worked perfectly but that the armature of the relay remained raised even when no current was flowing through the coil. The residual magnetism in the relay was sufficient to hold up the armature. The design of the coil was responsible for this, as the armature when raised pressed directly against a stationary iron core. A very simple remedy for the trouble was to attach a thin brass ring on top of the armature so that the two pieces of iron can not come into actual contact. Since this ring has been added no trouble from this source has been experienced.

Salisbury, N. C. J. H. ROBERTSON.

Synchronous Motor Saves $30,000 a Year in Refrigerating Plant

A SAVING of $30,000 a year has been effected for the Sheffield Farms Company, New York City, by replacing steam engines with a synchronous motor drive. This motor, a 500-hp. Westinghouse 440-volt machine, drives through a belt connection four 80-ton and one 12-ton ammonia compressor, two 14-in x 10-in. (35.6-cm. x 25.4-cm.) air compressors and two generators of 110 kw. and 125 kw. respectively. Although the installation is not well arranged for motor drive, the saving and increase in capacity have been large. The synchronous motor is better adapted to driving such a refrigerating plant than an induction motor because of its high efficiency, uniform speed and high power factor. The starting torque is small since by-passes are commonly used.

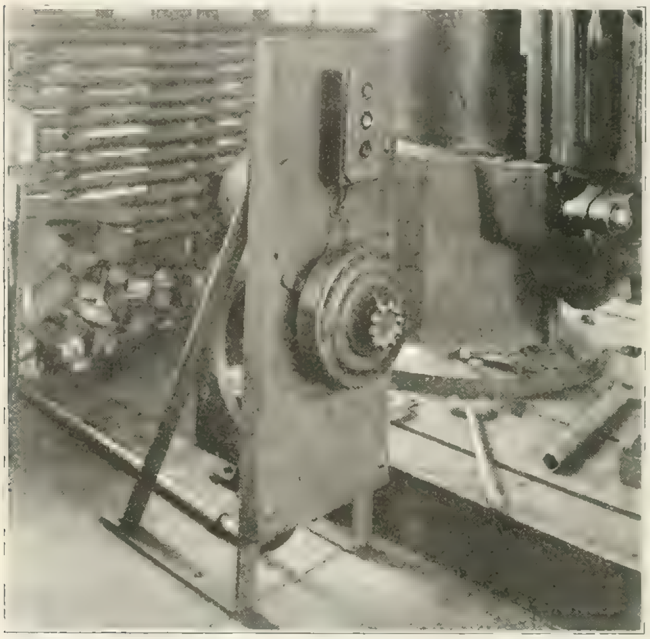


SYNCHRONOUS MOTOR-DRIVING COMPRESSOR HAS INCREASED EARNINGS IN THIS PLANT

A valuable feature of the installation is the curve-drawing meter which indicates immediately any change in load caused by trouble developing in the refrigerating machinery, such as worn parts, change in temperature of brine or water, etc. A variation in the recorded curve immediately shows that trouble is present.

Home-Made Floor Stand for Remote Control of Machine Tool

A CONVENIENT floor stand to hold the control buttons and speed-regulating rheostat of a 42-in. (107-cm.) Warren radial drill in the Chapman Valve Manufacturing Company shops was made by bolting a heavy pine slab to a strap-iron frame bolted to the concrete floor. This was a case where the control could not be mounted on the machine but where it should be convenient to the operator. So a switch box with the forward, reverse and stop buttons and a control rheostat are mounted on this 36-in. x 14-in. x 1¾-in. (92-cm. x 36-cm. x 4.5-cm.) slab near at hand. For fastening the frame of 2-in. x ⅜-in. (51-mm. x 9.5-mm.) iron to the floor 0.5-in. (1.3-cm.) bolts are screwed into lead-lined holes. This lead lining is made by fastening an oiled bolt upright in the hole which has been drilled in the floor and pouring molten lead into the hole around the bolt. As soon as the lead cools the bolt is withdrawn by unscrewing and this lead screw-hole forms a good anchor for holding the frame. There was no trouble encountered from shrinking of the lead in cooling.



MOTOR CONTROL NEAR MACHINE

Indian Orchard, Mass. **Walter B. Atchinson.**

Testing Contact of Knife-Switch Blades

IN ORDER to be assured that the blades of switches make good contact with the jaws, a "feeler" is sometimes used. This device can consist of any thin. hard material, but usually a piece of mica, about ⅜ in. (9.6 mm.) wide and a couple of inches long, is satisfactory. A very thin piece of sheet steel will also serve. The feeler should be about 0.003 in. (0.76 mm.) thick.

To use the tool, insert it between the jaws and the blades at different points. At locations where it can be pushed in readily the contact is poor. Such difficulties may be corrected by light hammer blows on the jaws. The blade should always be "ground in" to insure good contact between it and the break jaws.

Denver, Col. **H. J. Wade.**

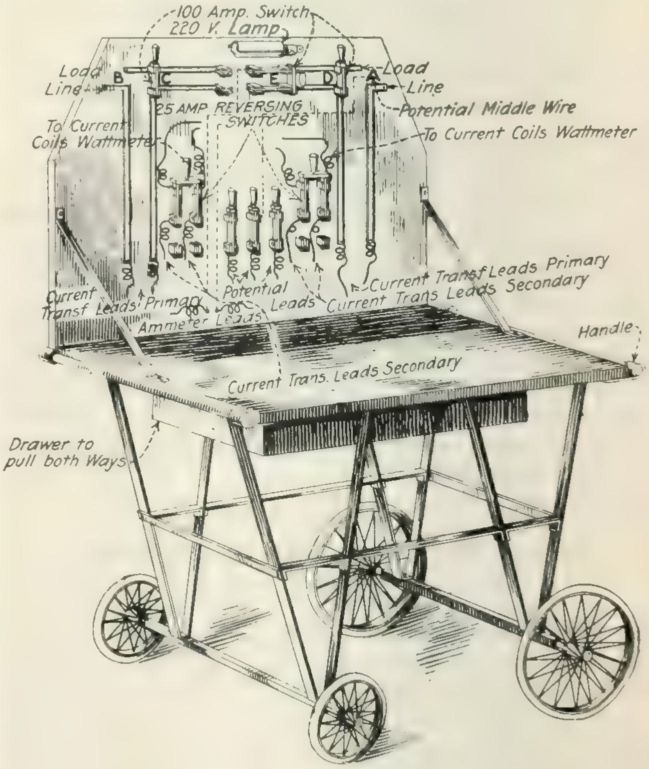
Portable Testing Table for Industrial Plant

IT IS very essential to know the conditions under which motors are operating, particularly if machines are of special design. Various methods and apparatus have been developed to help in determining these conditions.

The portable testing table shown in the accompanying illustration has been used by the writer eight years and has been found very satisfactory. This table, with current transformers, polyphase wattmeter, ammeter and voltmeter, is wheeled to the motor to be tested and connected thereto by dummy fuses and flexible cable leads attached to the testing table at *A* and *B*.

The instruments are connected in the motor circuit by removing the live fuses and allowing the motor to run single-phase an instant while replacing with the dummy fuse properly connected. The other leg of the line is connected in a like manner. Potential leads are connected by lamp cord to the middle leg of the line. All conductors on the front of the board are of polished copper bars ¾ in. wide and ⅛ in. thick (19 mm. by 3 mm.).

The dummy fuses are made from standard fuses of the sizes used in the plant. The fuse wire is removed and the interior is filled with sealing wax so that the fuse will keep its shape under continuous handling. If the fuse is of the knife type, the blades are soldered to the end ferrules in order to insure solidity and good connection. The leads are soldered to the ferrule and a small copper strip is bolted around them to keep them from pulling off.


100 Amp. Switch
220 V. Lamp
Load
Line
B
C
E
D
A
Load
Line
25 AMP. REVERSING SWITCHES
Potential Middle Wire
To Current Coils Wattmeter
To Current Coils Wattmeter
Current Transf Leads Primary
Current Trans Leads Secondary
Current Transf Leads Primary
Potential Leads
Ammeter Leads
Handle
Current Trans. Leads Secondary
Drawer to pull both Ways

TEST TABLE MAY BE ROLLED TO MOTOR SWITCH

I. H. Gaskin,
Electrical Engineer.

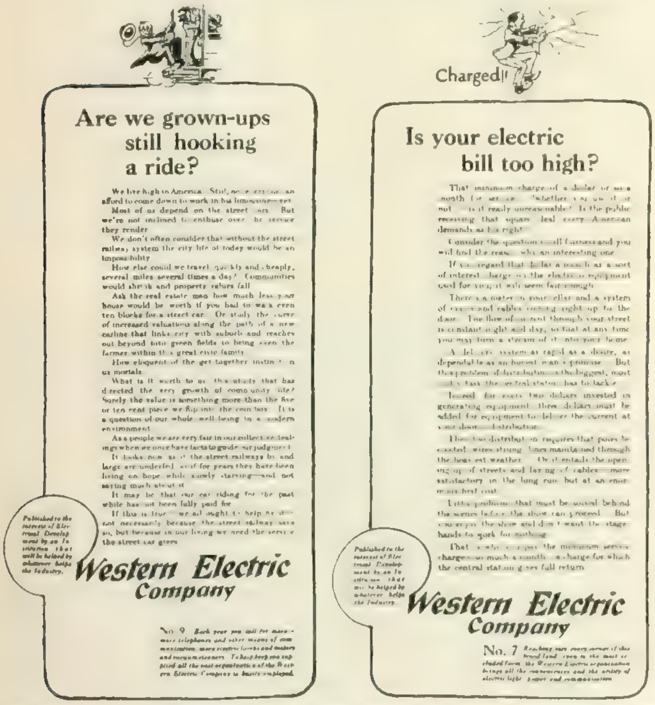
Gillette Safety Razor Co.,
South Boston, Mass.

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

Building Good Will for the Industry

THROUGH advertisements in several of the popular magazines the Western Electric Company is now conducting an educational campaign designed to build good will for the several branches of the industry. Eleven advertisements have been prepared that deal with some common problem in the home or business life of the average citizen and carry a common-sense appeal for fair play and a better understanding of electric service in all its phases. Two of the advertisements are reproduced here. The nine others are similar and are written from the standpoint of the electric street railway, electrical contractor, architect, telephone company, underwriters and steam railroad.



Are we grown-ups still hooking a ride?

Western Electric Company

No. 9

Is your electric bill too high?

Western Electric Company

No. 7

COMMON SENSE APPEALS TO THE PUBLIC THAT INSPIRE FAIR PLAY AND AN APPRECIATION OF JUST WHAT ELECTRIC SERVICE MEANS IN THE AFFAIRS OF TODAY

C. G. Du Bois, president of the Western Electric Company, in referring to this campaign, says: "We seek for ourselves as a company to build according to ideals that will be in harmony with the changing ideals of the times. Our effort, it seems to us, must go beyond the physical and commercial growth of our nation-wide system of distributing houses. We must seek to understand alike the problems of the producer from whom we buy and of the customer whose trade we seek, so that we may interpret each to the other. If we can aid both to be better understood by the public which both, like ourselves in the last analysis, must serve, we shall of course be aiding all those in the great industry of which we ourselves are only a part. But we believe that only to the extent that we serve the whole electrical industry can we share in the hoped-for and well-deserved prosperity of an industry that is of incalculable benefit to civilization. These advertisements, editorially written to you—the central station, the contractor, the engineer, the telephone company, the architect, the railroad—are the expression of our belief in this helpfulness. Their purpose is selfish to the extent that it is selfish for the whole industry, of which for fifty years we have been a part. Occupying as manufacturer and jobber a neutral zone, holding no brief for one department of the industry as against another, we have chosen to treat those organized divisions of it which the American people recognize as serving them."

Net Earnings of Dayton Company Increased 37 Per Cent

A SUBSTANTIAL increase in the business of the Dayton (Ohio) Light & Power Company for the year ended Dec. 31, 1919, is shown in its recent report to stockholders. Gross earnings increased $502,139.35, or 20.60 per cent, over 1919, while operating expenses for the same period increased only $213,957.48, or 12.87 per cent, making an increase of $288,187.87, or 37.49 per cent, in the company's net revenue. The output in kilowatt-hours increased 14.62 per cent, and steam supplied for heating purposes was 28.32 per cent more than in 1918.

Growth of the Dayton company's business is evidenced by the addition during 1919 of 5,083 meters installed and 13,841 hp. connected. During the past year negotiations were completed for supplying energy for four villages formerly served by municipally owned plants.

Forty-six miles of high-tension transmission lines were built during the year, connecting eleven additional towns and communities, making a total in all of fifty-seven in the territory served. The total additions and betterments to the plant and property for 1919 amounted to $1,094,026.

Safeguarding Employees' Health

A DENTAL clinic has been established by the Union Electric Light & Power Company, St. Louis, Mo., for the benefit of its employees. Taking the names in alphabetical order, the employees will be notified every fourth month to appear at the clinic for a dental examination. The teeth will be cleaned and extractions made where necessary absolutely free, while fillings, crowns, bridge work, etc., will be charged for at the bare cost.

Infections in the mouth and blind abscesses at the roots of the teeth are the cause of many diseases, and it is felt that absence from duty because of sickness will be lessened by the work of the clinic.

Handling of Customers' Orders

By Charles A. Collier
Contract Agent, Georgia Railway & Power Company

Usually the only point of contact between the average customer and the company is the order department, and inevitably lost motion, inefficiency, haste or discourtesy in that department leaves an unfavorable impression on the customer's mind. If his order is handled promptly, courteously and efficiently, his opinion of the company is enhanced.

With this idea in mind, the Georgia Railway & Power Company, a combination gas and electric company with approximately 27,000 gas and 24,000 electric customers, decided in the summer of 1919 to install a new system of handling customers' orders. Under this new system, at the same time the customer's order is written, other records, such as line orders, connected load records and a work sheet for the line and meter departments of the electric company and the gas shop of the gas company, are made out in a single operation.

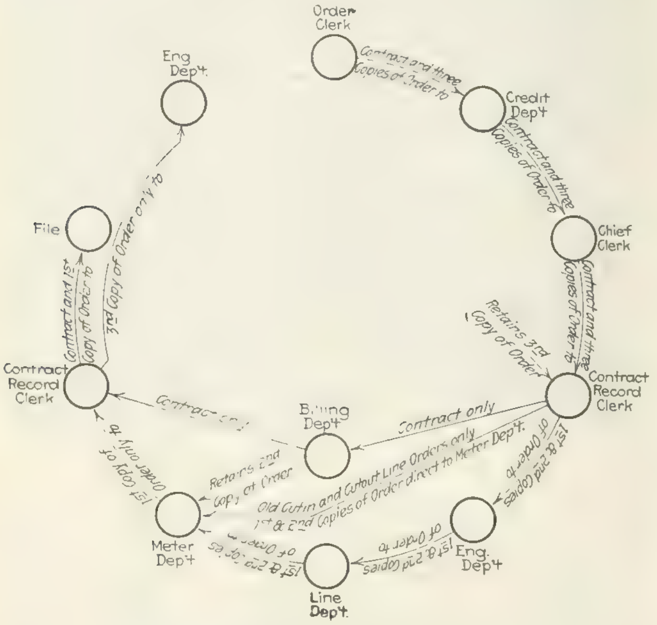
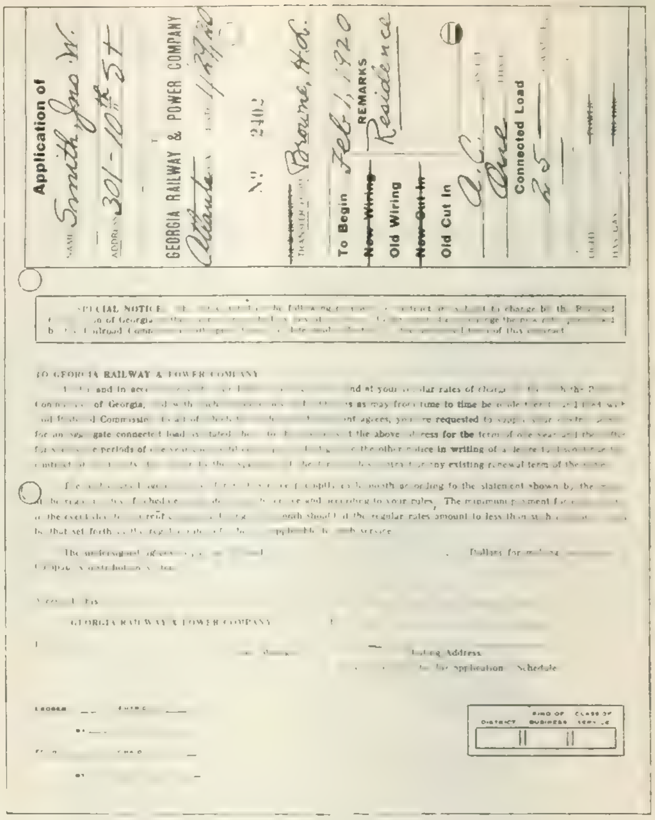

Order Clerk
Contract and three Copies of Order to
Credit Dep't
Contract and three Copies of Order to
Chief Clerk
Contract and three Copies of Order to
Contract Record Clerk
Retains 3rd Copy of Order
Contract only
Billing Dep't
Old Cutin and Cutout Line Orders only 1st & 2nd Copies of Order direct to Meter Dep't.
1st & 2nd Copies of Order to
Eng. Dep't
1st & 2nd Copies of Order to
Line Dep't.
1st & 2nd Copies of Order to
Meter Dep't
Retains 2nd Copy of Order
1st Copy of Order only to
Contract Record Clerk
Contract only
Contract and 1st Copy of Order to
File
3rd Copy of Order only to
Eng Dep't.

FIG. 1—ROUTINE FOR HANDLING NEW CUT-IN, OLD CUT-IN AND CUT-OUT LINE ORDERS

This is made possible by providing four forms, consisting of an original and three copies, which are filled out in the case of straight gas and straight electric orders. In the case of a combination order (gas and electric) an original and six copies are made. As shown in the accompanying illustrations, the original contains the agreement which the customer signs, while the carbon copies serve the following purposes:

In the case of electric orders, copies No. 1 and No. 2 go to the line department. When the line work is completed these two copies are forwarded to the meter department, where the second copy is used as a work sheet. After the setting of the meter the first copy is returned to the contract record department, where the third copy has been held as a memorandum order. It is there attached to the original application and filed. The original application is sent to the consumers' billing department at the same time the customer's order goes to the line department and upon entry by the consumers' billing clerk is returned to the contract record department for final filing.


Application of
Smith, Jno. W.
301-10th St
GEORGIA RAILWAY & POWER COMPANY
Atlanta
No 2402
Browne, H.C.
To Begin Feb. 1, 1920
REMARKS Residence
~~New Wiring~~
Old Wiring
~~New Cut In~~
Old Cut In
A.C.
One
Connected Load 25

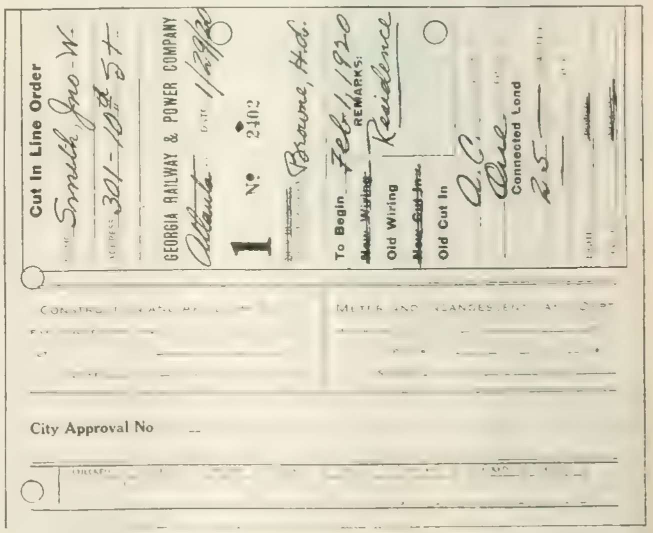
SPECIAL NOTICE

TO GEORGIA RAILWAY & POWER COMPANY

GEORGIA RAILWAY & POWER COMPANY

FIG. 2—APPLICATION FORM WHICH IS ACCOMPANIED BY THREE COPIES OF THE FORM IN FIG. 3, ALL BEING FILLED OUT AT ONE TIME

In the case of a combination gas and electric order the electric routine remains as outlined above, while the gas orders are sent direct to the gas shop, where the second copy is used as a work sheet, the first copy being returned to the contract record department for attachment to the application. After that it is filed, the original order having been entered in the meantime by the consumers' billing clerk and returned to the contract record department. The third copy, which is held by the contract record department as a memorandum, finally finds its way to the engineering department, where it is filed by streets as part of the load records, displacing the cards which it was necessary theretofore to have made out by a separate clerk.


Cut In Line Order
Smith, Jno. W.
301-10th St.
GEORGIA RAILWAY & POWER COMPANY
Atlanta
1
No 2402
Browne, H.C.
To Begin Feb. 1, 1920
REMARKS: Residence
~~New Wiring~~
Old Wiring
~~New Cut In~~
Old Cut In
A.C.
One
Connected Load 25

City Approval No

FIG. 3—LINE ORDER FORM WHICH BEARS A CARBON COPY RECORD OF INFORMATION ON APPLICATION (FIG. 2) FOR SERVICE

This routine may be more readily understood by reference to the diagram showing the routes the orders follow. In the application forms also shown it will be noted that practically all information required by the departments concerned is contained on the face of the application. An extra-hard indelible pencil insures legible carbons. The size and mechanical arrangement of all orders, which are made up in pads with the proper number of copies, are such as to permit their being folded to fit the proper files and metermen's work book, thus standardizing the size and shape of all customers' orders.

This system was put into operation on October 6, 1919, and the work it eliminated has enabled the contract and contract record departments to reduce the clerical force by five persons in these departments alone and at the same time expedite the handling of the order, despite the fact that the year 1919 shows an increase in customers of 10 per cent over the year 1918, while customers' orders show an increase of 26 per cent over the corresponding period of last year.

Not only is the routine thus simplified, but the order clerks are now able to take the customer's order intelligibly in about half the time formerly required. Since all the data necessary are printed on the face of the application, there is a constant reminder to the clerk that he must obtain from the customer the data requested before the order goes through, thus eliminating many omissions and reducing the errors.

Increase in Lighting Business of Buffalo General Electric Company

THE annual report to stockholders of the Buffalo (N. Y.) General Electric Company through its statement of revenues and expenses for the year ended Dec. 31, 1919, shows interesting developments in the company's business. In spite of a reduction in its revenue from commercial power of approximately $464,000, or 14 per cent, the revenue from lighting increased so that the total reduction in sale of energy was less than three-quarters of 1 per cent, while the total gross income was increased about 7 per cent. An increase in street lighting of 4 per cent is shown, in municipal lighting of 16 per cent, in residence lighting of 37 per cent and in commercial lighting of 15 per cent. The total increase in domestic and commercial lighting business of $416,580 during 1919 was nearly 8 per cent of the total sale of energy for 1918.

Through a reduction in the cost of power due to the purchase of coal at a lower price than in 1918 and the use of Niagara power, the cost of power was about 14 per cent less for 1919 than in 1918. The report, therefore, shows an income from operation approximately 10 per cent more in 1919 than in the previous year and a net income after other non-operating additions and deductions of about 23 per cent more than 1918. Under the heading "expenses" an increase is shown in system operation of 27.5 per cent and in taxes of 8.5 per cent.

Owing to the termination with the coming of peace of arrangements by which a large amount of electrical energy was diverted to the industries at Niagara Falls under the direction of the Government the output of the company's 90,000-kw. steam station was reduced from 252,000,000 kw.-hr. in 1918 to 190,000,000 kw.-hr. in 1919.

Why Patronize the Junk Dealer?

THERE is always a certain amount of waste material which is to be found around the offices and power plants of a power company. Too often, in the zeal of cleaning up, the combustible portions of this accumulation are piled up and touched off with a match, while the unassorted mass of scrap iron is sold to the nearest junk dealer for a few dollars. The poolings of power companies which have taken place in the West in the last few years have led to many such scrap heaps in the sorting out of duplicate material. The great posibilities which lie in the "junk pile" have been disclosed by H. N. Sessions of the Southern California Edison Company, who handled one such special "clean-up" at the time of the merging of the Southern California Edison and the Mount Whitney Power Company systems.

Much of the material which could be put into good condition was sold to other companies at prices that, owing to the present high level, were often equal to or greater than the original amount paid for the property.

Of the scrap material, there was much which could be sold in other markets than that provided by the ever-ready junk dealer and bring from eight to ten times the return. Arc globes make excellent fishbowls. Other shapes of glassware could be sold to florists and nurserymen for potted plants. Glass reflectors made fruit dishes. Marble switchboards find a market with the baker, or even with the housewife who does extensive baking in her own kitchen. Linemen's gloves which are no longer safe for this use may still afford protection for workmen handling injurious chemicals and will bring as much as $1 per pair, whereas the junkman will offer only a few cents for the leather. Harness makers provide a market for scrap leather belting, sawmills for odds and ends of manila rope, which will bring from 8 cents to 20 cents per pound, in contrast with the ordinary price of 4 cents per pound. A little exploring in each case revealed buyers at hand who were willing to pay well for carefully assorted material.

The importance of careful sorting is nowhere greater than in the case of scrap iron. Cast iron, cast steel, wrought iron and various types of wrought steel have each a different market, rods, tubes and like special parts sometimes bringing fancy prices as compared with the sum offered for mixed material. The Southern California Edison Company found it expedient to take out a scrap dealers' license during war time, when all prices were fixed by the United States Steel Administration, with the advantage in favor of regular dealers.

The general practice by the company is not to publish a list of material available, but to advertise a miscellaneous assortment of scrap to meet all kinds of needs and accustom possible buyers to make a statement of just what they want. The mechanism of handling is very simple. All obsolete or surplus material from every department and division of the system is forwarded to a central clearing house, where it is passed on by a committee of engineers. If it is found not available for use in any part of the company's work, it is then turned over to the chairman of this committee, the commercial engineer of the company, for salvage at the greatest possible profit.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Motors, Generators and Transformers

Subdivided Conductors for Alternating-Current Machinery.—L. FLEISCHMANN.—To cut down eddy-current losses in armature conductors carrying alternating current subdivided conductors are used, the different bars being systematically transposed. The author shows that in order to get the same current in each subdivision of the conductor the integral $\int y_2 dx$, taken over the length of the slot must be equal for each subdivision. y is here the distance from the conductor to the bottom of the slot, and x is measured along the slot. This condition implies that the center of gravity of the surface between the bottom of the slot and the conductor must, for all subdivisions, lie at the same distance from the bottom of the slot.—*Archiv für Elektrotechnik*, Oct. 10, 1919.

Losses in Transformers.—REGINALD C. KAPP.—This is a study of the proper division of iron and copper losses in a transformer in the light of the probable actual use of the transformer during a year.—London *Electrician*, Feb. 13, 1920.

Polyphase Windings.—RUDOLPF RICHTER.—The author develops the theory of fractional-pitch windings; that is, windings for polyphase machinery where the tooth pitch is not an even submultiple of the pole arc. For a great number of different cases the layout of different kinds of winding is shown in winding diagrams and tables.—*Archiv für Elektrotechnik*, Oct. 10, 1919.

Lamps and Lighting

New Intensive Street Lighting.—W. D'A. RYAN.—A new "white way" has been established in Los Angeles which is said to represent one of the best types of intensive street lighting in existence in the United States.—*Journal of Electricity*, Feb. 15, 1920.

Generation, Transmission and Distribution

Electrical Characteristics of Transmission Circuits, VII.—WILLIAM NESBIT.—In this article the author considers the performance of short transmission lines in which the effect of capacitance is not taken into account. The Mershon and the Dwight charts are printed and methods of solving transmission line problems are given when either the voltage at the sending end or at the receiving end is fixed.—*Electric Journal*, February, 1920.

Power-House Foundations. — E. M. LURIE. — The writer considers methods of testing soils, column footing, draining and other construction problems in connection with securing permanency of foundation.—*Power Plant Engineering*, Feb. 1, 1920.

Power from the Tidal Flow at Hopewell.—W. RUPERT TURNBULL.—The three great desiderata for a tidal plant are said to be: (1) That there should be sufficient height of tide to obtain a good head; (2) that there should be two natural reservoirs of large size so that continuous power can be obtained; (3) that power plants should be central to the population that would be served. It is also said that conditions are favorable in these respects at Hopewell for the installation of a plant of 200,000 hp. ultimate capacity. The author estimates that the cost per horsepower of this installation would be $122.50 for the first 100,000 hp.—Toronto *Electrical News*, Feb. 15, 1920.

Calculation of Saga Sag.—P. O. SZILAS.—A new method for calculating sag in aërial transmission lines is described, and a set of graphical charts is presented by the aid of which sag and tension may be quickly determined for different temperatures and spans and for wires of different sections of copper, aluminum, bronze and soft and hard steel.—*Elektrotechnische Zeitschrift*, Sept. 25 and Oct. 2, 1919.

Recent Advances in the Utilization of Water Power.—E. M. BERGSTROM.—The outstanding features in the development of the utilization of water power are summarized as follows: (1) The exclusive use of two types of turbines only, namely Francis reaction turbines for low and medium heads and Pelton impulse wheels for high heads; (2) the extension of the use of Francis turbines under heads approaching 800 ft. (240 m.) and Pelton wheels in single stage up to 5,500 ft. (1,680 m.); (3) the exclusive adoption of balanced wicket

AVAILABLE WATER-POWER IN THE PRINCIPAL COUNTRIES OF EUROPE AND AMERICA

Country	B.-hp. Available	B.-hp. Developed		Area in Square Miles	Population	B.-hp. Available per Square Mile	B.-hp. Developed per Square Mile	B.-hp. per Capita	
		In B.-hp.	In Per Cent					Available	Developed
United States	28,100,000	7,000,000	24.9	2,973,890	98,783,300	9.4	2.35	0.28	0 071
Canada A*	18,803,000	1,735,000	9.2	2,000,000	8,033,500	9.4	0.87	2.34	0.216
Canada B.	8,094,000	1,725,000	21.3	927,800	8,000,000	8.7	1 86	1 01	0 216
Austria-Hungary	6,460,000	566,000	8 8	261,260	51,173,000	24.8	2.17	0 13	0 011
France	5,587,000	1,100,000	11.6	207,500	39,601,500	26 8	3.14	0.14	0 016
Norway	5,500,000	1,120,000	20.4	124,130	2,391,780	44 3	9.62	2.30	0 468
Spain	5,000,000	440,000	8.8	190,401	19,588,700	26 3	2 31	0 26	0.022
Sweden	4,500,000	704,000	15.6	172,960	5,522,400	26 0	4 08	0 81	0.127
Italy	4,000,000	976,000	24.4	91,400	28,601,600	43.8	10.7	0 14	0.034
Switzerland	2,000,000	511,000	25.5	15,976	3,781,500	125 2	32 0	0 53	0.135
Germany	1,425,000	618,100	43.4	208,800	64,926,000	6 8	2.96	0 02	0.010
Great Britain	963,000	80,000	8 3	88,729	40,831,400	10 9	0 91	0 20	0 002

* A includes Yukon and northern area improbable of immediate development.

gates for regulation of Francis turbines and the circular nozzle with combined deflector and needle regulation for Pelton wheels; (4) the standardization of turbine runners and increased specific speed, permitting the use of single vertical units of large output under low heads; (5) the general increase of output per unit, the maximum output at present being 31,200 b.-hp.; (6) the general increase of the over-all efficiency of about 6 to 10 per cent; (7) the exclusive use of oil-pressure governer; (8) the efficient regulation (by means of differential surge tanks) of turbines using long pipe lines; (9) the employment of large-diameter pipe lines under high heads, resulting in an appreciable reduction of the initial cost of development. An interesting table on the water-power development in different countries of the world, as estimated in 1915, is given in this article and reproduced here.—London *Electrician*, Feb. 6, 1920.

Alabama Power Company's System, Its Development and Operation.—J. M. OLIVER, B. NIKIFOROFF and C. B. MCMANUS.—The authors set forth in a comprehensive manner many of the problems encountered in the operation of this extensive system and show the results from the use of relays and protective devices in establishing continuity of service. A comprehensive classification of the trouble which occurred on the system during the first six months of 1919 is given in the table.—*General Electric Review*, November, 1919.

CLASSIFICATION OF TROUBLES FROM JANUARY 1, 1919, TO JULY 1, 1919

	Substation		110 Kv. Lines		44-Kv. Lines		Customer	
	No.	Per Cent	No	Per Cent	No	Per Cent	No	Per Cent
*Lightning	1	25	6	33	57	43.7	10	12.05
Line insulators	2	50	11	61	39	29.7	16	19.25
Conductors		...	.	.	6	4.55	9	10.85
Poles, guys and cross-arms	.	...	.		1	0.76		..
†High-tension disconnecting switches	1	25	1	6	1	0.76		...
High-tension oil-switch bushing	..	..	..	...	1	0.76		
Blowing of high-tension fuses	..	..	..	.			32	38.55
Transformer failures	.	....	..	.	12	9.16	6	1.20
Transformer bushing failures	..	....	.		8	6.05	9	7.25
Customers' equipment		....	.	.	1	0.76		10.85
Operating errors		. .			5	3.8		
Unknown		. .						.
Total	4	100	18	100	131	100.00	83	100.00

* When line opens automatically during lightning storm and no failures are discovered.

† Switch blade dropped out while in service.

Characteristics of Some Polyphase Transformer Connections.—L. F. BLUME and A. BOYAJIAN.—In this article may be found a brief and condensed summary of the advantages and disadvantages of practically all common schemes of polyphase connection of transformers and auto-transformers. — *General Electric Review*, December, 1919.

Traction

Remotely Controlled Electric Locomotives.—H. H. JOHNSTON.—The writer describes an installation, at a byproduct coke plant, of remotely controlled combination third-rail and storage-battery locomotives for handling coke cars while they are being loaded at the screening station. The motorman first brings the locomotive with eight empty cars and spots the first car under the loading chutes at the screening station. The motorman then throws a switch and places the locomotive under the control of the operator in the screening station and leaves the locomotive. The operator then slowly moves the train forward, stopping or reversing it as conditions may require, thereby securing an evenly and completely loaded car. When the cars are loaded the motorman returns to the locomotive and draws the cars to the classification yards, returns for empty cars and the cycle is completed. The writer then proceeds to outline the advantages of using electric locomotives and particularly those of the remote-control type.—*Electric Journal*, February, 1920.

Installations, Systems and Appliances

The Permanence of Electric Pumping in California.—CHARLES H. LEE.—When underground waters were first used for irrigation purposes some mistakes were made on account of the inability to estimate the probable water supply from this source. The writer states, however, that at the present time it is possible to study the underground water available for development in any given district. This is of importance in connection with the supply of electricity for such a load.—*Journal of Electricity*, Feb. 15, 1920.

Automatic Door Hoist for Open-Hearth Furnaces.—H. A. LEWIS and W. H. BURR.—An electric door hoist is described which is said to be simple, rugged and controlled by means of a push-button. The device is described in some detail and its advantages over hydraulic door lifts are pointed out.—*Journal Engineers' Club of Philadelphia*, February, 1920.

Units, Measurements and Instruments

Absolute Method of Determining Coefficients of Diffuse Reflection.—F. A. BENFORD.—An exceptionally accurate method is described by the author which he originated and developed to measure the coefficient of reflection of a diffusing surface. In addition to being more accurate than its predecessors, it is said to be simple, independent of the color of the standard lamp and furnishes absolute not relative values.—*General Electric Review*, January, 1920.

Electrometer Sensitivity.—E. SCHREIBER.—The influence upon sensitivity and damping of the Dolezalek electrometer of such factors as needle form and needle potential, and of certain details of construction, has been investigated by the author, who considers a sensitivity of 10^{-4} volts per millimeter a moderate value for an instrument with a one-minute period. Very much higher sensitivities may be obtained if thinner quartz fibers are used, and to decrease the period needles may be used where the middle parts are removed, leaving only an 8-shaped rim.—*Annalen der Physik*, Aug. 5, 1919.

Switchboard Meter Connections for Alternating-Current Circuits, II.—J. C. GROUP.—In this article the author takes up meter connections for two-phase, two-phase four-wire, two-phase three-wire, four-phase four-wire and four-phase five-wire circuits.—*Electric Journal*, February, 1920.

A Universal Inductance and Capacity Testing Bridge.—G. V. DRYSDALE.—The writer states that the bulk of testing methods for comparing self and mutual inductances are bridge methods in which the inductance or capacity to be tested is either connected directly in one arm of the bridge or as a shunt to one arm. To secure accuracy it is important that the circuits should be free from interference, of minimum area and symmetrically disposed, and to obtain direct reading the total resistance of each arm of the bridge should generally be 1, 10, 100 or 1,000 ohms, etc. The bridge here described is said to fulfill these conditions and to lend itself readily to nearly every method of comparison.—*London Electrician*, Jan. 23-30, 1920.

Telegraphy, Telephony and Signals

The Telephone Receiver as a Mechanical-Electrical Transformer.—HAHNEMANN and HECHT.—The authors have recently published (*Physikalische Zeitschrift*, 1919, page 104) a theory regarding the electro-mechanical phenomena of the telephone receiver, wherein the transformations from acoustical to electrical energy and vice versa are analyzed in detail. The present paper deals with experimental results obtained during researches on the effect upon the efficiency of the receiver of external conditions, such as the surrounding air, and the adjustment of the receiver cap. In these experiments the effective resistance of the receiver was measured in a bridge at various frequencies. The efficiency of a receiver from electrical input to sound energy delivered to the ear was found to be from 1 per cent to one-tenth of 1 per cent at frequencies between 500 and 1,000 p.p.s.—*Annalen der Physik*, Nov. 20, 1919.

Structure and Operation of the Vacuum Valve.—ROBERT W. A. BREWER.—The w riter brings out some of the features upon which depend the uniformity of vacuum valves based upon extensive experiences in testing.—*Journal of Electricity*, Feb. 1, 1920.

Artificial Antennae.—K. W. WAGNER.—The electric properties of an antenna are only very roughly reproduced by an ordinary resonant circuit. Successively better approximations may be obtained by the use of networks with increasing number of elements. A single section, made up of a condenser in parallel with a branch consisting of an inductance in series with another capacity, has proved to depict very satisfactorily a homogeneous antenna for frequencies up to the fundamental frequency of the antenna. Corresponding to the three elements of this arrangement, any three conditions may be imposed upon the artificial antenna. The author studies in detail the behavior of such an artificial antenna when connected to different kinds of circuits, such as will occur in radio practice, and compares the results with those that would be obtained with an antenna having homogeneously distributed inductance and capacity.—*Archiv für Elektrotechnik*, Sept. 15, 1919.

Testing of Telephone Receivers.—PIRANI and PASCHEN.—The authors have devised a standard of sound intensity consisting of an organ pipe supplied with air under constant temperature and pressure. Telephone receivers could be compared as to efficiency by placing them in the acoustic field of the pipe and measuring the electric energy delivered by the receiver when acting as a generator. In this way results could be reproduced to ± 5%.—*Berichte der Deutschen Physikalischen Gesellschaft*, Feb. 28, 1919.

Old and New Theories Regarding Ferro-Magnetic Phenomena at High Frequencies.—H. FASSBENDER.—The older theory for explaining the apparent lowering of permeability at high frequency by hypothetical molecular viscosity has been discarded for the more modern magnetic skin-effect theory, assuming the static magnetization curve to hold even for radio frequencies. This is the conclusion reached by the author after examining in detail a great number of recent papers on the subject. μ, then, must be regarded as independent of frequency, at least down to wave lengths of a meter or two, and while the introduction of an "effective permeability" is of great help to the engineer, this quantity is usually rather vaguely defined. The author emphasizes that the so called "dynamic magnetization-curve" has no physical reality whatever, since it enters the induction in some infinitely thin layer, inside the metal as a function of the magnetic field strength at the surface.—*Jahrbuch der drahtlosen Telegraphie*, August 1919.

The Annapolis Radio Station.—A general description of the Annapolis radio station constructed by the navy and said to be the most powerful station in the United States. The high-power arc transmitter is of the Poulsen type, and the general equipment required is as follows: A source of direct current, an arc converter, an antenna loading inductor, an antenna and ground system, a signaling device and auxiliary and control apparatus.—*Wireless Age*, December, 1919.

A Method of Finding the Tension of Wires Without Tension Ratchets.—Curves have been worked out for obtaining the proper tension in small telephone and telegraph wires during stringing. In this method the linemen strike the wire and count the number of reflections which pass over the wire and return in a given time.—*Post Office Electrical Engineers' Journal* (London), January, 1920.

Miscellaneous

Harmonic Analysis.—R. SLABY.—The author shows that owing to certain properties of the Fourier series the amplitude of any harmonic component in an alternating-current wave may be determined in the following way: To determine the kth amplitude in the sine series of the periodic curve, form the difference between the squares of the r.m.s. values of the given curve and of a new curve which is derived by adding to the first one the function $h \sin k\omega t$. This difference is equal to the kth amplitude plus $h/2$. Cosine terms are obtained in a similar way. If the curves are plotted in polar co-ordinates, the r.m.s. values may be obtained from the inclosed area, as measured by planimeter. For the fundamental $h \sin k\omega t$ $(k=1)$ in polar representation is a circle and the construction is particularly simple. Also, in case of the higher harmonics, the analysis may be much simplified if certain special polar co-ordinates, so called wave co-ordinates, are employed.—*Elektrotechnische Zeitschrift*, Oct. 23 and 30, 1919.

The Thermal Conductivity of Solid Insulators.—W. M THORNTON.—Data are given for the thermal conductivity of quartz, flint glass, graphite, marble, paraffin wax and other insulating materials.—*Philosophical Magazine*, December, 1919.

Effect of Line Resistances Upon Short-Circuit Phenomena in Synchronous Machines.—BIERMANNS.—When a short-circuit takes place there is often a considerable resistance in the line from the machine to the point where the fault occurs. The author studies analytically the effect of such line resistance upon the short-circuit phenomena in synchronous generators and also discusses the effect of a ground upon a system to which several generators are connected in parallel.—*Archiv für Elektrotechnik*, Nov. 10, 1919.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Water-Power Conference Again Postponed

FURTHER consideration of the water-power bill by conferees of the Senate and House, which was to have taken place this week, has again been postponed. The conferees have decided to put off the meeting until next week owing to the pressure of other legislation.

It was some time after the passage of the Senate bill before the conferees first met because of the railroad bill conference, and then there was almost immediately further adjournment out of respect to Senator Bankhead, who had just died. The conferees met a week later and adjourned on March 9, without coming to an agreement, after a two-day conference. At this time there were only two major points of difference between the conferees. No meeting has since been held.

Nation in Throes of Local Daylight-Saving Decision

ALTHOUGH Congress did not favor the continuance this year of the daylight-saving plan which was adopted for two years as a war measure, a number of states and communities have signified their intention of turning the clock ahead an hour this Sunday. Other places have similar measures under consideration.

An attempt this week to repeal the New York State daylight-saving ordinance failed. New Jersey has such a law now before the State Legislature. There is no state law in Pennsylvania, but a number of cities have such an ordinance. Both Philadelphia and Meadville, Pa., repealed the local ordinance this week.

The daylight-saving act has passed the Massachusetts House and is now before the Senate. Local daylight saving is effective in Hartford, Conn., next Monday and is expected to spread co-operatively through Connecticut. Worcester, Lynn, Clinton and Marlboro, all in Massachusetts, have also adopted the plan. The Maine Legislature killed the act. New Hampshire and Vermont are hostile and Rhode Island is lukewarm.

Daylight saving is being re-established this year in many cities and towns of the Central States, and public sentiment seems to be generally in favor of the plan. The majority that have made the change have adopted a seven-month period, dating from the last Sunday in March to the last Sunday in October, though some prefer the five-month period from the last Sunday in April to the last Sunday in September. Cleveland, Detroit, Cincinnati and Denver are among the cities which will change over for seven months, while Columbus, Ohio, has decided upon the five-month plan. Chicago is expected to line up with Columbus when the City Council meets on Monday. The people of Minneapolis voted in favor of daylight saving.

Georgia has a state law placing the time for the entire state on the basis of eastern time. Atlanta, however, follows central time schedule. This law serves to put many Georgia cities on a daylight-saving basis.

No daylight-saving plans are contemplated on the Pacific Coast so far as can be learned. Local daylight-saving ordinances were overwhelmingly defeated in both Oakland and San Francisco, Cal., recently, although a petition from citizens is again before the San Francisco supervisors.

Many Projects Contemplated for Pacific Coast

A NUMBER of construction projects for the Pacific Coast are announced this week. A permit has been filed with the State Engineer of Oregon for appropriation of 200 second-feet to develop 26,000 kw. for irrigation in Harney Valley and to serve municipalities including the city of Vale. The Pacific Gas & Electric Company is to install during the current year two 12,000 kw. turbines on the Pit River and one 12,500-kw. steam turbine in Oakland, and to make additions to the Sierra San Francisco Light & Power Company's properties to produce 16,000 kw., additional power. The Sespe Light & Power Company of Ojai, Cal., is installing a power plant on the Sespe River and will issue bonds and capital stock for $1,000,000 to construct four dams, three ditch systems and three power houses. A hydro-electric plant is proposed for Paradise Creek, Rainier National Park, near Tacoma, to supply hotels with heat, light and power. Roseburg, Ore., is to vote on a $500,000 bond issue.

I. E. C. Meetings Being Held This Week in Belgium

MEETINGS of the advisory committees of the International Electrotechnical Commission on nomenclature, rating of electrical machinery, symbols and standard pressures will be held in Brussels, Belgium, commencing Saturday of this week. The Belgian electrotechnical committee has been actively engaged in completing the details for the meeting, and although a very busy time is before the delegates, the Belgians, General Societary C. le Maistre informs the ELECTRICAL WORLD, have been desirous of arranging for one or two excursions for the benefit of the visiting delegates.

The decisions arrived at at these meetings will ultimately be placed before all the national committees with a view to their adoption at the next plenary meeting, which is expected to be held later in the year. Dr. C. O. Mailloux, president of the commission, left for Belgium some time ago. The other American delegates nominated by the United States national committee to attend these meetings are Dr. Agnew, H. M. Hobart, A. H. Moore, L. W. Chubb and C. E. Skinner.

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

DEMAND for electrical supplies is not quite up to that experienced by the trade in the latter months of 1919. The shortage of many materials is holding back some business, but few jobs, it appears from reports, are really suffering because there is no equipment to complete them. The delivery situation has bettered to some degree, but is very far from satisfactory. Small shipments are coming in, but in many cases they are shipments that have been since January and February in transit.

FIBER-CONDUIT sales are good and mills are well booked up. The fan outlook is better than ever before at this time of year, and orders are coming in up to four times those of other years. A special shortage is noted in magnet wires because of the dearth of long-fiber cotton and the heavy demand.

MUCH confusion over daylight-saving projects exists in various sections of the country, indicating the adoption of widely varying programs.

MANY new construction projects are announced by electric power companies on the Pacific Coast.

BETTER public relations were urged by the speakers at the convention of the Wisconsin Electrical Association on Wednesday and Thursday.

FURTHER postponement until next week of consideration of the water-power bill by the Congressional conference committee has been made.

THE TENTATIVE program of the Pasadena convention of the N. E. L. A., to be held from May 19 to May 21, has been issued.

EIGHT per cent as a limitation of return is seriously handicapping the electrical industry, in the opinion of George N. Tidd, vice-president American Gas & Electric Company, as expressed in the ELECTRICAL WORLD.

CO-ORDINATED effort as the great need of electrical manufacturers was strongly advocated at the annual meeting of the Associated Manufacturers of Electrical Supplies. J. F. Kerlin was elected president of the association for the ensuing year.

PRESIDENT WILSON'S Industrial Conference in its final report outlines a plan for settling trade disputes which it has extended to cover public utilities.

THE MERGER of Westinghouse, Church, Kerr & Company and Dwight P. Robinson & Company has been declared operative.

CONSOLIDATION of the construction and engineering departments of the Postal Telegraph-Cable Company into the plant and engineering department has taken place.

POWER-FACTOR correction and outdoor substations were discussed at an open meeting of the transmission and distribution committee of the Ohio Electric Light Association at Canton.

BY A DECISION of the Appellate Division of the Supreme Court of New York the New York Edison Company is sustained and the Public Service Commission overruled in the case arising out of the Edison company's refusal to furnish break-down service to a firm owning a private plant and desiring to supplement its supply to outside consumers in this way.

GENERAL GEORGE H. HARRIES has been nominated as president of the Illuminating Engineering Society.

THE DISPUTE between the Hiawassee Power Company and the Carolina-Tennessee Power Company will not be adjudicated by the United States Supreme Court, which disclaims jurisdiction.

ARGUMENT has been had before the United States Supreme Court in the suit of the Kansas City Bolt & Nut Company charging breach of contract against the Kansas City Light & Power Company.

INCREASED production is to be the keynote at the convention of the Chamber of Commerce of the United States to be held at Atlantic City, N. J., April 27 to April 29.

WHITE SULPHUR SPRINGS, W. Va., has been selected by the Conference Club as the place for its next meeting to be held in June or July. A committee of three will represent the club at the Pasadena convention of the N. E. L. A.

A MEASURE passed by the State Legislature of Ohio permits municipalities to assess all or part of the costs of "white way" lighting on the owners of abutting property.

ELECTRIC UTILITIES as investments are coming into public favor according to a Stone & Webster report issued this month.

A SURVEY of residential lighting in Chicago is being made with the object of improving the standard of lamps and fixtures.

UNDER the provisions of the naval appropriation bill as reported to the House of Representatives, $28,000,000 is provided for the new Bureau of Engineering, which will have charge of the navy's electrical work as well as of engineering operations of other kinds.

CONSTRUCTION of two 140,000-volt transmission lines 70 miles in length is part of a development program adopted by the Consumers' Power Company of Michigan.

SAMUEL GOMPERS declares that union labor should work for government ownership and operation of water powers and for close government control over utilities and corporations.

EXCLUDING war purchases by the Federal Government, the sales of the Western Electric Company for 1919 were $6,000,000 in excess of those for 1918.

GOVERNMENT control of coal prices will end on April 1. Bituminous coal miners are to have a wage increase on a 27 per cent basis.

ALL BRANCHES of the industry were represented at the question box conference of the New England section, N. E. L. A., in Boston, March 18, and active steps toward increased co-operation were evident.

AN EXTENSION of its boiler plant to cost nearly $750,000 will be made by the Narragansett Electric Lighting Company, Providence, R. I.

MEETINGS of the advisory committees of the International Electrotechnical Commission begin in Brussels, Belgium, today.

CONSTRUCTION work of a noteworthy kind has been begun by the Central Illinois Public Service Company.

FINAL plans have been made for the joint meeting in Boston on April 9 and 10 of the A. I. E. E. and the American Electrochemical Society and for participation by the Electric Furnace Association, which is also to hold a meeting at that time.

Better Public Relations Theme of Wisconsin Convention

NEARLY every speaker who addressed the opening sessions of the twelfth annual convention of the Wisconsin Electrical Association held Wednesday and Thursday at Milwaukee emphasized the necessity for better public feeling toward utilities and toward the regulating commissions. Confidence was expressed in the public's sense of justice when properly informed. It was said to be the utility manager's duty to show the masses that utilities are entitled to a higher place in the public esteem and to greater returns on their investments.

"Central stations are selling their service for much less than it is worth. Great as are the utility problems in this and other respects, they are not too difficult to be solved," said W. S. Lounsbury in his presidential address. His admonition to the members of the association was to "study the past while trying to follow every new path, hold fast to things which are fundamentally right, have faith, inspire public confidence in business and a spirit of loyalty to the company among your employees."

B. J. Mullaney of the People's Gas Light Company, Chicago, who substituted for M. E. Sampsell, president of the Wisconsin Power, Light and Heat Company, recommended that the Wisconsin utilities establish a committee for the dissemination of public utility information to newspapers and others as is done in Illinois, Indiana and elsewhere. The speaker said:

"For the expenditure of about one-fiftieth of 1 per cent of the companies' gross revenues gratifying results could be obtained. The Illinois committees' prepared articles were given 14,000 column inches in the principal papers in the state and this publicity was obtained without arousing any hostility or unfriendly comment and has had a very favorable effect on the attitude of the newspapers toward all public utilities."

M. H. Aylesworth, executive manager of the National Electric Light Association, in an address on public policy said that if the public utilities will tell the public what they need they can get it. "The public has found out that central stations and other utilities are not profiteers," said Mr. Aylesworth, "but the companies have not yet taken the people sufficiently into their confidence to make the masses realize that public utilities, instead of being heartless corporations, are true friends of mankind."

Program of Boston Joint Electrochemical Meeting

FOR the joint meeting in Boston April 9 and 10 of the American Institute of Electrical Engineers and the American Electrochemical Society, in which the Electric Furnace Association will also participate, the following program has been scheduled:

Friday Morning, April 9.—W. D. Bancroft presiding. Symposium on "Electrically Produced Alloys": H. E. Howe, "Fundamental Problems in Alloys Research"; R. J. Anderson, "Recent Developments in the Ferro Alloy Industry"; C. B. Gibson, "The Manufacture of Ferro Alloys in the Electric Furnace"; B. D. Saklatwalla, "Ferro-Vanadium"; Ellwood Haynes, "Stellite"; F. A. Raven, "Properties of Ferro-Silicon"; E. S. Bardwell, "Ferro-Manganese"; R. C. McKenna, "The Manufacture of High-Speed Steel in the Electric Furnace"; Alcan Hirsch, "Ferro-Cerium"; Theodore Swann, "Ferro-Zirconium"; B. G. Klugh, "Ferro-Phosphorus"; R. M. Major, "Nichrome and Other Special Alloys"; T. D. Yensen, "Electric Properties of Nickel-Iron Alloys"; M. A. Hunter, "Electrical Properties of Titanium Alloys"; C. F. Harding, "Nitrogen Fixation by the Silent Discharge."

Friday Evening, April 9.—President Townley of the A. I. E. E. presiding. Symposium on "Power for Electrochemical Industries": John L. Harper, "Power for Electrochemical Plants"; John A. Seede, "Automatic Control of Arc-Furnace Electrodes"; H. A. Winne, "Reactors for Electric Furnace Circuits"; C. A. Winder, "Economies of the Power Situation"; E. A. Wilcox, "Electric Furnace Power from the Standpoint of the Central Station"; H. L. Hess, "The Electric Furnace and the Central Station"; C. T. Maynard, "Location of a New England Electrochemical Plant"; F. F. Fowler, "Water Powers of the Pacific Coast"; J. W. Beckman, "Power Development in Scandinavia"; W. G. Berlin, "Power Problems from the Standpoint of the Furnace Operator."

Saturday Morning, April 10.—J. W. Richards, "The Soderberg Self-Baking Continuous Electrode"; Charles A. Jeller, "Synthetic Electric Furnace Pig Iron"; Philip B. Short, "Step Induction Regulators for Electric Furnaces"; Clarence J. West, "The Electric Furnace as Applied to Metallurgy"; H. M. St. John, "The Electric Brass Furnace, Its Evolution"; L. B. Lindemuth, "The Electric Furnace in Iron and Steel Metallurgy"; Edward F. Kern, "Reduction of Maganiferous Silicate Slags."

The delegates will visit the Lynn Works of the General Electric Company Friday afternoon and the Huff Electrostatic Separator Company Saturday afternoon.

An informal subscription dinner will be held Friday evening at the Copley-Plaza Hotel.

Pacific Coast N. E. L. A. Section Program

JUST prior to the N. E. L. A. Pasadena Convention the Pacific Coast Section will hold a two-day convention at the same place on May 17 and 18. All sessions will be joint meetings of the engineering, commercial, accounting and publicity sessions. A special report on the California Electrical Co-operative Company will be made by L. H. Newbert.

The program of papers follows:

Engineering Committee—"Railway Electrification," by J. E. Woodbridge; "Method of Improving Power Factor, and Suitable Rates," by E. A. Quinn; "Use of Maximum Rated Motors as Affecting Central Stations and Consumers," by John Hood; "Electric Furnaces," by J. A. Koontz and W. M. Shepard; "Economic Use of Galvanized Steel Wire," by J. P. Jollyman and J. F. Strachan; "Progress Report on Insulator Investigations," by J. A. Koontz; "Relay Protective Systems," by G. E. Armstrong; "Automatic Protection of Small Motors," by G. E. Armstrong; "Use of Variable Speed A.C. Motors vs. D.C. Motors for Elevator Service," by S. J. Lisberger.

Accounting Committee—"Construction Accounting," by C. P. Staal; "Standardization of Titles," by A. B. Carpenter and R. R. Reidford.

Commercial Committee—"How the Electrical Industry Should Co-operate with the Architect and Builder," by Garnett Young; "The Value of Proper Illumination," by F. D. Fagan; "Commercial Aspects of Railway Electrification," by E. B. Criddle, W. L. Frost and G. B. Kirken; "Commercial Aspects of Storage of Water at Higher Elevations," by E. B. Walthal, D. R. Kenney and E. J. Crawford; "Central Station Power versus Internal Combustion Engines," by R. E. Fisher; "Standardization of Wiring Devices, Terminals and Budgets," by H. H. Courtright; "Electrical Development of Oil Lands," by R. A. Balzari; "Value of Solicitors," by A. W. Childs; "Statistics Regarding Unelectrified Horsepower," by J. O. Case.

Publicity Committee—"Report of Activities," by L. W. Alexander.

General Harries Nominated for President of the I. E. S.

GEN. GEORGE H. HARRIES

AT THE recent meeting of the council of the Illuminating Engineering Society the report of the nominating committee was accepted. The following nominations were unanimously made by the committee: For president, Gen. George H. Harries; secretary, Clarence L. Law; treasurer, Louis B. Mark; vice-presidents: New England Section, H. F. Wallace; Philadelphia Section, G. S. Crampton; Chicago Section, J. J. Kirk; directors, Adolph Hertz, Walton Forstall and Frank S. Price.

Conference Club Decides to Meet at White Sulphur Springs

INSTEAD of holding its next meeting in California in conjunction with the N. E. L. A. convention and the jobbers' meeting, the Conference Club has decided to hold its next meeting between June 10 and July 10 at White Sulphur Springs, W. Va., and to send to the California conventions a committee of three composed of L. K. Comstock, W. C. Peet and Sullivan Jones. This decision, together with the election of new members, was the principal item of business at the meeting of the club held at Cleveland on March 18.

The decision as to the time and place of the next meeting came as the result of a feeling on the part of some members that the club would not be prepared for a meeting at the time of the California meetings. As a result of the balloting invitations are about to be sent to twenty-two proposed members, representing the different branches of the industry.

As soon as the men signify their intention in regard to membership in the club, the committee on bylaws and constitution will be appointed and asked to prepare a report for the next meeting. Members of this committee will represent all branches of the industry.

Coal Miners' Wages to Go Up 27 Per Cent

NO GOVERNMENT price-fixing control of coal will be exercised after April 1, President Wilson announced on Tuesday in making public the report of the bituminous coal commission. The commission awarded the miners a wage increase which is on a 27 per cent basis, the 14 per cent increase of last October to come to an end March 31. The new wage scale goes into effect April 1 and continues for two years. In this way the wage contract is terminated in the spring rather than the fall.

In addition to the award, the majority report made recommendations looking to the storage of a minimum of three months' winter supply of bituminous coal by July 1 of each year by federal government departments, public utilities, railroads and domestic consumers; the study of the Interstate Commerce Commission of the advisability of instituting freight rates on coal lower in the spring than in the fall and winter months, and that steps be taken to minimize as far as possible car shortages in the transportation of coal.

National Electrical Code Changes Under Consideration

FINAL recommendations for the 1920 National Electrical Code were received at an open meeting of the electrical committee of the National Fire Protection Association on March 23. These recommendations did not advocate any radical differences from the changes recently proposed by the committees of the association as outlined in the ELECTRICAL WORLD of Feb. 14, 1920.

After this public meeting the committees again went into session to adopt the final revision of the rules. This work was not completed at the time of going to press, but it is understood that the final changes will be incorporated within a short time.

Program of N. E. L. A. Pasadena Convention

A TENTATIVE draft of the program of the National Electric Light Association convention at Pasadena, Cal., in May has just been made public. Matters of broad, major importance will be presented in the general or morning sessions, while the more specialized subjects will be considered in detail at the afternoon sessions of the four national sections.

Following the president's reception on Tuesday evening, May 18, the convention will open Wednesday morning at 9:30. There will be four general sessions, on Wednesday, Thursday, Friday and Saturday mornings. The Wednesday morning session will be convened at 9:30, and each of the other sessions will be called to order promptly at 9 a.m. and adjourned about 1 p.m.

On the afternoons of these four days, excluding Saturday, there will be held eight sessions of the four national sections—Accounting, two sessions; Commercial, three sessions; Electric Vehicle, one session, and Technical and Hydro-Electric, two sessions. These sessions, some of which will be run in parallel, will be called to order at 2:30 p. m. and adjourned about 5:30 p. m.

The public policy session will be held Thursday evening.

This year, owing to distances from electrical manufacturing centers, difficulties of transportation, supply and demand conditions and lack of suitable space, the customary exhibition is omitted. However, there will be an unusually interesting and important exhibition and demonstration of industrial lighting equipment and its application, under the auspices of the lighting sales bureau, Commercial Section, in connection with the report of its industrial lighting division.

In addition to a large number of opportunities for entertainments, there will be a California mission play staged on Wednesday night, May 19, and Friday night will be given over to a monster entertainment, tendered by the Pacific Coast Section.

N. E. L. A. Pasadena Convention Program

(Tentative Draft Subject to Revision)

General Sessions

WEDNESDAY, MAY 19, 9:30 A. M.

1—Welcome to California, Gov. William D. Stephens.
2—Address of President Ballard.
3—Appointment of committee on president's address.
4—Report of Executive Manager Aylesworth.
5—Announcements.
6—Report of committee of water-power development, Franklin T. Griffith.
7—Report of committee on rate research, Alex Dow.
8—Report of committee on lamps, Frank W. Smith.
9—Report of insurance expert, W. H. Blood, Jr.
10—Address of chairman Commercial Section, John G. Learned.
11—Report of Merchandise Sales Bureau on electric ranges, J. Paul Clayton.

THURSDAY, MAY 20, 9 A. M.

1—Report of committee on company sections, F. A. Birch.
2—Report of committee on geographic sections, R. J. McClelland.
3—Address (speaker and subject to be announced by Lighting Sales Bureau).
4—Report of committee on commercial service and relations with customers, R. F. Bonsall.
5—Election of nominating committee.
6—Report of committee on constitution and bylaws, W. C. L. Eglin.
7—Appointment of committee on memorials.
8—Appointment of committee on resolutions.
9—Report of Bureau of Advertising and Publicity Service, L. D. Gibbs.
10—Paper: "Committee Service," S. M. Kennedy.
11—Report of committee on membership, Walter Neumuller.
12—Report of Treasurer Abell.
13—Address (title to be announced), E. O. Edgerton, president California Railroad Commission.

FRIDAY, MAY 21, 9 A. M.

1—Address, R. W. Symes, chairman Accounting Section.
2—Report of committee on education, Fred R. Jenkins.
3—Report of committee on accounting education, Douglass Burnett.
4—Report of committee on relations with educational institutions, John F. Gilchrist.
5—Report of committee on accident prevention, Charles B. Scott.
6—Report of committee on safety rules, W. C. L. Eglin.
7—Address, I. E. Moultrop, chairman Technical and Hydro-electric Section.
8—Report of committee on inductive interference, A. E. Silver.
9—Report of committee on electrification of steam railroads, Frank M. Kerr.
10—Address (speaker and subject to be announced by Power Sales Bureau).
11—Paper: "Trend of Regulation," Carl D. Jackson, chairman Wisconsin Railroad Commission.
12—Report of committee on electrical resources of the nation, M. S. Sloan.

SATURDAY, MAY 22, 9 A. M.

1—Address, George B. Foster, chairman Electric Vehicle Section.
2—Paper: "Electric Machinery for All Handling—An Opportunity," Zenas W. Carter.
3—Report of committee on public information, John F. Gilchrist.
4—Report of committee on bonus systems, Harry A. Snow.
5—Report of committee on insurance, E. J. Fowler.
6—Report of committee on co-operation in the industry, Lee H. Newbert.
7—Address: "The Society for Electrical Development," J. M. Wakeman.
8—Report of committee on sale of company securities to customers and resident citizens, George R. Jones.
9—Report of committee on Doherty and Billings prizes, A. S. Loizeaux.
10—Report of committee on president's address.
11—Report of committee on constitutional amendments.
12—Report of committee on memorials.
13—Report of committee on resolutions.
14—Report of committee on nominating.
15—Election and installation of officers.

Technical and Hydro-Electric Sessions

WEDNESDAY, MAY 19, 2:30 P. M.

1—Chairman's address, I. E. Moultrop.
2—Appointment of nominating committee.
3—Announcements.
4—Report of committee on meters, F. V. Magalhaes.
5—Report of committee on prime movers, N. A. Carle.

THURSDAY, MAY 20, 2:30 P. M.

1—Election of officers and executive committee.
2—Report of committee on overhead systems, W. K. Vanderpoel.
3—Report of committee on underground systems, F. E. Ricketts.
4—Report of committee on electrical apparatus, R. F. Schuchardt.

Commercial Sessions

WEDNESDAY, MAY 19, 2:30 P. M.

1—Chairman's address, John G. Learned.
2—Report of committee on finance, M. S. Seelman.
3—Appointment of nominating committee.
4—Report of committee on constitutional amendments, R. H. Tillman.
5—Report of committee on wiring, R. S. Hale.
6—Report of Merchandise Sales Bureau, E. A. Edkins.
7—Report of electrical merchandise division, F. D. Pembleton.
8—Report of division on electric shop management, C. E. Greenwood.
9—Report of division on standardization and testing, O. R. Hogue.
10—Report of division on electric ranges, J. Paul Clayton. (Discussion continued from general session, Wednesday morning.)

THURSDAY, MAY 20, 2:30 P. M.

1—Report of committee on "Electrical Salesman's Handbook," I. Lundgaard.
2—Report of division on economies of the use of central-station electric power (Power Sales Bureau), John W. Meyer.
3—Report of division on electrochemical processes (Power Sales Bureau), C. H. McClure.
4—Report of division on industrial electric heating (Power Sales Bureau), N. T. Wilcox.
5—Report of Bureau of Lighting Sales, Clarence L. Law.
6—Report of division on street and highway lighting, W. T. Dempsey.
7—Report of division on residence lighting, M. Luckiesh.
8—Report of division on lighting of large buildings, G. Bertram Regar.
9—Report of division on store lighting, F. C. Taylor.
10—Report of division on commercial aspects of lamp equipment, George H. Stickney.
11—Discussion of preceding Lighting Sales Bureau reports.
12—Report of division on industrial lighting, H. H. Magdsick. (In form of demonstration.)

FRIDAY, MAY 21, 2:30 P. M.

1—Report of committee on compensation of salesmen, Adolph Hertz.
2—Election of officers and executive committee.
3—Report of division on electric steel furnaces (Power Sales Bureau), Joseph McKinley.
4—Report of division on general power (Power Sales Bureau), W. E. Murphy. (This report will consist of a paper by W. G. Taylor, General Electric Company, entitled "Electric Power in the Oil Fields.")
5—Report of division on power contract (Power Sales Bureau), R. H. Ashworth. (This report will consist of a paper, presented by the chairman, entitled, "Standardization of Power-Factor Specifications in Power Contract on the Part of Central-Station Companies.")
6—Report of division on isolated plants (Power Sales Bureau). J. B. Stuart.
7—Report of division on electric development (Power Sales Bureau). Morse DellPlain.

Accounting Sessions

THURSDAY, MAY 20, 2:30 P. M.

1—Chairman's address, R. W. Symes.
2—Appointment of nominating committee.
3—Report of committee on credits and collections, David Darlington.
4—Report of committee on classification of accounts and accounting relations with other associations, William Schmidt, Jr.
5—Report of committee on form of annual reports to commissions, W. J. Meyers.
6—Report of committee on merchandising accounting, C. W. [illegible]
7—Report of committee on accounting service to member companies and the Monthly Bulletin, Frederick Smith and L. A. Coleman.
8—Report of committee on motor-vehicle records, G. P. Landwehr.

FRIDAY, MAY 21, 2:30 P. M.

1—Report of committee on purchasing and storeroom accounting, W. F. Stevens.
2—Report of committee on federal income tax procedure, H. E. Addenbrooke.
3—Report of committee on customers' records and billing methods, J. D. Jacobus.
4—Report of nominating committee on section officers.
5—Election of officers and executive committee.

Electric Vehicle Session

FRIDAY, MAY 21, 2:30 P. M.

1—Chairman's address, George B. Foster.
2—Appointment of nominating committee.
3—Report of committee on legislation, G. A. Freeman.
4—Report of committee on standardization, E. R. Whitney.
5—Paper: "The Uses and Abuses of Electric Vehicles," H. J. Butler and W. J. Burns.
6—Report of committee on electric vehicle and Power Sales Bureau co-operation, E. S. Mansfield.
7—Report of committee on garages and rates, Willis M. Thayer.
8—Report of committee on federal and municipal transportation, James H. McGraw.
9—Report of committee on transportation engineering, F. M. Feiker.
10—Election of officers and executive committee.

Gompers for Government Ownership of Water Powers and Utilities

THAT public and semi-public utilities shall be "owned, operated or regulated by the government in the interests of the people"; that the federal and state governments should "own, develop and operate all water power over which they have jurisdiction, power thus generated to be supplied to all citizens at rates based upon costs," and that there should be legislation for federal licensing of all corporations organized for profit, federal supervision and control over the increasing of capital stock and the incurring of bonded indebtedness, with the provision that all books of corporations shall be open at all times to federal examiners, are three among many radical planks favored by Samuel Gompers, president of the American Federation of Labor, in outlining union labor's political program in the current issue of the federation's organ.

Eight Per Cent Return Insufficient, Declares George N. Tidd

THAT the limitation by public service commissions of the return on invested capital to about 8 per cent is seriously handicapping the development of electric utilities is the opinion of George N. Tidd, vice-president of the American Gas & Electric Company, as expressed in a statement to a representative of the ELECTRICAL WORLD. Mr. Tidd said that additions and improvements to plants are now made only where most urgently required, and that while his company has an extensive construction program mapped out, it does not feel justified in going ahead with it when capital costs 9 per cent and the return allowed is but 8 per cent. There is now a greater demand for central-station energy than ever before, and this demand is coming from large manufacturers who are making extensions to their factories or wish to abandon their own power plants because central-station energy has been found cheaper and more satisfactory.

"We must meet this demand on the old basis of 8 per cent return," said Mr. Tidd, "while no such limitation is placed on the manufacturers. The commissions, in establishing a schedule of rates based on an 8 per cent return, have overlooked the fact that there are two classes of customers who purchase energy from utilities—first, those who must have the service, such as residences, commercial and small power users; second, large users of power who purchase energy only when to do so is cheaper than to develop it themselves. The latter is really a competitive proposition, and for this class of business electric companies should be allowed to adjust their rates to cover all items of interest, depreciation, obsolescence and operating costs. They would then bid for this business at a rate which would earn an adequate return on investment and yet, being competitive, would have to be low enough to show a satisfactory saving against a privately operated power plant."

Restricting electric utilities to an 8 per cent return, according to Mr. Tidd, has the effect of penalizing development, because, no matter what degree of economy is reached in operation, the ratio of net earnings to invested capital must remain the same. The company that has a high operating efficiency, he pointed out, is not permitted any higher reward in the rate of return than is the less efficient company.

"There is a growing sentiment in favor of the electric utilities and the high peak in operating costs has been passed," Mr. Tidd said, "but the electric utilities are in a position similar to the railroads of the country. They have passed through a strenuous period when construction was curtailed or discontinued entirely, and now, in order to give the high class of service demanded by the public, they must be permitted to earn a sufficiently high return on the investment to attract the necessary capital for their development."

Western Electric 1919 Sales Below War Period

FOUNDED in 1869, the Western Electric Company points, through President Charles G. Du Bois's annual report to stockholders, just issued, to total sales for its semi-centennial year of $135,722,000. This is an increase for 1919 as compared with 1918 of more than $6,000,000 in normal business, although a decrease of $16,000,000 in war emergency purchases by the United States Government makes the total fall $9,500,000 below the total figures for 1918. The year 1917, with $150,000,000 in aggregate sales, was also a war year. In 1916 the total was less than $107,000,000, and in 1915 it was only $63,852,000, or less than half last year's business, exclusive of government purchases.

The net earnings of the company for 1919 were $5,652,089, or 6.9 per cent on the average investment for the year, which was $81,400,000. The manufacture of telephone equipment constitutes more than 50 per cent of the company's business.

The unfilled orders of the company on Dec. 31 aggregated $47,442,000, which is the largest amount of business ever on the books and compares with $26,265,000 at the end of 1918.

No earnings from foreign business are included in the figures for 1919, but it is asserted that the International Western Electric Company owns interests ranging from 10 to 100 per cent in companies established in England, France, Belgium, Norway, Switzerland, Austria, Hungary, Russia, Italy, Australia, South Africa, Canada, Argentina, China and Japan.

Ohio Steel Mills Increase Central-Station Load Tenfold

STEEL mills operating in the territory served by the Trumbull Public Service Company of Warren, Ohio, have so enlarged their demands for energy that the peak load and kilowatt-hour output of that company are ten times what they were at the beginning of 1914. Starting with a generating capacity in 1914 of 4,400 kw. on which the peak load was 2,100 kw., the capacity, demand and kilowatt-hour output have now grown to ten times their sizes at that time. This is best shown by the following tabulation:

Year	Generating Capacity, Kw.	Peak Load, Kw.	Annual Output, Kw.-hr.
1913	4,400	2,100	7,047,174
1914	4,400	2,260	7,170,463
1915	8,750	3,836	11,842,401
1916	8,750	5,705	16,592,121
1917	8,750	7,155	26,828,267
1918	24,150	17,000	53,566,660
1919	36,650	21,220	69,208,946

At the present time the peak load on this plant is 24,000 kw. and the monthly output upward of 7,000,000 kw.-hr. It has been impossible, M. R. Bump, chief engineer of the Cities Service Company, stated to a representative of the ELECTRICAL WORLD, for the company to add generating capacity to keep pace with the demands of the steel mills in the territory. A 12,500-kva. turbo-generator is now being installed but will not be sufficient to take care of the additional load. He further said that were it possible to install the generating capacity to supply as much energy as has been requested by the steel mills, the present kilowatt-hour output of the Trumbull Public Service Company would be doubled. With the addition of the new 12,500 kva. unit the annual output for 1920 is expected to reach 100,000,000 kw.-hr.

Residential Lighting Survey Being Made

BAD as are illuminating conditions in Chicago factories, they are much worse in the city's homes if the preliminary figures of a survey now being made are a fair criterion, said W. A. Durgin of the Commonwealth Edison Company in a paper read before the Chicago Section of the Illuminating Engineering Society on March 17. Cheapness and artistic design seem to determine the choice of fixtures to the practical exclusion of engineering considerations. Fixture manufacturers can help to improve the standard of illumination in new residences, Mr. Durgin said, but the lamp and glassware men must be depended upon to help raise the standard in old homes.

A paper was presented by M. Uchisaka, illuminating engineer of the Tokyo (Japan) Electric Company, on the fixtures used in Japan.

Industrial Conference Outlines New Plan for Collective Bargaining in Utilities

JOINT organization of management and employees as a means of preventing misunderstandings and furthering co-operative effort—in other words, the shop council—is recommended in the final report, issued this week, of the Industrial Conference appointed by President Wilson. The conference has extended its proposed method of settling trade troubles to cover disputes affecting public utilities other than steam railroads. The report asserts that, as modified, the plan makes machinery available for collective bargaining with only incidental and noncompulsory arbitration. It involves no penalties other than those imposed by public opinion, does not deny the right to strike and does not submit to arbitrators the policy of the "closed" or "open" shop.

The method of adjusting disputes advocated by the conference involves the creation of regional adjustment conferences, which in the case of public utilities shall consist of a federal official as chairman, four representatives of the parties to the dispute, two from each side; one employer representative and one employee representative taken from a panel already formed in the class of public utility in which the dispute arises, and two members representing the government authority which has power to regulate the service of the public utility. In case of failure of the chairman to obtain the creation of a regional adjustment conference, he shall proceed to form a regional board of inquiry of similar composition, the members for any side refusing to join in the conference being selected from the panel already mentioned. Should an agreement be reached by the conference or the board of inquiry, this will constitute a collective bargain. Should agreement fail, the case is to be carried to a national industrial board of nine members appointed by the President and confirmed by the Senate, whose decision, if accepted by the parties to the dispute, shall also constitute a trade agreement. During these processes of adjudication no interruption of work must take place.

Manufacturers See Need for Co-ordinated Effort

J. F. KERLIN

THAT co-ordinated effort is more necessary now than ever before was voiced almost as the keynote of the fourth annual meeting of the Associated Manufacturers of Electrical Supplies, held in New York on March 18, by A. W. Berresford in his presidential address. The meeting came in a week full of activity in the various section meetings. A banquet was held at the Waldorf-Astoria Thursday evening, at which Dr. W. R. Whiting spoke on "Research" and F. R. G. Gordon of the National Electric Light Association on "Vital Questions of the Day." Edward J. Cattell of Philadelphia was also one of the speakers.

In opening the afternoon session Mr. Berresford, after speaking of the accomplishments of the association, emphasized the necessity for organization. Charles E. Dustin, general secretary, in a brief report laid particular emphasis on the formation of the general standards committee. (Reported in the ELECTRICAL WORLD for March 6.)

Judge Thomas M. Debevoise, counsel for the association, cautioned the membership not to hew too close to the line and stated that the board of governors had appointed a committee to investigate the work of the sections in order to find some program for widening the work of the association.

A full report of the activities of the international trade committee, of which John J. Gibson, Westinghouse Electric & Manufacturing Company, is chairman, made it clear that a better response to the committee's questions must be made by the manufacturers. If the information is not received through this committee, the Tariff Commission will take steps to procure it by law.

After other reports were received the program for the League for Industrial Rights was explained by its counsel, Mr. Merritt.

A resolution expressing the loss sustained by the membership in the death within the year of its first president, Robert K. Sheppard, was adopted.

Election of officers for the following year resulted as follows: President, J. F. Kerlin, Corliss Carbon Company, Bradford, Pa.; vice-president, Le Roy Clark, Safety Insulated Wire & Cable Company, New York; treasurer, J. W. Perry, H. W. Johns-Manville Company, New York; general secretary, Charles E. Dustin; to the board of governors, W. F. Field, H. D. Hanks, Shiras Morris, W. H. Thornley, J. H. Trumbull

Record Run at Providence 45,000-kw. Turbine

THE 45,000-kw. cross-compound Westinghouse turbo-generating unit of the Narragansett Electric Lighting Company, Providence, R. I., was shut down a few days ago after a continuous run of eighty-four days, eleven hours and thirty-six minutes. Nicholas Stahl, general engineer of this company, states that to the best of his knowledge this constitutes a world's record run for continuity in units of this type. During this period the unit generated 50,781,000 kw.-hr., which exceeds the annual output of the company for any year prior to 1915. The load varied on the machine from 6,000 kw. to 41,000 kw. To produce this output required 609,000 lb. of steam, with a coal consumption of about 71,000,000 lb., or 1.4 lb. per kilowatt-hour. About 27,500,000 000 lb. of condensing water was required.

Decision in Kansas City Contract Case Expected Soon

ARGUMENT has been had before the Supreme Court of the United States in the case of the Kansas City Bolt & Nut Company vs. the Kansas City (Mo.) Light & Power Company, and a ruling from the court of last resort is expected in the near future. A contract was entered into between the two companies concerned in the suit for the delivery of electrical energy. The contract was dated Sept. 7, 1912, or prior to the creation of the Missouri Public Service Commission, to which were given rate-fixing powers. The contract fixed the compensation and other conditions for a period of five years, with the proviso that at the option of the consumer these conditions could be renewed thereafter from year to year for a period of ten additional years. After supplying power for three years, the Kansas City light company insisted upon applying rates which had been prescribed by the Public Service Commission. The lower courts, including the Supreme Court of the State of Missouri, have refused to enjoin the Kansas City Light & Power Company from withdrawing power from the manufacturing plant.

High-Voltage Outdoor Substations Show Saving in Cost

POWER-FACTOR correction and outdoor substations were discussed at an open meeting of the transmission and distribution committee of the Ohio Electric Light Association held at Canton on March 18.

In an illustrated paper on the history of equipment for high-voltage outdoor substations by Stephen Q. Hayes of the Westinghouse Electric & Manufacturing Company the cost comparisons between a 135,000-kva. hydro-electric station and a 154,000-volt outdoor substation showed a saving of about 13 per cent in favor of the latter. Mr. Hayes said that about 80 per cent of modern high-voltage transformers are designed for outdoor service.

Advantages and disadvantages of synchronous motors, synchronous condensers and static condensers for power-factor correction were outlined in a paper on power-factor corrective apparatus by Robert Treat of the General Electric Company. At the close of the meeting an inspection trip was made to the 132,000-volt stepdown substation of the Central Power Company in Canton.

Merger of Two Prominent Engineering Firms Effected

THE plan for the merger of Westinghouse, Church, Kerr & Company, Inc., with Dwight P. Robinson & Company, Inc., as was outlined in the ELECTRICAL WORLD of March 13, was declared operative on March 18. Dwight P. Robinson has been elected president of Westinghouse, Church, Kerr & Company pending final completion of the merger.

It was stated at the office of Dwight P. Robinson & Company that the Westinghouse Electric & Manufacturing Company, the largest stockholder of Westinghouse, Church, Kerr & Company, will withdraw as a stockholder from the new company and that Guy E. Tripp will remain as chairman of the board of Westinghouse, Church, Kerr & Company only until the organization of the new company is completed.

Details of the new organization have not been fully worked out, but it was stated at the office of Dwight P. Robinson & Company that it is planned to retain the personnel of both of the merging companies. The new company will have an engineering office in the Grand Central Palace, New York City, and the present office of Dwight P. Robinson & Company, at 61 Broadway, will also be retained.

Chicago Electric Club Opens Permanent Home

THIS *comfortable "lounge" is one of several rooms in the Morrison Hotel, Chicago, that are now the permanent quarters of the Chicago Electric Club. On March 4 the quarters were officially opened to the club's 800 members and their guests. All told, the floor space, leased for five years by the club at an annual rental of $15,000, is 5,500 sq.ft. This is divided into seven rooms, including "lounges," a billiard room, a ladies' room and a dining room. For the club's large weekly luncheon gatherings the hotel provides the use of its main banquet hall. Among the new offers which the club is making is a non-resident membership for $15.*

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Another House Organ Appears.—From the Merchants' Heat & Light Company of Indianapolis comes the first number of *Flash*, a company news sheet.

Healthy Condition of Western Utility.—An indication of the condition of the Western public utilities is given by the recent report of the Pacific Gas & Electric Company showing that the number of its preferred stockholders, which on Jan. 1, 1919, was 6,411, on Feb. 10, 1920, had increased to 7,441. On the latter date there were 2,281 holders of common stock.

New Zealand Government Purchases Hydro-electric Plant.—United States Vice Consul Charles G. Winslow writes from Auckland that the New Zealand government has purchased the Horahora hydro-electric system from the Waihi Gold Mining Company for the sum of $1,034,131, with the view of distributing electricity to the Waihi Gold Mining Company, industrial enterprises and homes in the Auckland province south of Auckland.

New Home for West Penn. — The Hartje Building, a twelve-story structure at First Avenue and Wood Street, Pittsburgh, has been purchased by the West Penn system as a home for its executive departments at a cost of $560,000. The new owner will take possession on June 1, from which date the structure will be known as the West Penn Building. At present the associated companies occupy 21,000 ft. of floor space in Pittsburgh alone, principally in the Benedum-Trees Building. The acquisition of an entire building was necessitated by the growth of the West Penn Railways Company and the West Penn Power Company.

Civil Service Examinations for Electrical Engineers.—The United States Civil Service Commission announces open competitive examinations for marine, mechanical and electrical engineers for which applications may be filed with it up to April 20. Salaries range from $2,400 to $4,000 a year. The duties of those qualifying as electrical engineers will require training and experience in electrical machinery construction, testing of electrical machinery, and installation of electric wiring, electrical machinery or radio equipment in connection with marine construction. Applicants should apply for form 2,118, stating the title of examination desired, to the Civil Service Commission, Washington, D. C., or to the secretary of any United States Civil Service board.

Electricity at Hog Island. — In an official statement concerning the status of the work of the American International Shipbuilding Corporation at Hog Island, Pa., as of March 10, 1920, the length of wiring used to convey electricity to this mammoth enterprise, with its 103 acres of floor space and its 25,000 employees, is put at 675 miles. This figure is exclusive of telephone wiring, which reaches an aggregate of 3,000 miles.

Plant Operates Amid Flood Conditions.—An illustration of the efficiency of the main West Reading (Pa.) plant of the Metropolitan Edison Company was given recently when the plant was kept running without a moment's interruption during a 17-foot flood in the Schuylkill River, from which water is drawn for condensing purposes. The flood forced its way into the power station, pumps and similar equipment on the ground floor being completely submerged. The engineers succeeded in keeping one of the boiler-feed pumps running, although covered by several feet of water during the height of the flood, and this made possible the continued operation of the plant with little reduction of service.

Electricity Replaces Coolie Labor.—The punkas shown in this Baptist church in Rangoon, Burma, and which look like draperies hung from a gallery, are really electric fans, the motor having replaced the coolies who used to operate them in the intervals during which they could keep awake. "In the hot weather the fans are indispensable," says the pastor of this East Indian church. "It was a comparatively simple matter to rig them up to run with an electric motor, and now, no matter how hot the night or how sleepy the coolies, the fans swing backward and forward with perfect regularity."

Snow Mountain Company Increases Stock.—The Snow Mountain Water & Power Company of California was authorized on Feb. 26 by the Railroad Commission of that State to issue stock to the extent of $1,500,000 for the purpose of obtaining funds with which to build a dam in Lake County to provide reservoir capacity of approximately 73,000 acre-feet. In addition to the dam, which is to be constructed on what is known as the Gravelly dam site, the company intends to make changes in its generating plant and so increase its efficiency by approximately 25 per cent.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Empire State Gas and Electric Association.—The next meeting of the electric meter section of this association will be held on Aug. 27.

A. I. E. E., Philadelphia Section.—At the meeting of this section on April 12 Dr. Comfort A. Adams will speak on "Electric Welding as Applied to Shipbuilding."

Ohio Electric Light Association.—The annual convention of this association will be held at the Breakers Hotel at Cedar Point, Ohio, from July 13 to July 16.

National Association of Electrical Contractors and Dealers.—The twentieth annual convention of this association will be held in Baltimore next October.

A. I. and S. E. E., Birmingham Section.—An inspection trip through the nitrogen plant of the Government will be made by the members of this section next month.

A New A. I. E. E. Section. — The board of directors of the American Institute of Electrical Engineers has granted the petition asking permission to establish a local section of the Institute at Providence, R. I.

New York Electrical Society.—At a joint meeting of this society and the Aëro Club of America held in New York on Tuesday of this week Handley Page gave an illustrated address on the future of commercial aviation.

Missouri Association of Public Utilities.—This association will hold its next annual convention at Jefferson City, Mo., on June 3 to 5 inclusive. F. D. Beardslee, Mercantile Trust Company, St. Louis, is the secretary-treasurer of the association.

Minnesota Electrical Association.—The Minnesota Electrical Association will hold no annual convention this year as plans have been completed for making this association a section of the National Electric Light Association. When this geographic section is formed a meeting of the section will probably take place.

Pennsylvania Electric Association.—The western geographic section of this association will meet at the William Penn Hotel, Pittsburgh, on April 21 to consider the subject of power-factor correction and the methods of charging consumers who maintain power factors less than unity. Members of the Ohio Electric Light Association have been invited to meet with the Pennsylvania men.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Monopoly and Competition.—An electric utility, according to a finding of the Maine Public Utilities Commission, ought not to expect protection from competition where it cannot or will not extend service to applicants in cases necessitating little or no electrical equipment.

Higher Rates Made of Short Duration.—Complaints against an increase in the price charged for electrical energy by the Rockland Light & Power Company from 13 cents a kilowatt-hour to 15 cents less 1 cent for prompt payment having been made to the New York Public Service Commission. Second District, that body, in view of the unusually expensive operating conditions of 1918, confirmed the rates but made its order of short duration in the hope that conditions may so change as to justify at the end of the period a reduction in rates satisfactory both to consumers and to the company.

Adjustment of Residence and Power Rates. — In finding that a primary residence rate of 10 cents a kilowatt-hour is not discriminatory upon comparison with a monthly minimum power charge of $50 for 1,500 kw.-hr. plus 2 cents a kilowatt-hour for excess energy, the Public Service Commission of Missouri has held that differences between residence electric rates and power electric rates which disappear upon comparison on the hours' use of demand per month basis and which are due to differences in the service rendered and justified on the basis of cost do not discriminate against residence consumers.

Principles of Rate Fixing.—In a complaint by the city of Fargo, N. D., against the rates of the Union Light, Heat & Power Company, the North Dakota Board of Railroad Commissioners laid down these principles, among others, governing the fixing of rates: (1) Unit prices based on a five-year period, with 1916 as the index, include a fair consideration of present high prices in making a valuation; (2) in the main, 3½ per cent is a sufficient and adequate allowance for depreciation in a valuation for rate making for all of the general property of an electric utility; (3) the property of a utility devoted to the service of electric, gas and steam-heat consumers should not be treated as a unit in a valuation for rate making but should be apportioned between the different services; (4) an allowance of 8 per cent for return on the fair present value of the property of an electric, gas and steam-heating utility is reasonable.

Ascertainment of Discrimination.—For the purpose of ascertaining whether a class of consumers is being served at a loss, and if so to bring about a readjustment of rates, an assignment of revenue and expense incurred in each class of service, including depreciation and return on the property used, must be made, according to a recent decision of the Public Service Commission of Missouri.

Supervision Costs as an Element in Capitalization.—In granting an application for permission to float a bond issue made by the Twin State Gas & Electric Company, the New Hampshire Public Service Commission criticised the practice of the company in adding 10 per cent to the cost of construction to cover supervision by its own officials, employees' liability insurance and other expenses paid out of operating income but incurred for the benefit of construction. The 10 per cent is not added to payments for supervision outside the company's regular operating force. The commission expressed its conviction that in the case under consideration the charge did not represent more than it should, but held that the method of computing it was arbitrary and therefore not accurate.

Items to Be Excluded or Included in Valuation for Rate-Making Purposes.—In the complaint of the Engineers' Incitation Club against the Union Electric Light & Power Company of St. Louis, the Public Service Commission of Missouri has laid down principles of valuation for rate-making purposes under which the following items are excluded from consideration: Sums set up on the books against franchises, in the absence of evidence of payment therefor to the State or a political subdivision thereof; royalties and licenses on patents which have expired; costs of establishing the business where the utility's classification of accounts provides for the charging of such items against operating expenses; non-existent property or excess purchase price of property over the value thereof; bond discounts and organization expenses, which should be amortized; excess land purchased in acquiring right-of-way; syndicate expense of selling stock and bonds; discounts allowed on commodities purchased upon a license agreement which has lost its value on account of the expiration of patents. The following items are approved by the commission as entitled to capitalization: Cost of promotion and preliminary surveys; value of leaseholds; average overhead allowances of 18.1 per cent of specific construction to cover interest, taxes, acquisition, legal and engineering expenses, omissions, contingencies and insurance; privileges to place poles in foreign pole lines, easements covering installation of poles and wire crossings and the maintenance of contacts on poles of foreign companies, upon the basis of the saving effected; accrued depreciation due to wear and tear, obsolescence and inadequacy, and vacant ducts laid under municipal compulsion.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Rate-Fixing Powers of Public Service Commission.—If an order of the Public Utilities Commission fixing rates does not contravene any constitutional limitation, and is within the constitutional and statutory authority of the commission, and has substantial basis in evidence, it cannot be set aside by the courts. This is the determination of the Supreme Court of Illinois in State Public Utilities Commission vs. Springfield Gas & Electric Company. A court, it further holds, is without authority to set aside such an order of the commission unless it is against the manifest weight of evidence, and all doubts as to the propriety of means or methods should be resolved in favor of the commissioners. (125 N. E. 891.)

Condemnation Proceedings Taken Unconstitutionally. — The Supreme Court of Colorado has held that, in proceedings to condemn right-of-way for an electric power line, if an interlocutory order, before service of summons and without notice to landowners, permitting petitioner to take possession of the right-of-way violated constitutional provisions as to due process and the taking of property without just compensation, such order did not vitiate subsequent proceedings for condemnation, duly had; and where the landowners received notice and had their compensation judicially ascertained, judgment of condemnation will not be reversed on error because of such interlocutory error unless it injuriously affected their rights on the merits of the case. (186 P. 910.)

Powers of Oklahoma Commission.—Concerning the authority of the Corporation Commission of Oklahoma the Supreme Court of that state, in Muskogee Gas & Electric Company vs. State, has held (1) that the commission is not confined to prescribing permanent rates but may enforce temporary ones when occasion arises; (2) that its power to fix rates is not limited to complaints filed but is inherent in the powers delegated to it; (3) that its inquiries should not be too narrowly constrained by technical rules as to the admissibility of evidence; (4) that the right of the courts to review its conclusions is limited to determining whether the board acted within the scope of its authority or whether the order is without foundation in evidence or a constitutional right of the public utility has been infringed by fixing confiscatory rates or rates inadequate to return a reasonable profit. (186 P. 730.)

Men of the Industry

Changes in Personnel and Position—Biographical Notes

H. L. Wills, formerly electrical engineer of the Georgia Railway & Power Company, Atlanta, Ga., was made electrical engineer and operating manager of that company on Feb. 1. Mr. Wills has had a broad central-station experience in the engineering field. He entered the employ of the Georgia Railway & Electric Company in 1902 and remained with this company until 1907, holding positions as the head of the meter and repair departments. During that time he organized the testing department. In 1907 he resigned to become engineer and general manager of the Savannah (Ga.) Lighting Company. That position he held until 1912, when he was made special representative of the Georgia Power Company in charge of its Macon (Ga.) district office. Upon the merger of the Georgia Railway & Electric Company and the Georgia Power Company into the Georgia Railway & Power Company he entered into the employ of the latter company, and has since held various posts of a special engineering character. On Feb. 1, 1919, he was appointed electrical engineer, a position which, as already mentioned, was merged with that of operating manager on Feb. 1, 1920. Throughout his career Mr. Wills has been identified with constructive work of the American Institute of Electrical Engineers, the National Electric Light Association and other engineering societies, in all of which he maintains a very active interest.

H. L. WILLS

A. V. Guillou, of the engineering department, Southern California Edison Company, has been appointed assistant engineer of the gas and electric division of the California Railroad Commission. Mr. Guillou was graduated from the University of California with the class of 1912 and spent the two following years with the Westinghouse Electric & Manufacturing Company in Pittsburgh. He then joined the organization of the Pacific Light & Power Corporation and upon the purchase of the Mount Whitney Power & Electric Company became district agent at Porterville. Later he was transferred to the engineering department of the company.

George M. Ogle, formerly chief electrical engineer of the United States Shipping Board, Emergency Fleet Corporation, has joined the engineering force of the Vulcan Iron Works, Inc. Jersey City, N. J. in charge of its electrical contracting and consulting engineering department.

J. B. Fisken, formerly chief engineer of the Washington Water Power Company, Spokane, Wash., has been appointed consulting engineer of that company. V. H. Greisser, formerly of the engineering staff, has been promoted to the position of chief electrical engineer.

G. C. Miller, manager of the light and power department of the Aurora, Elgin & Chicago Railroad Company, Elgin, Ill., has resigned to engage in the electrical merchandising business in Kokomo, Ind., under the name of the Lacey-Miller Company. Mr. Miller was at one time a member of the new-business department of the American Gas & Electric Company at Muncie, Ind.

Walter Neumuller, who was appointed assistant secretary of the New York Edison Company early this year, was elected secretary of the company on Feb. 16. Mr. Neumuller's progress in the company has been rapid. He started in a clerical position in 1900 and advanced to the position of private secretary to Arthur Williams, general commercial manager. In 1918 he was placed in charge of all retail business of the company, which position he has held since that time. He is an active worker in a number of electrical organizations, including the National Electric Light Association.

WALTER NEUMULLER

Dr. Irving Langmuir of Schenectady, N. Y., whose electronic and atomic researches in the laboratories of the General Electric Company have led to the notable contribution to electrophysics known as the Langmuir postulates, was last month for the second time made the recipient of the Nichols medal of the American Chemical Society. The presentation was made by Dr. William H. Nichols, past-president of the society, who dwelt on the originality and scope of Dr. Langmuir's work. The latter, who was born in Brooklyn, N. Y., in 1881, and was graduated from Columbia University in 1903 with the degree of metallurgical engineer, did post-graduate work in chemistry at the University of Göttingen, Germany, and received the degrees of M. A. and Ph. D. from that institution. In 1906 he became an instructor in chemistry at the Stevens Institute of Technology, Hoboken, N. J., going from there in 1909 to the research laboratory of the General Electric Company, where he has ever since been engaged. To his researches can be attributed much of the advance made in the manufacture of tungsten lamps. Electric heating devices also have been the subject of his investigation. Thus he has devoted himself alike to practical and theoretical research. Dr. Langmuir has been a frequent contributor of papers at conventions of national scientific bodies, notably the American Institute of Electrical Engineers, American Electrochemical Society and American Chemical Society.

IRVING LANGMUIR

Emmet N. Britton has resigned his post as superintendent of gas distribution at Sacramento, Cal., for the Pacific Gas & Electric Company to become associate editor of the *Journal of Electricity*, the Pacific Coast publication of the McGraw-Hill Company. Mr. Britton was graduated from the University of Cailfornia in 1914 and was employed by the Pacific Gas & Electric Company until the United States entered the war, in which he saw active service in France. He is a son of John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies —Notes on Industrial Activities and Business Methods

Magnet Wire Shipments Long Under Heavy Demand

MANUFACTURERS of magnet wire are unable to satisfy the present demand. As far as can be learned there is no mill capacity available under three months, and from that length of time it runs up to nine months in one case. Producers have been carried away by this unprecedented condition, and there is apparently no immediate relief from the situation.

In the case of the cotton-covered magnet wire the greatest factor in the shortage is the dearth of long-fiber cotton. When this supply would increase no one was prepared to say. For enamel wire there was found no particular shortage of enamel, although its price has been constantly increased by the manufacturers. The inability to turn out any more product under present capacity seems to be the main cause.

Low Stocks of Wiring Materials Rule in Boston

A REPORT of conditions in the Boston jobbing industry early in March shows the extent to which stocks have been depleted in ten representative items. In few cases were they at all satisfactory as to volume and range of sizes carried, and in some cases the stock varied from zero to a nominal quantity from day to day.

Out of six representative jobbers, five were entirely out of single-strip and four out of double-strip flexible armored conductor. Four had no metallic flexible conduit and the same number had no loom. Two had no stocks of tubes and only one had any stock of "Nail-it" knobs. There was a certain quantity of sockets in all hands, and each had some pipe and some tape. Cotton lamp cord could be found in small amounts except in one case where there was none. Every jobber was entirely out of at least one of these items, and one was out of all but sockets, pipe and tape.

Fiber Conduit Mills Booked Up to Good Capacity

UTILITIES have been purchasing fiber conduit in large quantities this spring and mill capacities have been booked for many months ahead. The supply of pulp from Canada is in satisfactory condition for all requirements anticipated for the year. Conduit mills are running in a comfortable capacity, but if they are required to resort to extra shifts to supply a sudden demand in the summer it is expected that a price advance will result, possibly to the extent of 20 per cent.

Sufficient material is on hand to satisfy the orders now booked at the prevailing rate, which has held for some time. Additional business for quick delivery would require overtime labor and fresh ordering of raw materials at a rate higher than on those already laid in. Consequently it is of advantage to utilities and others contemplating extensions wherein fiber conduit would be used to place their orders as soon as possible for shipment as far ahead as can be done, in order to get in on present prices. It is known that some large contracts have not yet been placed which undoubtedly will have to be placed before the summer is out. At this time there is a certain amount of capacity which can be turned to shipment in five to six weeks. While the popular demand is for 3-in. conduit, there has been good ordering of 4-in. stock also.

Export business is in fair shape, and although shipping rates are high, there is a good volume going to South America and to Europe. Rates slightly favor European business because of a recent drop.

Good Year Expected in Electric Passenger Car Market

THERE has been little activity in the passenger vehicle market of late. In the East, North and Middle West, where the demand is good, the closed winter has kept down buying and delivery of cars. Dealers state that they expect a very good season ahead and have on hand many cars already sold which they are holding until weather conditions shall permit their delivery. There are very few new cars available, but there is a small number of used cars on hand. New shipments cannot be had under thirty days.

There is an acute shortage of plate glass, and especially of curved plate. Because of this one passenger vehicle producer has changed the design of his body from curved to straight line to eliminate this feature. At the same time the price of the glass is more than double that of a year ago. Otherwise there is no vital scarcity of materials.

The price of the Detroit car is expected to advance by April 1, bringing it to $4,000 and placing it on a par with the Baker. Labor cost is a big factor in this product because of the high grade of hand work which is used in the finish of the body.

Steel Products Slightly Easier with Car Movements

SOME little relief is being afforded the industry in the matter of steel and iron supplies through the movement of freight after it had been storm-bound for weeks. Rigid conduit is being received almost daily in carload lots, but the mass of back orders, accumulated over the period of slack deliveries, is keeping stocks in a very depleted state. Some jobbers have no pipe stocks despite the freight movement. It can hardly be said that production has increased except that slightly better supplies of raw materials have come in to the mills with better car activity. There is no immediate relief to the pipe situation in sight because of the extremely heavy call for pipe for the gas and oil regions.

Mills are booked on conduit far into the future, even to the middle of 1921. Where the mill policy to distributers has been to allow them to order for each month of 1920 delivery up to one-twelfth of their total orders for the year 1919, this policy has been changed since the acceptance of that allotment for January, February and March, 1920. Now the remainder of the 1920 quota has been canceled, with only the first quarter satisfied.

Jobbers are having difficulty in locating pipe for some of their customers and are going to great lengths to gain their ends, but it seldom happens that the pipe is not forthcoming. One New England jobber worked virtually a whole week before he succeeded in placing a paltry single carload order. Shopping among the trade for pipe is a daily occurrence, and a New York jobber finally succeeded in picking up some pipe from a Canadian jobber.

In the flexible armored conductor market the interrupted flow of steel strip has again been resumed and the mills are back on their production basis of a month or so ago. This production, however, is apparently satisfying the needs of the trade from day to day, with the end of the stock almost always in sight before another allotment is received. It is intimated in the steel trade that an advance in price of cold-rolled steel strip is expected rather than not, which in turn would undoubtedly be reflected in a higher price for armored conductor. This would probably be in the nature of a $5 rise per 1,000 feet.

Metal molding is at present scarce, but with the resumption of shipments it is stated that within a month the trade will be in receipt of sufficient to fill its demands.

March Collections in the East Show Falling Off

REPORTS from the industry in the Eastern territory indicate a slight retrogression in the credit situation. Jobbers are watching their collections very carefully and are firmly but quietly pushing overdue accounts. From some sources it appears that industrials are falling behind in their payments, and this has applied not only to small concerns but also to some large factories. Contractors and jobbers too are found in the list. One reason advanced for this is the effect of income tax payments on available funds after a long protracted season of poor shipments and deliveries.

Material billed at time of shipment in January and February has in many cases not been received until well into March, and some is just now coming in. Consequently the consignees, not having had the material to sell, have hesitated to pay in many cases, and collections are suffering; at the same time their receipts have fallen off because of this lack of material and their available funds have been depleted. This, on top of the income tax, is effecting a lower standard of collections at this time. One jobber reports a heavy falling off in discounted bills, and another has noticed it to some extent.

Orders on Hand Unreliable as Basis for Future Business

MANY electrical manufacturers and jobbers in the central part of the country are fortifying themselves against an expected period of depression by shortening up on credit, by taking up their loans as rapidly as practicable and by getting a large volume of orders on their books. After deducting the cancellations which they feel are bound to come they hope to have plenty of unfilled orders to help tide them over the dull period. Deliveries have been so long and uncertain that it has been a common practice to duplicate orders with different manufacturers, and it has been a very general practice to place orders recklessly without counting the cost. This condition seems to have come to an end in some other lines of business, and the electrical industry of the Middle West is beginning to get its own house in order.

The rising interest rates have begun to slow up mercantile activities in the Central States. Many wholesale merchants believe that the peak of prices has been practically reached in mercantile, building and industrial lines and a period of price recession is looked for. Some of the banks have told commercial borrowers that to continue their policy of doing business on the basis of war inflation will extend the period of high interest rates and will lead to ultimate losses. Business men have also been advised to watch the foreign exchange situation and conditions which may grow out of it.

Foreign manufacturers have already established sales agencies in this country, and the rapidly growing volume of imports indicates that foreigners intend to make more and more use of the low rates of exchange to help them compete with local manufacturers in the American market. These increasing imports, especially when coupled with our decreasing exports, will of course tend to improve exchange rates, but the Federal Reserve Bank of Chicago says it will be a slow process. While exchanges are still low, foreign manufacturers expect to undersell Americans profitably in the United States. If imports are allowed to come unchecked and foreigners capture an appreciable amount of American business American manufacturers may expect to build up surplus stocks which they will probably try hard to sell abroad. After business has been readjusted on a peace basis and the process of squeezing the water out of the financial structure has been completed business men in all lines expect an era of big business and true prosperity to follow.

Early Fan Orders Far Surpass Those of Previous Seasons

FROM the standpoint of the manufacturer and the distributer, the fan season is well under way. In fact, it is under way to a much greater extent, according to reports from fan manufacturers, than it ever was before at this time of year. By the first of March, when the Central and Northern parts of the country were snowed in, distributers had so lined up their summer business that various fan manufacturers had booked orders for two, three and even four times the volume booked at this season of the year heretofore. One producer reports his entire capacity up to the middle of June already cared for by his distributers.

This condition shows the encouraging way in which distributers and jobbers apparently have been combining their trade with dealers and showing them not only the possibility but also the probability of unfilled orders if these are not placed until the hot season descends. The difficulties manufacturers are experiencing in obtaining raw materials on time is a great drawback to rushed production, to say nothing of the labor shortage which now exists and which is hardly expected to become any better by the time the summer season is on.

An increase in prices in the neighborhood of 20 per cent over those of last year certainly is not acting as a brake on early-season fan orders. From all appearances the electric fan is out of the luxury class and is being bought for its utility. Of special note is the increase in business being done in the 16-in. types. Orders so far indicate an especially heavy demand for this large size. At the same time it is not expected that the demand for the smaller sizes will in any way fall off, because already the 9-in. and 6-in. sizes are proving very popular in the ordering.

Manufacturers have stated that they expect the season to continue heavy and would not be at all surprised if there still was insufficient producing capacity to satisfy it. A hot spell last June played havoc with some jobbers' stocks. A similar hot spell this coming June probably would not have the same effect because of the heavy advance ordering, but a second one following closely on the heels of the first would without doubt find some jobbers with a pretty badly broken assortment of fans. The situation as a whole, however, is on a very satisfactory basis, especially compared with that of former years. Many carloads of fan motors have already found their way into distributers' warehouses, while more are still en route from factories.

Quick Unloading of Freight Helps Relieve Car Shortage

THE seriousness of the car shortage is daily being brought home to electrical manufacturers and jobbers. Certain railway companies are demanding that their cars be sent back to their own lines immediately—cars which had been allotted to other lines while the roads were under Government control. In cases this insistence has been so great that freight cars have gone back empty where with a little manipulation they could have picked up a load, although at a cost of a few days' further delay. This recall of cars to their home lines is undoubtedly going to cause a still greater car shortage than now exists on certain lines and divisions, but it will benefit the home lines.

Pressure is being brought to bear on industrial plants and business houses to expedite the unloading of freight and the release of greatly needed cars for service. This pressure might well be applied, it seems, to the element which is refusing to handle freight at this time along the Atlantic seaboard. Here hundreds of cars will remain loaded with the materials which normally would have quickly been transferred but for which there is no storage space except the very cars in which they came.

Very heavy weather conditions have held up cars throughout the whole winter season, but particularly from the first of the year on. It is only now that some of them are finding their way to their destinations and helping to relieve the critical situation that exists. One manufacturer reports that of one hundred cars ordered from the railway to remove finished products from his factory only nineteen were sent, and of this number nine were unfit for use because they leaked so badly it would have been unsafe to trust the materials to them. One jobber reports the receipt of rusted heating devices in a recent shipment made during a storm. It has been virtually impossible to withdraw cars from service for repairs because they were so badly needed. Recent orders placed with car builders promise to give some relief to this situation in the near future. With the condition of steel deliveries this relief is even more likely, because it is understood that steel for railway purposes is getting the preference over that for other industries.

Many manufacturers have resorted to express shipments, and although units have been limited to 200 lb. each, a great amount of material has been delivered in this way. A report just received gives freight shipments from Schenectady to New York City at thirty days, while express is coming through in ten days. Furthermore, manufacturers have of late been using the parcel post for shipments up to 50 lb., and a surprising amount of business is being handled in this way. The consumer, it is said, pays the bill in the end.

It cannot be too strongly urged that manufacturers and all others handling freight expedite in every possible way the unloading of cars in order to effect a quick turnover of rolling stock.

Metal Market Situation

COPPER has been moving in large quantities since last Saturday, and the market is extremely strong. Producers are holding their price at 18.75 cents for April, May and June delivery and are showing no desire to sell for third quarter. With all the purchasing, copper consumers are known to be without enough of the metal to last over the second quarter, and further activity in the market is expected.

The second-hand market is rather inactive, and dealers have been playing the part of lookers-on, believing that the price is going to 19 cents at least within a few days and desiring to hold off and see. This price of 19 cents is relatively low for copper when present costs of production are considered. In fact, copper prices show less rise over pre-war prices than those of other metals.

NEW YORK METAL MARKET PRICES

	March 16	March 24
Copper	£ s d	£ s d
London, standard spot	107 0 0	108 0 0
	Cents per Pound	Cents per Pound
Prime Lake	18.50 to 18.75	19.25
Electrolytic	18.12½	18.75
Casting	17.87½	18.37½
Wire base	22.25	22.50
Lead, trust price	9.25	8.85 to 9.15
Antimony	11.00	10.75
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.00	12.50
Spelter, spot	8.85 to 8.95	8.85
Tin	62.00	60.75 to 61.25
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.50 to 16.00	16.00 to 16.50
Brass, heavy	10.00 to 10.25	10.00 to 10.25
Brass, light	8.50 to 9.00	8.50 to 9.00
Lead, heavy	7.75 to 8.00	7.75 to 8.00
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

CONSIDERABLE activity is reported from virtually all over the country, but in particular from New England, the Middle West and the South. The New York district is not quite up to the mark.

Shipments are coming through in a little better shape, but the supplies of pipe, conductors, loom and other materials which do come in are immediately prorated on back orders and shipped out again. Wire stocks are good except in the Chicago district. All the specially covered wires, such as magnet wire, cords and annunciator wire, are in very bad shape and deliveries are at best three months off. In sections far from the mills schedule materials are very low in stock, although the mills are getting out better production.

Building is active all over the country except in New York City. There it is almost stagnant. Strikes in certain parts of the building trades are keeping builders out of the market because of the risk of shut-downs if they should start operations. Housing projects and private building are progressing well.

Collections as a rule are good but are being closely watched.

NEW YORK

Demand for electrical supplies is not quite up to that experienced by the trade in the latter months of 1919. Of course, the shortage of many materials is holding back some business, but few jobs, it appears from reports, are really suffering because there is no equipment to complete them. One jobber thinks he could increase his business 30 per cent if he could get materials. Probably most jobbers are in a similar condition, but a big part of this increased business undoubtedly would go to fill back orders and be spread around for stocking purposes.

The delivery situation has bettered to some degree but is very far from satisfactory. Small shipments are coming in, it is true, but in many cases they are shipments that have been in transit since January and February. This is reacting on credit standing with billings up to two months ahead of receipt of goods. Collections are off a bit, possibly because of the influence of income-tax payments, but are being watched carefully and followed closely.

Building is almost at a standstill in New York City because of labor unrest and its apparent unwillingness to feel any responsibility in relieving the housing situation. Suburban building is progressing at a fair rate, but reaction from the city is felt there, too.

Flexible Armored Conductor.—Shipments from factory are coming through better with the release of cars, but stocks are extremely spotty and at best are low and do not last. Where the material exists jobbers are getting about $98 for No. 14 double-strip in the largest quantities they can sell, and up to $120 in small lots.

Sockets.—Here and there small stocks of pull chains may be found, while key and keyless are worse yet. Apparently manufacturers, to fill the demand for pulls, put so much energy on that type that production of the two other types suffered.

Rigid Conduit.—Small amounts of pipe are coming in, but here and there stocks are flat. Car releases should help the situation any day.

Non-Metallic Flexible Conduit.—Occasionally a jobber is found with what could be called a fair stock, but in general little is available. Some jobbers have none. A price of $45 per 1,000 ft. is being received for $\frac{7}{32}$-in. loom.

Lamps.—Stocks in general are good, but unlooked for heavy orders are breaking holes in stocks of some distributers. In several cases the 75-watt size is short.

Bare Wire.—Base is holding at 22.50 cents, but a rise would not be unexpected. Large sizes are plentiful, but small sizes around No. 30 are in great demand for use with textiles.

Wire.—Rubber-covered business attracts no special attention and stocks are good. Shipments are around ninety days, and base price is holding around 28½ cents on an average. Jobbers' prices in 10,000-ft. quantities for No. 14 are around $11.50, and from this up to $13.50 for smaller quantities. Weatherproof base is holding around 28 cents, with an increasing demand and shipments about six weeks.

Batteries.—Dry-cell sales are being limited in many cases to available stocks. The spring demand is good, but shipments are poor.

Lamp Cords.—Cotton and silk cords are available only in extremely limited amounts. No. 18 twisted cotton lamp cord is selling at $23.25, while as high as $65 per 1,000 ft. has been paid for No. 18 parallel silk cord in 25,000-ft. quantities.

BOSTON

Business remains intensely active. A leading jobber reports 125 per cent larger sales in February than ever before for that month. Traffic tie-ups and delays merely slowed down orders for a short period, and conditions are gradually improving as regards freight movement, although the situation is still most unsatisfactory. Pressure is being brought to bear upon industrial plants and business houses to expedite unloading freight and release greatly needed cars for service. Jobbers' stocks are irregular and are very low in porcelain, rigid conduit, outlet boxes and loom. Building and engineering contracts exceed all previous records, the total placed for 1920 to March 18 in New England being $66,110,000.

Collections are somewhat improved. Prices show little change.

Wire.—Although one jobber had a million feet of No. 14 rubber-covered wire on hand at the end of the week, there is expectation of a shortage in this size and type in some wholesale circles. The demand is active, and rubber-covered, No. 14, is quoted around $11.50 per 1,000 ft. in 5,000-ft. lots and $13 for lesser quantities. Weatherproof is on a 30-cent base and bare on a 23-cent to 24-cent base. A good supply of heavy cable is understood to be available.

Dry Cells.—An advance of 5 cents per 100 cells has been effected to cover increased freight charges. No. 6 cells are quoted at $32.95 and igniters at $33.95 per 100, with good stocks. Small dry cells are moving well.

Lamps.—It is getting harder to meet demands, and some jobbers' stocks reflect shortened lines, especially in 75-watt and 100-watt units.

Flexible Armored Conductor.—Prices are firm, No. 14 single-strip bringing $105 per 1,000 ft. in coil to 1,000-ft. lots. Stocks are low and demand vigorous.

Non-Metallic Flexible Conduit.—Stocks are shot to pieces, very little loom being on hand. Quotations are steady at $37 per 1,000 ft. for 7/32-in. and $40 for ½-in. in coil to 1000-ft. lots.

Knobs and Tubes.—The flood of orders has virtually cleaned out the stocks even of leading jobbers. One of the most reliable houses had no Nail-it knobs or 3-in. tubes on hand at the week-end. These tubes are quoted at $9 per 1,000 in standard packages, and Nail-it knobs at $28 per thousand in barrel lots; but prices mean little in the present scarcity of material.

Sockets.—Pulls are easy at 47.5 cents each in case lots, keys at 28 cents and keyless at 26 cents, with plentiful supplies. For the present this material is coming through finely.

Rigid Conduit.—Famine conditions threaten, if indeed they have not already arrived. One jobber spent practically a week before succeeding in placing a carload order, and the mills are talking for 1921 delivery. Local stocks are hard hit, and shipments are being parceled out as much as possible. Card 44 prices obtain, with a decided stiffening in quotations. Black pipe, ½-in., brings $85.43 per 1,000 ft., and galvanized $90.53. The ¾-in. black is quoted at $113.28 and white at $120.18.

Foot-Candle Meters.—A vigorous demand has lately sprung up among central stations and contractor-dealers.

Electric Passenger Cars.—A 10 per cent advance took place last week in the factory prices of Detroit electric automobiles. Glass and tires are short. Sales of electric delivery wagons to bakers are features of the markets in Boston and Providence.

Appliances.—Staple domestic labor-saving devices continue in great demand.

CHICAGO

Local developments having to do with the immediate future of the electrical trade, particularly in schedule material, have during the past week been very encouraging. The height of buildings permitted under the municipal code was increased from 200 ft. to 260 ft., and it is anticipated that numerous projects which have been held up on account of the difficulty of erecting a building within the prescribed limits that would earn sufficient revenue will now go ahead.

The building trades labor outlook, which looked stormy for a time, bids fair to clear up. Letting of construction contracts and issuing of building permits are proceeding at a rate sufficient to promise a busy season for contractors. This week's building permits were slightly over $1,000,000. Expansion is the order of the day among electrical manufacturers in this district.

Market conditions in the main are unchanged. Orders continue to pile up in the back order files and prices remain steady. Large retailers announce the adoption of a policy of closely co-operating with national advertisers in their sales efforts of the future.

Bare Copper Wire.—Better deliveries are obtainable in this commodity than on any other item in the electrical line. Price is up a cent to a 24-cent base. In 200-lb. lots No. 8 is quoted at $25.25 per 100 lbs. and No. 12 at $25.50. In larger quantities prices are $24 and $24.50 respectively.

Rubber-Covered Wire.—Demand exceeds supply to such an extent that deliveries are six months in arrears. Orders are accepted on basis of price ruling at time of delivery. Current shipments are being billed from Chicago at $12.50 per 1,000 ft. for No. 14 and $17 per 1,000 ft. for No. 12 in 5,000-ft. lots, $11.25 for No. 14 and $16 for No. 12 in larger quantities.

Line Material.—No further price changes are reported and a slight recession in buying pressure is noted. It is felt that this can be attributed to the general financial condition rather than to any curtailment in the plans of power distributing concerns.

Locust Pins.—The advance in jobbers' price which was forecast last week has not yet gone into effect. Price ruling now on 1½-in. x 9-in. is $48 per 1,000. Deliveries are ranging from prompt to six weeks.

Lamps.—Trade in common sizes is holding up well and, barring transportation troubles, deliveries are good.

Electric Signs.—Manufacturers report excellent business with no price changes recently. Difficulties in securing raw materials are slowing up production and will undoubtedly soon result in advances.

Washing Machines and Vacuum Cleaners.—A "dollar-down sale" conducted by the Commonwealth Edison Company two weeks ago was very successful and will cause the March retail sales of these items to be considerably above par. Manufacturers are falling behind on orders and favored makes are hard to get.

Farm-Lighting Sets.—Announcement is made by the manufacturers of "Delcolight" sets as follows: Price on No. 216, a ¾-kw. outfit with large battery, is advanced to $580; No. 208 has been withdrawn from sale; additions are made for the line of a ½-kw. set with small battery at $395; a ½-kw. set with large battery is $495 and 1-kw. set with large battery is $595. Distributers will increase discounts to A and B dealers, the new figures not having been made public.

ATLANTA

All indications point to a continued brisk demand for material entering into building and home construction. Even with the high prices of building material there has been no appreciable slackening in the erection of business houses, manufacturing plants and dwellings, and new construction is announced daily.

Continued difficulty is experienced in obtaining supplies of material requiring steel, cotton or porcelain. The car shortage is aggravating shipping conditions, with resultant difficulty in obtaining supplies of commodities from manufacturers. Shipments are coming through very slowly. Jobbers anticipate, however, that spring weather will assist in relieving this shortage and that large quantities of material already shipped will be delivered shortly. Building permits in the city of Atlanta from March 1 to March 15 amounted to approximately $500,000. Bank clearings continue to show a 30 per cent increase over the corresponding period of last year.

Conduit.—No change for the better in stocks is to be noted, the situation continuing acute, especially in the popular sizes.

Wire.—Good shipments have enabled jobbers to accumulate fair stocks of weatherproof and rubber-covered, despite brisk demands. Satisfactory quantities of No. 6, No. 8 and No. 10 are, however, not yet on hand. Jobbers report varnished-cambric cable very difficult to obtain and there are no stocks of moment in the territory.

Schedule Material.—No improvement in schedule material stocks can be reported; in fact, poor deliveries coupled with brisk demands are serving materially to deplete stocks throughout this section. Prices are quoted as follows: Key sockets, 49 cents; snap switches, single-pole, 5 amp., 42 cents; fuse plugs, 8 cents; split knobs, $3.20 per 100; friction tape, 60 cents per pound.

Flexible Armored Conductor.—Some improvement is to be noted in the available supplies of this article. Orders placed several months ago are beginning to come in and are serving to relieve somewhat the shortage that has existed for several weeks. Prices are quoted as follows: No. 14, two wire, 250 ft. to 1,000 ft., $12.22 per 100 ft.

Non-Metallic Flexible Conduit.—Despite the receipt of orders placed six months ago, there are still far from sufficient quantities of this material available on local markets. Jobbers do not offer much encouragement for the betterment of the situation. Prices are quoted as follows: 250 ft. to 1,000 ft., $\frac{3}{16}$-in., $6; $\frac{7}{32}$-in., $5.50 per 100 ft.

Pole-Line Material.—The greatest demand for several years is noted in all lines of pole-line material. The shortage in cross-arms due to the lumber situation and in pole-line hardware is holding up the construction of a quantity of proposed extensions. Chestnut poles are quoted: 30 ft., $5.75; 35 ft., $6; cross-arms, pine, four-pin, 4 ft., 77 cents; six-pin, 6 ft., $1.15.

Portable Drills.—Heavy buying has badly depleted local stocks. Jobbers report a growing appreciation of this labor-saving device and predict a steady increase in the demand for it. A number of jobbers are placing orders in quantities. Shipments are reported from three to six weeks.

SEATTLE—PORTLAND

Conditions in the electrical industry in Seattle and Puget Sound cities show no particular change over those of the past two weeks, except that stock shortages along nearly all lines are becoming more acute. This condition exists in the face of a brisk demand, especially for schedule materials, including house-wiring devices of all kinds, labor-saving devices and fractional-size motors. Pre-spring building, which continues to show increasing growth, is liable to be retarded to a considerable extent unless portion shipments of schedule materials and wiring devices arrive at an early date. Advices from the Gray's Harbor country and western Washington points state that the shortage of certain materials is serious and that building is being held up.

Manufacturers' representatives in the Portland district report that there is a very good demand for goods, but that the general bulk of business is slow on account of such a shortage in supply. They report a great scarcity in motors of all lines and that deliveries are long for practically every line of material and apparatus. Six or seven months' delivery seems to be about the best that can be obtained.

Spokane jobbers report general volume of sales increasingly good and building showing noticeable increases from week to week. Small motors for grain elevators, fruit canneries, garages, etc., are showing fine movement, and recently several sales of moment of electrical apparatus for mining uses were noted. The prime activity, however, is still confined to household appliances, especially washing machines, ranges and sewing machines. The movement of toasters, flatirons, percolators, etc., is well sustained.

Metallic Flexible Conduit.—There has been a noticeable increase in demand which so far has been met, but stocks are running perilously low. Shipments are coming through very slowly.

Conduit.—Stocks are practically exhausted in the case of nearly every jobber and shipments are negligible. Fortunately, in the face of shortage or entire depletion of stocks in many cases, the demand is light.

Flexible Armored Conductor.—Very poor stocks are reported and the demand far exceeds available supply. Shipments due in Seattle but still on the road will do much to relieve the local situation.

SAN FRANCISCO

Building continues brisk, with many residences and apartment houses under construction. No very large structures are under way, but there is much business in remodeling stores. Electrical firms are making a gratifying showing in this respect. Sales of heating devices are very good. Household devices are held up in some cases by poor deliveries, but in general continue lively. Collections are good; in fact, the recent continued rains have revived the usual state of optimism.

Heating Devices.—Percolator stocks are especially poor as only a few of the pot styles are to be had. Some factories will not accept orders for percolators until they shall be able to cope with present orders on hand. A rather mild winter has hurt the heating-pad sales, and dealers are carrying over good radiator stocks for next season. Some manufacturers are soliciting advance orders for 1921 radiators.

Fixtures.—"Duplexalites" have advanced from 25 to 50 per cent on various styles, and some dealers are inclined to be pessimistic over the effect of this advance, claiming that it will chill the growing business. Jobbers' stocks are good, and dealers who have gone after the business report a receptive public.

Plugs.—Jobbers report good stocks and good demands for attachment plugs, especially in the higher priced separable types. Price does not seem to influence sales except in the case of a few manufacturers of products employing attachment plugs who sometimes specify one-piece plugs on a bid basis.

Sockets.—Pull candelabra sockets are very popular just now and Coast stocks are exhausted. Firms making special portables and fixtures for the remodeling of the finer shopping stores and cafés are responsible for this unusual demand.

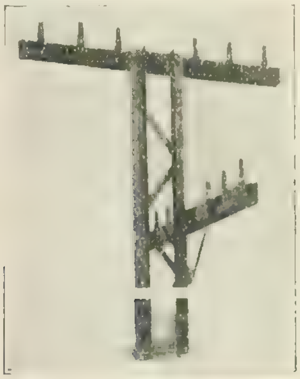
Vacuum Cleaners.—Slow deliveries are rather hurting the sales, but it is a fact that the special makes, which are not legitimately represented on the Pacific Coast, seem to be getting the bulk of the business. There is more and more of a tendency on the part of dealers to stock many different makes, but the shrewder dealers are limiting their stocks to one or a limited number of types and such dealers report good turnovers. Prices are very steady. Few dealers are availing themselves of the collecting services of banks.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Steel Extension Pole Top

The steel extension frame designed for adding 10 ft. or 15 ft. to the length of wooden poles which is made by S. W. Hull & Company, 3729 Prospect Avenue, Cleveland, Ohio, has been improved so that it will fit on any pole from 6 in. to 10 in. in diameter and will hold a crossarm at right angles to the direction of the main line.



FITS 6-IN. TO 10-IN. POLE

Automatic Starter With Cast-Iron Inclosing Case

An automatic starter of the inclosed type, which may be operated by a self-contained knife switch with external handle or controlled from a remote point by a push-button master switch, has recently been put on the market by the Cutler-Hammer Manufacturing Company of Milwaukee and New York. This starter is for use with small direct-current motors not rated over 2 hp. at 115 volts or 3 hp. at 230 volts. The automatic feature is obtained by an accelerating contactor which closes when the motor attains about three-fourths full speed and automatically shunts out the starting resistor. A magnetic main-line contactor mounted on the panel allows remote control from two push-button switches of the momentary-contact type. A common snap switch, a float switch or a pressure regulator can also be used for remote control of the motor. When remote control is not desired the magnetic main-line contactor is omitted and the motor is controlled by a fused knife switch mounted on the panel with an operating handle outside of the case. The handle can be locked in the open position to prevent unauthorized operation. Interlocks prevent lifting the cover while the switch is closed.

WHEN SWITCH IS "OFF" COVER CAN BE LIFTED

Collapsible Canvas Bag for Linemen

A collapsible canvas bag with wooden bottom for carrying linemen's tools, insulators and other objects has been developed by the Industrial Products Company, 1001 Chestnut Street, Philadelphia. A large rope loop at the top answers the purpose of a handle, and a smaller rope at the side forms a hook for putting over an insulator pin. There are no metal parts to come in contact with live wires. The width of the bag is such that it will pass between circuits. This bag can be used for carrying material up and down the pole and also for holding tools and other implements on the crossarms

Coil Winder and Shaper

A coil winder and shaper has been developed and patented by the Palmer Electric Company, 60 Park Place, Detroit, Mich. This piece of apparatus, according to the makers, can be made to wind and shape any size of coil, from the hairpin to the diamond style, which is almost entirely used today in direct-current armatures, two-phase and three-phase stators and single-phase rotors. At present the new winder is being made in two sizes, except on special orders. The smaller size makes coils up to and including 7.5 hp., 1,700 r.p.m., and the larger one from 2 hp. to about 35 hp.

Lighting Unit with Appliance Receptacle

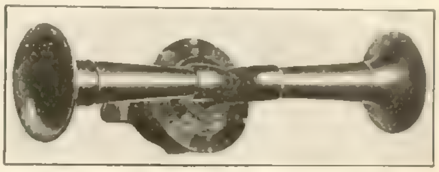
The Luminous Unit Company of the St. Louis Brass Manufacturing Company, St. Louis, Mo., is now equipping Brasscolite reflectors with a separate plug receptacle for attaching toasters, electric irons or other appliances. The receptacle is on the under side of the reflector and is intended to facilitate the use of table appliances and other electrical household equipment.

Twelve-Inch Oscillating Fan

The Pittsburgh Electric Specialties Company, 447 Greenwich Street, New York City, is offering this year a 12-in. oscillating fan, in addition to its 8-in. and 10-in. sizes. The fan is in black japan finish, with brass-finished blades, and is adjustable for desk or wall use. The motor has three-speed regulation on alternate or direct current. The fan can be used as either a straight or an oscillating device. and is equipped with cord and plug. Its shipping weight is 18 lb.

Double-Horn Factory Signal

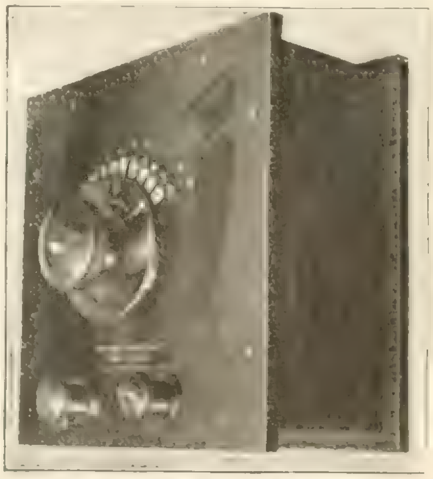
A double-horn factory signal has been developed by the Benjamin Electric Manufacturing Company, Chicago, Ill. This signal is designed to be placed in a passageway where it is desired that the sound be projected both ways along the direction of the passage. The body is cast brass and is tapped for conduit.



TO BE PLACED IN CORRIDOR

Ten-Step Variable Inductor

A ten-step variable inductance made by the Clapp-Eastham Manufacturing Company, 139 Main Street, Cambridge, Mass., consists of a single coil wound with a view to obtaining small distributed capacity and low resistance to high frequency currents. The ten taps are brought out to a dead-end switch to eliminate dead effects when only a portion of the coil is in use. The inductance at 1,000 m. may be varied from 1.25 to 254 millihenries. When used with a variable condenser of 0.001 mf. it is said that all wave lengths from 1,000 m. to 30,000 m. may be obtained. It is mounted in an oak box with bakelite cover measuring 6 in. x 6 in.



INDUCTANCE VARIED BY TURNING THE HANDLE

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE SUNBEAM ELECTRIC MANUFACTURING COMPANY, Evansville, Ind., has increased its capital stock to $275,000.

THE PRECISION INSTRUMENT COMPANY has removed its factory from Detroit, Mich., to 21 Halsey Street, Newark, N. J.

THE BLUEBIRD MANUFACTURING COMPANY, St. Louis, Mo., has increased its capital stock from $1,000,000 to $4,500,000.

THE NATIONAL INSULATING COMPANY, Lamberton, Ohio, plans to erect a new plant, 80 ft. x 216 ft., at Parkersburg, W. Va.

THE INTERNATIONAL BATTERY COMPANY, Grand Rapids, Mich., has taken over the property and holdings of the Monarch Storage Battery of Grand Rapids.

THE AMERICAN RADIO & RESEARCH CORPORATION, New York City, is constructing a new plant for the manufacture of ¼-hp. motors.

THE POWER EQUIPMENT COMPANY, 343 South Dearborn Street, Chicago, is planning to build a one-story plant, 124 ft. x 150 ft., to cost about $50,000.

THE LAPP INSULATOR COMPANY, Leroy, N. Y., manufacturer of electrical porcelain insulators, has increased its capital stock from $150,000 to $500,000 for business expansion.

THE ELECTROMECHANICAL COMPANY, 530 North Calvert Street, Baltimore, Md., will occupy a four-story building at Calvert and Franklin Streets, which is being remodeled.

THE B. & K. MANUFACTURING COMPANY, New Britain, Conn., manufacturer of portable lamps, has announced the removal of its plant to 62 Franklin Street, New Haven, Conn.

THE UNIVERSAL BATTERY COMPANY, 3410 South La Salle Street, Chicago, is planing to build a two-story plant on Wentworth Avenue, near Thirty-fifth Street, to cost about $100,000.

THE NEW ENGLAND INCANDESCENT LIGHTING COMPANY has leased the building at 258 Elizabeth Street, New York City, to be used for a new electrical specialty works.

THE UNITED STATES LIGHT & HEAT CORPORATION, Niagara Falls, N. Y., has awarded contract for an extension to its acid plant at Highland Avenue and New York Central Railroad, to cost about $50,000.

WILLIAM R. ROOT, who has been in the slate business in Virginia for a number of years, has been appointed sales manager of the American Steam Conveyor Corporation, manufacturers of ash-handling plants, Chicago.

THE NATIONAL CARBON COMPANY, Niagara Falls, N. Y., has awarded contract for construction of a one-story brick and steel furnace building, 85 x 320 ft. at its plant, to cost with equipment about $150,000.

THE AMERICAN MANUFACTURING COMPANY, Dayton, Ohio, recently incorporated with a capital stock of $100,000, has taken over the property of the Pasteur-Chamberlain Company and will manufacture washing machines.

THE AMERICAN ELECTRICAL HEATER COMPANY, 1351 Woodward Avenue, Detroit, Mich., has had plans prepared for the construction of a two-story and basement plant, 30 ft. x 130 ft., on Conner Avenue, Hamtramck, Mich.

THE STANDARD ELECTRIC TOOL COMPANY, Cincinnati, Ohio, has increased its capital stock from $40,000 to $75,000. New equipment, it is understood, will be purchased to increase its production of electric drills and grinders.

THE MOLONEY ELECTRIC COMPANY, St. Louis, Mo., has opened an office at 451 Ellicott Square Building, Buffalo, N. Y., under the management of J. Leo Scanlon, who formerly represented the company in Iowa and adjacent territory.

THE WAITE & BARTLETT MANUFACTURING COMPANY, 252 West Twenty-ninth Street, New York, N. Y., manufacturer of electrical equipment, plans to remodel a five-story building at Jackson Avenue and Fifth Street, Long Island City, for a new plant.

THE MANHATTAN ELECTRIC SUPPLY COMPANY, 17 Park Place, New York City, manufacturer of electrical specialties, has leased the building at 423 Broome Street, New York City, for ten years, which it will use for general manufacturing purposes.

THE APEX APPLIANCE COMPANY of Chicago is planning the construction of a branch plant at Oakland, Cal., to have an initial capacity of 20,000 electric washing machines annually. This company also manufactures vacuum cleaners, ironing machines and similar appliances.

THE WAGNER ELECTRIC MANUFACTURING COMPANY of St. Louis has moved its Buffalo office to 16 Carlton Street and has opened a service station at the same address. Alfred W. Baldwin, who has been connected with the company for a number of years, is in charge as branch manager.

THE DOMESTIC ELECTRIC COMPANY, Cleveland, Ohio, manufacturer of small motors, has taken over the plant of the Vahan Products Company at St. Clair Avenue and East Seventy-third Street, which it will soon place in operation. The company will retain its present quarters in the Whitney Power Block.

THE WESTINGHOUSE LAMP COMPANY, 165 Broadway, New York, N. Y., has had plans prepared for the erection of a four-story building, 80 ft. x 550 ft., at its plant in the Watsessing district of Bloomfield, N. J. The cost of the structure, including machinery and equipment, is estimated at about $1,000,000.

A. S. WINTER, formerly advertising and sales manager of the William Powell Company, has joined the sales force of the Fairbanks Company of Pittsburgh, Pa., and will represent the company in Southern Ohio. Mr. Winter's address will be 3126 Vine Street, Cincinnati, Ohio. He will handle Lincoln motors among other things.

THE UNION LAMP COMPANY, Union Hill, N. J., recently organized, plans to establish a plant to manufacture nitrogen lamps. The proposed plant will have a capacity of 2,000 lamps per day. Charles Levy, formerly sales manager of the Weehawken (N. J.) Tungsten Lamps Company, is at the head of the new company.

THE GENT-JEWETT ENGINEERING COMPANY, 12,369 Euclid Avenue, Cleveland, Ohio, was recently organized as successor to the Electro-Call Signal Company of Cleveland. The new company will retain the trade name "Electro-Call" and will continue the manufacture of Electro-Call equipment and other electrical specialties.

THE RELIABLE ELECTRIC COMPANY, Chicago, maker of lightning protection devices for telephone equipment, splicing sleeves for aërial and underground conductors and various other apparatus, has placed under construction an addition to its plant which will cost $75,000 and increase capacity by about 50 per cent.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, in April will move its offices and iron and wood-working departments into a new building across the street from the old plant. The other departments will expand to the limit of space left by these departments, the effect being practically to double the company's space and capacity.

THE LANGSTADT & MEYER COMPANY, Appleton, Wis., is erecting a two-story machine shop for manufacturing self-contained electro-generating systems and is also enlarging its automotive electric service and contracting branches at Green Bay and Oshkosh, Wis. The company recently increased its capital stock from $50,000 to $400,000.

THE FOUNDATION COMPANY, Woolworth Building, New York City, has purchased the twelve-story office building at 120 Liberty Street and will occupy five floors about May 1. This will give the company use of about 18,000 sq ft. of space at the start, which will be increased as present long leases expire. The building will be known as the Foundation Building.

THE WESTINGHOUSE UNION BATTERY COMPANY, recently organized by Westinghouse interests, is arranging for the occupancy of three floors of one of the buildings at the plant of the Union Switch & Signal Company, Swissvale, Pa., for the manufacture of electric storage batteries. A new plant, it is understood, will be built for the company at a later date adjoining the Swissvale works.

THE DRIVER-HARRIS COMPANY, of Harrison, N. J., manufacturer of electrical resistance wires, special alloys and pure metals for electrical, mechanical and chemical uses, is now putting up a three-story building, 52 ft. x 100 ft., to which will be added a 100-ft. extension. The company contemplates the erection of another large building later in the year. Its capitalization has been increased to $3,000,000.

THE WESTERN ELECTRIC COMPANY announces that it will proceed immediately with the construction at Hawthorne, Ill., of three new six-story-and-basement additions to its telephone apparatus department, aggregating 277,000 sq. ft.; a four-story and basement warehouse, to contain 150,000 sq.ft., and a small packing-material factory. The company is making additions to its branch houses in sixteen different cities.

THE GENERAL ELECTRIC COMPANY has announced the appointment of E. W. Lankenau as head of the new plant of the company at Decatur, Ill., where small motors will be manufactured and where it is expected operations will begin some time this spring. Mr. Lankenau has been connected with the Fort Wayne (Ind.) plant for a number of years and, during the past year, was assistant general foreman of the small-motor department of that plant.

THE ELECTRIC EQUIPMENT COMPANY has been formed in Boston, Mass., by John I. O'Brien and Carlton N. Merrill for the purpose of dealing in new and used electric motors and dynamos, making repairs on electrical machinery and wiring for and installing all kinds of electrical equipment. Both members of the firm have been connected with the Carl G. Miller Company of Boston many years. The company is established at 161 Summer Street, Boston.

THE H. S. WHITING COMPANY, INC., 104 East Forty-first Street, New York City, has taken over the manufacture of the lighting fixtures formerly brought out by J. Livingston & Company, Inc. The new company will manufacture and distribute the "Livingston Economy Light" (licensed under Duplexalite Corporation patents) and other commercial units, operating with practically the organization that heretofore constituted J. Livingston & Company's commercial department.

THE UTILITIES ENGINEERING & AUDIT COMPANY, Crawford Building, Topeka, Kan., has been organized for the purpose of preparing valuations and appraisal of industries and utility properties and also for making rate investigations and financial reports. John M. Kinkel, formerly chairman of the Kansas Public Utilities Commission, and Paul L. Grady, formerly acting chief engineer of the same commission, are members of the firm. Herbert B. Couch, formerly electrical engineer of the Nebraska commission, has recently joined the organization.

THE HAMILTON-BEACH CARPET WASHER COMPANY, with general offices at 114 Liberty Street, New York City, has been organized to manufacture and market the new Hamilton-Beach electrically operated carpet washer which was described on page 731 of the Sept. 27, 1919, issue of the ELECTRICAL WORLD. In its sales policy the new company will follow the Goodwin idea of distributer-dealer-consumer channels. The new rug and carpet washers are ready for immediate delivery, it is said. F. J. Osius is president of the company, and Frederick Riebel, Jr., who for ten years was connected with the Westinghouse Electric & Manufacturing Company, is general sales manager

GENERAL ELECTRIC TO BUILD PORCELAIN PLANT. The General Electric Company will build a porcelain manufacturing plant at Pittsfield, Mass., in connection with its existing works, utilizing local clay in this product. About 300 additional employees will be required when the plant is placed in operation. The estimated cost of the new plant is $250,000. The company is now building a wire-insulating factory more than 400 ft long at the Pittsfield works and has carried the reinforced-concrete construction work along during the recent cold weather by the application of localized heating methods. At present the demands upon these works are exceeding their capacity.

F. W. KENNEDY, formerly assistant business manager of the ELECTRICAL WORLD, resigned on March 1 to become sales manager of the Kleinschmidt Electric Company, Inc., manufacturer of automatic printing telegraph and fire alarm telegraph apparatus, Sperry Building, Manhattan Bridge Plaza, Brooklyn, N. Y. Mr. Kennedy, a 1909 electrical engineer of Columbia University, has been connected with engineering work on New York harbor fortifications, was for a year and a half with the General Motors Company as claim manager and sales engineer of its export company and truck company, and before becoming connected with the ELECTRICAL WORLD in 1914 had been assistant works manager of the Diehl Manufacturing Company, Elizabeth, N. J.

THE AMERICAN STEAM CONVEYOR CORPORATION, 326 West Madison Street, Chicago, Ill., announces the appointment of the Kon-Wald Engineering Company, Buffalo, N. Y., as its representative in Buffalo and western New York. F. A. Konzelman is manager of the latter company. The Brooks-Fisher Company, Atlanta, Ga., has been appointed Southeastern representative of the American Steam Conveyor Corporation. The Brooks-Fisher Company was organized last summer to carry on the business of manufacturers, agents and contractors. J. M. Fisher was for fifteen years in the erection department of the Babcock & Wilcox Company, and for the last six of these years he was district superintendent for the Atlanta territory. E. A. Brooks, the other member of the firm, was up to the time of the organization of the company, assistant sales manager for the Atlanta office of the Babcock & Wilcox Company.

Supply Jobbers' Notes

THE WESTERN ELECTRIC COMPANY has recently established a new warehouse at Nashville, Tenn., to serve from that city all the territory in Tennessee formerly assigned to Cincinnati. Karl B. Mayer, formerly with the Dallas house, is store manager of the new warehouse.

THE ACME STORAGE BATTERY CORPORATION, Poughkeepsie, N. Y., has changed its principal product from house-lighting batteries to starting and lighting batteries of the automobile type. The capital stock of the company was recently increased from $100,000 to $175,000.

FREDERICK RALL, manufacturers' agent of electrical appliances, 19 Park Place and 16 Murray Street, New York, N. Y., about May 1 will move to 38 Murray Street. At the new location he will have double the floor space provided at the present quarters and will carry a complete stock of the products of the O. C. White Company of Worcester, Mass.; the Trumbull Vanderpoel Electric Manufacturing Company, of Bantam, Conn., and the Jewell Electrical Instrument Co. of Chicago, Ill. With increased space Mr. Rall is negotiating for additional accounts.

THE COMMERCIAL ELECTRIC COMPANY, 42-50 East Congress Street, Detroit, Mich., through F. W. Woolrich, president, announces its decision to discontinue a certain part of its regular jobbing business, and in the future it will confine its efforts and sales to the following: Westinghouse products, including motors, fans, ranges and heating appliances; Hamilton-Beach products, "Economy" renewal fuses, Westinghouse lamps, Cutter material, lighting specialties such as "Brascolites," "Industrolites," "Aglites," X-ray reflectors and Cutter "Sol-lux" industrial lighting fixtures; Bluebird electric clothes washers, Roma ironing machines, Free-Westinghouse sewing machines, vacuum cleaners, dishwashers and other household electrical appliances. At the present time the company catalogs and carries in stock about 500 different items. Under the new management it will reduce its lines to about twenty commodities. The new policy of the company will definitely establish a basis of wholesale distribution only, and both dealers and contractors will have the assurance that nothing will be sold at retail nor will any counter trade be permitted. No broken package orders will be accepted.

Foreign Trade Notes

THE CANADA WEST ELECTRIC COMPANY, 1221 Osier Street, Regina, Saskatchewan, contemplates improvements to its plant, to cost about $40,000.

THE CANADIAN GENERAL ELECTRIC COMPANY, it is reported, will expend between $600,000 and $1,000,000 on extensions to its plant at Peterborough, Ontario, including buildings and equipment. Construction work is expected to begin in June. The company is asking the city for a ten-year extension of its present fixed assessment of $150,000.

PROPOSED EXTENSION OF HYDRO-ELECTRIC PROJECTS IN JAPAN.—Commercial Attaché James F. Abbott, Tokyo, Japan, reports that the proposed extension of hydro-electric projects in Japan will involve the building of about 1,000 miles of high-tension transmission lines within the next two years, the most of which, it is reported, will probably be of the steel-tower type.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm in Spain (No. 32,127) desires to secure agencies for the sale of electrical materials.

A firm in India (No. 32,242) desires to purchase and secure an agency for electrical goods.

A commercial agent in Italy (No. 32,162) desires to secure an agency for the sale of electric meters.

A firm in China (No. 32,137) desires to get in touch with manufacturers of electric wire or machinery for making electric wire.

An engineering firm in New Zealand (No. 32,271) desires to secure an agency for the sale of electric generators, motors and supplies.

A firm of contractors and engineers in Siberia (No. 32,136) is desirous of getting in touch with manufacturers of electrical equipment, telephones, etc.

An importing firm in India (No. 32,297) desires to be placed in communication with merchants and manufacturers of electrical goods with a view to securing sole agencies.

An importing firm in England (No. 32,125) desires to purchase from manufacturers ebonite moldings for electrical work, especially telephone handles. Drawings of the handles were forwarded and may be examined at the bureau or its district offices. (Refer to file No. 21,771.)

Trade Publications

ELECTRICAL INSTRUMENTS. — The Roller-Smith Company, 233 Broadway, New York, has issued a small pamphlet describing electrical instruments, circuit breakers and meters.

DRY BATTERIES.—Bulletin 7 of the Burgess Battery Company, Madison, Wis., describes the dry batteries of different types, including sets composed of a number of batteries in one box.

POLYPHASE MOTORS.—Bulletin 122 issued by the Wagner Electric Manufacturing Company, St. Louis, Mo., describes starterless squirrel-cage motors and wound-rotor polyphase induction motors.

VENTILATING FANS.—The Sprague Electric Works, 527 West Thirty-fourth Street, New York City, have issued a small booklet on ventilating fans driven by direct-current and alternating-current motors.

AIR-CIRCUIT BREAKERS.—The General Electric Company has issued bulletin 47,520, describing type CG air-current breakers, which are used on direct current up to 300 amp. and 500 volts and on alternating current up to 300 amp. and 600 volts.

STEAM TABLES.—The Wheeler Condenser & Engineering Company, Carteret N. J., announces the publication of the 1920 edition of their "Steam Tables for Condenser Work." The book gives the properties of saturated steam from 29.8 vacuum to atmospheric pressure in increments of tenths of an inch, besides regular tables for pressures above atmospheric.

CENTRIFUGAL PUMPS.—In a pamphlet entitled "High-Efficiency Centrifugal Pumps" the De Laval Steam Turbine Company of Trenton, N. J., has described official tests made by the city of Minneapolis upon a 20-in. De Laval centrifugal pump driven by an induction motor and similar tests made by the city of St. Paul upon two 12-in. De Laval centrifugal pumps driven by synchronous motors.

New Incorporations

THE TAPPEN ELECTRIC COMPANY of Lima, Ohio, has been incorporated with a capital stock of $15,000 by L. B. Morehouse and C. L. Tappen.

THE PRIMA ELECTRIC SHOP COMPANY of Toledo, Ohio, has been incorporated with a capital stock of $10,000 by E. F. Chittenden and C. H. Steele.

THE TRAVIS ELECTRIC COMPANY of San Antonio, Tex., has been incorporated with a capital stock of $10,000 by Fred Krisch, J. E. Smith and J. H. Cunningham.

THE MASON HALLS LIGHT & WATER PLANT of Mason, Tenn., has filed articles of incorporation with a capital stock of $3,000. The incorporators are J. H. Wood, J. H. Sawyer and J. A. Hollman.

THE CENTRAL ELECTRIC COMPANY of Anderson, Ind., has been incorporated with a capital stock of $5,000 by Lee Longfellow, Ray Thornsburg and Clyde Culbertson. The company proposes to operate an electric plant.

THE THERMO-ELECTRIC COMPANY of Los Angeles, Cal., has been incorporated with a capital stock of $250,000 by Frank L. Burns, W. E. Tipton and Theodore Stensland. The company proposes to manufacture electrical apparatus.

THE ASTORIA (ORE.) ELECTRIC COMPANY has been incorporated by F. C. Green, E. P. Steele and A. W. Norblad. The company is capitalized at $10,000 and proposes to do a general electric contracting, construction and engineering business.

THE ORANGE COUNTY PUBLIC SERVICE COMPANY of Orleans, Ind., has been incorporated with a capital stock of $75,000 to supply water, heat and power. The incorporators are George H. Carter, Ralph M. Jenkins and Oliver W. Stephenson.

THE DENLINGER LAMP & IGNITION COMPANY of Syracuse, N. Y., has been incorporated by C. J. Bennett, F. A. Brown and M. G. Denlinger. The company is capitalized at $12,000 and proposes to manufacture ignition equipment and automobile accessories.

THE BIG FOUR BATTERY COMPANY of Hammond, Ind., has been incorporated with a capital stock of $30,000 by Charles N. Nau, Felix J. Nau, William F. Ryan, Leland L. Wicker, Fred W. Dempsey and Leo F. Carroll. The company proposes to manufacture storage batteries.

THE POLLACK CONDUIT & ELECTRICAL SUPPLY COMPANY of New York, N. Y., has been incorporated with a capital stock of $20,000 to manufacture electrical conduits and equipment. The incorporators are L. Pollack and M. Simon, 205 Twenty-fifth Street, New York, N. Y.

THE SKINDERVIKEN ELECTRICAL COMPANY of New York, N. Y., has been chartered with a capital stock of $35,000 by J. Skinderviken, H. E. Goldsmith and M. Moskowitz, 1265 Broadway, New York City. The company proposes to manufacture telephone and telegraph apparatus.

THE L. & N. STORAGE BATTERY COMPANY of Louisville, Ky., has been incorporated with a capital stock of $50,000 to manufacture storage batteries and other electric equipment. The incorporators are M. Y. Middleton of Louisville, John U. Field and George E. Goodwin of Lexington, Ky.

THE COMMONWEALTH BATTERY COMPANY, 17 Elm Street, Rochester, N. Y., has been incorporated with a capital stock of $50,000 to manufacture plates for storage batteries, supplying service stations in preparing these batteries. The officers are J. Harris, president and general manager; G. H. Van Blaricum, vice-president, and Linus Heberger, secretary and treasurer.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

NEW BEDFORD, MASS.—The New Bedford Gas & Edison Light Company plans additions and improvements to its plant to cost about $2,000,000. Eight boilers, with a capacity of 20,000 hp. and a 20,000-kw. turbine will be installed.

ROXBURY, MASS.—The Tremont Manufacturing Company plans to build a new substation.

PROVIDENCE, R. I.—The General Electric Company has taken over the plant of the D. & W. Fuse Company in Auburn and plans extensive improvements. L. W Downes is manager.

BRISTOL, CONN. — The Chamber of Commerce is considering an improved street-lighting system for the business center of the city.

MERIDEN, CONN.—The Connecticut Telephone & Electric Company contemplates an addition to its Britannia Street plant, involving an expenditure of about $300,000.

NEW BRITAIN, CONN.—The New Britain Children's Home, 81 Garden Street, is having plans prepared by W. P. Crabtree, architect, 272 Main Street, for a new 3-story school and home on Rockcliffe Heights, to cost about $350,000. Considerable electrical equipment will be required.

Middle Atlantic States

BLACK RIVER, N. Y.—The St. Regis Paper Company of Watertown is having plans prepared for power house and 9,000-hp. hydroelectric development on Black River.

BROOKLYN, N. Y.—The Flatbush Gas Company contemplates the erection of seventy-two 13,200-volt feeder lines. H. E. McGowan is secretary.

CHEEKTOWAGA, N. Y.—The capital of the Depew & Lancaster Light, Power & Conduit Company has been increased from $500,000 to $1,250,000.

FAR ROCKAWAY, N. Y.—The Queensborough Gas & Electric Company will erect an addition to its generating station to provide for the installation of two additional 600-hp. boilers. C. Macy is manager.

GENEVA, N. Y.—The Empire Coke Company contemplates extensive improvements in its local plant, including the installation of a carbureted water gas plant, a new boiler and power plant and an additional gas compressor. The total cost is estimated at $263,885. E. H. Palmer is president.

HADLEY, N. Y.—The Hadley Light & Power Company contemplates the construction of an addition to its local plant.

NEW YORK, N. Y.—The New York Telephone Company, 15 Dey Street, is having plans prepared by McKenzie, Voorhees & Grelin, 1123 Broadway, for construction of an automatic telephone exchange on West Seventy-third Street, to cost about $1,540,000.

NEW YORK, N. Y.—The New York & Queens Electric Light & Power Company will erect three transmission cables, one from the plant of the United Electric Light & Power Company, Manhattan, and two between Flushing and Jamaica. H. C. Dean is general superintendent.

NEW YORK, N. Y.—The United Electric Light & Power Company contemplates the installation of a 22,000-kw. turbo-generator, the erection of a 300,000-kw. generating station, and changing its transmission voltage in all stations, from 7,500 volts to 15,000 volts. F. W. Smith is manager.

OLD FORGE, N. Y.—The construction of a municipal lighting plant and waterworks system is under consideration, to cost from $150,000 to $200,000. Maurice Callahan, president First National Bank, is reported interested.

TUCKAHOE, N. Y.—A power plant will be erected in connection with the construction of the proposed new six-story plant of the Hodgman Rubber Company on Scarsdale Avenue.

WALDEN, N. Y.—The Walkill Valley Electric Light & Power Company has increased its capital from $30,000 to $50,000.

ESSEX FALLS, N. J.—The Central & South American Telephone Company, 89 Broad Street, New York, N. Y. contemplates the erection of a local plant for the manufacture and repair of cable instruments.

JERSEY CITY, N. J.—The City Commission will soon receive bids for the construction of a power house and installation of mechanical equipment for the Jersey City Hospital building. The cost will exceed $50,000.

JERSEY CITY, N. J. — The Whitlock Cordage Company, Communipaw Avenue, is having plans prepared for a one-story power plant in which turbines, four 400-hp. boilers, etc, will be installed, in connection with the construction of a new four-story addition to its plant.

TRENTON, N. J.—Plans are being prepared by J. R. Fell, engineer, City Hall, for the installation of arc lamps and fixtures in Stacy Park. G. W. Page, City Hall, is in charge of the lighting system.

CHESTER, PA.—The Chester Hospital will require considerable electrical equipment in connection with the construction of the proposed new surgical building.

ERIE, PA.—The Skinner Engine Company, Twelfth and Chestnut Streets, is having plans prepared by A. F. Shotte, Marine Bank Building, for extensive improvements and additions at its plant, including a new power plant and a shop building to cost about $80,000.

PHILADELPHIA, PA. — The General Electric Company, it is reported, plans to construct a new plant in the southwestern part of the city. The project includes five manufacturing buildings and auxiliary structures, to cost over $5,000,000.

READING, PA.—Plans are under consideration by the city officials for improvements and alterations in the Maiden Creek pumping station of the municipal waterworks plant. D. E. Dampman, superintendent of parks and public property.

BALTIMORE, MD.—The Maryland Casualty Company will require large quantities of electrical and mechanical equipment, including motors for individual drive, in connection with the new administration building and printing plant to be erected at Fortieth Street and Cedar Avenue, to cost about $1,500,000.

DENTON, MD.—The Town Council contemplates the erection of a new municipal electric light and power plant, to cost about $40,000.

HAMPTON ROADS, VA.—Plans are being prepared in Commander McKay's office, Bureau of Yards and Docks, Washington, D. C., for construction of underground electric distributing system at the local naval operating base.

WARRENTON, VA. — The Warrenton Electric Light & Power Company contemplates the installation of one 90-kw., 2,200-volt, 60-cycle generator, one 150-hp. Erie boiler and the erection of 5 miles transmission lines. M. J. O'Connell is manager.

North Central States

BAD AXE, MICH.—N. J. Frost and others contemplate the construction of a completely equipped electric power plant to supply the city of Bad Axe and surrounding territory.

DETROIT, MICH.—The Hannan Real Estate Exchange, 1 McGraw Building, plans to erect a commercial building, five stories, at Woodward Avenue and Sibley Street, at a cost of about $200,000, for which considerable electrical equipment will be required.

DETROIT, MICH. — Bids will soon be asked by the City Water Board for construction of a new booster pumping station at Waterworks Park, for which five electrically driven centrifugal pumping units will be needed. The cost is estimated at $100,000. T. A. Leiser, 232 Jefferson Avenue, is engineer.

FLINT, MICH.—The Flint Medical Society, Detroit Street, contemplates the erection of a five-story office building at Fourth and Detroit Streets, to cost about $200,000. Considerable electrical equipment will be required.

FLINT, MICH.—The Knights of Columbus, P. Callahan, chairman, plan to build a new three-story clubhouse, in connection with which considerable electrical equipment will be required, at an approximate cost of $250,000. Van Leyen, Schillin, Keough & Reynolds, Union Trust Building, Detroit, are the architects.

HIGHLAND PARK, MICH.—The Detroit Osteopathic Hospital, care of P. H. Gray, Highland Park, will require equipment for electric lighting and elevator control in connection with new five-story hospital to be erected at Highland and Third Avenues, at a cost of about $250,000.

HILLSIDE, MICH.—At an election to be held April 5 the proposal to issue $60,000 in bonds for improvements to the municipal power plant will be submitted to the voters.

IRONWOOD, MICH.—Plans are being prepared by Alvord & Burdick, engineers, 8 South Dearborn Street, Chicago, Ill., for extensions to the municipal waterworks system and installation of electrical pumping equipment. The cost is estimated at $300,000.

JACKSON, MICH.—The Michigan Light & Consumers' Power Company contemplates the erection of a substation and a single line steel-tower transmission line to Battle Creek. The cost is estimated at $410,000.

MANISTIQUE, MICH.—The construction of a new municipal pumping station will be necessary in connection with a new power contract approved by the Board of Public Works.

PONTIAC, MICH.—The Grand Trunk Railway System, Brush Street, Detroit, contemplates the construction of a roundhouse to have a fifty-engine capacity and will require complete electric light and power equipment. F. P. Sissons is division engineer.

CLEVELAND, OHIO.—The Board of County Commissioners, Court House, Cleveland, contemplates the erection of a new heating plant at Lakeside Avenue and West Third Street. The cost is estimated at $250,000. E. S. Krause is clerk.

CLEVELAND, OHIO.—Considerable electrical equipment will be required for the proposed new school building to be erected on St. Clair Avenue, by St. Joseph's Church. The estimated cost is $300,000. C. Greco Guardian Building, is architect. For further information address Rev. J. W. Bell, 14,422 Aspinwall Avenue.

DAYTON, OHIO.—The Allsteel Ridewell Tire & Rubber Company, Lindsey Building, contemplates the purchase of complete electrical equipment for power plant to be erected in connection with its new factory, for which building contract was recently awarded to the Osborn Engineering Company, 2848 Prospect Avenue, Cleveland. The total estimated cost is $100,000.

MARION, OHIO—The Columbus, Delaware & Marion Traction Company plans the erection of a power plant to cost about $500,000 at Newmans, 7 miles south of this city, and also a three-story terminal station and loop in Marion.

MARYSVILLE, OHIO.—The Marysville Light & Water Company contemplates the installation of an additional boiler and turbine. M. Mackan is superintendent.

MIAMISBURG, OHIO.—The installation of a gas-engine-driven generating unit in the municipal water and light plant is under consideration, to cost about $30,000. A. W. Kepler is superintendent.

ST. BERNARD, OHIO.—The Union Gas & Electric Company is contemplating the purchase of the municipal electric plant and also to install centrifugal pumping equipment in the waterworks plant, to cost about $15,000. The price offered for the municipal plant is $50,000.

SPRINGFIELD, OHIO.—The Dale Electric Company has increased its capital stock from $10,000 to $50,000.

HAZARD, KY.—The Hazard Light & Power Company has increased its capital stock from $50,000 to $200,000, and plans immediate extensions and improvements.

WHITESBURG, KY.—The Whitesburg Light & Power Company contemplates various improvements this spring. H. C. Daniel is manager.

CONNERSVILLE, IND. — The Hydro Electric Light & Power Company has increased its capital stock from $750,000 to $1,125,000.

GREENFIELD, IND.—The City Council has authorized the construction of a transmission line to connect the municipal electric plant with that of the Indianapolis Light & Heat Company, Indianapolis, for the purpose of supplying Greenfield with energy. The cost is estimated at $60,000.

CHICAGO, ILL.—The Alemite Die Casting & Manufacturing Company, 341 West Chicago Avenue, is having plans prepared by R. C. Ostergren, architect, 155 North Clark Street, for the proposed new factory building, to cost about $250,000. Considerable electrical equipment will be required.

BELLEVILLE, WIS. — The Belleville Electric Company plans the erection of additional rural transmission lines. W. E. Seward is superintendent.

KOHLER, WIS.—The Council is considering calling an election to submit to the voters the proposal to issue $12,000 in bonds for construction of a municipal electric lighting system. J. Donahue of Sheboygan is engineer.

MADISON, WIS.—The State Board of Control, Capitol Building, contemplates the erection of a new power plant in Capitol Square to cost about $18,415.

MANITOWOC, WIS. — The Aluminum Goods Manufacturing Company is having plans prepared by L Greene & Company, engineers, South Dearborn Street, Chicago, for construction of a two-story rolling mill to cost about $500,000. Electrical power and wiring equipment will be required.

MARSHFIELD, WIS.—The Roddis Lumber & Veneer Company of Marshfield is having plans prepared by Cahill & Douglas, 217 West Water Street, Milwaukee, for a power house. A generating unit and boilers will be installed.

MILWAUKEE, WIS.—Bids are now being receivd by A. S. Hecht, architect, 640 West Randolph Street, Chicago, Ill., for construction of the new four-story, terminal for the Chicago, Racine & Milwaukee Railroad, Broadway and Erie Streets, Milwaukee. The estimated cost is $750,000.

TOMAHAWK, WIS.—The Pride Pulp & Paper Company, recently organized, contemplates the construction of a pulp and paper mill, a sulphate-fiber mill and hydroelectric power developments at Grandmother Falls and Nigger Island, on the Wisconsin River, near here. The entire project will entail an expenditure of about $3,500,000. C. B. Pride is president.

WAUKESHA, WIS. — The Waukesha Foundry Company plans to install an overhead trolley system in its proposed new plant. The total cost is estimated at about $40,000.

BENSON, MINN.—The city officials are considering improvement and alterations in the municipal electric light plant, to cost about $40,000. T. B. Lee is superintendent.

MINNEAPOLIS, MINN. — The Russell Grader Manufacturing Company, 203 University Avenue, S. E., contemplates the construction of a power house and office building, with complete electrical equipment, in connection with proposed new grader factory on Kennedy Street, near Stinson Boulevard. The cost will be about $250,000.

DES MOINES, IOWA.—The Iowa Telephone Company (Bell System) Seventh and High Streets, will require complete electrical equipment in connection with the construction of the proposed three-story building it plans to erect at a cost of about $300,000. G. B. Prinz, Omaha National Bank Building, is architect.

ST. LOUIS, MO. — The Union Electric Light & Power Company contemplates the erection of an outdoor transformer station on Lewis Street.

FESSENDEN, N. D. — The Fessenden Light & Power Company contemplates the installation of one 200-hp. generating unit and extension of its transmission lines. H. O. Whitcomb is manager.

FORDVILLE, N. D.—The Fordville Garage & Light Company contemplates the installation of one 25-hp. oil engine and a generator. C. R. Thol is manager.

NEW ROCKFORD, N. D.—Bids will be received until further notice by C. L. Pillsbury Company, engineer, Metropolitan Life Building, Minneapolis, Minn. for furnishing and installing a 75-kw. generator and engine in the power plant of the General Utilties Corporation.

WHITE LAKE, S. D.—The White Lake Light & Power Company contemplates the extension of its transmission lines. V. J. Peters is manager.

SUTTON, NEB.—Extensions to the municipal electric transmission system are contemplated. H. H. Bauer is commissioner of light and water.

HARVEYVILLE, KAN.—Bonds to the amount of $10,000 have been voted for the construction of a municipal electric lighting and power plant.

TOPEKA, KAN.—The Atchison, Topeka & Santa Fé Railway Company, 80 East Jackson Building, is having plans prepared by J. Yonkers, supervising architect, Park Building, Chicago, Ill., for construction of a central heating plant for which considerable electrical equipment will be required. The cost is estimated at about $85,000.

Southern States

GRAHAM, N. C.—Bids will soon be recieved for construction of a sewerage system with two pumping stations equipped with motor-driven centrifugal pumps. Norcross & Keis, Atlanta, Ga., are engineers.

MORAVIAN FALLS, N. C.—The Moravian Falls Milling & Power Company contemplates the installation of a new turbine. L. C. Humphries is manager.

JACKSONVILLE, FLA.—The City Commission has plans under consideration for extensions to street-lighting system. Cost is estimated at $23,500.

GREENFIELD, TENN.—Surveys are being made by A. Jenks, engineer of Union City, in connection with the proposed new municipal light plant. The cost is estimated at about $50,000.

KINGSPORT, TENN.—Kingsport Utilities, Inc., contemplates the erection of a substation and transmission lines supplying all city circuits.

PAWNEE, OKLA.—An election will be held April 6 to vote on an issue of $100,000 in bonds for the improvement to the municipal electric light plant and water system.

PONCA CITY, OKLA.—The installation of a 1,000-hp. oil engine in the municipal electric light and water plant is under consideration. P. R. Dunton is superintendent.

POTEAU, OKLA.—The Leflore Gas & Electric Company will install an additional generator and one 100-hp. boiler in its plant. F. E. Baird is manager.

RED FORK, OKLA.—The Sunlight Carbon Company contemplates the construction of a new plant to cost about $100,000.

ARCHER, TEX.—The construction of a new municipal electric light plant in Archer is under consideration. A. Minnich is manager.

BROWNWOOD, TEX.—Bonds to the amount of $150,000 have been voted for the erection of a municipal electric lighting plant, street improvements, etc.

CANADIAN, TEX.—The Canadian Water, Light & Power Company will install additional engines and extend its transmission lines. E. Hoover is manager.

CLARENDON, TEX. — The Clarendon Light & Power Company, recently organized with a capital stock of $200,000, will erect an electric lighting and power plant.

DENISON, TEX.—At an election to be held on April 6 the proposal to issue $244,000 in bonds for municipal improvements, including an electric lighting system in the downtown section and purchase of electrical pumping equipment for city reservoir, will be submitted to the voters.

LEWISVILLE, TEX.—The plant of the Lewisville Electric Light & Power Company, has been purchased by S. Cunningham. The new owner contemplates improvements, including the installation of additional machinery, to cost about $6,000.

Pacific and Mountain States

EVERETT, WASH.—At an election to be held this spring the proposal to issue bonds for construction of a new municipal electric plant and street-lighting system will be submitted to the voters.

EL CENTRO, CAL.—The Chamber of Commerce is urging an election to vote on a $165,000 bond issue for improvements to the municipal water and lighting system, installation of a fire-alarm system, and the erection of a City Hall.

INGLEWOOD, CAL.—Bids will soon be received by the Board of Trustees, J. H. Kew, city clerk, for furnishing centrifugal booster pumps of 400 to 1,200-gal. capacity. Olmstead & Gelleden, Hollingsworth Building, Los Angeles, are engineers.

LONG BEACH, CAL.—Bids are now being received by the Southern California Edison Company for furnishing and installing a 30,000-kw. horizontal steam turbine in its local plant.

LOS ANGELES, CAL.—The State Railroad Commission has authorized the Southern California Edison Company to issue $4,500,000 in capital stock for additional hydro-electric developments, etc.

LOS ANGELES, CAL. — The Southern California Edison Company announces that it is going to proceed at once with the construction of a power plant on Big Creek, to be known as Big Creek plant No. 8, which will be below the present Big Creek plant No. 2 and will utilize water formerly intended to pass through Big Creek No. 3. A tunnel has been driven below Big Creek No. 2 as part of the proposed development of Big Creek No. 3. The present plan is to break out from this tunnel and install a penstock for Big Creek No. 8, after which the water will again be taken in a tunnel through the mountain and dropped down through the Big Creek plant No. 3. Big Creek No. 8 will have a capacity of 22,500-kw. and during the year 1921 is expected to generate 100,000,000 kw.-hr. In addition to this development the Southern California Edison Company is making active progress on the impounding of water in Shaver Lake, which will be capable of supplying 46,000,000 kw.-hr. during the year 1921, to be generated in Big Creek No. 2 and Big Creek No. 8.

YUBA CITY, CAL.—Bids will soon be asked by the Reclamation District No. 1,660, P. H. McGrath, Clerk, California Fruit Building, Sacramento, for construction of levees, canals, pumping plants, etc., to cost about $1,800,000. J. C. Boyd, 803 Forum Building, Sacramento, is engineer.

GLENDALE, ARIZ. — Bonds to the amount of $20,000 have been voted for extensions and improvements to the municipal electric lighting system. Harry Hancock is city engineer.

RONAN, MONT.—The Mission Valley Electric Company has applied for permission to divert the waters of Crow Creek, near Ronan, for power purposes in connection with its proposed hydro-electric development.

KENO, ORE.—The Keno Power Company plans installation of an 800-hp. turbogenerator and the construction of a 6-mile transmission line. W. Kerns is manager.

SCIO, ORE.—Bonds to the amount of $40,000 will be issued for the construction of the proposed new light, power and pumping plant at Thomas Creek. A. Cunningham is engineer.

TILLAMOOK, ORE.—The Coast Power Company is considering the installation of a 1,000-kw. turbine. C. J. Edwards is manager.

WASCO, ORE—Steps have been taken by citizens to organize a company to be known as the Sherman Electrical Company for the purpose of erecting a transmission line to connect with the White River plant of the Pacific Light & Power Company of Los Angeles, Cal.

Canada

CALGARY, ALTA. — Additional boilers are to be installed in the municipal electric light and power plant. R. A. Brown is general superintendent.

PINCHER CREEK, ALTA. — Improvements are contemplated to the municipal electric plant, including the installation of a switchboard and rebuilding five blocks of pole transmission line. A. Langstaff is superintendent.

RED DEER, ALTA.—The Western General Electric Company, contemplates the installation of a new generating unit. W. A. Moore is manager.

OXFORD, N. S.—The Oxford Electric Light & Power Company contemplates the erection of 26 miles of transmission lines. S. D. Downing is manager.

YARMOUTH, N. S. — The Yarmouth Light & Power Company, contemplates the installation of a 750-kva. hydro-electric unit. D. R. Stoneman is secretary.

COBOURG, ONT. — The Hydro-Electric Power Commission of Ontario, Toronto, is considering plans for the construction of a 35-mile radial railroad from Cobourg to Campbellford, to cost approximately $2,500,000. F. A. Gaby, Hydro-Electric Power Company Building, Toronto is engineer.

HAWKESBURY, ONT — The Hawkesbury Electric Light & Power Company, contemplates the installation of a 2,500-hp. waterwheel and a 2,000-kva. generator. J. Ross is manager.

NIAGARA-ON-THE-LAKE, ONT. — Improvements are contemplated by the local Hydro Commissions to the municipal electric distribution system, including erection of new poles, wires, etc.

PORT DOVER, ONT.—Plans are being prepared by E. A. James Company, Ltd., 36 Toronto Street, Toronto, for new waterworks system. Centrifugal pumps will be installed. The cost is estimated at $100,000.

SARNIA, ONT.—The Sarnia Gas & Electric Light Company plans the erection of several miles of transmission lines J. E. B. Phelps is manager.

ARCOLA, SASK.—The Arcola Light & Power Company contemplates the installation of a 30-hp. engine and a 2,200-volt motor. H. F. Roberts is manager.

Record of Electrical Patents

Notes on United States Patents

(Issued March 9, 1920.)

14,816 (Reissue). Method for Controlling the Efficiency of Mercury Rectifiers; William Tschudy, Port Huron, Mich. App. filed July 1, 1916. Reduces resistance and regulates power consumed in compartment of gas or vapor electric apparatus.

1,332,879. Electric Toaster; Bernhard M. Beskow, Lake George, N. Y. App. filed Oct. 7, 1919. Two adjustable sections between which meats are broiled.

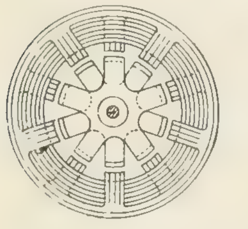
1,332,891. Trolley Wheel; William R. Fearn, Camden, N. J. App. filed Feb. 27, 1919. Lessens friction on curves and facilitates passage of trolley over crossings.

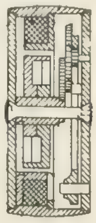
1,332,935. Electric Toaster; Mary A. Thomas, New York, N. Y. App. filed July 11, 1919. Two link-connected adjustable members.

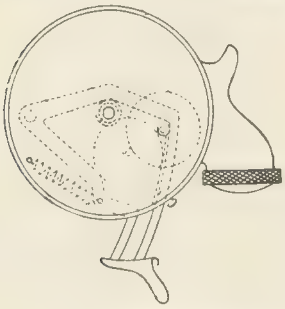
1,332,951. Transmitter; Thomas R. Purman, Washington, Pa. App. filed Feb. 12, 1918. Mercury-cup adapted to receive platinum and contact plunger-pin.

1,332,961. Signaling System; De Witt C. Tanner, Glen Ridge, N. J. App. filed June 6, 1918. Switches and sending distributer for storing up impulses pending transmission.

1,332,976. Signaling System; Andrew D. Dowd, Hoboken, N. J. App. filed June 6, 1918. Impulse storage devices permitting selective actuation of switches.







No 1,333,119. Hand Generator

1,333,000. Synchronizing System; Charles G. Spencer, East Orange, N. J. App. filed Jan. 4, 1918. For synchronous multiplex telegraphy and switching systems for control of remote signals.

1,333,003. Outlet Box; William A. Titus, Chicago, Ill. App. filed Jan. 22, 1917. Double socket outlet attached to power feeder for temporary use in extending taps to any desired position.

1,333,014. Signaling System; Joseph C. Field, Orange, N. J. App. filed Aug. 19, 1918. Selective devices at local stations controlled over single-line circuit from central station for transmission of telegraph messages without interference.

1,333,026. Telephone System; Alben E. Lundell, New York, N. Y. App. filed Dec. 27, 1916. Trouble-indicating signals which render apparatus unselectable until abnormal condition is relieved.

1,333,027. Telephone-Switch Controlling System; Alben E. Lundell, New York, N. Y. App. filed April 12, 1917. Controls change-over from one selective operation to next.

1,333,036. Tungsten Crucible and Method of Making and Using Same; James H. Robertson and David Jankower, New York, N. Y. App. filed July 14, 1919. Pressure and heat applied in forming crucible made from commercial tungsten.

1,333,046. Light Signal; Herbert B. Taylor, Westfield, N. J. App. filed July 25, 1918. Almost frictionless mechanism gives three indications.

1,333,058. Alternating-Current Relay; Eli J. Blake, Westfield, N. J. App. filed April 19, 1917. Induction type having a non-magnetic cup rotor acted upon by a shifting field.

1,333,077. Electric Lantern; Thomas H. Jackson, Philadelphia, Pa. App. filed April 25, 1919. One-cell portable flashlight.

1,333,080. Electric Heating Apparatus for Metal-Working Machines; Frank P. Kobert, Amityville, N. Y. App. filed April 5, 1917. For electric riveting and welding machines.

1,333,081. Art of Metal Working; Frank P. Kobert, Amityville, N. Y. App. filed Oct. 21, 1916. Power press for forging, upsetting and welding.

1,333,095. Art of the Transmission of Electrical Power Without Wires; Charles H. Roe, Weidman, Mich. App. filed Aug. 1, 1918. Principle of resonance in circuits wherein currents are propagated by conduction.

1,333,111. Impedance Equalizer for Use with Transformers; Ray S. Hoyt, Brooklyn, N. Y. App. filed Jan. 17, 1918. Impedance of primary circuit independent of frequency and equal to impedance of the secondary circuit multiplied by transformer ratio.

1,333,117. Ringing and Listening Key; Albert Klay, Chicago, Ill. App. filed June 23, 1915. Standard cams used for all different functioned keys.

1,333,119. Hand Generator; Karl K. Krag-Moller, Frederiksberg, Denmark. App. filed June 5, 1918. Pocket flashlight of flat cylindrical shape.

1,333,182. Plural Lamp Socket; Frank W. Minor and Robert H. Wood, Richmond, Va. App. filed Feb. 8, 1919. Economizes on space and eliminates danger of breakage should socket be dropped to floor.

1,333,190. Indicator; William F. Smith and Edwin P. Sanford, Flint, Mich. App. filed May 16, 1916. Current for operating rollers taken from trolley.

1,333,240. Elevator Signaling System; Franz A. Boedtcher, Bergenfield, N. J. App. filed Aug. 13, 1915. Automatic threshhold illuminating circuits.

1,333,247. Electromagnet; George C. Cummings, East Orange, N. J. App. filed May 1, 1919. Eliminates residual magnetism in oscillating relay arranged along face of polar end of magnet.

1,333,273. Electric Welding; Thomas E. Murray, Jr., Brooklyn, N. Y. App. filed May 2, 1919. Equalization or variation of current distribution at joint.

1,333,274. Apparatus for Electrically Welding the Sections of a Hollow Object; Joseph B. Murray and Thomas E. Murray, Jr., Brooklyn, N. Y. App. filed Sept. 18, 1919. Supports thin metal from within sections and on opposite sides of welding joint.

1,333,275. Metal-Incased Tube and Method of Producing the Same; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed Oct. 8, 1919. Casing united by electrical welding after tube is introduced.

1,333,295. Storage Cell; Rudolphe Drambourg, Brooklyn, N. Y. App. filed Nov. 27, 1918. Plates arranged radially.

1,333,298. Sound Emitter; Sydney Evershed and Willie D. Kilroy, Chiswick, London, Eng. App. filed May 3, 1910. Intensive sound waves convey messages by Morse code signaling.

1,333,311. Process of Scoring Metal; Herman A. Holz and Frank P. Fahy, New York, N. Y. App. filed March 21, 1918. Rotating disk to fuse particles of metal.

1,333,331. Starting, Generating, and Ignition Apparatus; William B. Moses, Brookline, Mass. App. filed June 29, 1917. Special application to Ford cars.

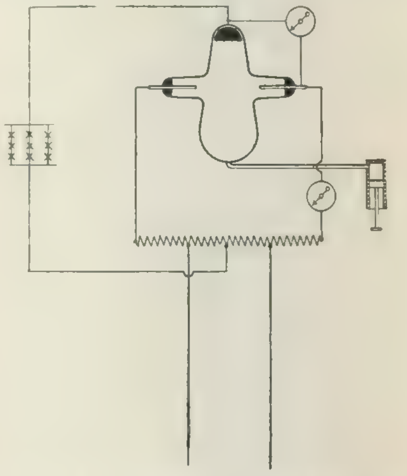
1,333,352. Pull Socket; George B. Thomas and Carl E. Anderson, Bridgeport, Conn. App. filed Aug. 25, 1914. Wide parting between switch terminals and switch plate

1,333,359. System of Electric Welding; David H. Wilson, Franklin Township, Bergen County, N. J. App. filed June 12, 1916. Maintains even amperage regardless of resistance and space across which arc must travel in making weld.

1,333,376. Oscillation Generator for Wireless Systems; Milton Berel, New York, N. Y. App. filed June 20, 1918. High-frequency polarity reversing switch combination with source of current and a condenser whereby condenser terminals are reversed to produce continuous oscillations of radio frequency.

1,333,415. System of Differential Magnetic Transmission; David C. Henry, New York, N. Y. App. filed Jan. 14, 1918. Controls slip by varying excitation of rotating fields and thus controls the speed.

1,333,420. Insulator Brackett; Charles C. Iles, Enterprise, Ohio. App. filed July 30, 1917. Supports twin wires and is attached to cross-arm by single fastening device.



No. 14,816 (Reissue) Method for Controlling the Efficiency of Mercury Rectifiers.

1,333,422. Polarity Indicator; William Kaisling, Chicago, Ill. App. filed June 16, 1916. For ignition and lighting circuits of automobile.

1,333,427. Lamp and Reflector Holder for Flashlights; Harry M. Koretzky, Brooklyn, N. Y. App. filed April 1, 1918. Special holder for reflector and light.

1,333,428. Lamp; Cecile Lafitte, New York, N. Y. App. filed June 5, 1919. Decorated lamp shade and holder.

1,333,452. Duplex Method of and Apparatus for Sending Telegraphic Messages; Eugene S. Sandberg and Leland B. Newell, Springfield, Ill. App. filed July 21, 1917. Doubles capacity of a single-wire line for Morse telegraphy even when operated by a duplex machine.

1,333,458. Electric Sealer; Robert D. Sorver, Pasadena, Cal. App. filed Sept. 19, 1918. Sealing wax heated as used.

1,333,542. Lifting Magnet; Harry G. Geissinger, New York, N. Y. App. filed July 1, 1918. Reduces magnetic reluctance of idle gap and secures great tractive effort with minimum energy.

1,333,548. Electric Igniter; Edmund J. Kane, Chicago, Ill. App. filed Jan. 14, 1915. Actuates oscillatory inductor of magneto for operating make-and-break contacts.

1,333,586. Electrical Arc-Welding Electrode and Process of Making; Jack Churchward, New York, N. Y. App. filed July 21, 1919. Welding characteristics permit of rough handling.

Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 75 New York, Saturday, April 3, 1920 *Number* 14

Daylight Saving

WHO would have thought that so simple an expedient as daylight saving would be attended with such confusion? In the contention between the farmer and the city dweller daylight saving seems to be having a hard time of it. "A plague on both your houses!" say public utilities, which must serve both.

Jobbers' Service

A PROMINENT electric supply jobber gives an excellent epitome of the present situation in that field. "We are no longer selling agents for manufacturers," he says, "but purchasing agents for customers. Instead of carrying a warehouse stock and selling it, we take orders from our customers and go out in the market and try to buy the goods they want." And yet some people maintain a jobber does not render service!

Capitalizing Present Expenditures

THE present abnormal market conditions bring a new obligation to regulating commissions that scrutinize utility expenditures—one which must be squarely met. Deliveries on materials required by the central stations are so long and uncertain that the utilities often have to place their orders for supplies and apparatus as much as a year in advance in order to be prepared to meet the estimated requirements of their customers. This may mean that the utilities have paid more for their material and apparatus than subsequently may be found to have been necessary. However, the central stations should not be called upon to speculate on prices. It is much better that the public shall be able to get service when it is needed than that it be deprived of service because the utility management is waiting for prices to drop. The companies should be ready to serve the communities in which they operate, and the controlling commissions should approve the expenditures which such a policy entails.

Electric Furnace Rates

ELECTRIC furnaces have made possible such economies to users that the amount of the power bill is of small moment. The net result is that the electric furnace can very well afford to pay rates approximating those paid for lighting service, since the value of the service is such as to command those rates. On the Pacific Coast at the present time plans are being made to increase the electric furnace load enormously. One single plant is planning to add 30,000 kw. in furnaces as quickly as the electric energy can be provided. Others are contemplating smaller increases. The field for furnaces to melt scrap in small establishments is growing so rapidly that the total furnace load promises to be of considerable magnitude. Power companies should therefore establish a rate for this business based on the value of the service furnished. Such a basis has been successfully tried in the Nevada gold fields, where the rate fluctuated with the value of the ore recovered.

Department of Public Works

BY ALL means let's have a national department of public works to supervise the engineering work of the country, and let it be manned from top to bottom with engineers. Lawyers may make good referees and receivers, but with engineers on the job there will be very little to adjudicate, and as for receiverships, failures will be so few that the title of receiver will become obsolete.

Light, Power and Stock Dividends

ALL dollars looked alike to utility managers at one time, but today the far-sighted executive seeks to enroll local funds even in small amounts for needed developments in plants and lines. This method of bridging the gap between the so-called public on the one hand and the company on the other has developed a new influence on local opinion when company problems are being discussed, an influence that cannot be exercised by a distant investor who may be many times more heavily committed financially. This new public policy not only opens the investment door to the thrifty customer and employee but extends the meaning of the term service to them to include light, power and stock dividends.

The Factory Electrical Engineer

WHILE there is a growing recognition of the value of the electrical department in mills and factories, even yet the managements frequently do not assign to this department the broad field that it deserves. Very often the man who is charged with the responsibilities of proper utilization of electrical energy and electrical maintenance in the plant will be found in an unsightly office in the repair shop. Here his entire time is taken up with the never-ending petty details of maintenance—details that might better be left to the handling of a subordinate foreman. The large problems of economies, proper selection of equipment and general policy of the department are, under such a system, neglected in the mass of detail connected with operation. Since the possible economies of a well-organized electrical department show up in a reduction in cost of product through increased production, the head of this department should occupy a position on a par with the works manager, or at least a first assistant, with an office in the section devoted to executive work. Instead of bearing the non-descriptive trade designation of chief electrician, he should carry the title of mill, factory or works electrical engineer and possess the experience that merits this title. A man of no unusual qualifications so situated and studying the economies of production from the standpoint of electrical operation can justify a very attractive salary in possible annual savings even in a moderate-sized plant.

Problems of Turbo-Generator Design

An IMPORTANT paper by J. Shepherd before the (British) Institution of Electrical Engineers, dealing with the practical difficulties of design encountered in large turbo-generators, was abstracted in our Digest of Electrical Literature on March 6. As generators have grown bigger higher steam economy has been attained, but at the expense of grave mechanical difficulties. Mr. Shepherd directs particular attention to the formidable mechanical stresses induced in the rotor coils by the high peripheral speed which has to be reached even at best. It has been the practice to reduce this speed as far as possible by cutting down the rotor diameter and increasing its length, which again leads to mechanical difficulties. As an example of the magnitude reached by such stresses Mr. Shepherd points out a case in which the pressures at the exterior of the rotor coil rise to 4,600 lb. per square inch (320 kg. per sq. cm.), implying a very severe pressure strain on the insulation. Still further electrical difficulties may follow the imposition of such serious pressures.

In the stator there has been constant difficulty with the stresses set up by short circuit or under sudden variations of load, straining of the insulation and its ultimate failure ensuing as a result. The usual form of design, with considerable length and relatively small diameter, makes cooling increasingly difficult and the provision of the proper air supply troublesome. As a remedy for some of these difficulties Mr. Shepherd has some interesting suggestions. First of these is the ordinary one of provision of better insulation from a mechanical standpoint, a subject which is being continuously investigated. In particular, he attaches importance to a change in the customary methods of cooling and very strongly recommends water cooling, as in transformers, the circulation extending through both the rotor and the stator with particular attention to the end coils of the latter. He figures that a substitution of water for air cooling would lead, as indeed it does in the case of transformers, to a very considerable increase of output, which he estimates at 20 or 25 per cent. In plants working at rather high altitudes the difference would be more even than this. Of the effectiveness of such water cooling, if well carried out, there can be very little doubt. It involves, however, some inherent mechanical difficulties, and its success would depend on rather large modifications in design, the effect of which cannot be readily reckoned. It would be exceedingly interesting to have the water-cooling problem thoroughly worked out, but to get convincing results this would have to be done on a considerable scale, since its difficulties, like all others associated with turbine design, increase with added output. The plan certainly looks promising, although its execution might involve complications.

Divide Loads and Reduce Losses

THOUGH it is a well-known possibility, the advantage of economical division of a load over several lines seems worthy of renewed attention. In a short article which appears in this issue Lansing W. Thoms gives a mathematical solution of the economically correct division of load to be aimed at, as well as a concrete example of what the application of the solution can produce. The example chosen is one taken from everyday central-station life, and the magnitude of the possible saving is well worth pondering over. Such an example brings up vividly the importance of the energy loss on lines that carry heavy and continuous loads and shows what a large return investigation of this nature will pay to those that will spend the little time necessary to obtain the data and to determine what division of load should be made. Furthermore, throw-over service is becoming more and more a necessity to the industries depending on our central stations. Many throw-over lines are idle while the so-called operating lines are handling large blocks of power. Would not oftentimes large savings be obtained from carrying some load both on the operating line and on the throw-over line and depending on one line for the service only in case of breakdown?

The Pending Patent Bill Should Become Law

A BILL is now pending in Congress to bring the United States Patent Office to a reasonable degree of efficiency by adding moderately to the personnel and bringing the salaries paid to a point where they will at least give some encouragement to competent men to stay in the government service. The situation in the Patent Office is much the same as that in the Bureau of Standards, to which we have more than once had occasion to refer. Notwithstanding that the Patent Office is one of the few departments of the government which have rather consistently shown a surplus instead of a deficit, salaries have been so inadequate that sixty of the examining force have resigned since the first of last May and found outside employment at largely increased remuneration. Many of this number were men of long experience whose services were exceptionally valuable. It is the same story through all the departments. There is a constant drain of good men outward into the professions and the industries—men who can in time be replaced, but only after a long period of training in the peculiar duties of the several offices. This means a loss of efficiency in the service.

The bill now before Congress is the result of drafts by the exceptionally learned and skillful patent committee of the National Research Council and bears the indorsement of a great and notable body of inventors, patent lawyers and men of affairs. It has already passed the House and lies before the Senate for action. The net increase in the force is about 10 per cent, the total net increase in salaries only about half a million dollars. We believe that in the promiscuous hurling about of public funds this moderate amount should find lodgment in the department which represents in so distinctive a manner the industrial growth of the country. At present the Patent Office is fairly swamped with matters demanding immediate attention, and it has no force adequate to meet the requirements. The situation is unfortunate in the extreme, and unless quick relief is given it will go from bad to worse until the office will vie in dilatory pre-eminence with the traditional court of chancery. The Senate should lose no time in ratifying the measure now before it. It can do so all the more cheerfully since it is proposed fully to cover the additional cost by slight added charges within the office.

Iron-Nickel Alloys and Their Properties

JUST as mechanical engineering is in large measure the science and art of utilizing the mechanical properties of steel, so electrical engineering may be likewise described as the science and art of utilizing the electromagnetic properties of steel. Without steel we should have very little mechanical engineering, as we now understand that term, and, again, without steel electrical engineering would be greatly restricted. With steel dynamos, motors, transformers and electromagnets all become available. The subject of the possible electromagnetic improvement of steel is of great industrial consequence. The bulk and cost of a dynamoelectric machine of given output depend mainly upon four constants of material—namely, the mechanical strength of the structure, the electrical conductivity of the winding, the electric insulation of the dielectric and the magnetic saturation of the steel, particularly of the steel teeth. Any available increase in these four constants, or in one of them, tends to diminish the size and cost of the machine.

In an article in this issue on the properties of iron-nickel alloys T. D. Yensen describes the results obtained in an important research directed to increasing the available magnetic conductivity of the steel used in constructing electrical machines. It is pointed out that an alloy of iron and cobalt, in the proportions represented by the formula Fe_2Co is capable of adding materially to the magnetic flux density which can be carried by the pole teeth of stators and rotors. This, however, is an expensive alloy, and inquiry has been directed experimentally to the question whether a nickel-iron alloy could be found with similar properties.

The results described do not indicate any appreciable gain in the magnetic conductivity of nickel-iron alloys over pure iron or open-hearth steel. Certain other useful magnetic properties have, however, been revealed in the nickel-iron alloys. Moreover, the results indicate that a definite combination or critical association is produced when the ingredients in the alloy are such as correspond to the formula Fe_2Ni, namely, at about 34.6 per cent of nickel and 65.4 per cent of iron. In the neighborhood of this composition, as the nickel content is gradually increased, the electrical and magnetic properties of the alloy undergo very marked and sharp changes, although the resulting properties are not nearly so useful as when cobalt replaces nickel in the alloy.

It is interesting to notice that as the amount of nickel in the alloy increased from zero to 100 per cent, or from pure iron to pure nickel, the specific gravity of the resulting metal increased steadily from 7.9 to 8.93 and did not reveal any sharp variations at critical values in the component ratios. This tends to show that the conditions which determine the electrical and magnetic properties of the material are submolecular and perhaps subatomic. From a scientific viewpoint the results set forth in the article are valuable and we are all indebted to the laboratory which supplies them.

Rebuilding Old Equipment

IF ALL equipment were perpetually new and depreciation were only an idle fancy the work of the industrial electrical engineer would be a simple matter of routine. But equipment becomes obsolete, unusual operating factors arise that cause rapid depreciation, breakages take place, designs may be at fault—and so life for the industrial man becomes a series of ingenious schemes to overcome difficulties. In this issue James Dixon describes the methods used in repairing 150 direct-current motors to put them in better shape to meet the severe operating conditions of a steel mill. Repairing motors is only one of a large number of the electrical problems that exist in a large mill or factory where the works electrical engineer has proved himself and his position an economical factor not only from the standpoint of a trouble mender but as well from the standpoint of a trouble preventer and therefore an exponent of increased production.

Triple Harmonic Frequencies in Three-Phase Systems

ONE OF the many remarkable properties of an iron-cored alternating-current transformer is that it is a generator of harmonics. When it is excited from a source of the frequency of say 60 cycles per second it will develop automatically a series of higher harmonics. The most prominent of the series, however, is the triple-frequency harmonic of 180 cycles per second. An explanation for this remarkable fact is found in hysteresis. The current excitation values necessary to increase the magnetic flux in the steel core are considerably larger than those required for demagnetizing, or bringing the flux back to zero. Consequently the exciting current necessary to produce a sinusoidal voltage and flux will be dissymmetrical in its rise and fall and so will not be sinusoidal. On the other hand, if the exciting current is forced to be sinusoidal, the flux and the voltage thereby generated in the windings will not be sinusoidal.

D. I. Cone in an article elsewhere in this issue discusses the average magnitudes of triple harmonic frequencies in three-phase systems under ordinary conditions of operation. It is pointed out that the triple harmonic component current in the excitation of modern transformers is commonly between one-third and one-half of the total current excitation, so that the triple-frequency excitation component is usually about 2 per cent of the rated load current. If, on the other hand, this triple-frequency excitation is suppressed or prevented from flowing, a triple-frequency component of voltage will appear on open circuit in the circuit of the transformer to the extent of about half the fundamental voltage. These magnitudes indicate the importance that the triple harmonic frequencies may develop in the action of a three-phase transformer system.

If the three transformers of a three-phase bank are connected in delta, the triple harmonic component of current excitation will travel in a closed loop around the delta. This may almost prevent the appearance of the triple-frequency harmonic in the external system, but it will warm up the delta transformers. If, on the other hand, the transformer bank is connected in star, with a grounded neutral, the triple harmonic current will seek to establish itself in this connection. The article will interest transmission and telephone men.

Elihu Thomson

An originator of the series arc-lighting system, a pioneer in alternating-current design, and an inventor of remarkable depth and range of scientific knowledge

FOR more than forty years Prof. Elihu Thomson has enriched the electrical industry as an inventor, an engineer and a savant. His practical ideas drawn from experimentation and research, his insatiable interest in science and his comprehension of electrical needs have yielded contributions of fundamental importance to the welfare of humanity the world over. After securing patents for his series arc-lighting system, he gave up a professorship in chemistry at the Central High School of Philadelphia in 1880 and, with the late Prof. Edwin J. Houston, moved the business of the American Electric Company to New Britain, Conn., where it became known as the Thomson-Houston Electric Company. In 1883 a further removal to Lynn, Mass., took place. Here a large business developed which was merged in 1892 with the Edison General Electric Company to form the present General Electric Company. Because of this consolidation the Thomson-Houston Electric Company has contributed two prominent presidents to the resulting company, C. A. Coffin and E. W. Rice, Jr. Since then Professor Thomson has been retained as their consultant. To him have been issued some 700 United States patents, of which 550 have covered electrical apparatus. His first important invention was the three-coil arc dynamo with an automatic regulator, a design with armature coils spaced 120 deg. apart which in structure was a three-phase alternator. In 1881 experiments with a magnetic field to interrupt an electric arc produced a horn lightning arrester and magnetic blow-out switches, and in 1883 came his reactive coil for controlling alternating currents and his idea of grounding the secondary circuit. In 1886 he was working on electric welding, and two years later he proposed the use of oil for insulating and cooling transformers. The induction regulator and single-phase repulsion motor he invented about this time. Later followed experiments and inventions covering current transformers, electric meters, the high-frequency generator, stereoscopic X-ray pictures, time-limit switches, multiple-unit train control, the resistance electric furnace, steam and oil engines, optics and acoustics.

Many learned societies have honored Professor Thomson, and he has served as president of the A. I. E. E., of the International Electric Congress and of the International Electrotechnical Congress. For some years he has been a member of the corporation of the Massachusetts Institute of Technology and is now serving as its temporary president. On Monday of this week Professor Thomson celebrated his sixty-seventh birthday.

Limiting Substation Short-Circuits—I

Calculations Are Made to Show the Best Arrangement of Reactances at a Substation Tapping Tie Lines Between Two Generating Plants—Mechanical Forces Acting Upon Bus Supports Are Also Determined

By R. F. GOODING

IN PREVIOUS issues of the ELECTRICAL WORLD[1] two articles have appeared giving in detail the method of calculating short circuits in the generating stations of a large power system. This article will consider in the same way similar problems for the 13,000-volt and 2,300-volt buses in a substation. A comparison is made between the possible short-circuit currents resulting when no reactance is installed at the substation, when bus reactance is used and also when reactance is inserted between tie lines and substation bus. The last arrangement is shown to be most effective in limiting short-circuit effects. This substation will be assumed to be between stations A and B, and to tap the six tie lines between these two stations, as shown in Fig. 1.

Fig. 1 shows a single line diagram of the system under consideration, and substation X is located 30,000 ft. (9 km.) from station A and 20,000 ft. (6 km.) from station B. Each tie line between stations A and B is a 500,000-circ.mil. three-conductor lead-covered cable, having a reactance of 0.0325 ohm per 1,000 ft. (300 m.) Assuming 350 amp. per phase (approximately 8,000 kva.), we find the reactive drop per 1,000 ft. to be 11.375 volts. This gives a reactive drop of 341.25 volts from station A to substation X and of 227.5 volts from B to X. At 13,200 volts the voltage to neutral is approximately 7,600, and the two values just given divided by 7,600 would give 4.48 per cent as reactance of cable from station A to X and 2.98 per cent from B to X. Adding to these values the 2.5 per cent feeder reactance at each generating station, we get 6.98 per cent from A to X, and 5.48 per cent from B to X. These values may be taken as 7 per cent and 5.5 per cent respectively without introducing any appreciable error.

The equivalent power—as derived in the previous articles—on station A bus is 100,000 kva. at 7.55 per cent reactance (7.5 per cent close enough). At station B this figure is 100,000 kva. at 10 per cent reactance. The figure for station A includes the power from station C. Of course, the values for station B are for B operating alone.

The first consideration will be to determine the amount of power developed on the 13,200-volt bus in case of a short circuit with no reactance at the substation, as shown in Fig. 2.

With one tie line operating, station A would deliver to X 100,000 kva. at 95 per cent reactance, obtained as follows:

	Kva.	Per Cent Reactance
Power on station A bus........ =	100,000	7.5
One feeder 8,000 kva., 7 per cent reactance	100,000	87.5
Power from A to X............	100,000	95

Similarly, B would deliver 100,000 kva. at 78.75 per cent (say 78.8 per cent) reactance, using 5.5 per cent reactance from B to X and 100,000 kva. and 10 per cent reactance as the power at station B.

It should be borne in mind, as stated in the previous articles, that for series curcuits the kva.'s in the different circuits must be the same if the reactances are added. This accounts for the values above—one feeder, 8,000 kva., at 7 per cent reactance = 100,000 kva. at 87.5 per cent reactance. In the same way, for parallel circuits, the equivalent reactances must be the same if the kva.'s are added.

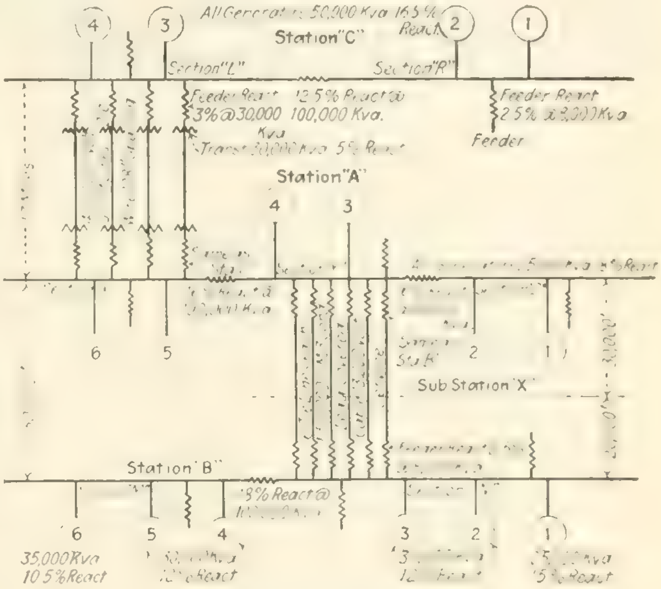


FIG. 1—SINGLE-LINE DIAGRAM SHOWING STATIONS AND CONNECTING LINES

Following the statement just made, it is necessary to reduce the power from station A and station B to its equivalent at the same reactance, and then to add the kva.'s, as follows:

	Kva.	Per Cent Reactance
Power A to X (100,000 kva., 95 per cent reactance).......... =	83,000	78.8
Power B to X.................. =	100,000	78.8
Total power on X bus.......... =	183,000	78.8
=	100,000	43

100,000 kva. at 43 per cent reactance gives 232,000 arc kva. = 10,200 amp.

With two tie lines operating, station A would deliver 100,000 kva. at 50 per cent reactance, and station B 100,000 kva. at 43.4 per cent reactance. Then:

	Kva.	Per Cent Reactance
Power A to X (100,000 kva., 50 per cent reactance).......... =	82,000	43.4
Power B to X.................. =	100,000	43.4
Total power on X bus.......... =	182,000	43.4
=	100,000	23.8

100,000 kva., at 23.8 per cent reactance gives 420,000 kva. = 18,500 amp. in case of short circuits.

Table I gives values for one to six tie lines operating, with connections as shown on Fig. 2.

It is readily seen that a possible 40,000-amp. short circuit on this bus is too much, so steps should be taken to reduce this value. Probably the cheapest way to do this would be to sectionalize the bus, as shown in Fig. 3.

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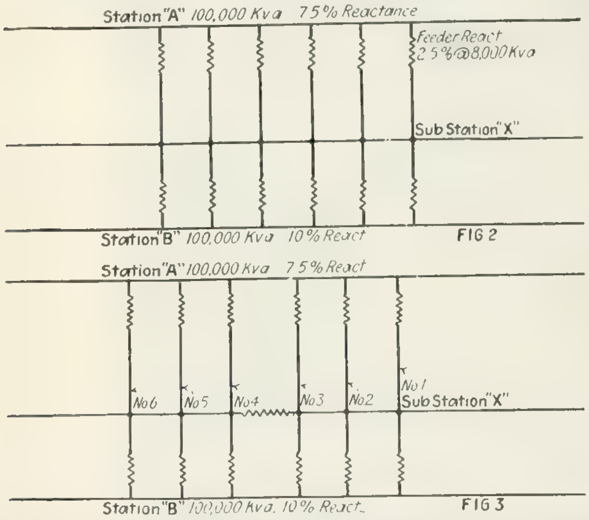
[1] ELECTRICAL WORLD, Oct. 18 and Nov. 15, 1919, pp 827 and 938 respectively.

With a bus reactance of 2.5 per cent at 16,000 kva. and lines Nos. 1 and 4 operating, a short circuit—say on the right-hand section—would be figured thus: Line No. 4 would deliver to the left bus section 100,000 kva. at 43 per cent reactance, as seen in Table I, when no reactance was used at the substation. Adding this to the bus reactance—2.5 per cent at 16,000 kva. (15.6 per cent reactance at 100,000 kva.)—we get 100,000 kva. at 58.6 per cent reactance as the power from left bus section to right section. Then:

TABLE I—NO REACTANCE AT SUBSTATION X

Tie Lines Operating	Equivalent Reactance at 100,000 Kva. (Per Cent)	Short-Circuit Kva.	Short-Circuit, Amp.
1	43.0	232,000	10,200
2	23.8	420,000	18,500
3	17.5	572,000	25,000
4	14.3	700,000	30,700
5	12.2	820,000	36,000
6	11.0	910,000	40,000


Station"A" 100,000 Kva 7.5% Reactance
Feeder React 2.5%@8,000 Kva
Sub Station"X"
Station"B" 100,000 Kva 10% React
FIG 2
Station"A" 100,000 Kva 7.5% React
No 6
No 5
No 4
No 3
No 2
No 1
Sub Station"X"
Station"B" 100,000 Kva. 10% React.
FIG 3

FIGS. 2 AND 3—REDUCTION OF SHORT-CIRCUIT CURRENTS BY BUS REACTANCE

	Kva.	Per Cent Reactance
Power from line No. 4 (100,000 kva., reactance)	= 73,500	43
Power from line No. 1	= 100,000	43
Total power on right bus section	= 173,500	43
	= 100,000	24.8

100,000 kva. at 24.8 per cent reactance gives 404,000 kva. = 17,700 amp. as the short-circuit power on right bus section.

Table II gives results with two to six lines operating.

TABLE II—BUS REACTANCE 2.5 PER CENT AT 16,000 KVA.

Tie Lines Operating	Equivalent Reactance at 100,000 Kva. (Per Cent)	Short-Circuit Kva.	Short-Circuit, Amp.
2	24.8	404,000	17,700
4	14.8	675,000	29,600
6	11.4	880,000	38,600

As this scheme reduces the short-circuit current so little (40,000 amp. to 38,600 amp.), the next step would be to double the bus reactance, making it 5 per cent at 16,000 kva. Table III shows results obtained.

Tables II and III show clearly that a bus reactance will not solve the question. It would not only tend to introduce unequal voltages, unless the same number of tie lines is always on each bus section, but the reduction of short-circuit current from 40,000 amp. to 34,000 amp. is too small to justify the expense of installation. The lines feeding direct to the section in trouble would always deliver their full current into a fault, regardless of what could be added through the bus reactance by the lines on the other bus section. With six lines operating, the three lines next to the fault would supply 25,000 amp., while 9,000 amp. would come from the other three, through the bus reactance, making a total of 34,000 amp. at the fault. The substation bus might be in three sections, with two lines per section, but this would make a layout rather too expensive and elaborate for most substations.

TABLE III—BUS REACTANCE 5 PER CENT AT 16,000 KVA.

Tie Lines Operating	Equivalent Reactance at 100,000 Kva. (Per Cent)	Short-Circuit, Kva.	Short-Circuit, Amp.
2	27.2	368,000	16,100
4	16.6	600,000	26,400
6	12.8	777,000	34,000

TABLE IV—TIE LINE REACTANCE 2.5 PER CENT AT 16,000 KVA.

Tie Lines Operating	Equivalent Reactance at 100,000 Kva. (Per Cent)	Short-Circuit, Kva.	Short-Circuit, Amp.
1	58.6	170,000	7,400
2	31.6	317,000	14,000
3	22.7	440,000	19,300
4	18.2	552,000	24,200
5	15.4	650,000	28,500
6	13.6	735,000	32,300

REACTANCE BETWEEN TIE LINES AND BUS

The next arrangement to consider would be to locate a reactance between the tie line and the bus, as indicated in Fig. 4. With a 2.5 per cent reactance at 16,000 kva. and only one tie line operating, the equivalent power on the bus will be 100,000 kva. at 58.6 per cent reactance. The one line would deliver to the substation 100,000 kva. at 43 per cent reactance, and this, added to the tie-line reactance of 2.5 per cent at 16,000 kva. (15.6 per cent at 100,000 kva.) gives 100,000 kva. at 58.6 per cent reactance as the power on the bus. This gives 170,000 kva. for 7,400 amp.

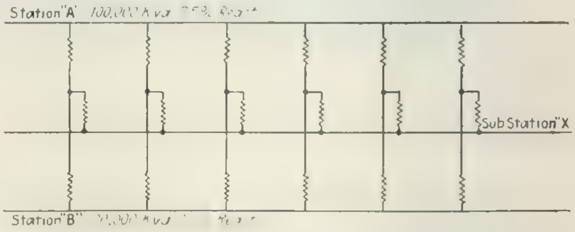


FIG. 4—REACTANCE BETWEEN TIE LINE AND BUS HAS MAXIMUM EFFECT

When two lines are used, the power just outside of the reactances would be 100,000 kva. at 23.8 per cent reactance. With the two reactances virtually in parallel, we get 32,000 kva. at 2.5 per cent = 100,000 kva. at 7.8 per cent. By adding this to the power just outside the reactances we get 100,000 kva. at 31.6 per cent reactance as the power on the bus. Values for more than two cables would be calculated in a similar way. Table IV gives results with one to six lines operating.

Table V gives values obtained when using a reactance of 5 per cent at 16,000 kva.

From the results shown in Tables IV and V it is apparent that the reactance does its best work when placed between the tie line and the bus, as just discussed. Subsequent calculations are based on a 5 per cent reactance, giving an equivalent power on the bus of 100,000 kva. at 16.2 per cent reactance.

Although six lines are run into the substation, it is quite probable that the substation load would never require more than four lines. During switching operations all six lines might be on the bus, but this condition would last for only a few minutes at the most. If four was the maximum number of lines on the bus, the short-circuit current would be reduced from 27,000 amp. to 19,600 amp.—a 31 per cent reduction. In view of this reduction in short-circuit current many engineers might prefer to have the structure and breakers capable of withstanding the short-circuit current and stresses from four lines only, considering the possibility of a short circuit during switching operations as too remote to cause any great worry. However, in this article we will consider everything on the basis of preparing against the worst that could possibly happen and will accordingly figure on six tie lines.

Now, with the possibilty of a 27,000-amp. bus short circuit, the question arises, "What is the duty on each individual breaker? Which has the heaviest and which the lightest duty to perform?" To answer the last question first, the breakers having the lightest duty to perform in case of a bus short circuit are the breakers on the tie lines themselves. Each tie line breaker would have to rupture only the current that could be supplied through its own line—something less than 5,800 amp. When only one line is operating it will supply 5,800 amp. to a bus short, but when six lines are on the bus the total is 27,000 amp., or 4,500 amp. per line. If the power on the bus were infinity and six lines were operating, each line would, of course, supply 5,800 amp., the same as when only one line is on the bus.

TABLE V—TIE LINE REACTANCE 5 PER CENT AT 16,000 KVA.

Tie Lines Operating	Equivalent Reactance 100,000 Kva. (Per Cent)	Short-Circuit, Kva.	Short-Circuit, Amp
1	74.2	135,000	5,900
2	39.4	254,000	11,200
3	27.9	357,000	15,600
4	22.0	453,000	19,600
5	18.5	540,000	23,700
6	16.2	618,000	27,000

In the event of a short circuit on a tie line, its breaker must break all of the current that the five good lines can supply through its own reactance. With five lines on the bus its equivalent reactance at 100,000 kva. would be 18.5 per cent. The tie-line reactance added to this gives 100,000 kva. at 49.7 (say 50) per cent reactance and gives 200,000 kva. or 8,800 amp. as the maximum duty on any tie-line breaker.

In the case of outgoing 13,200-volt feeders, a short on a feeder near the substation would be virtually the same as a bus short with a current of 27,000 amp. to be opened. According to curves published by the American Institute of Electrical Engineers[2] and allowing 0.4 second for the breaker to open, we find that the current at time of opening would be approximately three and three-quarters times normal. This gives 375,000 kva. = 16,500 amp. as the actual duty on a feeder breaker rupturing close to the bus.

This shows what at first sight seems an impossible condition—that a breaker 30,000 ft. and 20,000 ft. (9 km. and 6 km.) respectively from the two power stations must rupture 50 per cent more current than a feeder breaker located directly on the buses of the power stations. However, in the first article on this subject it was found that the short-circuit current on a radial feeder was not more than 11,700 amp., and this is the *initial* value, with no allowance made for its decrease by the time the breaker opens. It is well to bear this condition in mind when considering breakers for such a system as this, because a breaker that is satisfactory for use on the power-station feeders may be entirely unfit for use on substation feeders. In fact, this will usually be the case when the substation is fed from tie lines between power stations or has several parallel feeders from one power station.

Calculation of Mechanical Stress at Bus Supports

Having determined the duty on the 13,200-volt breakers, the next problem is to determine the amount of stress on the bus supports. For these calculations it is best to proceed on the basis of unsymmetrical short circuits, although for breaker applications all shorts are assumed to be symmetrical. When a short circuit is asymmetrical, or unsymmetrical, its value may be one and three-quarters times to twice that of the symmetrical short. To be on the safe side then it is best to design the bus structure on the basis of an entirely unsymmetrical short circuit, with the initial value twice that of the symmetrical short. This means that 54,000 amp. should be the current used for this calculation.

The force per foot between buses is figured from the formula[3]

$$F_3 = (I_3^2 \times 8.08 \times 10^{-7})/S,$$

where I_3 = three-phase short-circuit current and S = distance between centers of buses in inches. Assume $S = 18$ in.; then:

$$\text{Force} = (54{,}000^2 \times 8.08 \times 10^{-7})\ 18 = 142.5 \text{ lb. per foot.}$$

With bus supports 4 ft. (1.2 m.) apart, this gives 570 lb. (258.5 kg.) as the force on each support.

The consideration of short circuits on the low-tension bus and substation feeders will be taken up in an early issue.

Coke Breeze and Anthracite Screenings Burned at 200 Per Cent Rating

Coke breeze and anthracite screenings have been burned on a coke traveling grate stoker under a flat-arch furnace by the Rochester (N. Y.) Gas & Electric Corporation with very satisfactory results. It was found that 125 per cent to 200 per cent of the normal boiler load could be maintained so long as fuel of this kind was uniform in size and well mixed and contained not more than 10 per cent to 15 per cent of moisture. For best results the furnace should have a flat arch. A draft of 1 in. to 1¼ in. (2.5 cm. to 6.3 cm.) is required for a 4½-in. (11.1-cm.) fuel bed. In burning this fuel some trouble was experienced with clinkers adhering to the firebrick walls, but this might be overcome by running the carborundum bricks used for lower courses higher.

I. E. Powell.

Rochester, N. Y.

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[2] *Transactions*, A. I. E. E., 1918, p. 123.

[3] Leonard and Riker, *Electrical Journal*, December, 1917.

Magnetic Properties of Iron-Nickel Alloys

In Strong Fields Alloys Low in Nickel Content Show High Saturation and Permeability, but Also High Hysteresis Loss—At About 50 per Cent Nickel the Alloys Give Excellent Characteristics

By T. D. YENSEN

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THIS investigation was undertaken to determine whether any iron-nickel alloys could be found having a higher saturation value than pure iron. Alloys were prepared containing 0-100 per cent nickel. Pure Fe-Ni alloys do not forge readily, and to make them forgeable it is necessary to add alloying elements like manganese or titanium. The results show that the saturation value decreases slowly with increase in nickel content up to 20 per cent Ni, then rapidly to 30 per cent, again rises rapidly to 50 per cent, and falls off gradually toward 100 per cent Ni. At no point does it exceed that of pure iron. For values of *H* between 100 and 400 the permeability is about 5 per cent higher for 6 to 8 per cent Ni than for pure iron, but this advantage is offset by the large increase in hysteresis loss. Alloys containing 35 to 70 per cent Ni have high permeability at low and medium densities and low hysteresis loss, the highest permeability occurring for 50 per cent. Thirty to 50 per cent alloys are characterized by a nearly straight line *B-H* curve from the origin to $B = 2{,}000$ to 4,000 gausses, and also by low retentivity and coercive force, properties which are of value in connection with certain electromagnetic meters.

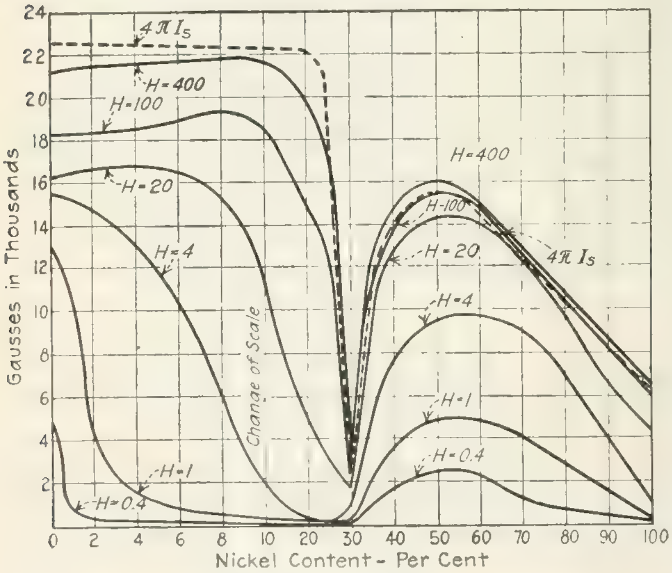

FIG. 1—SATURATION INTENSITY AND ISO-GILBERT CHARACTERISTICS

Previous investigations on commercial iron-nickel alloys have shown that 25 to 35 per cent alloys have irreversible magnetic and electrical transformation points occurring below ordinary temperatures. The present investigation confirms these results for pure alloys. It is pointed out that the irreversible transformation causes an enormous increase in the hysteresis loss.

IMPORTANCE OF HIGH MAGNETIC SATURATION

The discovery of materials having higher magnetic saturation than pure iron is of great importance in connection with dynamo-electric machinery, because it is the saturation value of the material in the teeth of the armature that determines to a large extent the size of the machines. If the saturation value could be raised 10 per cent, this would mean that the length of the armature—and consequently the field and frame—could be decreased by approximately 10 per cent, with a resultant large saving in the cost of the machine. Cobalt has been known for some time to increase the saturation value, in the case of the alloy Fe_2Co by as much as 10 to 13 per cent.[1] At high inductions the author[2] has shown that the permeability of Fe_2Co may be as much as 25 per cent higher than that of pure iron. This alloy would therefore seem to be very suitable for the purpose mentioned were it not for its high cost. Efforts have consequently been made to discover less expensive materials with properties similar to those of Fe_2Co.

Nickel has been suggested as a possible substitute for Co, although according to Weiss,[3] nickel lowers the saturation value of iron. Burgess and Aston[4] prepared a large number of alloys ranging from 0-100 per cent Ni, and among these there were one or two alloys having a slightly higher permeability at high inductions than pure iron. The composition of these alloys was in the neighborhood of 5 per cent Ni. These results and certain others obtained with low-nickel steels prepared commercially made it desirable to investigate carefully the possibilities in the direction indicated. Alloys were consequently prepared from the purest materials obtainable and by the most approved method known to yield pure alloys.

The alloys were made by melting the desired proportions of electrolytic iron and electrolytic nickel placed in magnesia crucibles in an Arsem type vacuum furnace under pressure of 1 mm. to 2 mm. Hg.

The first attempts that were made to forge the ingots revealed the fact that pure iron-nickel alloys do not forge very well at ordinary forging temperatures. Up to 8 per cent Ni, and in rare cases with higher nickel contents, fairly good forgings were obtained by forging at a dull red heat, but not by forging at a bright red heat. In other cases the alloys would forge at a black heat, or even cold, while some alloys could not be forged under any conditions. In order to obtain pure iron-nickel alloys in the form of test pieces it was, therefore, necessary in some cases to machine rings directly from the ingots. Forgeable alloys were obtained by means of certain addition agents. Titanium and manganese worked successfully for this purpose, while Si, Al and magnesium had no effect. The amounts of Ti and Mn required varied from 0.2 per cent for 10 per cent Ni to 1.0 per cent for 50 per cent.[5]

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[1] Weiss, "Electromagnet with Ferro-cobalt Pole Pieces," *Comptes Rendus*, 156, p. 1970, June 30, 1913; *Trans. Faraday Soc.*, 8, p. 149, 1911-12. Yensen, "Magnetic Properties of the Iron-cobalt Alloy Fe_2Co," *Gen. Elec. Rev.*, 18, p. 881, September, 1915; *Proc. A. I. E. E.*, 34, p. 2463. Kalmus and Blake, "Magnetic Properties of Cobalt and Iron-cobalt Alloys," Canadian Department of Mines, Mines Branch, Report 413, 1916. Becket, "Alloys of Iron and Cobalt," U. S. Patent 1,247,206, November, 1917.

[2] *Loc. cit.*

[3] *Loc. cit.*

[4] "Magnetic and Electrical Properties of Iron-nickel Alloys," *Met. and Chem. Engr.*, 8, p. 23, January, 1910.

The annealing was done at 900-950 deg. C., in rare cases at higher temperatures, in a vacuum furnace, under a pressure of 0.1 mm. Hg., the test pieces being buried in granulated MgO and the temperature measured by means of a platinum-platinum-rhodium thermocouple. The cooling was extended over a period of twenty-four hours and was done at a rate of approximately 30 deg. per hour.

The magnetic testing of the rods was done by the Burrows compensated double bar and yoke method, this being the most approved method thus far developed for rods. The rings were tested by means of the ordinary two-winding method, no other method being either simpler or more accurate.

DISCUSSION OF SATURATION AND PERMEABILITY

The curves for H = 0.4, 1, 4, 20, 100, 400, and for the saturation intensity, $4\pi Is$, have all been plotted in Fig. 1, showing at a glance the variation in permeability for various magnetizing forces with variation in nickel content. These curves might be termed the magnetic iso-gilberts for the iron-nickel alloys. To this set of curves the following general statements can be applied:

1. The saturation intensity, I_s, decreases slightly—not more than 1 or 2 per cent—from pure iron to 20 per cent nickel. Between 20 and 30 per cent nickel I_s decreases to one-tenth of its previous value, increases again rapidly beyond 30 per cent, reaches a maximum for 50 per cent nickel, and finally decreases gradually toward 100 per cent, the value for pure nickel being between one-third and one-fourth that for pure iron.

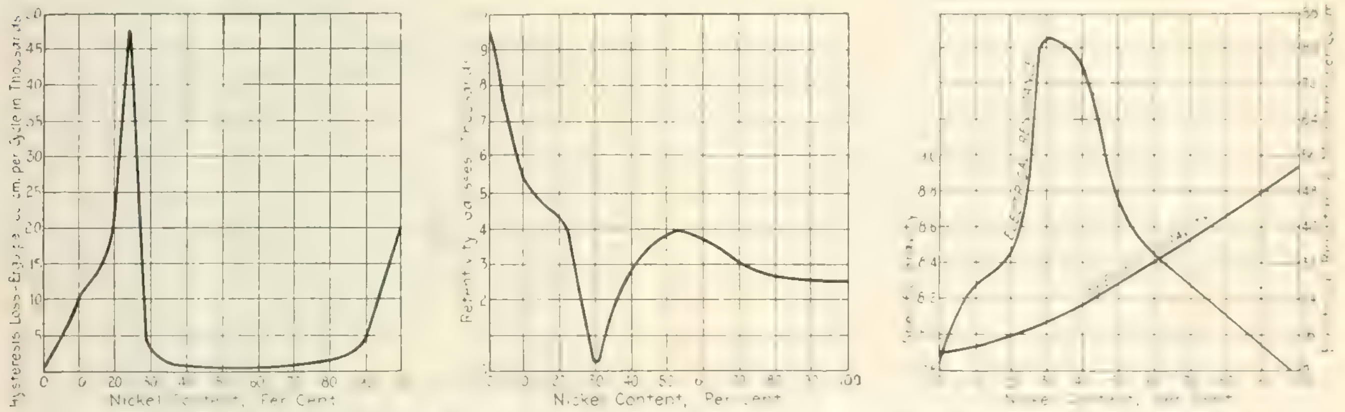
2. The iso-gilberts for high values of *H* are of the same general shape as that for I_s, except that there is a slight increase—about 5 per cent—in permeability between 0 and 8 per cent nickel.

3. For low values of *H* the iso-gilberts drop rapidly from pure iron and remain very low until the 30 per cent point has been passed, reaching a maximum between 50 and 60 per cent nickel, for which in some cases a permeability has been reached approaching that for pure iron, and finally decreasing to very low values for 100 per cent nickel.

Fig. 2 shows the variation of hysteresis loss for B = 10,000 gausses with nickel content. As might be expected from the iso-gilberts of Fig. 1, the loss increases rapidly even with small additions of nickel, and the loss becomes very high for alloys containing 15 to 25 per cent, reaching a maximum of nearly 50,000 ergs per cc. per cycle for the 25 per cent alloy. Between 30 and 70 per cent the loss is as low as or even lower than for pure iron, but above 70 per cent the loss again increases rapidly, reaching 20,000 for pure nickel.[6]

Fig. 3 shows the retentivity to decrease with increasing nickel content, reaching a minimum of only 200 for the 30 per cent alloy. With further increase in nickel content the retentivity again increases, reaching a maximum between 50 and 60 per cent nickel.

Fig. 4 shows the variation in electrical resistance, checking very closely the results obtained by Burgess[7] and by Honda.[8] The curve has been drawn through the points for pure iron-nickel alloys for all cases in which alloys were available in the form of rods. In every case the alloys containing a small amount of silicon have a decidedly higher resistance than the alloys without silicon, as might be expected. The curve reaches a maximum for 30 per cent nickel, corresponding to the composition of the alloy having the lowest magnetic saturation value.



FIGS. 2, 3 AND 4—VARIATION OF PROPERTIES OF NICKEL ALLOYS WITH PERCENTAGES OF NICKEL FROM 0 TO 100

(2) Hysteresis loss, (3) retentivity, (4) electrical resistance and specific gravity

The specific gravity shown in Fig. 4 was obtained incidentally as a means of obtaining the true cross-section of the ring test pieces. The values increase uniformly from 7.9 per cent for pure iron to 8.9 for pure nickel.

AN IRON-NICKEL COMPOUND MAY EXIST AT ABOUT 30 PER CENT NICKEL

The results thus far given would seem to indicate that an iron-nickel compound exists corresponding to about 30 per cent nickel, because both the magnetic and electrical properties change very abruptly for this composition. However, these results are misleading in this

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[5] The problem of forgeability of the iron-nickel alloys is dealt with in a paper presented at the New York meeting of the A. I. M. E., February, 1920.

[6] All losses are based on a flux density of 10,000 gausses. In case of the 30 and 80-100 per cent alloys having saturation values lower than 10,000, the losses were obtained for as high densities as possible, and the hypothetical loss for 10,000 calculated by means of the formula:

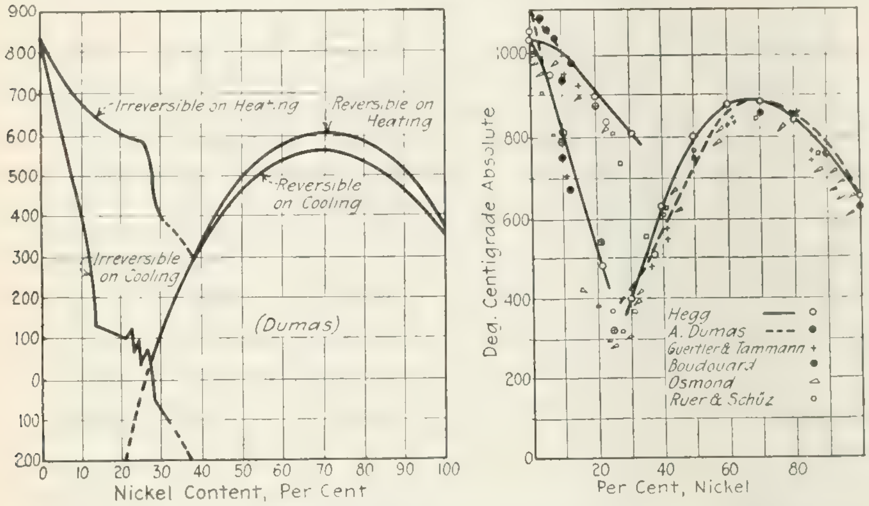
$$W = W_B \times \left(\frac{10000}{B}\right)^{1.6}$$

where W_B is the loss actually obtained by test for the flux density *B*. The 1.6 law may not be strictly applicable in the case of the alloys mentioned but is believed to be sufficiently accurate for the purpose of comparison.

[7] *Loc. cit.*

[8] "The Thermal and Electrical Properties of Nickel Steels," *Scientific Reports Tohoku Imp. Univ.*, 7, pp. 59-66, 1918.

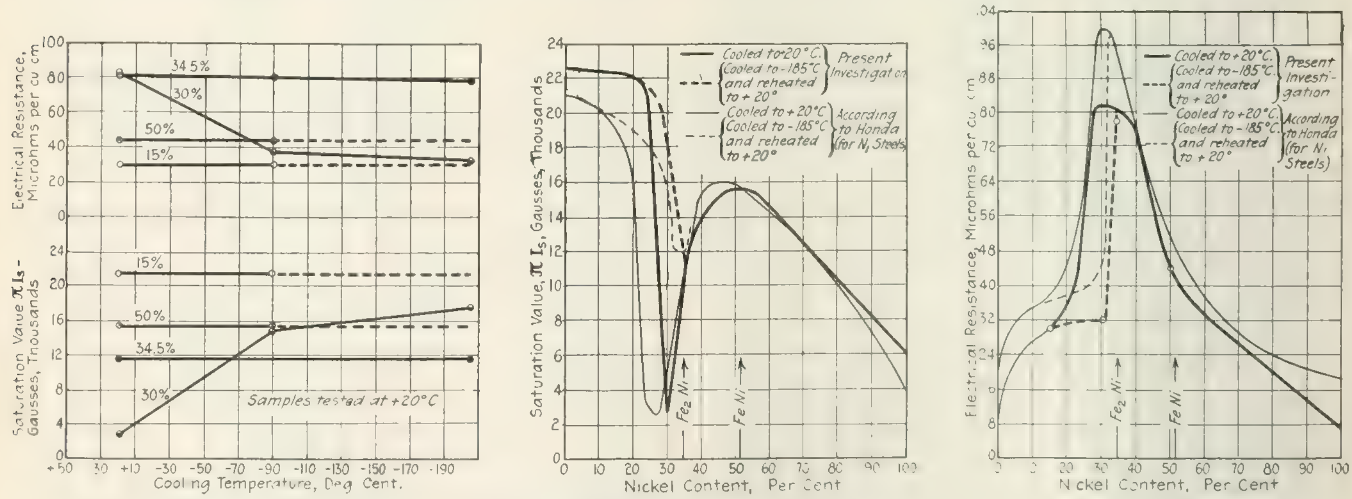
respect. It has been shown that the properties of the alloys in the neighborhood of 30 per cent nickel are very different after being cooled to liquid air temperature from what they are after being cooled merely to room temperature, and furthermore that this difference is due to the fact that these alloys—in addition to the reversible magnetic transformation points occurring above room temperature—have irreversible transformation points occurring below room temperature.[9]



FIGS. 5 AND 6—RESULTS OBTAINED BY MANY INVESTIGATORS OF REVERSIBLE AND IRREVERSIBLE TRANSFORMATIONS

Fig. 5 gives results of Dumas, for alloys without *C* and Mn

These transformations have been studied a great deal in recent years, the pioneers in the field being Hopkinson[10], LeChatelier[11], Osmond[12], Guillaume[13] and Dumas[14]. The alloys investigated by these scientists all contained foreign elements to some extent, particularly carbon and manganese. As a matter of fact manganese was considered an essential constituent, because without it the alloys could not be forged. It is very unfortunate, however, for the interpretation of the results of the above investigations that these two elements referred to are the ones that affect the transformation points the most. Thus carbon is twenty times as effective as nickel in lowering the transformation points, and manganese, while less effective in this respect than in carbon, still is much more effective than nickel. Dumas[15] realized this when he stated that "No nickel steel is non-magnetic at ordinary temperatures except steels containing carbon and manganese," and he consequently attempted to keep these elements as low as possible. The results of his experiments are shown in Fig. 5. It will be noted that in the region of 27 to 31 per cent nickel Dumas found both reversible and irreversible transformations. Of the two, however, the irreversible was by far the more intense. The broken curves indicate probable transformations in pure alloys that are too feeble in comparison with the transformations that have already occurred to be readily detected. However, by introducing carbon into the alloys the irreversible transformation points may be lowered sufficiently without lowering the reversible points, to reveal the latter. Dumas cites the example of a 23 per cent alloy, which when pure has an irreversible point on cooling at + 75 deg., but apparently no reversible point. By adding 0.85 per cent *C* and 1.41 per cent Mn to this alloy the irreversible point is decreased to —188 deg., and on cooling from 0 deg. — the alloy is now non-magnetic—the reversible point is revealed at —150 deg. On the assumption that the reversible points are unaffected by *C* or Mn, Dumas concludes that the pure Fe-Ni alloys between 20 and 37 per cent nickel have both reversible and irreversible transformation points.



FIGS. 7, 8 AND 9—COMPARISON OF RESULTS OBTAINED BY AUTHOR AND BY HONDA IN STUDY OF REVERSIBLE AND IRREVERSIBLE TRANSFORMATIONS

In a recently published circular[16] the Bureau of Standards has compiled all the important data published prior to 1916 relating to iron-nickel alloys and includes an extensive bibliography. Fig. 6 gives the magnetic transformations according to Hegg reproduced from this circular, giving also points determined by Dumas and by Osmond magnetically, by Guertler and Tammann and by Rurer and Schuz metallographically, and by Boudouard thermo-electrically. The ordinates of this curve are in absolute degrees centigrade (= 273 + deg. C.).

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[9] The magnetic transformation point is the temperature at which the alloy loses a part or all of its magnetizability on heating and the temperature at which it regains a part or all of the magnetizability on cooling. If these two temperatures coincide, the transformation point is reversible, otherwise it is irreversible.

[10] *Proc. Royal Soc.*, 46 and 47, p. 23, 1889; 48, p. 1, 1890.

[11] *Comptes Rendus*, 90, p. 285, 1890.

[12] *Comptes Rendus*, 118, p. 532, 1894; 121, p. 648, 1895; 128, pp. 306, 1395, 1513, 1899.

[13] *Comptes Rendus*, Jan. 25, April 5, June 18, July 26, 1897.

[14] *Comptes Rendus*, 139, p. 42, 1899; *Jour. Iron and Steel Inst.*, 11, p. 225.

[15] *Loc. cit.*

[16] Circular No. 58, "Invar and Related Nickel Steels," April 4, 1916.

More recently Honda[17] has studied the magnetic and electrical properties of nickel steels at ordinary temperatures and after quenching in liquid air. The latter treatment caused remarkable changes in the region of 25 to 30 per cent nickel, but no appreciable changes for other nickel contents, thus confirming the results already referred to. The results are shown in Figs. 8 and 9. On account of the foreign elements present in Honda's steels it seemed desirable to repeat his tests with pure alloys and thus round out the investigation of the iron-nickel alloys by the writer.

The samples used were selected from those used in the previous investigation, the preparation of which is fully described in the first part of the paper. The test pieces used are as follows:

Two Ni (225)—15 per cent Ni, two rods.
Two Ni (232)—30 per cent Ni, two rods and one ring.
Two Ni (233)—34.5 per cent Ni, one rod and one ring.
Two Ni (234)—34.5 per cent Ni, one rod and one ring.
Two Ni (261)—50 per cent Ni, one rod.
Two Ni (262)—50 per cent Ni, one rod.

As a preliminary the rings were tested successively at room temperature, in CO_2 snow (—80 deg. C.), again at room temperature, then in liquid air (—180 deg. C.) and finally at room temperature. Then the rods were tested at room temperature, after having been cooled to —80 deg. and after having been cooled to —180 deg. The cooling to —80 deg. was done by immersing the test pieces in gasoline, gradually adding CO_2 snow until no more would melt and maintaining the temperature for about half an hour by adding more snow from time to time.

REMARKABLE EFFECT OF COOLING TEMPERATURE ON 30 PER CENT ALLOY

The results are shown graphically in Figs. 7, 8 and 9. It will be noted that while there is practically no change in the properties of the 15, 34.5 and 50 per cent alloys, the 30 per cent alloy has undergone a marked change. Its saturation value was increased from 2,700 to 14,600 by cooling to —80 deg. and to 17,800 by cooling to —180 deg. Similarly, the electrical resistance was decreased from 82 to 38 and to 32 by the above treatments. It is probable that the change would have gone to completion at —80 deg. if the test piece had been held there sufficiently long and that the irreversible transformation point therefore lies between 0 deg. and —80 deg., thus confirming Dumas' results.

While only a few points were determined, they are sufficient to demonstrate that the cusp of both curves, after the completion of the transformations, occurs for approximately 34.5 per cent nickel instead of for 30 per cent, as the previous investigation would lead one to believe. This points strongly toward the existence of the compound Fe_2Ni, corresponding to 34.6 per cent nickel, suggested by earlier investigators. The existence of the compound FeNi, corresponding to 51.5 per cent nickel, is more doubtful, because there is no definite indication of it in the electrical resistance curve.

It is interesting to note that while the saturation value of the 30 per cent alloy was increased to a remarkable extent by being cooled to below the irreversible transformation point, the permeability at low flux densities was decreased and the hysteresis loss enormously increased, the latter fifteen times. In other words, the reversible transformation produces a material with low hysteresis loss and low magnetic saturation, while the irreversible transformation produces a material with six times the saturation value but with fifteen times the hysteresis loss.

It is also interesting to note that there apparently is no change in the microstructure of the 30 per cent alloy accompanying the marked magnetic and electrical transformation. It is therefore apparent that the magnetic and electrical transformations are atomic or ionic in their nature.

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[17] "The Thermal and Electrical Properties of Nickel Steels," *Scientific Reports*, Tohoku Imp. Univ., 7, p. 59, 1918.

Economical Division of Load on Several Lines

Based on Maintaining Equal IR Drops—Where Not Considered, Annual Energy Losses Are Sometimes Twice Annual Investment Charge

BY LANSING W. THOMS

IN CENTRAL-STATION practice a condition often arises wherein a load at a particular point is so large that it has to be served by several lines. Sometimes it is possible by proper arrangement of that load to obtain any desirable division of it over the several lines. A common instance of this is the single customer who requires several lines for his service. In such a case some arrangement may be made with him for proper division of his load at his bus. By this method an apportionment of the load can be made whereby the maximum economy of operation can be obtained. In the following article a determination of the most economical division of load over several lines is made and an illustration of actual conditions is given.

Since the investment charges on the installation are constant, the only variable cost in handling the load is the cost of the energy losses. Therefore the minimum total cost, and hence maximum economy, is obtained in the case where there is a minimum cost of energy losses.

It is at once evident that if the several lines are of the same size wire, spacing and length the most economical operation would be obtained when the load is equally divided. However, in most cases the lines will not be of the same length or wire size, and there will be differences in the size and length of cable and wire used; hence the resistance will be different. Since the energy losses vary as the resistance and the square of the current, it can be seen that the total energy losses with a given load will vary as the load is divided among several lines. There is then a certain division of the load with which the total energy losses are a minimum.

ANNUAL ENERGY LOSS SOMETIMES DOUBLE INVESTMENT CHARGE

The cost of the energy losses can be calculated with a fair degree of accuracy. With a heavy load it is possible, and indeed not rare, to find the annual cost of these energy losses equal to and even twice as much as the annual investment charge on the installation. It can be seen, then, that with an appreciable load at an appreciable distance the cost of transmission will depend upon the load division between the several lines.

The mathematical solution is as follows:

Nomenclature:

Y_t = total annual cost of line, including investment charge, taxes, depreciation and cost of energy loss.

Y_{tt} = total annual cost of all lines, including investment charge, taxes, depreciation and cost of energy loss.

Y_i = annual charge on investment of line, including investment charge, taxes and depreciation.

Y_{it} = total charge on investment of all lines, including investment, charge, taxes and depreciation.

Y_e = annual cost of energy losses in line.

Y_{et} = total annual cost of energy losses in all lines.

I = current per line in amperes.

I_t = total current in all lines in amperes.

I_{ec} = economical current per line in amperes.

k = constant.

R = total equivalent resistance of line.

Considering two lines, let one line be designated by prime (′) and the other by double prime (″). Then:

$$Y_{tt} = Y'_t + Y''_t$$

$$Y_t = Y_i + Y_e$$

$$Y_e = kI^2$$

$$Y_{tt} = Y'_i + Y''_i + k'I'^2 + k''I''^2$$

$$I' + I'' = I_t$$

$$I' = I_t - I''$$

$$I'^2 = I_t^2 - 2I_t I'' + I''^2.$$

Then:

$$Y_{tt} = Y'_i + Y''_i + k'(I_t^2 - 2I_t I'' + I''^2) + k'' I''^2.$$

With a given installation the investment charge is a constant; then the total annual cost of the installation is a minimum when the energy losses are a minimum.

Hence Y_{tt} is a minimum when Y_{et} is a minimum.

Since:

$$Y_{et} = k'(I_t^2 - 2I_t I'' + I''^2) + k'' I''^2 \qquad (1)$$

$$\frac{Y_{et}}{I_t} = k'\left(I_t - 2I'' + \frac{I''^2}{I_t}\right) + k''\frac{I''^2}{I_t}$$

Then the minimum operating charge is obtained when Y_{et}/I_t, or the annual cost of energy loss per ampere transmitted, is a minimum. This occurs when

$$\frac{d\,(Y_{et}/I_t)}{d\,I''} = 0$$

$$= -2k' + 2k'I''_{ec}/I_t + 2k''I''_{ec}/I_t$$

or

$$I''_{ec} = I_t\frac{k'}{k' + k''}$$

and

$$I'_{ec} = I_t\frac{k''}{k' + k''}$$

and

$$I''_{ec}/I'_{ec} = k'/k''.$$

Since k is proportional to R:

$$I''_{ec}/I'_{ec} = R'/R''$$

or

$$I''_{ec}R'' = I'_{ec}R'$$

In the case of more than two lines, two lines can be considered as one by use of an equivalent circuit and the mathematical development carried as above.

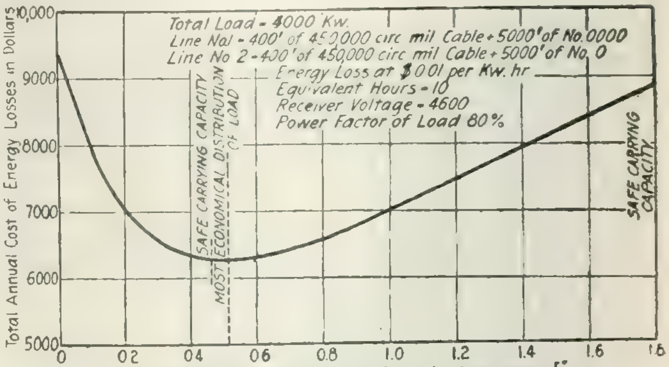
Then:

$$I'_{ec}R' = I''_{ec}R'' = I'''_{ec}R''' = I^{IV}_{ec}R^{IV}, \text{ etc.};$$

i.e., the most economical division of load over several lines is effected when the *IR* drops over several lines are equal. From this a chart can be made up for any combination of lines giving the most economical currents for any total load. Arrangements can then be made to divide the load so that each line carries a load as near as possible to the most economical.

IR DROP SHOULD DETERMINE LOCAL DIVISION

It should be noted that with lines of different characteristics there will be differences in the power factor of the several lines. Hence the ratio between amperes and kilowatt load will be different for each line. The most economical division of the load, however, is attained when the *IR* drops over the several lines are equal. The load then should not be divided according to the kilowatts but with reference to the *IR* drops in the lines.



TOTAL ANNUAL COST OF ENERGY LOSSES FOR VARIOUS METHODS OF DIVIDING LOAD BETWEEN TWO LINES

In order to show the effect in annual costs of different divisions of load a particular case is considered as follows:

Number of lines = two.
Total load = 4,000 kw.
Power factor = 80 per cent.
Receiver voltage = 4,600 volts.
First line — 400 ft. (122 m.) of 450,000-circ mil. cable and 5,000 ft. (1,524 m.) of No. 4/O overhead.
Second line — 400 ft. (122 m.) of 450,000-circ. mil. cable and 5,000 ft. (1,524 m.) of No. O overhead.
Cost of energy loss = $0.01 per kilowatt-hour.
Equivalent hours = 10.

The total annual costs of the energy losses (Y_{et}), computed by equation (1), are shown as a curve in the accompanying illustration as a function of I''/I'. It can be seen that as the proportions of the total load carried by each line varies the annual costs also vary. In this case the annual cost of energy losses runs from $6,200 at the most economical point of operation to $8,750 at the maximum cost of operation. The maximum variation in the annual cost of the installation is $2,550, depending upon whether it is economically operated or not.

The division of the load is limited by the allowable current capacity of each line as shown on the curve. From the value of $I''/I' = 0.45$ to about $I''/I' = 0.65$ the actual difference in annual cost is not large. Beyond this point the curve rises more rapidly. The point of minimum cost comes at $I''/I' = 0.51$, which, as might be anticipated from the foregoing theoretical discussion, is the point where $I'R'' = I''R''$

$$R' = 0.2643 \qquad R'' = 0.5198$$

$$R'/R'' = 0.2643/0.5198 = 0.51 = I''/I'$$

High-Voltage Service Entries*

St. Louis Practice Covering Methods of Protection and Installation —Types of Equipment Specified for Indoor Customers' Substations Designed for 13,200-Volt Primary Metered Service

By **WALTER H. MILLAN**

Superintendent of Substations Union Electric Light & Power Company, St. Louis

THE problem of working out a safe layout for primary substations is comparatively simple when the entire establishment is a new one and the building is of good fireproof construction. However, a large number of installations are needed in old buildings where some intensive manufacturing process requires a very much larger amount of power than was originally intended to be fed into the building. An explanation of the method of handling such layouts in St. Louis will be given here.

The first obstacle to be overcome is generally to secure the assignment of adequate space for the installation of the equipment. Some 400 sq.ft. to 600 sq.ft. (40 sq.m. to 60 sq.m.), with 14 ft. (4.2 m.) head room, in a clean part of the building, should be allotted for substations rated at from 150-kw. to 1,500-kw., 13,200 volts, 25-cycle or 60-cycle.

Another consideration in the layout of the substation equipment is safety with respect both to those who must operate and maintain the equipment and to fire fighters who may be called upon to enter the main building. Next should be considered the provision of ready access to equipment to facilitate cleaning and repairing it. The average installation consists of a bank of single-phase transformers or of a single three-phase transformer for supplying 230-volt or 460-volt power circuits and a separate single-phase transformer for supplying 115/230-volt lighting circuits. Outdoor-type transformers are always specified on account of the possibility of interchanging with units in outdoor substations.

Each transformer bank is protected by a 300-amp., 15,000-volt, triple-pole, single-throw automatic oil switch mounted in a brick or concrete cell which effectively isolates it. A very rugged switch is used with an instantaneous rupturing capacity of 4,000 amp. at a sustained voltage of 13,000 (A. I. E. E. rating). The switch is operated by means of hand lever mounted on a panel remote from the switch cell, the panel being so located as to permit the operator to reach the substation exit without passing any of the equipment. This arrangement practically eliminates the likelihood of personal injury should a switch failure occur.

The lighting transformers are protected by fusible disconnecting switches. The circuits to the power transformers are usually provided with disconnecting switches so that these transformers may be disconnected when not in use without cutting off the building lights. An attempt is made to arrange the equipment in such a manner that passageways at least 4 ft. (1.2 m.) in width will be provided.

All live exposed high-tension conductors and terminals as far as possible are kept at least 8 ft. (2.5 m.) above the floor line. This usually necessitates 14-ft. (4.3-m.) head room. Where the exposed live parts must be placed lower they are protected by screens 8 ft. (2.5 m.) in height.

At the present time it is the practice to feed all such customer installations through underground entrances even though the supply feeder is an overhead line. In this case a three-conductor cable is brought down a conveniently placed pole and through an underground conduit to a pothead in the consumer's substation. Near each pothead is a set of disconnecting switches feeding a primary bus. This in turn feeds (1) the power transformers through disconnecting switches and an oil switch, and (2) the lighting transformers through fusable disconnecting switches which are so mounted that the fuses are dead when the switch blades are open.

GENERAL SPECIFICATIONS FOR 13,200-VOLT CUSTOMERS' SUBSTATION EQUIPMENT

DISCONNECTING SWITCHES:

Six 300-amp., 15,000-volt disconnecting switches mounted on steel base and equipped with safety latches.

LIGHTNING ARRESTER:

One 13,200-volt indoor-type oxide-film or electrolytic lightning arrester suitable for operation on three-phase ungrounded neutral cycle system.

Three 50-amp., 15,000-volt combined disconnecting switches and carbon-tetrachloride fuse holders mounted on steel bases. Six 25-amp. fuses should be provided, three of which are for emergency purposes.

CHOKE COILS:

Three 200-amp., 15,000-volt indoor-type choke coils mounted on steel bases

OIL CIRCUIT BREAKER:

One 300-amp., 15,000-volt triple-pole, single-throw, hand operated remote-controlled automatic oil circuit-breaker with two-coil transformer-trip and including two 15,000-volt current transformers. This oil circuit-breaker should have a rupturing capacity of 4,000 amp. at 13,200 volts, three-phase (A.I.E.E rating) and should consist of three separate single-pole elements operated by common mechanism and arranged for mounting in masonry cell.

The necessary cell material consisting of slate, soapstone, doors, structural steel work and fittings for cell must also be provided.

POWER TRANSFORMERS:

....Kva., ...phase, ... cycle, oil insulated, self-cooled, out-door type, transformers; primary voltage, 13,200 volts with four 2½ per cent taps below Scondary, 230-460 volts.

LIGHTING TRANSFORMERS:

....Kva., single-phase, ...cycle, oil-insulated, self-cooled outdoor type transformer; primary voltage, 13,200 with two 5 per cent taps below; secondary. 115-230 volts.

....amp., 15,000-volt carbon-tetrachloride fuse holders mounted on steel base. .... amp fuses. Four fuses should be provided for each transformer, half the number being for emergency purposes.

SWITCHBOARD PANEL:

One 62-in. by 20-in. by 2-in. (158-cm. by 51-cm. by 51-mm.) slate panel with 28-in. by 20-in. by 2-in. (71-cm. by 51-cm. by 51-mm.) sub-base mounted on pipe framework. The switchboard to have mounted thereon:

One 175-volt alternating-current voltmeter with 21,000-volt scale. Two single-pole inverse-time-limit circuit-opening overload relays.

Operating lever for oil circuit breaker.

One eight-point potential receptacle with four-point plug and holder.

Space and drilling for one G. E. Co. type DS-6 watt-hour meter and one G. E Co. type G-4 demand meter, both of which will be furnished by the power company.

If the supply originates in an overhead line, the substation is protected by an electrolytic or "oxide-film" lightning arrester installed as near the pothead of the incoming cable as possible. The arrester is protected and controlled by fusable disconnecting switches in each phase. These "disconnects" are fed from the pothead side of the main disconnecting switches, making the arrester independent of the rest of the equipment and effective even though the main disconnecting switches are open. Where an arrester is used choke coils are connected in the main circuit on the load side of the main disconnecting switches.

Where practicable the main wiring consists of No.

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*Presented before the recent annual meeting of the Western Association of Electrical Inspectors.

1/0 (53.5-sq.mm.) solid copper, insulated with ⅜-in. (9.5-mm.) varnished cambric and the whole covered with a single white flame-proof braid. This wire is carried on standard busbar supports, the porcelains of which have a rating of 22,000 volts. When sufficient head room is available these supports are mounted on ½-in. (32-mm.) pipe framework supported from the floor. All of the wiring and equipment are mounted independently of the walls and ceiling of the room when possible. Insulators, disconnecting switches, current and potential transformers, choke coils, etc., so far as possible are incorporated in the 1¼-in. (32-mm.) pipe structure, which is carried down to the floor. The various members of this framework are joined by clamp-type fittings to avoid threading and bending. The center-to-center spacing of all 13,000-volt wiring is kept at 30 in. (75 cm.) or more, except where the circuits must be brought closer together to permit entering the oil-switch coil. At this point, however, there are no exposed live parts. Where possible the spacing is increased to 36 in. (90 cm.) between wires.

Ventilation is afforded by means of louvres (roof ventilators) and screened windows, admitting air directly from the outside of the building.

Particular attention is paid to the grounding of the frames and bases of all equipment. This is accomplished by means of driven pipes. Independent grounds are provided for the lightning arrester, the cases of the power and lighting transformers, the instrument wiring and the pipe framework. The bases of all disconnecting switches, choke coils, current transformers, etc., are grounded to the iron framework. Conductors connecting the various bases, framework, etc., to the ground pipes are No. 1/0 (53.5 sq.mm.) solid bare-copper wire. This connection is larger in cross-section than the line feeding the installation and will not burn off under the most severe conditions.

In general the wiring from the secondary side of the transformers is placed in conduits buried in the floor, which arrangement usually facilitates the removal of any of the high-voltage equipment and increases the safety of the installation.

Third Harmonics in Three-Phase Systems

Calculation of the Third-Harmonic Currents Which May Flow in Transformers and Transmission Lines—By Connecting One Side of a Transformer Bank in Delta Triple Currents Are Partially Short-Circuited

By D. I. CONE

THE behavior of harmonic currents of triple frequencies (third, ninth, fifteenth, etc.) arising in transformer banks with star or delta connections on three-phase systems, due to variation in permeability of the iron, is of considerable importance in several respects. Among the cases of interest are:

1. Inductive interference with communication circuits, paralleling electric supply lines.
2. Interference with relays installed in grounded neutral connections.
3. Prevention of overheating of delta-connected windings.

A number of examples are given to show how the triple-harmonic voltages and currents may be calculated and controlled by proper selection and connection of transformers for three-phase lines. While precise calculations are not ordinarily practicable, because of variations in quality of iron, and because under normal conditions a small change of voltage causes a change several times as great in the magnetizing currents, it is often possible to make fairly close estimates of the amount of triple-frequency currents under given conditions, especially with star-star connection and for the third harmonic, which is usually largest in size.

It is well known that the triple-frequency magnetizing currents of transformers in star or delta with three-phase balanced impressed voltages are in the same time phase in all three phases.* With the delta connection the winding of each transformer that is involved in the delta is effectively short-circuited, so far as the triple frequencies are concerned, and a delta circulating current is set up, as shown in Fig. 1 (a). With star connection and grounded neutral, these currents flow in the three star-connected windings in parallel, through the neutral connection, and complete their circuit through the impedance between lines and ground, which is determined by the capacitance to ground of the wires and by the impedances of other banks of transformers on the line, provided that their neutrals are grounded, as in Fig. 1 (b).

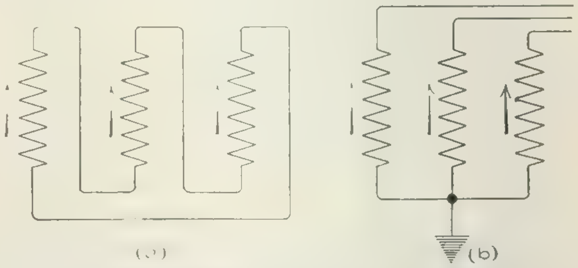

FIG. 1—TRIPLE-FREQUENCY CURRENTS IN (A) DELTA AND (B) STAR-CONNECTED TRANSFORMER WINDINGS

In the case of a star-star-connected transformer bank without grounded neutrals, or where the impedance to ground from the line connections is very large, the triple-frequency magnetizing currents cannot flow, consequently large triple-frequency voltages are induced in the transformers.

As an example, consider the third-harmonic neutral current to be expected from a bank of three 1,000-kva. transformers connected in star with grounded neutral on a 60-kv. line. At first assume the low-voltage windings to be star-connected as in Fig. 2.

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*See "Transformer Magnetizing Currents," by J. F. Peters, *Trans. A. I. E. E.*, Vol. 34, page 2,157 (1915), or "Tertiary Windings in Transformers," by J. F. Peters, *Electric Journal*, November, 1919, page 477.

Present-day transformers at rated voltage and under conditions permitting free flow of the magnetizing currents develop a third harmonic magnetizing current of 30 to 50 per cent of the exciting current, which in turn is about 3 to 6 per cent of the full-load current. Hence a reasonable value of the ratio of third-harmonic magnetizing current to rated load current is 2 per cent. For a 1,000-kva. transformer the rated load current at $60/\sqrt{3}$ kv. is 29 amp.; hence 0.6 amp. third-harmonic magnetizing current is estimated. Where the third-harmonic current is prevented from flowing, the "open circuit" third-harmonic induced voltage amounts to 50 per cent or more of the fundamental voltage, or in this case say 18,000 volts. Thus the transformer may be regarded as a third-harmonic generator,† with a very large internal impedance of 18,000/0.6—that is 30,000 ohms—or about 10,000 ohms for the three phases in parallel.

With such large internal impedance the amount of third-harmonic current will not be materially altered by the impedance from lines to ground likely to be experienced in practice. Thus, suppose the 60-kv. line to be 60 miles (96 km.) in length, with no other grounded neutrals. The capacitance per mile of the three wires in parallel to earth will be about 0.020 microfarads or 1.2 microfarads total, having a reactance at 180 cycles (third harmonic of 60 cycles) of 740 ohms, which will be approximately the line impedance if the neutrals of other transformer banks are isolated.

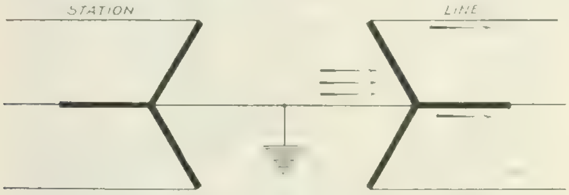

FIG. 2—CURRENTS OF TRIPLE FREQUENCY IN SYSTEM GROUNDED AT ONE END

Usually, the low-voltage side of such a transformer bank offers relatively very high impedance, so that practically the entire third-harmonic current will flow in the high-voltage side. Hence the total third-harmonic neutral current arising in this transformer bank would be 3 × 0.6, or about 2 amp.

By changing the low-voltage transformer connections from star to delta the third-harmonic neutral current due to this bank will be, of course, greatly reduced. In this case there are two paths in parallel for the third harmonic:

1. Through the high-voltage windings and line to ground, the impedance being the line impedance to ground in series with that part of the "leakage" or "short-circuit" impedance of the transformers contributed by the high-voltage windings.
2. Through that part of the leakage impedance contributed by the low-voltage winding (the delta connection serving as a short circuit for the third harmonic).

Assuming the "impedance voltage" of the transformers to be 4 per cent, the impedance at rated load is 34,600/29, or 1,200 ohms, and the leakage impedance is 0.04 × 1,200, or 48 ohms, mostly inductive reactance (in terms of high-voltage windings, at 60 cycles). If the leakage impedance is divided equally between the high-voltage and low-voltage windings, it will be 24 ohms in each. For the third harmonic it will be about three times as great, or 72 ohms. The impedance of one line wire to ground is three times that of the three in parallel, or, for the case taken above, about 2,200 ohms, mostly capacitive reactance. Thus the delta side of each transformer offers an impedance (in terms of the high-voltage winding) of about 72 ohms, while the line side offers an impedance of about 2,200 — 70 = 2,130 ohms. Hence only about one-thirtieth of the total third-harmonic current should now follow the line side path.

While the process just outlined for the case of delta connection shows the general effect, it is very inaccurate, since inequalities among the transformers may change by several hundred per cent the amount of neutral current. It is evident that by reducing the part of the leakage impedance contributed by the delta-connected winding the amount of third-harmonic current in the lines can be lessened.

As shown in the papers by Mr. Peters, already referred to, core-type three-phase transformers star-star-connected behave like single-phase delta-star transformers in that the required triple harmonic magneto motive forces are supplied within the bank, hence the triple harmonic neutral currents are of the same order of magnitude as for delta-star banks.

Consider now the effect of connecting a star-delta bank, of the same size and kind, with grounded neutral, in parallel on the 60-kv. line with the original star-star bank. The impedance to the third harmonics from the star-star bank offered by the auxiliary star-delta bank is its leakage impedance. As given above, the leakage impedance per transformer is 48 ohms. For the third harmonic it is three times as great, but as the three transformers are in parallel, so far as the third harmonic is concerned, the bank impedance is 48 ohms.

The line impedance to ground for the case considered is 740 ohms, and the two paths are in parallel, so only about one-fifteenth as much third-harmonic current would flow in the line as for the star-star bank alone. It should be noted that the whole third-harmonic current would in this case flow in the neutral, though not on the line beyond the star-delta bank.

A much more elaborate and extensive treatment of this subject will be found in the technical reports of the California joint committee on inductive interference, recently published by the California Railroad Commission.

Experience with Aluminum Transmission Conductors

THE Iowa Railway & Light Company, Cedar Rapids, Iowa, has decided to adopt aluminum conductors for use on all transmission lines operating at 6,600 volts or more. The company already has 700 miles (1,100 km.) of aluminum conductors in use, and its experience with these circuits has been such that its engineers think the much-talked-of difficulties with aluminum wire will not arise. They argue that stranded aluminum conductor with a steel core, if purchased to give equal conductivity with copper, will have greater strength and give lighter loading on the poles than copper wire. They contend at the same time that aluminum is cheaper and easier to haul and handle in the field than copper. This is a considerable advantage, especially in handling reels of wire in outlying territory.

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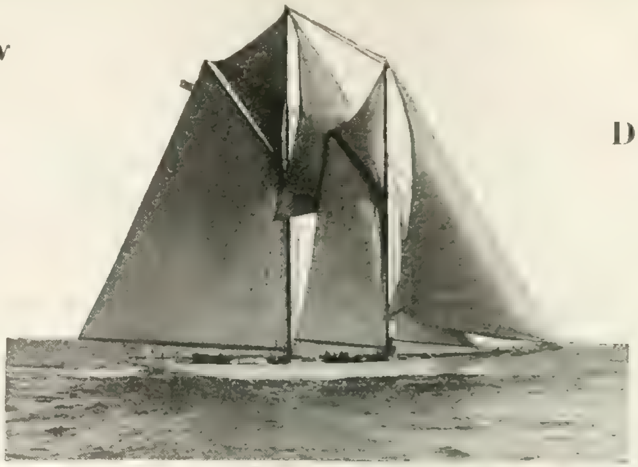
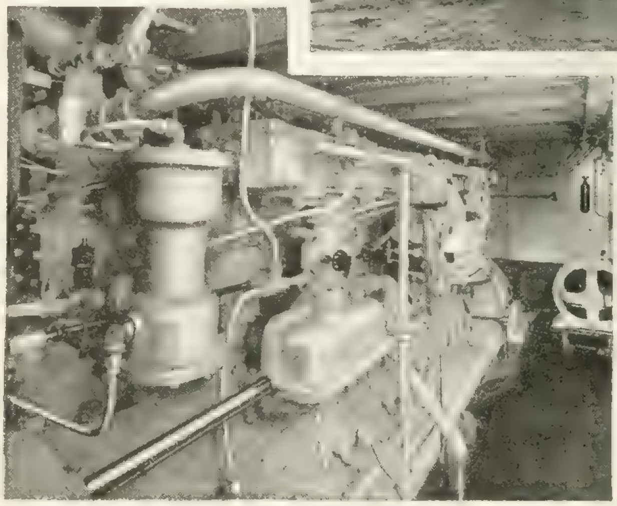
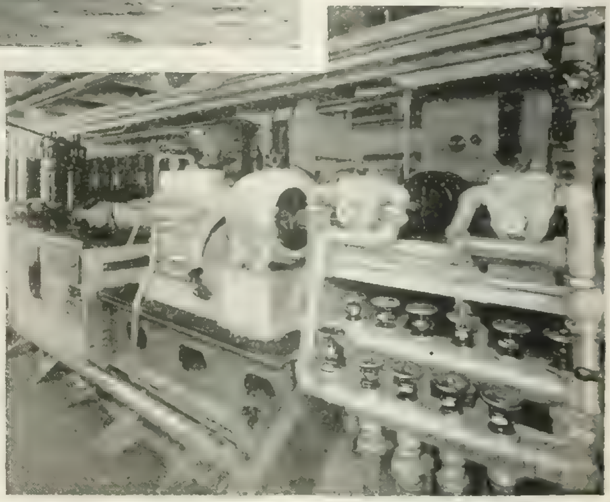
†See *Trans. A. I. E. E.*, Vol. 34, 1915, page 2,175, for detailed discussion by H. S. Osborne.

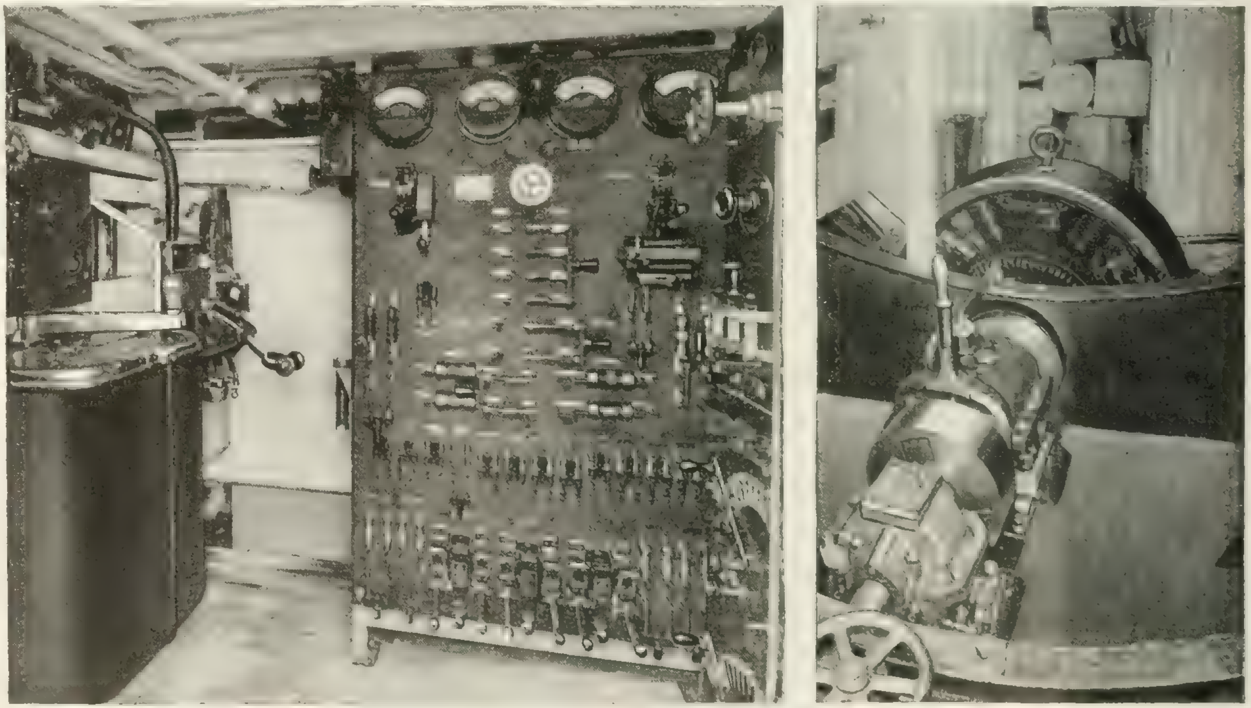
152 Ft. Yacht *Elfay* Owned by Russell A. Alger Driven by Motor Operated from Diesel-Generator Set







The drive includes a six-cylinder full-Diesel oil engine rated at 115 hp. and 425 r.p.m. and driving a 75-kw., 125-volt generator and exciter. The generator operates a 90-hp. motor, which drives the propeller through a clutch that disconnects the motor when the yacht is sailing.



The control station of this electrically driven yacht is situated on the deck just forward of the steering gear, where it is under the supervision of the navigator. Only the intensity and direction of the generator field is adjusted in controlling the yacht speed.

Rebuilding Old Motors

Owing to Severe Operating Conditions 150 Motors Had to Be Rebuilt in One Mill—Oil Troubles Eliminated by Changes in Bearing Design—Commutators Rebuilt to Increase Protection Against Oil

By JAMES DIXON

IN REBUILDING 150 old direct-current motors to make them meet the severe operating conditions encountered in steel-mill work many interesting problems were solved successfully and in a way that may be of interest to other industrial engineers. The method of working out the details was very satisfactory and has been adopted by a number of companies. There are many other industries whose equipment operates under similar conditions that may also apply similar modifications.

Graphite dust accumulating in the motors, thereby clogging oil wells and causing the oil to run out of the housings, was one source of trouble. The particular effect of this oil was to cause burn-outs in the front-collar insulation of the commutator. The trouble was somewhat intensified by the excessive zeal of the crane operators, as this company had made a practice of giving an enforced "lay-off" of two weeks to operators whose motor equipment was put out of service by a hot box. The natural result was the use of too much oil, not all of which reached the proper places.

The original journal boxes had a clearance space of $\frac{1}{32}$ in. (0.8 mm.) between the halves next to the shaft to insure the outside edges coming together. These were babbitt-lined cast-iron boxes. All were rebuilt with close joint next to shaft and clearance outside as shown in *A*, Fig. 1. This prevented oil squirting along the shaft, especially with geared motors.

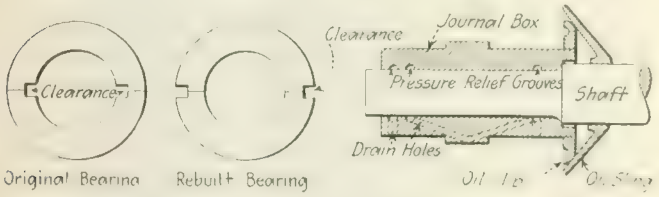


FIG. 1—CHANGES IN BEARING DESIGN

A—Clearance changed to outside eliminates squirting along shaft. B—Pressure-relief grooves drained by holes catch creeping oil. C—Oil lip catches oil forced from between box and housing. D—Flange to keep oil off commutator and windings.

Owing to the journal boxes being loose in the frame housings and their not being held firm by the lugs which are intended to keep the boxes from rotating, they rocked through a small angle, becoming abraded on the outside. To remedy this trouble the frames were scraped at the joints, and in some cases new and larger boxes were installed so that the frame would grip the boxes. This stopped the squirting of oil between frame and journal box.

Pressure-relief grooves, each drained by two holes, were added at both ends of each box. (See *B* in Fig. 1.) These catch any squirting or creeping oil and drain it back into the well. An oil lip (*C* in Fig. 1) was added to each bearing to catch any oil squirted from between box and housing, and an oil "sling" or flange (*D* in Fig. 1) was put on the shaft at each end to keep oil from the commutator and windings. These precautions were so effective that in six months' operation after the changes no oil was ever found on the oil "slings."

To prevent spattering of oil the web supporting the housing in the frame was grooved (see *A* in Fig. 2) both top and bottom, and a bigger and better oil overflow was designed to keep graphite out. The old overflow was a $\frac{1}{4}$-in. (6-mm.) hole. The new one was made of pipe fittings (*B* in Fig. 2) attached to the old $\frac{3}{4}$-in. (19-mm.) drain-plug hole and firmly strapped to the frame. The cap on the end kept the graphite out. The overflow point was set $\frac{5}{8}$ in. (15 mm.) below the bottom of the journal-box shell. A heavy, hinged, spring-closed, double-shrouded oil-hole cover was fitted to each bearing. This facilitated pouring oil in and kept graphite from falling in *C* (Fig. 2).

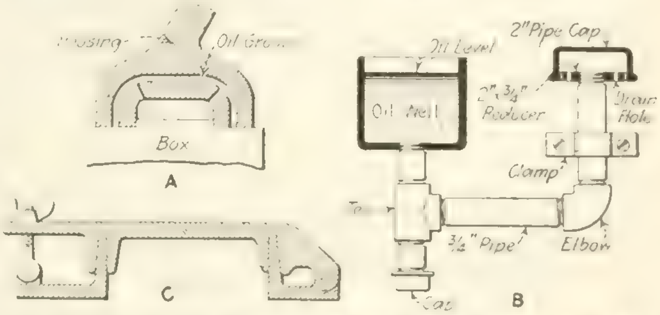


FIG. 2—DEVICES TO KEEP OIL WHERE IT BELONGS AND AWAY FROM DUST AND DIRT

A—Housing grooved to prevent spattering of oil. B—Overflow for oil designed to keep out dust and dirt. C—A cover that will enable oil to be put in easily and yet is dust-proof.

COMMUTATORS REBUILT TO PROTECT FROM OIL AND DIRT

The old commutators were built with shellac which melted and ran out at high operating temperatures. As a result dirt collected in the space between the bars and collars, and in a comparatively short time the insulation broke down, grounding the bars to the motor frame. In order to overcome this trouble the commutators were rebuilt as follows:

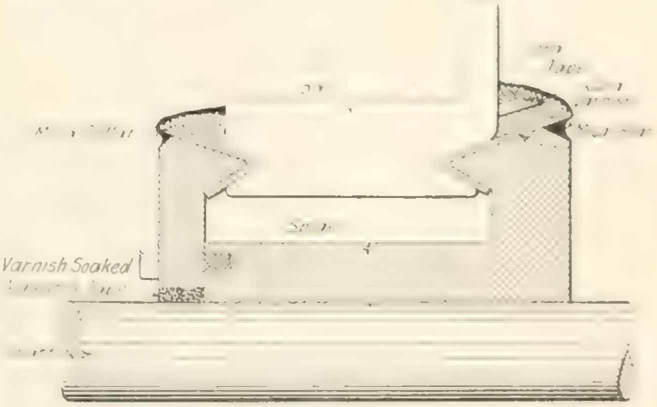


FIG. 3—METHOD OF REBUILDING COMMUTATOR TO PROTECT INSULATION FROM OIL

A clamp was placed around the commutator and the spider was removed. The V grooves were then cleaned by turning out on a lathe. Each V groove was then varnished with Sterling "extra elastic" insulating varnish and baked until dry. New mica collars were then put in, and the spider was replaced and the clamps drawn tight. Two layers of cord were put on each collar and in addition at the back, as well as several layers of asbestos tape and more cord. One end was then brush-varnished with Sterling varnish and the commutator set with this end down and the other end filled and puddled with Sterling varnish until it would take no more. Then the commutator was baked and the screws were tightened. After the operation was repeated on the other end, the entire process was followed again so that each end had two puddlings and two bakings. As a result the cord was all smoothed over, all crevices were filled, and a big fillet of varnish was formed at the ends of the bars, as shown in Fig. 3. A commutator treated in this way is "seasoned" when finished by allowing sufficient time for the boiling out of the excess shellac and the settling of the mica laminations and will not change shape or loosen. After this treatment the commutator was turned true and mica undercut $\frac{1}{32}$ in. (0.8 mm.).

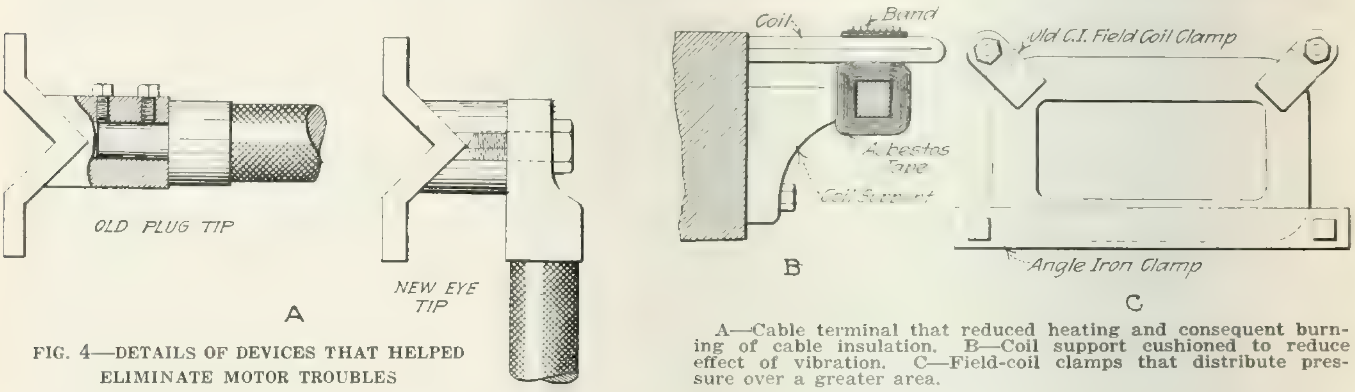


FIG. 4—DETAILS OF DEVICES THAT HELPED ELIMINATE MOTOR TROUBLES

A—Cable terminal that reduced heating and consequent burning of cable insulation. B—Coil support cushioned to reduce effect of vibration. C—Field-coil clamps that distribute pressure over a greater area.

Another trouble which was encountered with nearly all these motors was known as "graying" of commutators. This was due to the mixture of oil and graphite forming a greasy, pasty surface on the brush-holders which kept the brushes from moving freely and as a result causing a poor contact with the commutator. Under these conditions the face of the commutator would lose its polish and become literally gray. If the trouble is not remedied the burning away of the commutator bars leaves high mica, which intensifies the trouble. In order to keep out the graphite and prevent the formation of this pasty surface, new hand-hole covers and frames with deep shrouds were made and bolted to the motors. The joint between the cover and frame was filled with steel cement. These covers, indicated as *C* in Fig. 3, stopped the graying of the commutators entirely.

The original armature cores, which were held together by pipe rivets, had weak end fingers and the ventilating duct spacers reached only to the bottom of the slots, allowing the laminations to spring apart or flare and close the ventilating ducts. To overcome this trouble the pipe rivets were replaced by insulated bolts, longer spacers reaching nearly to the top of the teeth were substituted, and new and stronger end-fingers were provided. The coil lashings were removed, grooves turned in the cores, and No. 14 phosphor-bronze core bands sunk flush with the core were bound on to hold the coils.

Steel-mill motors are often overspeeded, and experience shows that coil lashings are inferior to core bands if the speed attained exceeds twice the rated speed. The insulation used under the bands was asbestos tape with layers of mica between.

Considerable trouble was experienced with the original plug connections to the brush holders. The connector (*A* in Fig. 4) made what was practically a line contact with the cable, and as a result there was enough heating at times to cause burning of the cable insulation. The sockets were taped, as shown, and a heavy terminal was attached with stout cap screws. As an added precaution all cables inside the motor were taped with heavy asbestos tape, half lapped, and varnished with baking varnish.

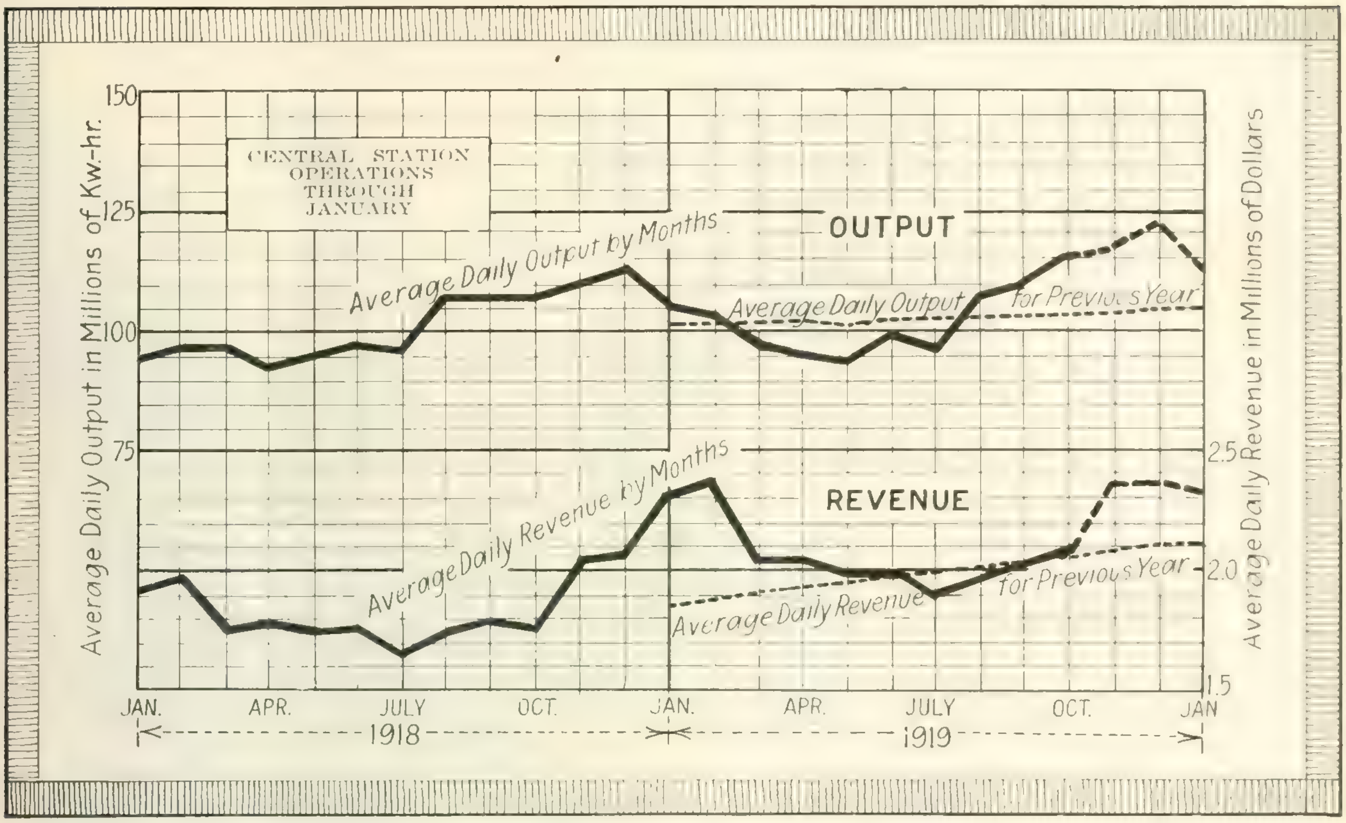
A rear head-coil support (*B* in Fig. 4) was put on each armature and a cushion of insulation applied. This consisted of six layers of asbestos tape $\frac{1}{8}$ in. (3 mm.) thick and 2 in. (50 mm.) wide, with a single binding layer of narrower light tape. To avoid grounding of coils at slot ends, U-shaped mica reinforcements 0.025 (0.63 mm.) thick were placed around the coils. The armatures were rewound and after soldering were put in an oven to warm up and dry out. After this treatment each armature was varnished several times until it would not absorb any more varnish and was allowed to stand over night. After another coat had been applied it was baked for at least twelve hours and the bands were put on while armature was still hot.

The field coils required attention because they had grounded against the frame casting. As a solution for this difficulty washers of No. 10 duck with three coats of varnish were put in between the coils and the frame. The cast-iron field-coil clamps were removed and angle-iron pieces using the same bolts were inserted to distribute the pressure. (*C* in Fig. 4.) Pipe washers were put over the bolts to keep the angle-irons straight on the coils, and the bolts were reversed to bring nuts on the outside of the frame. Lock washers were put under the nuts and two nuts on each bolt.

As mill riggers will not trust eyebolts, such bolts were removed and plates were screwed over the holes to keep the graphite out. All other holes in the frames were covered by steel plates fastened with cap screws. This construction gives better results than riveting as screwed plates can be removed for inspection when desired.

TO ME *it is abundantly clear that there is no alternative between free competition and government ownership and operation. The control which the government has exercised over the railroads during the last fifteen or twenty years has in effect amounted to government operation. What has happened in the railway business will happen in every other business which the government undertakes to control.*—PHILIP CABOT.

New Year Begins with Large Gains



GENERAL prosperity is reflected in the returns from central stations received by the **Electrical World** for the month of January. For seasonal reasons largely the January output was about 7 per cent less than for December. Probably the most striking figure derived from the returns is the large percentage of increase over January, 1919, due in part to the retrenchment which took place the first part of last year in all lines of industry. It is apparent from all reports that this slump has been more than overcome and that the central-station industry in all probability must prepare to meet largely increased calls for energy from manufacturers in the near future.

With the settlement of the coal and steel strikes business in general commenced the new year on a better basis than at any time since the armistice, which resulted in a demand for electrical energy in excess of that rendered at any time during the war period in all sections of the country except the Mountain States. The New England section showed a remarkable gain of 30.7 per cent over January of 1919. A study of this section indicates unusual prosperity in virtually all lines of industry. The textile mills operated approximately 100,000 more spindles in January than in any previous month and were reported as working at around maximum capacity. All industries in this section appeared to be rushed. All but two central stations in this section reported a largely increased energy demand, the two exceptions being small stations with only a local demand, which for the most part is for lighting.

The Atlantic States also recorded a large gain over the previous January, but not so pronounced as in the New England States. Steel mills as a whole were working at between 85 and 90 per cent capacity at the end of January against 80 per cent capacity at the beginning of the month and an average of not over 60 per cent capacity during the last three months of 1919. With the settlement of the coal and steel strikes business in general was in the best shape for months, and a large majority of the factories of all kinds were reported as working at capacity, resulting in a near maximum demand for power.

Returns from the Central States indicated remarkable prosperity throughout the section. In the Great Lakes manufacturing centers almost every factory was again working at maximum capacity. Extensive expansions were made during the winter to many of the zinc refineries in Wisconsin and Minnesota, and drills were operating extensively at all the mines, resulting in an 80 per cent increased demand in January for electrical energy in that section. In the South Central States large additions were made to the existing central-station plant capacity during the first part of the month, and many factories of all classes in this section were reported as changing over to electric drive.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Installed Capacities Represented	Revenue from the Sale of Energy			Percentage of Installed Capacities Represented	Kw.-Hr. Output		
		1919 Thousands	1918 Thousands	Per Cent Increase		1919 Thousands	1918 Thousands	Per Cent Increase
Jan.	48	$34,209	$28,400	20.1	48	1,562,563	1,396,338	12.1
Feb.	45	29,929	24,570	20.1	45	1,309,945	1,214,414	8.0
Mar.	45	28,579	24,447	17.3	45	1,359,296	1,340,210	1.0
Apr.	45	27,740	23,919	16.0	45	1,279,274	1,240,782	2.9
May	45	27,795	24,291	15.5	45	1,306,622	1,314,216	—1.0
June	47	28,175	24,701	14.1	47	1,399,951	1,367,908	2.3
July	44	25,794	22,568	14.1	44	1,309,301	1,281,874	2.0
Aug.	54	32,756	29,006	13.0	54	1,801,836	1,793,706	0.5
Sept.	53	32,344	28,336	14.0	53	1,761,582	1,695,862	4.3
Oct.	55	35,492	30,077	18.0	60	2,175,636	1,987,004	9.0
Nov.	53	37,439	31,927	17.2	58	2,055,428	1,895,693	8.2
Dec.	52	38,252	33,024	15.9	58	2,218,101	2,027,869	9.2
		1920	1919			1920	1919	
Jan.	46	33,557	28,088	19.5	52	1,840,953	1,572,555	17.0

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Installed Capacities Represented.	New England States			Percentage of Installed Capacities Represented	Atlantic States			Percentage of Installed Capacities Represented	Central States			Percentage of Installed Capacities Represented	Pacific and Mountain States		
			1919	1918	Per Cent Increase.		1919	1918	Per Cent Increase.		1919	1918	Per Cent Increase.		1919	1918	Per Cent Increase.
REVENUE	Jan	70	4,106,000	3,412,000	20.3	46	13,736,000	11,412,000	20.0	40	11,004,000	8,931,000	23.3	60	5,363,000	4,645,000	15.5
	Feb.	71	3,908,000	3,052,000	28.0	45	12,475,000	10,243,000	21.2	36	9,349,000	7,520,000	24.0	54	4,197,000	3,755,000	12.0
	Mar.	71	3,561,000	3,020,000	17.9	44	11,809,000	10,312,000	14.5	36	8,991,000	7,430,000	20.9	54	4,218,000	3,685,000	14.1
	Apr.	71	3,468,000	2,942,000	17.8	43	11,516,000	10,213,000	12.3	36	8,427,000	7,009,000	20.3	56	4,329,000	3,755,000	16.5
	May	70	3,190,000	2,781,000	14.9	43	10,817,000	9,826,000	10.1	36	8,320,000	6,910,000	20.5	56	5,468,000	4,764,000	14.2
	June	71	3,317,000	2,904,000	14.1	43	10,605,000	9,537,000	12.0	38	8,757,000	7,504,000	16.2	63	5,496,000	4,767,000	15.2
	July	70	3,406,000	2,995,000	13.7	40	9,320,000	8,375,000	12.0	38	8,854,000	7,442,000	19.0	49	4,214,000	3,756,000	12.1
	Aug	74	4,225,000	3,693,000	14.4	57	12,174,000	10,995,000	11.1	45	10,942,000	9,309,000	17.1	61	5,415,000	5,009,000	8.5
	Sept.	73	4,019,000	3,536,000	13.6	53	11,429,000	10,069,000	13.5	44	11,395,000	9,766,000	16.2	63	5,501,000	4,965,000	10.9
	Oct.	72	4,127,000	3,453,000	19.1	53	12,684,000	10,822,000	16.9	50	13,241,000	11,003,000	20.1	62	5,440,000	4,799,000	13.9
	Nov.	71	4,432,000	3,800,000	16.2	56	14,738,000	12,761,000	15.7	44	12,604,000	10,383,000	22.1	63	5,665,000	4,983,000	13.9
	Dec.	73	4,878,000	4,223,000	15.9	51	13,849,000	12,079,000	14.4	39	10,420,000	8,734,000	19.4	77	9,105,000	7,988,000	14.0
			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan	71	5,026,000	4,221,000	19.2	47	13,302,000	11,041,000	20.0	36	9,987,000	8,402,000	20.9	56	5,242,000	4,424,000	18.3
			1919	1918			1919	1918			1919	1918			1919	1918	
KW.-HR. OUTPUT	Jan	70	140,959,000	122,115,000	15.4	46	536,772,000	467,923,000	14.8	40	488,517,000	429,318,000	14.0	60	396,315,000	376,982,000	5.3
	Feb	71	129,196,000	110,233,000	17.2	45	460,628,000	425,520,000	8.1	36	427,934,000	379,953,000	12.3	54	292,187,000	298,708,000	-2.0
	Mar.	71	125,411,000	122,541,000	2.3	44	461,567,000	462,972,000	-0.1	36	441,604,000	422,928,000	4.1	54	330,714,000	331,769,000	-0.3
	Apr.	71	123,111,000	116,411,000	5.7	43	431,572,000	424,049,000	2.0	36	382,779,000	358,858,000	6.9	56	341,812,000	341,464,000	0.1
	May	70	120,856,000	120,908,000	-0.1	43	413,043,000	430,729,000	-3.9	36	390,667,000	377,525,000	3.6	56	382,056,000	385,054,000	-0.9
	June	71	127,260,000	119,217,000	6.7	43	408,335,000	419,060,000	-2.5	38	418,542,000	386,422,000	8.0	63	445,814,000	443,209,000	0.5
	July	70	141,551,000	130,393,000	8.2	40	373,105,000	378,053,000	-1.5	38	428,370,000	408,165,000	5.3	49	366,275,000	365,263,000	0.1
	Aug.	74	161,431,000	153,266,000	5.1	57	640,616,000	662,120,000	-3.2	45	555,763,000	513,591,000	8.1	61	444,026,000	464,729,000	-4.2
	Sept.	73	153,837,000	146,209,000	4.5	53	610,254,000	610,179,000	0.1	44	573,835,000	518,767,000	11.0	63	423,656,000	420,707,000	0.5
	Oct.	72	162,859,000	142,326,000	14.4	53	694,584,000	659,859,000	5.3	62	882,439,000	766,407,000	15.2	62	435,754,000	418,412,000	4.1
	Nov.	71	153,171,000	140,240,000	9.2	56	724,607,000	707,347,000	2.4	56	754,838,000	657,362,000	14.8	63	422,812,000	390,744,000	8.2
	Dec.	73	177,874,000	149,648,000	18.5	52	705,044,000	661,334,000	6.5	53	723,737,000	619,764,000	17.5	77	611,446,000	597,123,000	2.2
			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan.	71	183,502,000	140,369,000	30.7	48	633,509,000	552,261,000	14.5	50	675,651,000	593,257,000	14.0	56	348,291,000	286,668,000	21.4

Output for the Pacific and Mountain States was 21.4 per cent above that recorded in January, 1919, although the copper industry was operating at only about 50 per cent capacity. This lack of demand for energy in the copper regions was overcome to a large extent by largely increased operations in the zinc regions. Almost all the central stations of the Pacific Coast States reported increased output over December, reflecting the general prosperity of that section of the country.

In line with its constant endeavor to present the most reliable data possible on central-station operations, the ELECTRICAL WORLD has made a recompilation of the central-station returns for the years 1918 and 1919, based on the latest data obtainable pertaining to the installed capacity of the electic light and power plants of the country. Such a correction will be made at regular intervals as the installations of the central stations are increased. The output and revenue figures in Tables I and II are the results of this recompilation According to these figures the total central-station output in 1919 was 38,559,000,000 kw.-hr. and the revenue was $773,000,000.

Running 42-Cycle Induction Motors from 25-Cycle Supply

If a 42-cycle induction motor is operated at its normal voltage, but from a 25-cycle distribution system, it will take an excessive magnetizing current, heat up and run inefficiently. According to J. Mathivet (*Revue Générale d'Electricité*, Nov. 22, 1919), however, if the impressed voltage is reduced in a proportion equal to the square root of the ratio of the frequencies the motor will give much the same characteristics as if run at its rated frequency and voltage, and although at full rated output the motor will absorb about 28 per cent more than rated current, it will, as a rule, run in a perfectly satisfactory manner.

In order to be able to interconnect two distribution systems of respectively 42 cycles and 2,500 volts and 25 cycles and 5,000 volts, without discarding any motor equipment, the Compagnie des Mines d'Anzin, in dropping the 42-cycle supply, installed 25-cycle, 5,000/1,950-volt transformers and simply ran its motors, through these transformers, from the 25-cycle system. Of course. the pulleys had to be changed in the ratio 25 to 42.

The plan is said to work well, and in this connection it is pointed out that a very high economy is reached. While a frequency changer, notwithstanding its higher cost, will only reach an efficiency of about 85 per cent. a transformer will give up to 97 per cent efficiency. Even if the efficiency of the individual motors is slightly impaired by the change in frequency, the total economy thus is very good.

The same company later was confronted with the problem of utilizing a number of 25-cycle, 220-volt, induction motors on a 50-cycle system of the same voltage. If the same principle is again applied to this new problem, we find that the motors should be operated at $220\sqrt{2}$, or 310 volts. Since it is difficult to obtain 220/310-volt transformers, however, the motors were instead changed over from star to delta connection, which has the same effect as a transformation of the voltage in the ratio $\sqrt{3}$, and, by choosing small conductors for the transmission, an artificial drop of voltage was obtained, so that the impressed voltage was substantially correct.

By simply adding to the plant a static transformer of suitable ratio of transformation, an induction motor drive, designed to operate on a certain frequency, may cheaply be adapted to a system of supply of another frequency, provided, of course, that the motor will stand the change in speed and voltage.

Readers' Views and Comments

The Old Socialism and the New

To the Editor of the ELECTRICAL WORLD:

SIR: Students of social economics were once wont to exclaim at the ignorance of those in America to whom socialist, communist and anarchist were synonymous terms. They were right in pointing out the wide differences in the creeds of these schools of radical thought. None the less, the whirligig of time has brought about in a totally unforeseen manner a condition that might almost be said to justify retroactively the mental attitude of the persons who refused to make distinctions. For the socialist party in America today has been swallowed up by its "left" or communist branch, which proclaims a belief in the Russian soviet system, and if that system in its first stages had really anything about it that distinguished it from anarchism it was not perceptible at this distance from Moscow, though it is true that it appears to have eventuated—as anarchy may always be trusted to do—in a species of despotism.

The American socialism of other days, the leaders of which quite generally cut loose when in war time the party broke from their guidance and adopted a disloyal and virtually pro-German platform, was, in a nation of born individualists, an exotic affair which served its chief purpose, as some thought, in providing a means of protest for voters when they deemed both of the large parties too subservient to the "interests." Many persons, influenced by the books of imaginative writers like Edward Bellamy, thought of the socialist party as one working for an ideal state of human existence through the destruction of monopoly and the abolition of the fear of want. Universal brotherhood, prosperity and happiness were conceived to be its object, and in this aim, however visionary, lay no treason to the state. The mistake, of course, lay in putting the cart before the horse—in assuming that all-pervading virtue would follow ideal political arrangements, when obviously it must precede them. If the great majority of mankind ever become both virtuous and intelligent, Utopia will come automatically. So long as those who are virtuous but not intelligent, those who are intelligent but not virtuous and those who are neither intelligent nor virtuous make up a combined majority, Utopia will remain a dream and in human affairs an ounce of amelioration realized will be worth a ton of perfection imagined.

It cannot, however, be said that our present-day socialists, with their allegiance to communist or bolshevik theories, make the mistake to which allusion has just been made. They neither claim nor inculcate virtue, and their propaganda is founded not on any principle of fraternity but solely on "proletarian" rights and revenges. Malice, envy, sloth and hatred are its procreating forces —sometimes naked and unashamed, sometimes disguised so that even those they dominate fail to recognize them for what they are. There is no fear that theories thus predicated and thus fathered will gain the upper hand in these United States; but it behooves our governing bodies by an unswerving recognition of the political rights even of those whose theories they detest, by a determined effort to uproot legalized social injustice wherever it may have taken root, and by ample provision for the Americanization of immigrants whose mental processes still bear the imprint of European conditions, to cut away the soil from which such growths spring. In this patriotic process public utilities employing hundreds of more or less newly made citizens can immensely help.

FRANK W. CHASE.

Brooklyn, N. Y.

Power Resources in Arizona

To the Editor of the ELECTRICAL WORLD:

SIR: The development of Arizona coal resources has been a matter of only passing interest hitherto, since it was overshadowed by the tremendous output of the state's metal mines. There are at least three places in the state, however, where coal is found in large quantities, and when the Gallup fields of New Mexico commence to give out and there is a local demand for power for manufacturing and for agricultural purposes activity is bound to be directed toward the development of these deposits. The great possibility offered by them would seem to lie in erecting power plants at the mines from which energy could be transmitted by high-tension lines to other parts of the state for various purposes, including artificial refrigeration. Energy might also be used to recover nitrogen from the air right at the plant.

The Black Mesa coal field lies in and around Black Mesa in the Hopi and Navajo Indian reservations in Coconino, Navajo and Apache Counties. At present the field is difficult of access. The Sante Fé railroad lies 70 miles to 90 miles (112 km. to 144 km.) south. This coal is as good as or better than that from the Gallup mines. The Pinedale coal field is in two beds. The upper is a very dirty deposit, while the lower is fairly clear and of good sub-bituminous quality. The Deer River coal field lies on the south side of the Gila River at its confluence with the San Pedro. It is about 85 miles (135 km.) northeast of Tucson. The eastern end of the field is accessible from San Carlos through Hawk Canyon.

The coal field is near the center of the great copper-producing region of the state. The total tonnage is estimated at 30,000,000 short tons. The coal is, generally speaking, of two qualities. The first is hard block coal adaptable for transportation, for commercial use and for coke making. The second is a soft coal, badly crushed, and is of little use for marketing, although it offers possibilities for manufacture of gas and for use in a power plant at the mine. The fact that these fields occur on Indian reservations injects a point of difficulty, but efforts are being made by prominent engineers of Arizona, among whom is Dean G. M. Butler, director of the Arizona Bureau of Mines, to have legislation passed that will permit these mines to be developed and worked, the Indians being at the same time properly recompensed for them.

Arizona is a state of great wealth and natural resources. It is waiting for the hand of the engineer to develop it, not merely along manufacturing and engineering lines but in agriculture as well. Cheap power will do it.

PAUL C. COKE.

Tucson, Ariz.

Station and Operating Practice

A Department Devoted to Problems of Installation,
Operation and Maintenance of Equipment for Economical Generation and
Distribution of Electrical Energy

Overcharging Battery 100 Per Cent Reduces Life 15 Per Cent

CHARGING at other than normal rate is the most destructive factor to the life of lead-and-acid storage batteries. It has been ascertained that practically no disintegration of battery plates takes place in discharge, but a variation from normal charging rate causes sluffing of the material with consequent shortening of life. Sluffing is due to gassing within the plate, which is a natural phenomenon of charging; but overcharging, which is passing more current than can be absorbed in the normal chemical reduction of lead sulphate to lead oxide, produces excessive gassing. This is evidenced by a milky appearance of the electrolyte, which increases sluffing in greater proportion than the charge rate is increased, and the life of the battery depends on the amount of this sluffing. It will be seen from Fig. 1, showing the variation of life with different rates of charge, that charging either above or below normal rate shortens battery life. The two other curves show the amount of sluffing and the percentage capacity of a paste cell which has been charged normally. The horizontal ordinates represent the number of cycles (charge and discharge) through which the battery has passed, and the vertical ordinates represent respectively the battery capacity and the amount of sluffing that has taken place.

P. L. RITTENHOUSE
New York, N. Y.

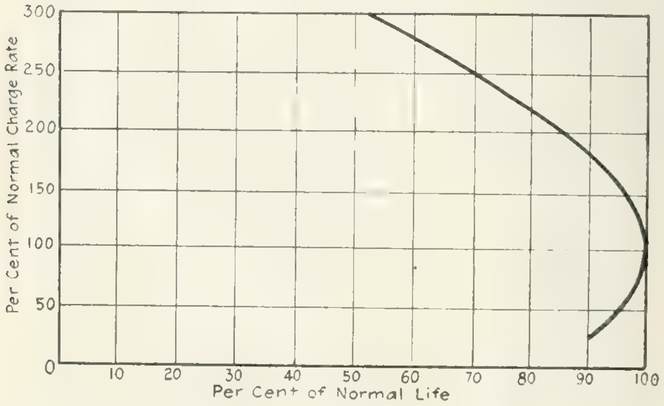


FIG 1

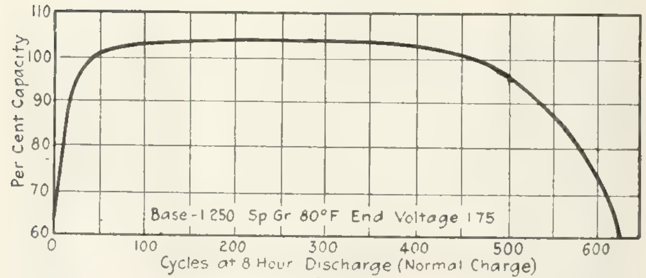


FIG. 2

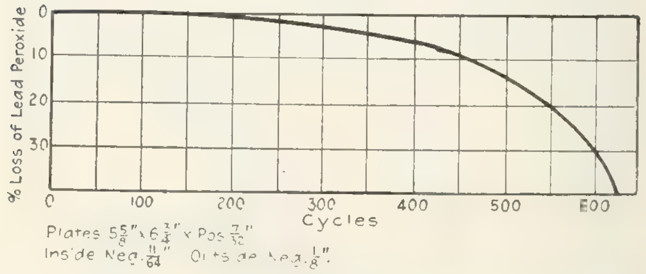


FIG. 3

FIG. 1 — LIFE OF BATTERY COMPARED WITH CHARGING RATE. FIG. 2—CAPACITY AFTER NORMAL CHARGE. FIG. 3—AMOUNT OF SLUFFING THAT HAS OCCURRED AT NORMAL CHARGE

Fuel is 52 Per Cent and Labor 18 Per Cent of Operating Expenses

OPERATING expenses of a municipal company with 1,070 kw. in generators are given in the accompanying table and show that the two outstanding expenses are coal, 51 per cent of the total, and labor, totaling almost 18 per cent. The generating equipment of this company, which operates in the borough of Wallingford, Conn., consists of a 450-kw. engine-driven generator, a 500-kw. turbo-generator, both fed by boilers rated at 725 hp. total, and a 120-kw. water-wheel unit. The yearly output in this town

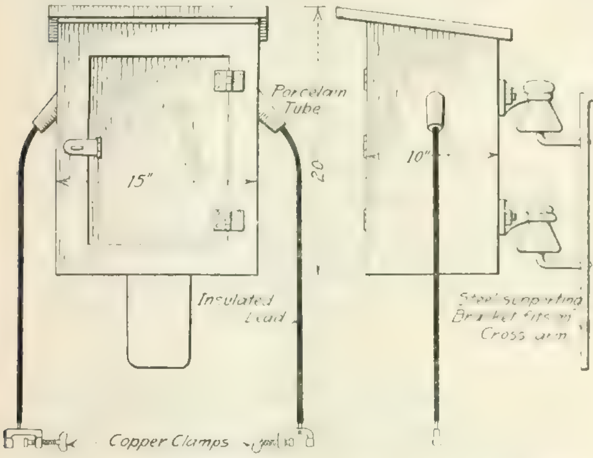
OPERATING EXPENSE OF 1,070-KW.
MUNICIPAL COMPANY

Maintenance:	Per cent	
Electric equipment	0.35	
Steam Equipment	5.41	
Line equipment	3.23	
Station and buildings	2.38	
Street lamps	2.89	
Meters	2.07	
Fire alarm	0.53	
Total maintenance	16.86	
Fuel		51.23
Oil and waste		0.45
Labor:		
Steam plant		15.88
Water plant		2.83
Salaries		5.47
Office rent		0.05
Insurance:		
Liability	0.95	
Compensation	1.30	
Boiler	0.13	
Building	0.59	
Total insurance	2.97	
Miscellaneous expense		4.37
Total		100.00

of 10,000 people for a connected load of 3,336 kw. was 1,273,000 kw.hr., with a consumption of 2,887 tons of coal costing $8.83 per ton. This energy is distributed over about 28 miles (45 km.) of primary lines. These expenses included maintenance and operation of 257 street incandescent lamps, 208 of these being 100-watt tungstens.

Maximum-Demand Outfit Installed Without Interrupting Service

FOR obtaining the maximum demand on a transformer serving several customers an outfit which can be hung on a cross-arm near the transformer is used by the Merchants' Heat & Light Company, Indianapolis, Ind. This apparatus is installed without interrupting service as follows:



HANGS ON CROSS-ARM TO METER MAXIMUM DEMAND

A Wright demand indicator is mounted inside a wooden box, the flexible insulated leads passing from the indicator through porcelain bushings in the sides of the box and terminating in copper clamps. The box is supported by two insulators mounted on a bracket which will hang on the cross-arm. As the box is hung near one of the 2,400-volt fuses which are in the transformer leads, only short connectors are necessary. The insulation is cleaned from the wires on the line side and the transformer side of the fuse, and the two clamps are screwed to these two wires. Then the fuse is pulled and the fuse wire is removed.

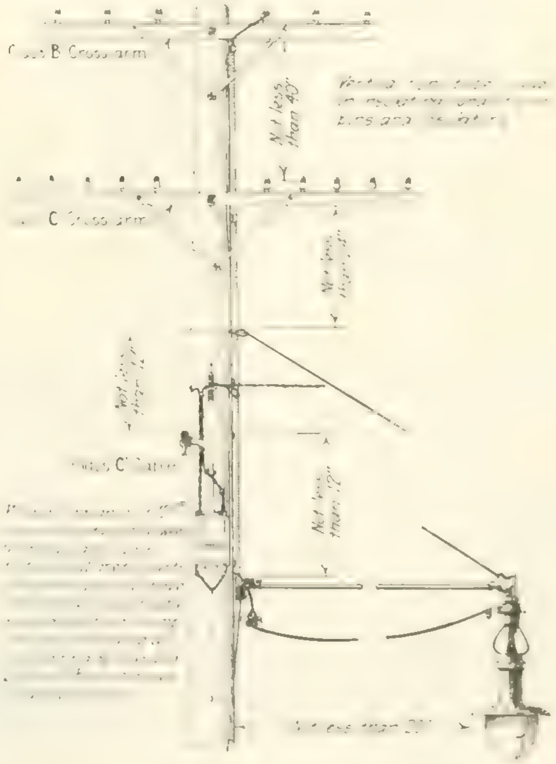
Tentative Specifications for Joint-Pole Lines

TENTATIVE specifications covering construction of jointly used pole lines for electric supply circuits and signal circuits have been compiled by the engineering committee of the Pennsylvania Association and the American Telephone & Telegraph Company. This is one of few instances where such information has been compiled, the Connecticut code being one of the most prominent cases.

In the general specifications included in this report the circuits are classified as follows: Class B, constant-potential currents not exceeding 5,000 volts between wires and constant-current circuits not exceeding 7.5 amp.; Class D, constant-potential, direct-current trolley contact wires and feeders not exceeding 750 volts to ground; Class C, commercial telephone, telegraph call-box or other signal circuits for public use, and Class P, private telephone or signal circuits. The relative positions on a pole to be occupied by attachments of the different classes in most cases are from top to bottom as follows: Class B, Class C and Class D. In most cases the rules provide that the distance between Class B and Class C cross-arms should be not less than 48 in. (1.2 m.) from center to center and for other attachments with the exception of cross-arm braces and guys the distance should be not less than 40 in. (1 m.). Between Classes C and D these two distances must be the same in both cases. In further reference to vertical clearance the report says that line wires or suspension wires of different classes where strung at different sags shall have vertical spacings at the supporting structure so adjusted that the minimum spacing at any point in the span at 60 deg. F. (15 deg. C.) with no wind shall not be reduced more than 25 per cent from these values.

The ruling concerning climbing space on the pole says that there must be a space of at least 30 in. (75 cm.) on one side or corner of the pole for this purpose.

The section devoted to attaching live wires on cross-arms provides that single-line arms shall be carried on the same side of the pole and that generally lightning protection wires should be attached to insulators on cross-arms. A further requirement made is that all live wires carried on cross-arms shall clear the pole at least 5 in. (13 cm.). Class B secondary wires not exceeding 250 volts to ground may be carried on insulators supported on metal brackets or rails attached directly to the pole. If class C wires are insulated properly, they can be attached directly to the pole.



ARC LAMP BELOW CLASS C ATTACHMENTS ON JOINTLY USED POLE. SHOWING USE OF INSULATING CONDUIT FOR VERTICAL RUN

Concerning guys the committee decided that all guys except anchor guys shall be preferably attached to non-conducting supports so placed and maintained that no part of any guy shall come within 8 ft. (2.4 m.) of the ground. In addition, all guys shall be so placed as to maintain a clearance of at least 6 in. (15 cm.) from the nearest live wire on the guyed pole, and every guy which passes over or under any electric wires other than those carried upon the guyed pole shall not at any time come within 2 ft. (60 cm.) of the said electric wires. A further requirement is made that the strain insulators to be used in guys should not flash over at twice the maximum line voltage.

FLASHOVER VOLTAGES OF INSULATORS ON CLASS A CIRCUITS

Voltage of Circuit	Flashover Dry	Voltage Wet
6,600	40,000	30,000
7,500	45,000	33,000
11,000	60,000	45,000
22,000	110,000	83,000

When supply voltages exceed 500 volts the circuits are known as Class A. The vertical clearance required is 72 in. (1.8 m.) between cross-arms and 60 in. (1.5 m.) between other attachments.

SAGS AT 60 DEG. F.

For medium and hard-drawn covered copper wires:

	Span Lengths								
	100	125	150	175	200	250	300	400	500
No. 6	18	27	40	..	..	..		..	
4	12	18	27	36	48	..	..	..	
2	12	18	27	30	36	60	96	..	
1	12	18	26	29	33	52	80	.	
00	12	18	25	28	31	46	66	..	
0000	12	18	24	27	30	38	50	..	.

For soft-drawn covered copper wires:

	Span Lengths								
	100	125	150	175	200	250	300	400	500
No. 4	21	32	48	..	..	..	..	..	..
2	18	27	40	54	.	..	..	.	..
1	15	22	33	45	60	.	..		
00	12	18	25	33	42	..	..	.	
0000	12	18	24	30	36	..	..	..	.

For medium and hard-drawn bare wires:

	Span Lengths								
	100	125	150	175	200	250	300	400	500
No. 6	12	18	27	..	..	..	..	..	..
4	10	15	21	28	38	71	15	.	
2	10	15	18	21	24	44	68	138	228
1	10	15	18	21	24	40	59	120	204
00	10	15	18	21	24	36	50	102	168
0000	10	15	18	21	24	32	42	84	132

Insulators used on the Class A circuit shall be capable, says the report, of withstanding without flashover, at a frequency of 60 cycles, voltages not less than those listed in the accompanying table.

Load Regulated by Headgate When Governor Control Fails

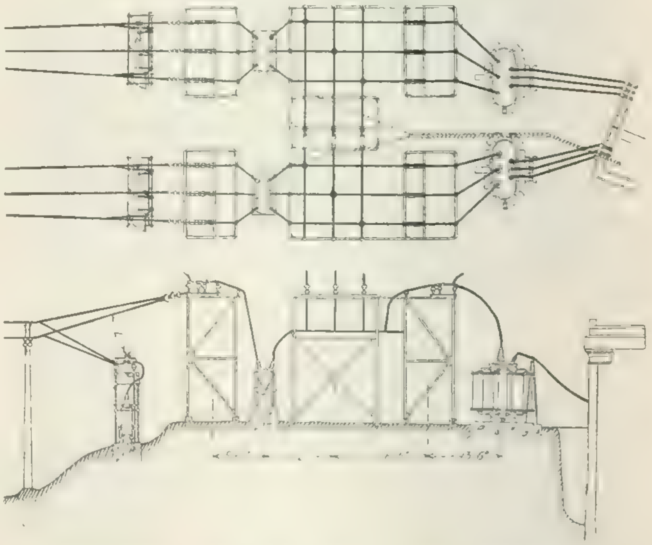
DEFECTIVE gate control on a water turbine-generator does not necessitate complete shut-down of the machine if care is used in its operation. The cause of defective operation may be that a governor has burned out a bearing or stripped a gear or that a regulator valve is sticking. If this is the case, hand control can be used generally, but sometimes the gates cannot be operated by hand. Then the headgates must be depended on. If the generator tends to run away, these gates should be closed before opening the generator circuit breaker. In a runaway machine the roller bearings are likely to be damaged, although slide bearings will not be. On the other hand, if the generator is loaded so heavily that it does not overspeed and if it is needed on the line to carry the load, it may be left in operation. However, it should be watched and it is advisable to reduce the number of open headgates as much as possible to carry the load. A man should be posted at the headgates ready to close them in case the load drops off the machine. In addition, if the layout permits, a large water rheostat may be held ready to tie to the machine to prevent runaway in case of sudden loss of load.

These directions refer only to a machine already connected to a system, but it may be necessary sometimes to start up a defective machine in order to take care of an increasing load on the plant. If it is necessary to connect such a crippled machine to the system, it may be synchronized and its load may be regulated by operation of the headgates. After the wheel pit is filled with water the gates have to be opened only a slight distance to attain synchronous speed. Another method of paralleling such a generator is to tie it to a generator whose control is in good condition while both generators are at a standstill. Both machines should have strong fields for best results. After connecting the machines together the good one is brought up to speed and the crippled machine will keep in synchronism with it. When both are up to speed they are synchronized with the station bus and tied to it simultaneously.

These directions are taken from rules of the Pennsylvania Water & Power Company, for use in the Holtwood (Pa.) plant of that company.

Simple Design for Outdoor Substation

A VERY desirable arrangement of lines and apparatus is obtained in the outdoor substation at the McClure plant of the Cleveland Cliffs Iron Company, Ishpeming, Mich. The two 5,000-kva. three-phase transformers are fed from separate lines connected to the 2,200-volt generator bus by switches inside the station.



10,000-KVA., 2,200/30,000-VOLT OUTDOOR SUBSTATION

The outgoing 30,000-volt lines may be tied together on the outdoor tie bus. Beyond this tie are the line automatic oil switches, choke coils and lightning arresters.

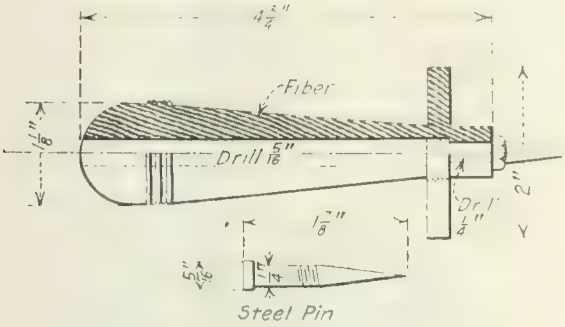
This design brings out the simplicity of arrangement which may be obtained where space is not limited. The apparatus is arranged in a logical order so that mistakes by operators or repairmen are not probable. The substation was designed by **F. C. Stanford**, electrical engineer for the Cleveland Cliffs Iron Company.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

Fiber Handles for Reading Voltage Without Cutting Insulation

LEADS attached to fiber handles holding steel points have been found very convenient in a Michigan copper mine for making voltage readings with portable instruments. The sharp steel point assures a firm contact on bare buses and pierces ordinary weatherproof insulation so that cutting the insulation is unnecessary. On 2,200-volt tests the insulating handle reduces the danger and allows quick work. In making the handle, it is drilled lengthwise so that the steel pin to which the flexible lead wires are soldered may be passed through it, point first, until the pin's shoulder rests on a shoulder in the handle. After this it is drawn up tight with the hexagonal nut on one end of the handle. Terminals are soldered on the other end of the lead wires for use with the instruments or transformers.



INSULATED HANDLES FOR USE WITH VOLT METERS

John E. Rock,
Electrical Foreman.
Copper Range Company,
Painesdale, Mich.

Calculating Proper Size of Motor for Irregular Loads

IN CALCULATING the largest irregular load which a motor can carry the most important factor is the temperature which the insulation will reach. The maximum temperature to which insulation should be subjected is 105 deg. C., and motors are usually so rated that a continuous overload of about 15 per cent will give this temperature. However, where the load varies, the heavy load being carried only part of the time, the motor may be smaller since part of the heat developed under the heavy load will be dissipated during light load. The effective load is dependent on the resultant heating, and if the load cycle is known this effective load, called the "root-mean-square" load, may be calculated.

The following example will explain the method of calculating the load for a 75-hp. direct-current motor rated at 220 amp., 230 volts, which drives a chain bench, drawing two bars of soft steel, of $2\frac{1}{16}$ in. diameter to 2-in. finished size:

Load	Seconds	Volts	Amp.	Kw.	(Kw² Sec.)
Friction ...	25	215	40	8.6	1,848
Drawing ..	50	175	450	78.7	309,185
Total ...	75				311,033

Adding the sums of the squares of each load multiplied by the seconds, the result is 311,033. Then, dividing and extracting the square root, $\sqrt{311{,}033 \div 75}$, or 64.4 kw., is found as the effective load. As the motor is rated at 62.2 kw., it is properly loaded. This method must not be applied to a motor used intermittently, because when at rest a motor does not cool as quickly as when running unloaded on account of lack of ventilation. In this case another formula must be used, effective load $= \text{kw.} \sqrt{t_l \div t_l k t_r}$, where kw. = power demand on loaded t_l = time running loaded, t_r = time standing still, and $k = 0.5$ for inclosed motors and 0.33 for open motors.

D. W. Blakeslee.
Pittsburgh, Pa.

Convenient Transformer Mounting in Factory Testing Department

IN A MASSACHUSETTS factory a bank of three 440/110-volt, 25-kva. transformers and a type S 10-kva. Westinghouse voltage regulator have been conveniently mounted in a space 13 ft. (4 m.) long by 40 in. (1 m.) wide, the arrangement shown providing for compact wiring and effective drainage of oil in case of need. The transformers are each set upon two $2\frac{1}{2}$-in. x $2\frac{1}{2}$-in. x $\frac{1}{4}$-in. (6-cm. x 6-cm. x 6-mm.) angle iron pieces $20\frac{1}{2}$ in. (50 cm.) apart, the angles being fastened by carriage bolts to two horizontal 4-in. (10-cm.) channels 9 ft. (2.7 m.) long and 28 in. (70 cm.) apart on centers. The channels are carried 24 in. (60 cm.) above the floor level by similar vertical members. Diagonal braces of $\frac{5}{16}$-in. x $1\frac{3}{4}$-in. (8-

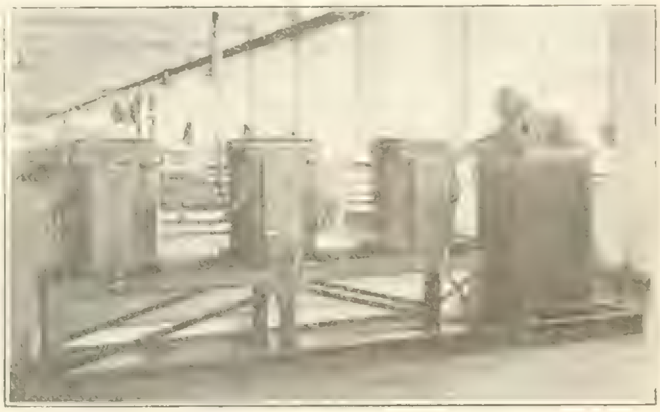


FIG. 1—TRANSFORMER AND REGULATOR MOUNTED IN SMALL SPACE

mm. x 45-mm.) steel are used. The wiring is carried to the regulator and transformers in 2-in. (5-cm.) conduit, and the open connections are carried at the rear on split porcelain insulators fastened to 1⅛-in. x ¼-in. (28-mm. x 6-mm.) vertical straps with a horizontal tie strap 1½ in. x $\frac{3}{16}$ in. (3.8 cm. x 4.7 mm.) in section. Drainage is effected through 1-in. outlet pipes screwed into the transformer casings, each being fitted with an elbow and cock at the outer end so that splashing is avoided in emptying the cases. A floor reservoir 6 in. (15 cm.) deep, lined with tin and connected with a trap and sewer drain, is installed below the equipment. Frames and conduit are grounded, and the installation enables good ventilation to be obtained at little cost in space.

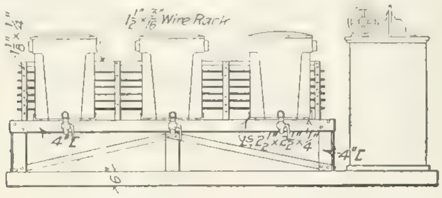
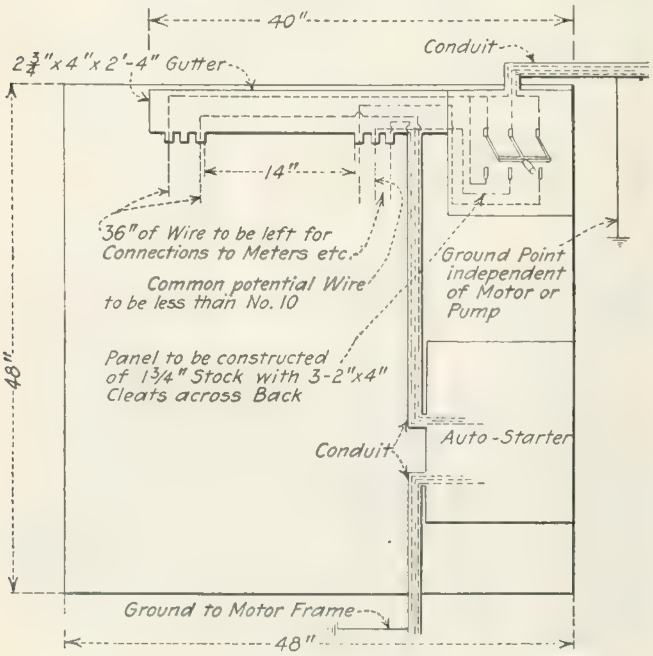


FIG. 2—DETAILS OF TRANSFORMER MOUNTING

Standard Meter Panel Saves Difficulties in Pumping Installation

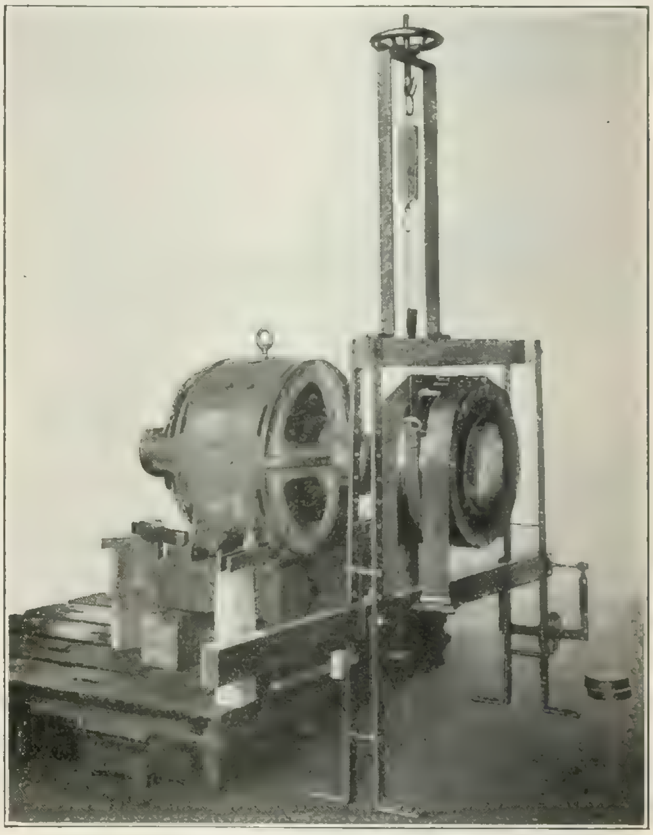
After considerable difficulty was experienced by the San Joaquin Light & Power Corporation due to unsatisfactory meter panel work in connection with pumping plants for agricultural purposes, it was found necessary to standardize methods of construction. Inferior materials were often used by contractors, and the work was occasionally done in such a makeshift manner that trouble was noticed immediately when the service lines were connected. To avoid constant breakdowns a standard meter panel was designed which complies with all safety regulations. Blue prints of this are furnished to all applying for such service and the company insists that the layout should be used. The resulting satisfaction on the part of consumers more than makes up for the small cost involved in designing this panel and the number of complaints since the adoption of this system has appreciably lessened.


40"
2¾"x4"x2'-4" Gutter
Conduit
14"
36" of Wire to be left for Connections to Meters etc.
Common potential Wire to be less than No. 10
Ground Point independent of Motor or Pump
Panel to be constructed of 1¾" Stock with 3-2"x4" Cleats across Back
48"
Auto-Starter
Conduit
Ground to Motor Frame
48"

METER PANEL FOR PUMPING PLANT 15 HP. OR LARGER

Testing Brake for 100-Hp. Motors

A testing brake for motors up to 100 hp. rating built in a New Jersey shop gives very accurate results. In this brake, bands of automobile brake lining pressing on a steel pulley give the braking effect. One end of these bands is attached to a wooden scale beam which is balanced by means of iron weights. There are two main 4-in. (10-cm.) belts passing up and three-quarters around the pulley, where they are connected to a 2-in. (5-cm.) belt the end of which is fastened by a wire to a small spring scale. The brake lining is of asbestos interwoven with brass or copper wires and stands the heat well. In order to lessen the friction maple-wood strips are inserted between the band and the pulley.

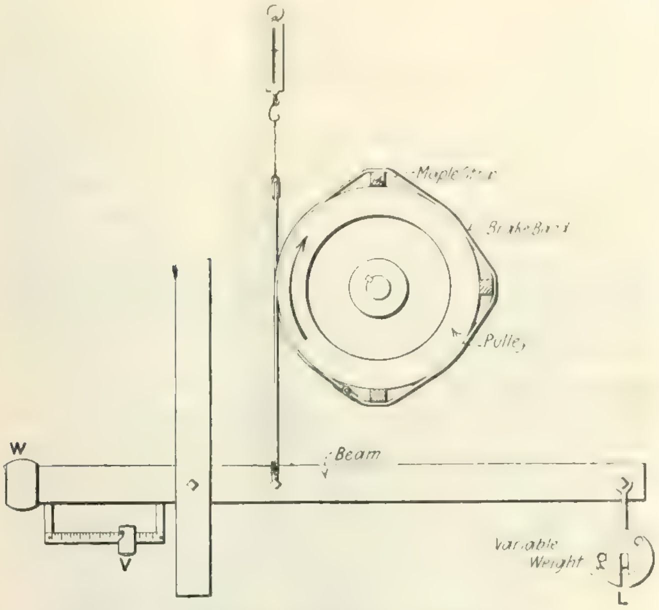


MAKING ACCURATE BRAKE TEST ON 35-HP. MOTOR

In making a test, after the belt is placed around the pulley the beam is balanced by means of the sliding weight *V*. As the motor is brought up to speed the belt tends to lift the beam. To put different loads on the motor the weight *L* is changed. The beam is so proportioned that 1 lb. at *L* will give a pull of 5 lb. on the belt. The pulley shown has a diameter of 25.2 in. (64 cm.) and a 12-in. (30-cm.) face. With a pulley of this diameter twice the net pull in pounds multiplied by the revolutions per minute and divided by 10,000 gives the horsepower directly. This pulley may be used for any torque up to 300 lb.-ft. (41 kg.-m.). A 12.6-in. (32-cm.) pulley is used for measurements up to a torque of 100 lb.-ft.

(14 kg.-m.). To prevent the pulley overheating it is flanged so that it will hold water during a test.

Care must be taken to prevent the belts jamming around the pulley and tearing loose with possible serious damage. The best results are obtained when the spring balance pull is about one-tenth of the main belt pull. The net pull which is used to calculate brake horsepower is the pull on the main belt minus the pull on the spring scale.



SCHEME OF TESTING BRAKE

The bearings of the scale beam are carefully lined and are babbitted. The arm is counter-balanced for its own weight and that of the belts and fittings by weights *W* and the sliding weight *V*. The frame must be strong enough to stand an upward pull of 1,000 lb. (450 kg.).

Crocker Wheeler Company,
Ampere, N. J.

F. W. Gay,
Chief Tester.

Rotary Converter Made from 15-Hp. Direct-Current Motor

FOR obtaining alternating current in a Chicago repair shop where only direct current was available a 15-hp., 550-volt direct-current motor was changed over into a rotary converter to give, in conjunction with an auto transformer, 115, 230 and 460 volts alternating current. The motor has four poles and formerly ran 1,200 r.p.m. and was wave-wound with two turns per coil. It was rewound in open-wave style, connecting in parallel the two coils which were of three No. 13 (2.5 sq. mm.) wires each. The fields were changed from all in series to two in parallel, two in series, which on 220 volts gives a speed of about 1,800 r.p.m. As there are 121 bars, alternating-current taps were made at Nos. 1, 41 and 81. The open-wave winding takes less room at the end of the armature than the two-turn coil which it replaced, because the knee formed by the two-turn coil is eliminated and therefore the commutator could be moved closer to the armature and the slip rings mounted on the same end of the shaft. The slip-ring leads were led through the commutator spider and are held in position by a fiber disk between the commutator and the rings.

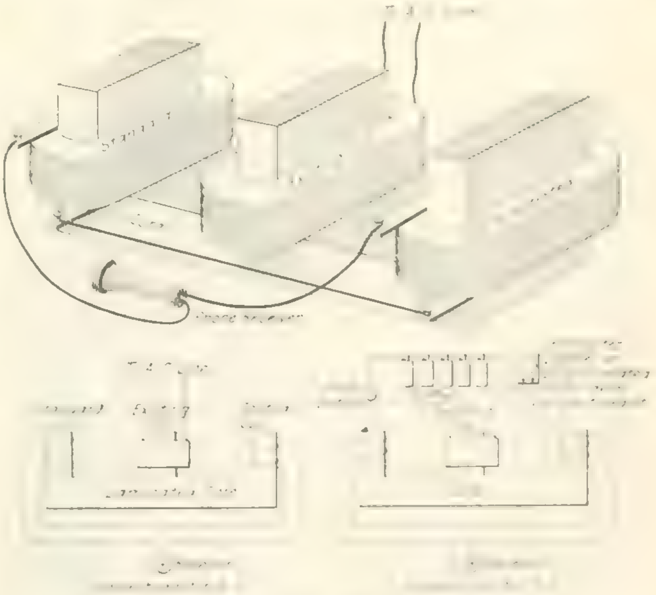
Both sets of brushes are mounted on the same studs, which are braced at the armature end by a fiber ring, the alternating-current brushes being insulated from the studs while the direct-current leads are attached to them.

The machine gives 140 volts at 60 cycles, which by an auto transformer is changed to 115, 230 or 460 volts. Approximately 25 cycles may be obtained by paralleling all four fields and operating on 110 volts. Although not connected for the purpose at present, the machine might also be used to drive shop equipment when the alternating-current load is not too heavy. C. W. Goding.

Chicago, Ill.

Testing Low-Resistance Coils With Telephone Receiver

WHILE overhauling an equipment of series motors in a steel mill a quick and reliable means of testing the field coils for short circuits was desired. For this purpose a method which proved quick and accurate employed a telephone receiver to detect any difference in the induced currents in the tested coil and a coil which was known to be good. For inducing the current in the coils a laminated-iron core shaped like a letter E taken from an old transformer was used. Over one end of this core was placed the good coil, and the coil to be tested was placed over the other end leg. These two coils and the telephone receiver were connected in series in such a way that the voltages in the coils induced by an exciting coil on the middle leg were in opposition. When the exciting coil is energized, if the coil under test is not short-circuited, the voltage induced in it balances that of the good coil and the telephone receiver is quiet. If there are any short-circuited turns, the voltages will not balance and a buzz will be heard in the telephone. The exciting current in the middle coil may be furnished from a 110-volt alternating circuit or, when no alternating-current supply is available, by direct current interrupted by a common doorbell or buzzer. If the 110-volt alternating current is used, the exciting coil must have sufficient resistance to prevent heating, while a coil used with an interrupted dry battery current need not have a high resistance.



BAD COIL CAUSES A BUZZ

Cleveland, Ohio. James Dixon.

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

Interrelation of Revenue from Washing Machines and Irons

THE washing machine, which in itself is one of the poorest producers of central-station revenue, indirectly causes a very appreciable increase in customers' bills because of its relation to the electric flatiron. This is the experience of Robert Montgomery, commercial manager of the Louisville (Ky.) Gas & Electric Company, as given in a paper read before the commercial section of the Indiana Electric Light Association. He said that an electric washing machine insures the weekly washing being done at home, with the result that the electric iron is put to work. In this manner the electric iron is made to produce a revenue of about $12 per year, whereas without the machine the washing is often sent out, and in that event the flatiron produces virtually no revenue.

Utica (N. Y.) Company Maintains Contractor-Dealer Window Display

BY W. J. REAGAN

Commercial Manager Utica Gas & Electric Company

THE Utica Gas & Electric Company of Utica, N. Y., has adopted a unique method of handling window displays. This company does not merchandise domestic appliances but has advanced ideas with reference to co-operation with the local contractor-dealers. The office windows are fitted with a handsome valance and draw curtains, made of poplin, lined and embroidered. These completely screen the windows while the displays are being arranged and present a draped effect from the sides when opened. The window floors are covered with rich Wilton carpet and inclosed in the rear with a quartered-oak barrier standing 5 ft. (1.5 m.) from the floor. Pedestals of varying heights, card holders and decorative fabrics are included in the equipment. The company has secured the services of a decorator from a leading department store to work on a part-time basis and arrange the displays. One-half of the decorator's time is paid for by the company and the remainder by the exhibitor.

TYPICAL WINDOW DISPLAY WHICH HAS ESTABLISHED CENTRAL-STATION AND CONTRACTOR-DEALER CO-OPERATION

Membership in the local section of the National Electric Contractor-Dealers' Association extends to each dealer the privilege of exhibiting for two weeks in the utility company's windows. The members' firm names are listed alphabetically, and when the turn of each approaches the decorator notifies the firm, learns the particular feature it wishes to display, and on the arrival of the stock at the utility company's office arranges the exhibit. This method simplifies the matter for the contractor, and incidentally the company can maintain the standard of all displays. Six general campaigns are arranged throughout the year in which all members participate. Special apparatus is featured singly—washing machines, vacuum cleaners, electric irons, fans, etc.

Dealers who desire may have demonstrators on the office floor during these special sales efforts. W. J. Reagan, commercial manager of the Utica Gas & Electric Company, states that the results have shown that these specific drives are very remunerative to all who participate. Membership in the association is not confined strictly to contractor-dealers. Local department stores sustain connection as associate members. The accompanying illustration shows a window display which is typical of those used by the company. A card giving the name of the local contractor-dealer is shown in the window at the left.

Profiting from the Gas Man's Experience

IN A paper presented before a group meeting held under the auspices of the publicity committee of the New England Section of the National Electric Light Association at Augusta, Me., M. C. Osborn, in discussing the heating of water electrically as a problem associated with the installation of electric ranges, dwelt on the early experience of gas companies, which he thought afforded valuable hints of what to avoid.

When, about thirty years ago, the gas man invented the phrase "Cook with gas," said Mr. Osborn, he rushed frantically about extending mains, putting in pipes and services and installing appliances free of charge. He reduced his rate on gas used for fuel, installing another meter with this in view. The gas stoves were auxiliary to the coal or wood ranges, and no attempt at water heating was made. It was soon found that such a policy spelled financial ruin, and it was not until the all-gas kitchen appeared, simultaneously with the placing of gas water heaters on the market, that a profitable business was developed. The extra meter then disappeared—often the coal or wood range went with it—and all gas consumed was charged for at the same rate.

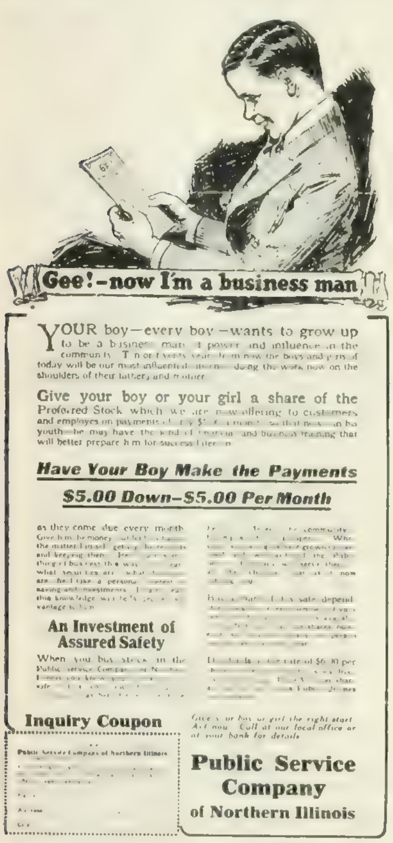
Here, maintained Mr. Osborn, is a hint for the central station bent on installing electric ranges. Why not begin with the all-electric kitchen, including a water-heating device, instead of coming to it by degrees after the unprofitable manner of the gas man?

Growth of Illinois Company Demands More Facilities

THE Public Service Company of Northern Illinois, which serves fifteen counties of that state, reports that there is every prospect during 1920 of exceeding last year's record in wiring old houses. That record was over 3,000. It is pointed out that many of the houses to be wired this year will use electricity for power in addition to lighting, for they will install electric ranges and household devices. Plans are also being laid for more store, factory and ornamental lighting. The power business of the company has been greatly increased by an important industrial region created in a belt around Chicago beginning at Waukegan on the south and extending through towns west of Oak Park to South Chicago, Harvey, Joliet and down to Kankakee and Streator.

The company's big electric station at Joliet, which now contains two units of 10,000 hp. each, is urgently in need of another unit of the same size. The Waukegan station requires a large increase in its capacity. New transmission lines are also needed to improve and amplify the company's distribution facilities. New transformer stations are also needed.

In the construction of these improvements new capital is required. This is being raised by a stock-selling campaign among customers of the company in which employees act as the salesmen. A typical advertisement used—one which appeals to the thrift instinct of the small purchaser—is shown in the accompanying illustration.


Gee!—now I'm a business man

YOUR boy—every boy—wants to grow up

Give your boy or your girl a share of the

Have Your Boy Make the Payments

$5.00 Down—$5.00 Per Month

An Investment of Assured Safety

Inquiry Coupon

Give your boy or girl the right start. Act now. Call at our local office or at your bank for details.

Public Service Company of Northern Illinois

INVESTMENT APPEAL TO CUSTOMERS IN ADVERTISING STOCK-SELLING CAMPAIGN

Wholesale Rate Making for Energy to Be Sold at Retail

Ideal Is That Purchasing Company Can Afford to Resell at Rates It Would Charge if Both Companies Were Under One Ownership

BY KASANDRA

THERE are two theories of prices. One is that price should be based on the costs that did occur. and this theory involves allocation of all the joint costs The other theory is that price should be based on what the lowest costs would be if the same service was performed in some other way, as by a competitor.

In many cases both theories lead to the same result For instance, a shoe manufacturer may base his prices on his own costs, but his own costs are apt to be the same as his competitor's costs; hence his prices come out the same whether he bases his prices on his own costs or on his competitors' costs.

When an electric utility makes the energy itself the various schemes for allocation of costs have been worked out by trial and error to give prices that are just enough lower than what it would cost the customer to get the equivalent service in some other way to insure that the customer will take the utility service rather than the competing service. The competing service may be an isolated plant, or gas, or oil, or sunlight (which is paid for in the form of rent), or the competing service may often be central-station energy in another town to which the customer can move.

When energy is made the allocation of the costs depends on the accounting system, but when energy is purchased and resold it is obvious that the allocation of the wholesale cost to the retail business depends on the form of the rate on which the purchase is made.

In figuring on the purchase of power two cases occur. First is the question of the existing business, and as regards this the only problem is the total bill or dollars paid for the purchased energy compared with what it would cost the utility to make the same amount of energy itself. If the utility can save money by purchasing, it should do so whatever the form of the rate.

If the utility uses 1,000,000 kw.-hr., costing to make $25,000, and can buy for $24,000, it makes no difference at the start whether the form of the rate is a monthly bill of $2,000 or a rate of 2.4 cents per kilowatt-hour or a block rate of 5 cents, 4, 3, 2 and 1 cent, making $24,000 for the 1,000,000 kw.-hr. The rate may even be a demand rate working out to $24,000 a year. At the start it makes no difference, but when the amount of service changes then there is a difference. A company making its own energy at an expense for interest and coal must consider how any new business will affect these costs, while a utility purchasing energy must consider how the new business will affect its power bill.

The same thing would be true if we compared water power and steam power. A water-power company finds that various kinds of new business will affect its costs in a very different way from the way in which they would affect the costs of a steam-power company.

Now, for ordinary small business the form of rates is the same whether the energy be purchased or made by steam or by water power. This is because in ordinary cases the prices are either based on what it would cost the customer for the competitive service or, if the prices are based on an allocation of past costs, the allocation has been worked out by trial and error to give the same results.

There are, however, cases where the prices that the customers can afford to pay are so low or when the effect of the customers' use on the costs is so high that the question of the sellers' costs must be considered, and a steam plant must often refuse business that a water-power plant can afford to take. Some chemical business and some water-heating business are instances. Vice versa, a steam-power plant can afford to take a certain business of a very poor load factor which a straight water-power company could not afford to handle.

If, instead of comparing steam power and water power, we consider purchased energy, we see that the form of the rate may have the same effect as the difference between water power and steam. A company purchasing on a straight kilowatt-hour rate cannot afford to take any business at less than the kilowatt-hour rate at which it purchases, but it can afford to take some business of very poor load factor which it could not handle if it made its own power. Vice versa, if the power is purchased on a demand rate of so much per kilowatt of demand and no kilowatt-hour charge the purchasing company can afford to resell at very low rates for business of good load factor but may not be able to afford to take on some business of low load factor, even though it could take on such business if it made its own energy.

The lesson is that the form of rate for the purchased energy may and often will affect the growth of the company that purchases. In turn this will affect the costs and profits of the selling company by reason of decreasing or increasing its sales. It follows that the ideal form of rate is such that the purchasing company can afford to resell at exactly the same prices that would be charged if both companies were under one ownership.

Some companies have this ideal in mind, as, for instance, when they make the rates for the bulk supply to a large apartment house such that the owner can just get paid for his metering and other expenses if he buys wholesale and retails to his tenants at the same price that the tenant would pay if he bought direct at the central-station retail rates.

When the form of the rate is not such as to attain this end, then the only thing to be done is for the selling and purchasing companies to keep in close touch, and if the form of the rates is such as to interfere with the development of any business that would be profitable in case the two companies were under one ownership, then the thing to do is to change the rate, either directly or by some special provision affecting only the special new business, so that the public shall get the maximum service and neither the selling nor the purchasing company shall lose thereby.

Some Advantages of Using Colored Bills

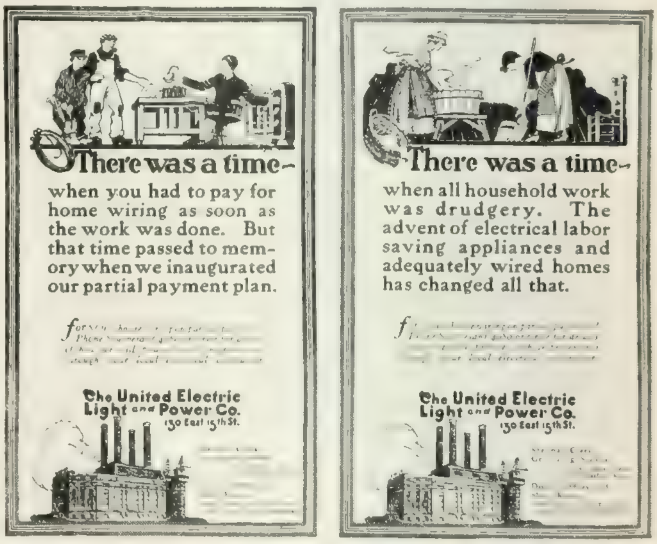
THE Springfield (Mo.) Gas & Electric Company has three bill-paying periods during the month and finds it desirable to use bills with a distinctive color for each period. Bills read between the twenty-seventh of one month and the fifth of the next are all delivered by the meter readers on about the tenth and the customers are given from the tenth to the twentieth to make payment. All bills due during this period are of a buff color; those due between the twentieth and the thirtieth are melon-colored, and bills payable between the first and tenth are white. This makes it easy for the company clerks and for collection agencies to tell at a glance whether or not a bill is paid on time.

The company makes a practice of delivering its bills, but finds it desirable to send some bills through the mails. For this reason colors were chosen from among those approved for mailing purposes by the postal authorities.

Nine-Week House-Wiring Campaign in New York City

ON MARCH 15 the United Electric Light & Power Company started, through advertisements in the newspapers of New York City, a house-wiring campaign which will be conducted during the spring months. Through the adoption of a partial-payment policy and an offer to help local contractors finance the work the co-operation of the electrical contractors in the districts which are served by the company has been wholeheartedly secured.

For nine weeks the company plans to use uninterruptedly in every New York newspaper advertisements such as are shown below. During seven weeks of this period the advertisements will appear in morning newspapers. Both morning and evening newspapers will, however, be used during the last two weeks. Twenty-seven separate pieces of advertising copy will be employed.



There was a time—
when you had to pay for home wiring as soon as the work was done. But that time passed to memory when we inaugurated our partial payment plan.

The United Electric Light and Power Co.
130 East 15th St.

There was a time—
when all household work was drudgery. The advent of electrical labor saving appliances and adequately wired homes has changed all that.

The United Electric Light and Power Co.
130 East 15th St.

TWO OF THE TWENTY-SEVEN ADVERTISEMENTS THAT WILL APPEAR DAILY IN NEW YORK CITY NEWSPAPERS DURING MARCH, APRIL AND MAY

A survey has been made of all unwired houses in the districts served by the United company, and after the advertisements have appeared for two weeks, form letters will be addressed to these prospective customers for house wiring, calling attention to the house-wiring campaign and its partial-payment feature. Form letters are also being sent to local contractors who might be interested in executing some of the contracts received.

The campaign is being conducted by Ralph Neumuller, advertising manager of the United Electric Light & Power Company.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

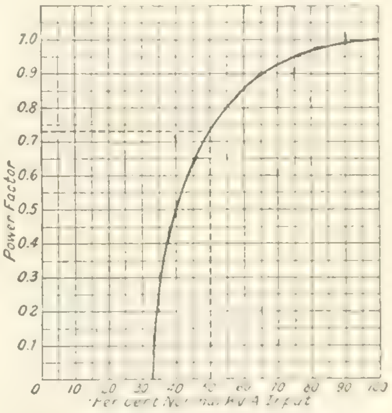
Unbalanced Magnetic Pull in Electric Machines.—TH. LEHMANN.—The Maxwell formula for magnetic pull holds only for cases where the pole surfaces are smooth. If applied in the computation of unbalanced pull in machines with salient poles or open slots, it will often give values which are 50 per cent too small, owing to the neglect of the non-homogeneity of flux. By considering energy stored in the magnetic field the author has obtained an equation for the pull in this more general case. He finds that the Maxwell expression $\phi 2/8\pi$ should be multiplied by $\delta R/\delta l$, the partial derivative of air-gap reluctance with respect to a rotor displacement. This relation holds also in case of armature reaction and is independent of saturation. Numerous examples are worked out algebraically and numerically, showing the application of the new formula to various kinds of machinery.—*Revue Général d'Electricité*, Nov. 29 and Dec. 6, 1919.

Parallel Operation and Synchronizing of Frequency Converters.—O. E. SHIRLEY.—The operation of a single-frequency converter between two systems is comparatively simple. However, when more than one converter is used the phase angle between the incoming generator and the bus introduces a factor which must be provided for. The author gives a clear explanation of the reasons for this phase displacement between loaded and unloaded converters tying in the same systems. In modern frequency-converter sets the difficulty introduced by this condition is taken care of by means of a motor-operated screw which shifts the stator of the motor or generator in its cradle to the required position.—*General Electric Review*, February, 1920.

Some Mechanical Features of Synchronous Machines.—A. P. WOOD.—A description of the mechanical features of the present-day design of synchronous machines. Illustrations are given of the improvements which have been made in design and construction by the introduction of arc welding and spot welding. The oil starting system and the oil circulating system are described, as well as the coreless and cored-box type of stator frame and the rotor spiders of various types and speeds.—*General Electric Review*, February, 1920.

Oscillating Frequency of Two Dissimilar Synchronous Machines.—R. E. DOHERTY.—In operating two or more alternating-current generators driven by reciprocating engines it is important to avoid a condition that will produce "hunting" or a periodic oscillation of the revolving elements ahead of and behind the normal position. In cases where the normal oscillating frequency of the alternator is near the periodic variation in the torque of the driving engine, hunting may occur in such proportion as to throw the generators out of phase or produce violent flickering of lamps or other trouble on the circuit. In a previous article published on this subject the author has discussed parallel operation of similar alternators with respect to hunting, and in the present article he extends the discussion to parallel operation of two dissimilar alternators.—*General Electric Review*, February, 1920.

Synchronous Motors.—W. T. BERKSHIRE.—The judicious employment of synchronous motors in combination with induction motors will correct the fault of low power factor and thereby result to the advantage of the distributing company as well as the user of the motor.



POWER-FACTOR CORRECTION OF SYNCHRONOUS MOTORS AT PARTIAL LOADS

The usefulness of the synchronous motor in correcting power factor is strikingly shown in the illustration. The curve shows the leading power factor at which a normally designed unity power-factor motor will operate at partial load with normal full-load field excitation.—*General Electric Review*, February, 1920.

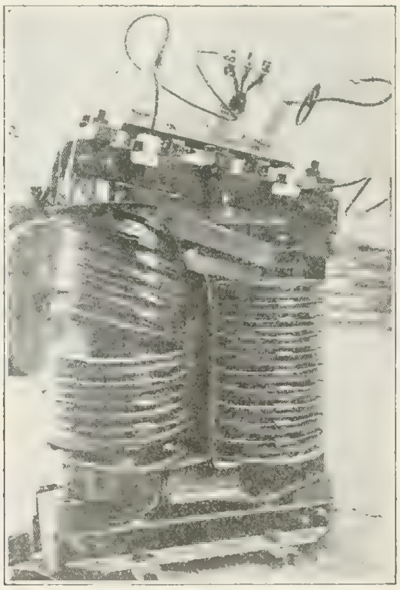
Lamps and Lighting

Lighting for Country Homes and Village Communities—WILLIAM KUNERTH.—The writer sets forth the advantages of electric lighting for this purpose and gives a table of comparative costs of lighting per year by various means, ranging from the candle to the gas-filled incandescent lamp.—*Bulletin* 55, *Engineering Experiment Station, Iowa State College*, Oct. 8, 1919.

Generation, Transmission and Distribution

Occurrence of Overvoltages at Points of Discontinuity on Transmission Lines.—GRABSCHEID.—Discontinuous changes in the electric constants of transmission lines may cause considerable overvoltages when surges pass along the lines. Such discontinuities may be due to a change in conductor diameter or in the distance to ground, or they may be due to the branching off of lines which are carried on the same poles for some distance. In connection with a theoretical discussion of this problem some numerical examples are worked out to show the order of magnitude of the effect. The author questions whether the abnormal number of insulator failures observed on a high-tension line in the neighborhood of Trieste could not be explained by overvoltages due to abrupt changes in the distance to ground. In these parts the ground contains huge masses of rock interspaced by regions of moist earth, and the effective distance from conductor to ground must therefore be subject to large and sudden variations from place to place. The seriousness of the situation is indicated by the fact that the transmission voltage had to be lowered from 50 kv. to 25 kv. in order to cut the rate of failures to normal proportions.—*Elektrotechnik und Maschinenbau,* June 29, 1919.

Four-Day Test on Five Boilers Burning Pulverized Coal.—A complete report and analysis of a four-day test on five boilers in the Oneida Street plant, Milwaukee, under average operating conditions in which comparisons were made with underfeed stoker operation. Under test conditions the efficiency of burning is only a trifle higher than with a modern-type stoker, but in daily operation the elimination of the many valuable conditions entering into stoker operation, the flexibility and ease of control and other advantages are reported in favor of powdered coal to offset the higher cost of fuel preparation.—*Power,* March 2, 1920.



TRANSFORMER TESTED TO POINT OF MECHANICAL FAILURE UNDER SHORT-CIRCUIT CONDITIONS

Effects of Short Circuits on Power-House Equipment.—E. G. MERRICK—The widespread tendency toward the interconnection of power systems and the development of generating stations of great capacity have created grave problems in properly handling the vast amounts of energy which can be concentrated in a single fault. The author deals particularly with the electromagnetic stresses and abnormal temperatures developed in power-house equipment resulting from short circuit.—*General Electric Review,* November, 1919.

Protection of Alternating-Current Systems.—KENELM EDGCUMBE.—The points which the author brings out may be summarized as follows: (1) In any scheme of protection continuity of supply should be the first consideration, simplicity the second and adaptability the third. (2) The neutral points of generators and step-up or step-down transformers should be earthed through a resistance having a negative temperature co-efficient. (3) When the neutral point is not available the system can be earthed through a zigzag transformer and an earthing resistance. (4) In a large number of cases special conductors are out of the question and any and every part of a distribution system can be protected by overload, reverse or leakage relays in accordance with the various methods discussed in the paper. (5) All overload relays must have similar time-current curves with a definite minimum, independent of the overload. (6) All reverse relays must be compensated for a fall of voltage down to 2 or 3 per cent and may in some cases be required to operate with a heavy current in either direction at zero voltage. (7) Current transformers should be of the straight-through type whenever possible, and should otherwise be protected by a non-inductive shunt of ample current-carrying capacity and specially adjusted to the transformer characteristics.—London *Engineer,* Feb. 20, 1920.

Traction

The Calculation of Track Pressure Drop and Losses on Direct-Current Electric Railways.—F. F. P. BISACRE.—In the design of an electric railway two important considerations are the pressure regulation of the distribution system between the trains and substations (track circuit) and the losses of energy therein. On these two questions the main features of the electrical layout of the distribution system hinge. The author states that there is little, if any, information published on the mathematical side of these questions. He then proceeds to make a mathematical analysis of the problems.—London *Electrician,* Feb. 20 and 27, 1920.

Electrification of the Turin-Cirie-Lanzo Railway.—This railway, which is a steam line, is being transformed into an electric one. The system adopted is the direct current one at 4,000 volts. The hydro-electric generating station at Funghera supplies 50-cycle, 40,000-volt, three-phase current to a single transformer station in Cirie, about half-way between Turin and Lanzo. In this substation are installed two 650-kw. groups, each consisting of transformer, synchronous motor and dynamo. The transformers step down the pressure to 500 volts. Special devices are used to avoid flash-overs in the dynamos. The locomotives serve also as baggage cars. They have four axles and four motors, each of 110 kw. at 1,800 volts, so that they are permanently connected two in series. The transmission from the motors to the axles is obtained through gears of the ratio 1:3:95. The locomotives can develop a tractive effort of 9,300 kg. when starting and 4,650 kg. when running The speed can vary between 31 km. and 65 km. per hour. The maximum weight of a passenger train will be 150 tons and that of a freight train 250 tons. The trolleys are pneumatically controlled, and the aërial wires are longitudinally supported by steel ropes. The distance between poles does not exceed 50 m.—*Science Abstracts, Section B,* Aug. 30, 1919 (Abstracted from *Elettrotecnica,* June 5, 1919).

Electrophysics and Magnetism

Magnetic Testing of Straight Rods in Intense Fields.—W. L. CHENEY.—Previous experiments at high inductions are discussed. A method which is suitable for measuring the magnetic properties of fairly long rods of ferromagnetic materials, when magnetized in intense fields, is described. Normal induction data are compared with those obtained by the Burrows method and found to agree satisfactorily within the range of the latter. From the normal induction data the intensity of magnetization and reductivity are calculated and discussed.—*Scientific Paper No. 361, U. S. Bureau of Standards*, Feb. 21, 1920.

Magnetic Mechanical Analysis of Cast Iron.—S. R. WILLIAMS.—The author calls attention to the results obtained by Rood (ELECTRICAL WORLD, Jan. 13, 1917) in which the conclusion was reached that cast iron does not have its permeability affected by tension. In the results of experiments reported in this paper the author comes to the conclusion that it has been shown that cast-iron rods, whose chemical compositions are given, have their permeabilities changed by tension.—*Proceedings American Society for Testing Materials, Part 2*, 1919.

Voltage Distribution Over a Condenser-Chain.—A. SCHWAIGER.—Owing to the capacity of the insulator units, the voltage distribution over a chain insulator is not even, but the unit close to the line will sustain a greater part of the line voltage than the next one, and so on, the distribution of voltage following a hyperbolic sine law. Experimental results by the author substantiate this theory. Measurements of breakdown voltage of a transformer, consisting of a number of insulated coils on a rectangular core, show that a similar law holds also for this case. The measurements were made at comparatively low voltages by means of a very small spark gap. If the capacity of a certain coil in the transformer shows a marked difference from the average, a sudden steep jump may occur in the voltage distribution curve. This suggests a reason for certain inexplicable breakdowns between coils in the middle of a transformer.—*Archiv für Elektrotechnik*, Oct. 10, 1919.

Electrochemistry and Batteries

Care of Storage-Battery Locomotives.—HUMPHREY D. SMITH.—A practical discussion of the care that should be given storage-battery locomotives used for coal mining. The modified constant-potential method of charging is recommended, and it is stated that the "constant potential" method has the disadvantages of high initial peak and that the voltage must be increased toward the end of the charge unless the charging is to be unprofitably slow, In order to prevent excessive gassing the temperature rise should not be too great. With the Edison battery, however, the charging rate should not be too slow, since it will reduce the speed and mileage of the locomotive on the discharge that follows. Many suggestions are given to the crews operating the locomotive and to those in charge of the electrical systems of the mines in order to get the best results from the batteries.—*Coal Age*, Feb. 5, 1920.

Estimation of Nitrates and Nitrites in Battery Acid.—L. B. SEFTON.—Three methods for the determination of nitrates, the diphenylamine, and hydrostrychnique and the brucine, were studied with reference to their use in testing storage-battery acid. It was found that nitrates in dilute acid could not be estimated in the presence of nitrites, but that by means of either the hydrostrychnique or the brucine method nitrates and nitrites could be estimated together. In the absence of iron, either the hydrostrychnique or a modification of the brucine method is recommended 'or the determination of nitrates and nitrites.—*Technologic Paper No. 149, U. S. Bureau of Standards*, Feb. 24, 1920.

Units, Measurements and Instruments

Potentiometric Amplifier Connections.—BLONDEL and TOULY.—In a previous article one of the authors has described various arrangements where thermionic amplifiers are used for the measurement of minute emfs. In the present paper some of the latest refinements in this field are dealt with. The principle of these amplifier systems is briefly as follows: A three-electrode vacuum tube, with its auxiliary batteries and resistances, is built into a Wheatstone bridge. At a balance no potential difference will exist between two corners of the bridge which are connected to the filament and grid of a second tube. However, if by impressing a small emf. on the grid of the first tube the current distribution over the arms of the bridge is changed, a voltage will be impressed on the grid of the second tube. Instead of a Wheatstone bridge various potentiometric arrangements have been used with good results. When two or more tubes are used regenerative action may also be obtained, by use of suitable back-coupling resistances. With only two tubes in regenerative coupling and three batteries, any desired voltage amplification may be obtained. For the direct measurement of small alternating emfs. with direct-current galvanometers a third tube is added, which acts as a rectifier.—*Revue Géneral d'Electricité*, Oct. 4, 1919.

An Improved Weir for Gaging in Open Channels.—CLEMENS HERSCHEL.—The author describes a new weir which indicates that for discharges from 0 cu.ft. to 9.55 cu.ft. per second per foot (0.08 cu.m. per sec. per m.) of weir length, the limits covered by the experiments, the quantity of water flowing, *Q*, was directly proportional to the difference, *d*, in two pressures, one measured just upstream of the weir (corrected automatically for the velocity of approach) and the other measured at the crest, the formula being Q 5.50 d. The paper contains descriptions and diagrams of the apparatus and tests of the new weir.—*Mechanical Engineering*, February, 1920.

Telegraphy, Telephony and Signals

An Experiment on Impulse Excitation.—JOHN H. MORECROFT.—A description of an oscillographic investigation of the current produced in an oscillatory circuit by a brief rectangular pulse of emf. directly introduced into the circuit. The pulse length is regulable. It is found that a pulse having a duration of one-half the natural period of the circuit produces the maximum disturbance. The bearing of the results on the effects of strays in reception is discussed. The behavior of "infinite impedance" loop circuits when subjected to pulse excitation is studied, and it is found that for pulses their filtering action is much reduced.—*Proceedings Institute of Radio Engineers*, February, 1920.

The New Marconi Distress Calling Device.—Where there is only one radio operator on shipboard, as is commonly the case, he cannot listen for twenty-four hours of the day on the chance of hearing a distress call. The problem thus caused was attacked by the research laboratory of the Marconi Wireless Telegraph Company with the idea of ringing a bell by means of wireless telegraphy, and a relay has been devised which will respond only to the predetermined distress signal. As long as the distress signal is being received the alarm bell will ring.—*Wireless World*, March, 1920.

News in Brief

Summary

of Important Happenings in the Industry During the Week

Insistent increased demand for electrical supplies during the past week is apparent in all sections of the country, with the activity most pronounced in New England and in the Southern states. Shipments are only slightly improved, but nevertheless contain enough building materials to keep construction going, although contractors have great difficulty in obtaining material, which is being doled out by jobbers on a piecemeal basis.

A general lengthening of collections has been noticed throughout the country because of the shortage of cash and high interest rates.

Malleable iron is scarce and electrical manufacturers are put to it to continue deliveries. Substitutes are being introduced.

Incandescent lamps have advanced in price, the increase amounting to from 5 cents to 15 cents on the list price. The advances are more pronounced on the frosted bulbs. Reductions, however, have been applied to the larger type C lamps. Further advances have been made on certain types of push-button switches.

Heavy export orders have been placed this week for suspension-type insulators.

Accrued depreciation may be taken into consideration in making rates in cases where dividends have not been excessive and no adequate depreciation fund has been maintained, according to the New York Public Service Commission, Second District.

Norfolk, Va., has officially adopted a policy of financial encouragement to public utilities, based on business agreements and an adequate rate of return.

That a customer of an electric supply company cannot be denied service because of his refusal to pay the fee necessary to obtain a certificate of approval from the Board of Fire Underwriters is the finding of the New York State Court of Appeals on the third trial of a suit for damages against the New York Edison Company.

A contract between the Eastern Pennsylvania Light, Heat & Power Company of Pottsville and the Metropolitan Edison Company of Reading for interconnection makes a total of three interconnection schemes entered into by the former company, the others being with the Lehigh Navigation Electric Company at Tamaqua and the Schuylkill Gas & Electric Company at Frackville.

Representatives of the state organizations of Wisconsin, Illinois, Indiana and Michigan have agreed to recommend to their respective bodies the formation of a Great Lakes geographic section of the N. E. L. A., to include these four states, as suggested by national headquarters.

Formal organization of the International Chamber of Commerce is to take place at Paris during the week of June 21.

Thomas N. McCarter, president of the Public Service Corporation of New Jersey, declares that the commissions should speed up their decisions, in view of prevailing conditions.

Prof. Elihu Thomson has accepted appointment as acting president of the Massachusetts Institute of Technology, pending the election of a permanent head.

Operating voltage on the Ellsworth-Veazie transmission line of the Bar Harbor & Union River Power Company, connecting with Bangor, Me., has been raised to 50,000 volts to handle increasing loads.

About $750,000 worth of group life and disability insurance for its 600 employees has been taken out by the Hartford (Conn.) Electric Light Company.

Increased coal costs due to the 27 per cent raise in miners' wages will result in a 15 per cent increase in the cost of producing electrical energy, and an increase in rates will be the natural result, according to M. H. Aylesworth, executive manager of the National Electric Light Association.

Development of the Moore lamp to the point where it can be operated from 220-volt circuits without the use of an auxiliary starting device was announced by D. McFarlan Moore before a meeting of the New York Section, A. I. E. E.

More than 2,000 members have been added to the N. E. L. A. since last November through the membership committee of its Pacific Coast Section.

Chairman Jackson of the Wisconsin Railroad Commission and Chairman Edgerton of the California Railroad Commission, who are to address the Pasadena convention of the N. E. L. A., will be the first commission chairmen who have ever appeared before that body.

Rural rates, valuations and automatic substations were discussed in the second day's sessions of the Wisconsin Electrical Association. W. C. Lounsbury was re-elected president.

Thirteen public utility companies borrowed a total of $34,562,940 in March on securities to yield between 7 and 8 per cent interest. Two ten-year bond issues, amounting to $8,503,000 are included in these figures.

H. L. Clark, vice-president of E. W. Clark & Company, Philadelphia, urges that public utilities be allowed to earn 9 per cent.

Bonds to the amount of $25,000,000 are being issued by the Western Electric Company to bear 7 per cent interest and mature in five years.

Installation of automatic telephones in New York City is to be begun at once.

W. L. Goodwin and S. A. Chase report much enthusiasm in the Southern cities they have visited in the interests of electrical co-operation.

Much optimism concerning the outlook for electrical utilities was expressed by Joseph B. McCall at a meeting of the Pennsylvania Electric Association.

After an extended session the Congressional conferees on the water-power bill report "no progress," and the opinion is expressed by some in Washington that considerable time will be necessary to work out a compromise.

James D. Mortimer has resigned as president of the North American Company, effective Nov. 1.

Comparatively little damage to central stations in the West and South is reported as a result of the tornado on Sunday last.

Sales of $230,000,000 for 1919 are shown by the annual report of the General Electric Company, or about $3,000,000 more than in 1918.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

Little Damage to Central Stations in Palm Sunday Tornado

COMPARATIVELY small damage to electric lighting systems was done by the tornado that swept over northeastern Illinois, northern Indiana, part of Ohio, Missouri and Wisconsin, west central Georgia and Alabama on Sunday, March 28. Wires and poles were down in the devastated regions, and electric light in some places was not available for forty-eight hours. Owing to the extensive damage to the telephone and telegraph systems little detailed information was available up to the time of going to press.

It was reported that the Elgin electric light plant (probably referring to the 720-kw. plant of the Elgin Merchants' Light Company) was wrecked. The storm was probably more severe in Elgin, Ill., than anywhere else. The expense of the storm to central stations in Chicago and the vicinity it is reported will be more than $25,000.

In the South considerable damage was done to the hydro-electric distributing system of the Columbus, (Ga.) Power Company between Newnan and Lagrange and between Lagrange and West Point. The Columbus Power Company reports a loss of more than twenty high-tension towers in this section. The retail distribution in the towns of Lagrange and West Point was so badly damaged as to prevent a resumption of service before Tuesday night. So far as can be ascertained, there was no damage by high water or storm to substations, hydro-electric plants or street-railway property.

State Commissioners to Address N.E.L.A. Convention for First Time

FOR the first time in the history of the National Electric Light Association, members of state regulatory bodies will address its convention, according to a statement issued from headquarters of the association this week. Chairman Carl Jackson of the Wisconsin Railroad Commission will read a paper on "The Trend of Regulation" and E. O. Edgerton, chairman of the California Railroad Commission, will speak on "The Reward of Efficiency."

G. E. Annual Report Shows 1919 Sales of $230,000,000

WHILE for some months after the armistice sales by the General Electric Company were curtailed, during the last eight months of 1919 orders increased steadily and rapidly, so that present demand is greatly in excess of the capacity of the company's factories, it is stated in the annual report of the General Electric Company for 1919. Orders amounting to $237,623,932 were received, or about $3,000,000 more than in 1918. Unfilled orders at the end of the year amounted to $98,880,000, compared with $80,000,000 at the end of 1918. Sales billed in 1919 amounted to $229,979,983, or $13,164,706 in excess of 1918.

The company is adding substantially to its manufacturing capacity by enlarging its present plants and in part by purchasing, or leasing with option to purchase, factories already constructed which offer immediate available facilities.

For additional land, buildings, machinery and other equipment there was expended during 1919, $14,462,286. Total factory floor space amounted to 20,681,000 sq.ft., which was an increase over 1918 of about 1,000,000 sq.ft. Inventories are carried at $83,978,463.

Higher Rates Natural Result of Coal Miners' Wage Increase

"INCREASED coal costs due to the 27 per cent raise in miners' wages will result in a 15 per cent increase in the cost of producing electrical energy, and the natural result must be an increase in rates throughout the country; in fact, the United States Bituminous Coal Commission, in its majority report, urges state commissions and other regulatory bodies to take into consideration the increased cost of coal in fixing rates for public utility service."

The above statement was made by Executive Manager M. H. Aylesworth of the National Electric Light Association after careful consideration of the text of the Coal Commission decision.

"Without passing upon the question of whether the coal operators are earning sufficient return upon their investment, or upon the question of whether coal miners, even under the increased wage scale, are receiving ample compensation for their work, it is very apparent that the increased cost of coal to the public utilities of the country must be absorbed in some manner," he continued. "It is equally apparent that public utilities under regulatory bodies have been allowed to earn only a fair return upon their investments, and in many cases not even that, so that it is impossible for them to absorb any increased cost of production without increasing their rates.

"More than 27,000,000 tons of coal is used yearly by electric public utilities of the country. The cost of this coal represents about 60 per cent of the cost of service by these utilities. Ninety-eight per cent of all coal used by electric public utilities is so-called 'contract coal,' which therefore must absorb the entire 27 per cent of the increase in wages. The remaining 2 per cent is exempt from the absorption of the increase of 14 per cent fixed by tentative agreement between operators and miners pending the decision by the commission, but of course it must absorb the additional 13 per cent allowed in the recent order."

In its opinion the Bituminous Coal Commission advocates a seasonal freight rate and a seasonal reduction in cost of coal to encourage storage in the summer months.

This is in line with suggestions made by N. E. L. A. representatives in a hearing before the commission and also in a hearing before the Senate committee on interstate commerce.

Mortimer Resigns from North American Company

AT A MEETING of the directors of the North American Company held in New York on Tuesday, James D. Mortimer offered his resignation as president of the company, to become effective Nov. 1. At the same time the directors voted to withdraw from the consideration of the stockholders the project for classifying the capital stock. This plan contemplated the creation of 297,933 shares of $50 par value of preferred and an equal number of shares of common of $25 par value. William Nelson Cromwell was elected chairman of the board to fill a vacancy which has existed since the death of George R. Sheldon. Albert B. Boardman was elected to fill a vacancy in the board.

No announcement could be had from the office of the North American Company relative to the plans of Mr. Mortimer after Nov. 1. His successor has not yet been chosen.

Big Membership Drive by Society for Electrical Development

BELIEVING that every central station, jobber, manufacturer and contractor-dealer within the electrical industry profits directly or indirectly by the work of the Society for Electrical Development, and that each one would profit infinitely more were he a member of that body, an intensive membership drive has been started by the society, with the slogan "A thousand new members by July." Since the signing of the armistice, the society's membership list has grown. Old members who were forced to withdraw on account of the curtailments made necessary by the war have all returned, and in addition a gratifying number of new members have joined.

An extensive direct-by-mail campaign has been mapped out. The first piece of this series has already gone out in the form of an enlarged letter, setting forth a few of the advantages of membership in the society. This will be followed by a broadside explaining more in detail the scope of the society's efforts and giving concrete evidence of benefits which present members are receiving. Other mailing pieces will follow to tell completely the story.

Because an increased membership, meaning increased funds, will also benefit existing members, all those now belonging to the society are being urged to "boost" the society and to obtain applications.

The annual meeting of the society is scheduled for Tuesday, May 4, and will be followed by a meeting of the board of directors.

F. W. Loomis has been traveling through the Southwestern and Middle West sections of the country on behalf of the society. He remained in Kansas City for a week and helped W. B. Satterlee with the electrical campaign which was conducted there by the local electrical interests. The society supplied the design used for the campaign poster and the copy used in the daily newspaper full page advertisements.

Utility Development Fostered by Norfolk, Va.

CAPITAL legitimately invested in public utility properties must be safeguarded and protected by municipalities, both as to principal and as to a just and inviting return thereon after reimbursement to the company for expenses incurred in providing service. This platform has been adopted both by the Public Utilities Commission of Norfolk, Va., a local body which acts in an advisory capacity to the City Council, and by the latter body itself as that by which they will be governed in their dealings with public utilities. Practically interpreted, it means that the city declares its conviction that the encouragement and development of the utilities is necessary to the welfare of the community and that it stands ready to enter into proper business relations with these bodies in order to insure the safety of their invested capital and a reasonable return upon it.

The particular case which caused this action is one in which the City Gas Company of Norfolk, included in the system of the Virginia Railway & Power Company, petitioned for an increase of gas rates from a base rate of $1.20 per 1,000 cu. ft. to $1.60. A. Merritt Taylor and Charles B. Cooke, Jr., of Philadelphia, were employed to make a valuation of the gas property, and upon the figures arrived at by them and accepted by the company and the city a cumulative return of 8 per cent was guaranteed. On this basis the company's requested rate was found to be justified.

Before the agreement can be consummated it must be indorsed by the State Corporation Commission. That body has shown itself to be as broad in its views as the local body, and, while it has reserved the right to check the figures in detail, its chairman, reasserting the commission's belief that unless public utilities get some relief and unless their business is recognized on a business basis Virginia will either lose its utilities or get poor service, says:

"In the present instance it seems a *prima facie* case, and it appears the commission's duty to approve this agreement."

Important Progress in Development of Moore Lamp

DEVELOPMENT of the Moore lamp, in which light is produced by the passage of electricity through a gaseous conductor, has come to the point where the lamp can be operated from 220-volt circuits without the use of any auxiliary starting device. This announcement was made by D. McFarlan Moore, of the General Electric Company, in an address to the New York Section, American Institute of Electrical Engineers, on March 26.

Mr. Moore gave a brief historical sketch of the history of light from gaseous conduction. He then showed some lamps, about the size of the ordinary incandescent lamps used for street lighting, which were provided with the usual Edison base for use on low-voltage circuits. The gas used in these lamps is neon and the characteristic color is orange. Although the supply of neon has not been sufficient in the past for any great commercial development, Mr. Moore declared that there is now assurance of an adequate supply for use in these lamps. He predicts a large development in gaseous conduction lamps with other gases as well as neon.

Kansas Industrial Court Grants Topeka Linemen More Pay

THE first wage controversy submitted to the new Kansas Industrial Court resulted in a marked increase in wages and new working conditions for linemen employed by the Topeka Edison Company. The company was ordered to pay its linemen 67½ cents per hour for an eight-hour day, which is an increase of 7½ cents an hour over the present wage of the linemen and 2½ cents an hour less than the men had asked before the proceedings in the Industrial Court were brought.

Automatic Telephone for New York City

ANNOUNCEMENT is made by the Western Electric Company that the installation of automatic telephone exchanges is to be commenced at once in New York City by the New York Telephone Company. After nearly fifteen years of experimental work and laboratory trial periods the Western Electric Company feels that it has developed a satisfactory machine-switching equipment which is almost 100 per cent foolproof and will eventually do away with manual operators. The initial installation of the automatic system will replace three of the present exchanges in New York. No interruption or confusion in the telephone service is expected as the conversion will, of course, be very gradual.

Some idea of the amount of engineering and preliminary work required in making this change-over may be had when it is stated that at the present time in the Western Electric Company's engineering offices there are 350 engineers and draftsmen devoting their entire time to the further development of machine switching and apparatus. In one machine-switching office the engineering for which has been completed recently the equipment and circuit drawings covered an area of 5,000 sq. ft., and that was for only one set of drawings.

Utility Banker Urges 9 Per Cent Return

PUBLIC Service Commissions in restricting electric utilities to earning a return of not over 8 per cent on invested capital have seriously impaired the credit of these utilities, declared H. L. Clark, vice-president of E. W. Clark & Company, public utility managers and investments bankers, Philadelphia, to a representative of the ELECTRICAL WORLD. At the present time, it was pointed out, investors demand a higher interest rate than ever before, and to attract new capital public utilities must offer securities at a price to net a return of 7 per cent or more. This means that the marketing expense of such securities will bring the cost of new capital to between 7.5 and 8.5 per cent. To attract new capital for vitally needed extensions and improvements, utilities, in Mr. Clark's opinion, should be permitted a return of at least 9 per cent.

"In many cases," stated Mr. Clark, "the rate schedules for electric service established by the Public Service Commissions do not permit a company to earn over 6 per cent above depreciation charges. This brings up the question of valuation, which at this time is very important, not only for the purposes of rate making but also from the investor's point of view. For every $100 of investment the security holders should at all times be assured that there is $100 of assets either in property or reserves. With this in view a company is entitled to include in its rates an amount sufficient to offset depreciation and obsolescence and enable it to keep up its plant and system in good operating efficiency and physical condition.

"To insure the quality of service now demanded by the public, commissions should be liberal in the matter of depreciation. In making valuations, the original cost, the cost of reproduction at present-day prices, no deductions for depreciation and a substantial addition for going value should be allowed."

In summing up the situation, Mr. Clark stated that in his estimation the outlook for public utilities is improving as the high point of operating costs already has been passed. But to attract the new capital necessary for development and extensions electric utilities, it was pointed out, must be allowed to earn more. He pointed out that the return required by investors in public utility securities is substantially greater than five years ago, and that Public Service Commissions in establishing the rate of return allowed must take into consideration these conditions: First, that all capital demands a higher return; second, that the credit of public utilities has been impaired by injudicious regulation, and, third, that the regulating authorities must realize that they cannot force into the utilities the large amount of capital required, but must make the investment attractive.

Rural Rates Debated by Wisconsin Electrical Association

CONSIDERABLE interest was taken in the report of the committee on rural line extensions of the Wisconsin Electrical Association, G. C. Neff, chairman, on the second and last day of the association's convention last week. In addition there were papers devoted to valuation and to automatic substations.

Equitable city rates plus the increase in fixed charges, energy losses and operating expenses incident to rural service were proposed for adjacent rural communities. The general practice of having farmers' lines exclusive of the necessary watt-hour meters financed wholly by the consumers was approved. Under this plan the utility is not entitled to earn interest on the investment, but it should earn annually, in the estimation of the committee, an amount equal to 10 per cent on the investment to cover the hazard of conducting the business, taxes, depreciation, maintenance and service.

A number of members thought the rural minimum charge would be too low under the proposed rate and favored a minimum of about $5. In reply, Mr. Neff said that the rate suggested by the committee was designed to encourage the increased use of energy. The greater the energy consumption the lower the additional rural charge would be, and vice versa.

The following officers were elected for the ensuing year: President, W. C. Lounsbury, general manager Superior (Wis.) Water Light & Power Company (re-elected); first vice-president, L. N. Boisen, vice-president Ashland (Wis.) Light, Power & Street Railway Company; second vice-president, Harold L. Geisse, vice-president Wisconsin Power & Light Company, Janesville, Wis.; third vice-president, P. D. Kline, vice-president and general manager Wisconsin & Minnesota Light & Power Company, Eau Claire, Wis.; secretary-treasurer, J. P. Pulliam, vice-president Wisconsin Railway Light & Power Company, Milwaukee (re-elected). The report of the first day of the convention appeared in the ELECTRICAL WORLD last week.

Great Lakes Section, N. E. L. A., Tentatively Approved

TENTATIVE approval was given to the plan of consolidating Wisconsin, Illinois, Indiana and Michigan into a "Great Lakes" geographic section of the National Electric Light Association at a recent conference in Chicago between M. H. Aylesworth, executive manager of the national body, and the presidents and secretaries of the four interested state associations. This will make the eleventh of the thirteen proposed geographic sections.

Besides maintaining their identity in the new organization, the state associations will have more responsibility given to them than they have now, because the national body will handle problems of a national character only.

The state representatives at the Chicago meeting were W. C. Lounsbury, Superior, Wis.; J. P. Puilliam, Milwaukee, Wis.; B. J. Denman, Moline, Ill.; R. V. Prather, Springfield, Ill.; W. M. Lewis, Muskegon, Mich.; H. Silvester, Ann Arbor, Mich.; P. H. Palmer, Kokomo, Ind., and T. G. Donohue, Lafayette, Ind. These were the presidents and secretaries respectively of the four state associations. They had not all been authorized to take final action on the proposition, but they agreed that the plan for reorganizing the N. E. L. A. so that it would include geographic sections was essentially correct and that they would recommend their respective state associations to give full co-operation to the plan.

Revisions to National Electrical Code

MOST of the changes to the National Electrical Code as outlined in the ELECTRICAL WORLD Feb. 14, 1920, were adopted after a public hearing on March 23. The final revision differs from these outlined changes in the following points:

The limit of low potential systems was fixed at 600 volts. The proposal to require polarity identification in all wires installed on and after Jan. 1, 1921, was modified to require that beginning July 1, 1921, twin wires for conduit work and twisted-pair wires for armored cable in sizes No. 12 and No. 14 B and S gage provide the means for continuous identification proposed in the bulletin for Rule 26-a. Rule 77 on fixtures is to be revised to require the identification marking by the fixture manufacturers of the wire connected to the screw shells of the socket.

In Rule 70-d, 2 on cabinet and outlet boxes, if the door is of No. 12 gage metal or over, an air space of one-half inch is allowed. Varnished cloth cable is limited to size No. 6 B and S gage and larger for general use. An amendment to 71-b provides that fuseless rosettes may be rated 660 watts at 250 volts and not over 6 amp.

Under the subheading of fixtures (Rule 30a) it was decided that insulating joints may be omitted in the case of straight electric fixtures installed on grounded raceways when the grounded wire of the circuit is connected to the screw shell and when approved fixture wire is used.

In the section on grounding the grounding of motors and generators operating at 150 volts or less and not accessible to other than qualified operators is not to be required. The recommendation to require externally operated inclosed type switches for motor circuits was not adopted. A substitute for Rule 23-d requires that service fuses must be enclosed unless connected to be cut off the supply circuit by the service switch or mounted on switchboards under competent supervision. Service switches may be located outside of buildings. It was ruled to amend 8-f to read that motors having brushes or sliding contacts exposed to combustible dust must be placed in non-combustible enclosures provided with ventilation to outside air. Under extreme conditions as in flour mills, grain elevators, etc., squirrel cage motors should be similarly enclosed.

A supplementary report on radio equipment described in the ELECTRICAL WORLD March 13, 1920, was adopted. Section e of the present Rule 13 is to be retained. Regarding oil transformers, drains in vaults are not required in certain cases. In regard to wattage limits for branch-lighting circuits special permission for 1,320 watts on circuits with medium-base sockets is still required. The recommendation to change 1,320 watts to 1,500 watts was not adopted. Provision was made for circuits up to 4,000 watts when mogul sockets are used, but special permission will be required. Under Rule 34 circuits of 4,000 watts will be permitted by special permission. Rule 26-g to 26-j retains the wording of the 1918 code except for the addition in the last sentence in proposed Rule 26-j as printed in the bulletin and except for recognition of varnished cloth insulation.

The report of the committee on reconciling the national electrical code and national electrical safety code were adopted except that present Rule 15-a is retained.

First Quarter Financing More Than $80,000,000

BOND and stock issues of public utilities for March show a decided increase over February not only in the number of companies represented, but also in the amount of money involved. Thirteen companies have borrowed a total of $34,562,940 at between 7 and 8 per cent interest. This brings the total since the beginning of the year to $81,280,940. About $24,000,000 of the March total is in notes and bonds, the rest in stock. As the table shows, there are only two ten-year bond issues, these amounting to $8,503,000; the remainder, representing nine companies, are made up of short-term obligations for three years or less. In every case the same high rate of interest prevails. Whether the issue is to fall due in ten years or one, the terms are such that the investment will yield between 7 and 8 per cent. The issues in detail follow:

Company	Amount of Issue	Period	Class of Security	Rate of Interest	Per Cent Yield	Offered at
Brooklyn Edison Co	$3,000,000	10-year	General mortgage gold bonds	6	7.25	92¾
Cincinnati Gas & Electric Co	2,400,000	3-year	Gold notes	6	7	97½
Detroit Edison Co	5,503,500	10-year	Gold debenture bonds	7	7	100
Eastern Wisconsin Electric Co.	1,200,000	3-year	General mortgage gold notes	7	7.8	98
Richland Public Service Co	850,000	3-year	Gold notes	7	7.6	98½
Denver Gas & Electric Light Co	2,000,000	2-year	Notes	7	7.25	98
Trumbull Public Service Co	360,000	3-year	Mortgage notes	7	7.65	98.4
Oklahoma Gas & Electric Co	3,500,000	1-year	Gold notes	7	7.8	99¼
Georgia Railway & Power Co	2,500,000	2½-year	Gold notes	7	7.5	99
Edison Electric Illuminating Co. of Brockton	649,440		Stock			110
Merchants' Heat & Light Co	600,000	1-year	Gold notes	7	7.56	99½
Dayton Power & Light Co.	2,000,000	3-year	Bonds	7	7.6	98⅝
Ohio Cities Gas Co	10,000,000	......	Preferred stock	8		

Arizona Utilities May Make Extensive Improvements

REPRESENTATIVES of many of the electric light and power companies and other public utility corporations of Arizona have conferred with the State Corporation Commission in regard to plans for extensive improvements the making of which would involve an increase of rates. It was stated at the conference that the electric companies alone purpose to spend not less than $5,000,000 in improvements. Several of these plants are to be enlarged in order to meet the increasing demand for power.

Companies represented at the hearing include the Globe Light & Power Company, Tucson Electric Light & Gas Company, Pacific Gas & Electric Light & Power Company, Flagstaff Electric Light Company, Bisbee Improvement Company, Desert Power & Water Company, Southside Gas & Electric Company, Arizona Power Company, Bisbee-Naco Water Company, Yuma Gas, Light & Water Company and Tucson Rapid Transit Company.

Ohio "White Ways" to Be Paid for by Owners of Abutting Property

A BILL to assess the cost of "white way" lighting upon the owners of the abutting property was passed by the Ohio State Legislature before its recent adjournment. By the terms of this law a municipal council may install a "white way" system on any public way upon the petition of owners of adjacent land with a valuation reaching three-fourths of that of all the property affected, and special assessments may be levied upon such owners for part or all of the cost. The assessments so levied may be collected in one or more instalments in the manner provided in the case of assessments for street improvements, and the legislative body may levy and provide for the collection of such assessments at any time before or after the completion of the lighting system. Any such assessing ordinance may be made to include the property specially benefited by such lighting system and may include property abutting upon any one or more streets or public places or parts thereof which are lighted by it.

The legislature declined to permit the cost of general street lighting to be assessed against abutting property, confining the law to boulevard or "white way" illumination.

Increased Production to Be the Keynote at Chamber of Commerce Meeting

WHEN the Chamber of Commerce of the United States meets in convention at Atlantic City, N. J., on April 27 to April 29 the one object it will keep to the front in addresses, papers and discussions will be to devise means of increasing production and thus restoring normal business conditions and reducing inflated prices. To this end discussions will range around government functions as they have been exercised in anti-trust legislation and in taxation; transportation, both land and water; international finance as the financier and the business man respectively view it; agriculture from the standpoints of the government, the farmer and the business man; labor as the employers on the one hand and the employed on the other see it, and topics closely related to these. In addition there will be group industrial meetings.

New England Convention Spot

For its annual convention, Sept. 14-16, the New England Section, N. E. L. A., will meet at one of New England's most beautiful resorts, the Mount Kineo House, Moosehead Lake, Kineo, Maine. In the background rises Squaw Mountain, and at the extreme right is the beginning of Kennebec River, the lake outlet.

McCarter Calls for Accelerated Commission Processes

DECLARING that the regulated public utilities have had to look solely to the public service commissions for relief from the almost intolerable burdens following the war—burdens which unregulated industries have been able to adjust—and that popular sentiment which insists that utilities must continue to function at pre-war rates is unreasonable, Thomas N. McCarter, president of the Public Service Corporation of New Jersey, in the report of that corporation for 1919, just issued, says:

"Conditions that have existed for the past two years make it imperative that commissions should act in such a crisis in a more or less summary manner. Protracted hearings, extending over months or years, defeat their object. When a patient is attacked by appendicitis an operation at the moment is often the only recourse."

Mr. McCarter points out that when the credit of public utilities is destroyed by a process of starvation two things happen: they cannot distribute satisfactory returns to existing investors and they cannot obtain new capital. Consequently no additional service can be provided and development in the territories served ceases, with resulting loss of prosperity all around.

The subsidiary Public Service Electric Company reports an increase in commercial sales of energy of 1,965,155 kw.hr., or 0.45 per cent. The revenue from electric sales showed a gain of 14.34 per cent, with an average price of 4.43 cents per kilowatt-hour, compared with an average price of 3.90 cents per kilowatt-hour in 1918. The war-time load was absorbed by other industries. A reserve supply of 220,000 tons of coal carried the company successfully through the strike.

New York Court Rules Against Compulsory Sale of Energy to Competitor

NO ELECTRIC central station can be compelled by the Public Service Commission to furnish break-down service to a consumer in order that the said consumer may be able in turn to supply electrical customers of its own from the energy so obtained. This is the decision of the Appellate Division of the Supreme Court of the State of New York in a case carried to it by the New York Edison Company on appeal from the decision of the Public Service Commission, First District.

The customer concerned is the grocery firm of Acker, Merrall & Condit, which has a generating plant of its own, from which it serves its tenants and other customers in the same block. Finding its supply of electricity insufficient, this firm applied to the New York Edison Company for break-down service. The company declared its willingness to furnish such service to Acker, Merrall & Condit for their own use and that of their tenants on condition that they would not use the service to supply customers in other buildings, contending that by doing so the grocery firm became a competing company and pointing out that there are more than six hundred private plants in New York which could, if the electric company's contention were overruled, all use that company's product to supply customers of their own. Not being obliged to maintain equipment for emergency service as is the electric company, such firms could underbid the latter. As a matter of fact, according to the judicial finding, Acker, Merrall & Condit retailed the energy received from the Edison company at a price 15 per cent less than that company's scheduled rates.

The Public Service Commission ordered the Edison company to supply Acker, Merrall & Condit with the break-down service. The Appellate Division of the Supreme Court, however, was unanimous in reversing the commission's order, finding that the resale of energy to outside concerns was not a proper use of break-down service and that alleged discrimination did not exist, the cases cited to the contrary involving no feature of competition as in the case under review.

Two 140,000-Volt Lines for Michigan System

CONSTRUCTION of two 140,000-volt transmission lines totaling 70 miles (112 km.) in length is a feature of an extensive development program to be carried out in Michigan by the Consumers' Power Company during 1920. One of the transmission lines, 26 miles (41.6 km.) in length, from Argenta to Battle Creek, will tie together a 30-cycle and a 60-cycle system. Frequency changers will be installed at Battle Creek. The other line connects Battle Creek and Jackson, a distance of 44 miles (70.4 km.). As a result of these connections the company will not only improve operating conditions but will add approximately 30,000-kw. capacity to its system.

Other additions to the company's property include a new 10,000-kw. steam unit and new boilers, condensing apparatus and general betterments in the various steam plants.

These improvements will be financed by about $6,000,000 of the proceeds from the sale of the Consumers' Power Company $5,000,000 general and refunding mortgage bonds and $3,000,000 debentures, as reported in the ELECTRICAL WORLD of Feb. 14. The balance of the proceeds of these issues is to be used for the retirement of certain underlying bonds of the company.

Program of the Arkansas Association Convention

THE annual meeting of the Arkansas Utilities Association will be held at the Arlington Hotel, Hot Springs, Ark., April 26, 27 and 28. At the conclusion of the reading of the committee reports at the opening session Governor Charles H. Brough will speak on "Arkansas' Attitude Toward Public Utilities." This address is to be followed by a paper on "Lightning Protection," by J. L. Buchanan, president Wesco Supply Company, St. Louis, Mo. The afternoon will be devoted to an inspection of the local utilities. The program for April 27 includes a paper by O. P. Barnell, Westinghouse Electric & Manufacturing Company, on "Underfeed Stokers"; a paper by P. W. Thomas, Arkansas Light & Power Company, Pine Bluff, Ark., entitled "Coal versus Oil," and a paper by W. G. Schmander, Texas Power & Light Company, Dallas, entitled "Present-Day Operating Problems." On April 29 Herbert R. Wilson, chairman of the Arkansas Corporation Commission, will deliver an address, upon the conclusion of which there will be a discussion on the topic "Public Policy and Good of the Association."

Public to Have Benefit from Government Inventions

THE bill authorizing the Federal Trade Commission to accept and administer for the benefit of the public inventions and patent rights which have been developed within the government service has been passed by the Senate and now goes to the House, where an effort will be made to obtain its prompt consideration. The passage of the bill is made possible by the withdrawal of objections by Senator Smoot, who had delayed passage of the measure because he believed the powers should be given to the Department of the Interior rather than to the Federal Trade Commission.

The committee on patents amended the original bill so as to allow such patents to go through the Patent Office without the payment of fees. The original bill had provided that each department should pay the fees out of its own appropriation.

New Lines for Central Illinois System

CONSIDERABLE construction work for the purpose of increasing capacity, tying in the system and shutting down isolated steam plants has been and is under way by the Central Illinois Public Service Company. A high-tension transmission line being constructed from Robinson to Palestine will permit the discontinuance of the present isolated steam plant at Palestine. The 33,000-volt transmission line between Bridgeport and Stoy is now in operation, connecting the Robinson-Oblong group with the Lawrenceville-Olney group and making it possible to close down the Robinson generating plant, except for stand-by purposes. The company has secured a renewal of the franchise in Edinburg.

There has been authorized the installation at the company's largest station, Muddy, near Harrisburg, Ill., of a third 6,250-kva. steam-driven turbo-generating unit, together with the necessary additional 686-hp. boiler and other apparatus. With the completion of this work, about July 1, the total capacity of the Muddy power station will be 25,000-hp.

The Pontiac-Fairbury transmission line was placed in service during February, enabling the Central Illinois Public Service Company to secure 500 kw. from the Public Service Company of Northern Illinois at Pontiac to supplement the Watseka power station and supply additional load in Division "P," formerly the Central Illinois Utilities Company.

The Central Illinois Public Service Company purchased on Jan. 1 the entire capital stock of the Central Illinois Utilities Company, Hoopeston Gas & Electric Company, Hamilton Utilities Company and the Eastern Illinois Ice Company. This advantageous purchase adds properties with gross earnings in 1919 of $543,987.

Further Interconnection in Eastern Pennsylvania

IN ADDITION to the tie-in lines with the Lehigh Navigation Electric Company at Tamaqua and the Schuylkill Gas & Electric Company at Frackerville, the Eastern Pennsylvania Light, Heat & Power Company of Pottsville has just entered into a contract with the Metropolitan Edison Company of Reading for an interconnection at a point south of Port Clinton on the border of Berks County. For this purpose there is now being erected a three-phase, 60-cycle, 23,000-volt transmission line which will be approximately 16 miles long. Line conductors of No. 1 solid copper and 45,000-volt insulators will be used so that at a later date the line can be changed over for 38,000-volt operation.

The Eastern Pennsylvania Company, of which C. A. Hall is manager, is in the position where demand far exceeds plant capacity. In addition to the interconnections considerable apparatus is to be installed to increase capacity.

Question-Box Conference Brings New Englanders Together

TWO hundred representatives of all branches of the electrical industry met at the American House, Boston, March 18, under the auspices of the New England Section of the National Electric Light Association to hold an all-day question-box conference. The program was confined largely to questions and discussions of commercial policy, merchandising of appliances, central-station service matters and public relations. C. R. Hayes, president of the New England Section, was general chairman.

A notable feature of the meeting was the presence by invitation of members of the Massachusetts branch of the National Association of Electrical Contractor-Dealers and representatives of the New England Electrical Supply Jobbers' Club. A committee consisting of William Gould, chairman, R. D. Cutler and J. T. Day was appointed to serve as a "contact committee" for conference with other branches of the industry.

President Hayes stated that, in his opinion, the relations between the different branches are far ahead of those of five years ago. In later issues résumés of the topical discussions which occupied the sessions will be printed.

Need for Trained Electric Furnace Men to Be Discussed

DEFINITE plans have now been made for the meeting of the Electric Furnace Association in Boston. The business meeting and election of officers will be held at the Copley-Plaza Hotel during a luncheon on Thursday, April 8, and afterward there will be a general meeting, which will be open to all who are interested in the electric furnace industry. The subject of the discussion will be "Adequately Trained Men an Urgent Need of the Electric Furnace Industry." This subject has been chosen at the instance of a number of electric furnace operators. Papers have been prepared by makers of furnaces and equipment and by electric steel manufacturers. A number of engineering institutions will also discuss what they are doing to train men for metallurgical work.

The following day the association will join with the American Institute of Electrical Engineers and the American Electrochemical Society in their discussions on "Electrically Produced Alloys" and "Power for Electrochemical Purposes." During the afternoon the members of all three organizations will probably make an inspection trip to the plant of the General Electric Company at Lynn.

The joint program was printed in ELECTRICAL WORLD last week on page 747.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Southern California Edison Employees' Stock.—More than 60 per cent of the permanent employees of the Southern California Edison Company were stockholders at the end of last year, and the number is continually increasing.

Radio-telephony in the Air Service.—The Air Service division of the War Department announces that Lieut. Stanley Smith has succeeded in talking by wireless with Fort Sam Houston, Tex., from a distance of 12 miles, exceeding by 7 miles the previous record distance for the apparatus used.

Penn Central Employees Organize.—Employees and officials of the Penn Central Light & Power Company have organized the Penn Central Patriotic and Beneficial Association. Each member will pay one-half of 1 per cent of his salary into a fund to provide benefits in case of accident, illness or death, and the company will add an equal sum, paying dollar for dollar.

Municipality Raises Rates by Eliminating Discount.—The City Council of Garrett, Ind., has discontinued the discount which had been allowed on bills for electric service furnished by the municipal plant. The discount for the entire town amounted to about $200, and it is hoped that the collection of this additional amount per month will obviate the necessity of revising the rate schedules upward.

Electrically Developed Blueprints.—Finding that its average weekly expense for blueprints, measuring in all 250 sq.yd., was about $160 and that the printing was sometimes delayed for days at a time, the San Joaquin Light & Power Corporation of Fresno, Cal., has installed an electrically operated outfit which turns out the same quantity of blueprints promptly and at an expense of not more than $50, or a saving of two-thirds the former cost.

Preventing Forest Fires by Wireless Telephony. — Preliminary tests of the wireless telephone in Oregon have led the Forest Service to think that it will prove of great utility in preventing fires in the national forests. One of the sets used was installed on Mount Hood, where the problem of providing a satisfactory support for the antennas was a difficult one, since a mast was needed which would be strong enough to resist the gales that sweep the mountains at 70 or 80 miles an hour and at the same time be light enough to permit of its being raised and lowered before and after sleet-storms. A 50-ft. bamboo pole was finally selected for the purpose.

New Bedford Company to Issue Stocks.—The New Bedford (Mass.) Gas & Edison Light Company is to issue $447,000 additional capital stock and $447,000 in 6 per cent bonds to meet the cost of plant enlargement demanded by increasing business.

Fuel Scarcity Prevents Plant Extension.—Owing to the scarcity of coal and oil fuel the South Norwalk (Conn.) electrical commissioners have been forced to hold in abeyance plans that had been made for increasing the capacity of the municipal plant in that city to take care of increased business.

National Immigration Conference.—Leaders in American industry and finance will discuss shortage of labor, the industrial unrest and the whole question of immigration at a conference to be held in the Engineering Societies Building, New York City, next Wednesday, April 7. Coleman du Pont, 120 Broadway, New York, will supply details of the meeting.

To Help Supply Electrical Help. — Because there is a shortage of master electricians in New York City and the code and rules are so complex that only twenty-five out of every hundred trying for a master's license or special maintenance license are able to pass the examinations, the West Side Young Men's Christian Association of New York has arranged for a special course of instruction in the code. John Domerhuizen, former city inspector and examiner for the Department of Water Supply, Gas and Electricity, will teach.

Cleveland Electrical Show a Great Success. — The Cleveland Electrical Show, held from March 10 to March 20 under the management of the Electrical League of that city, proved a greater success than even the most optimistic of its promoters anticipated. An average daily attendance of more than 15,000 was recorded, the majority being buyers rather than curiosity seekers. On one day more than 20,000 admissions were received, this being the highest daily attendance. At the close of the third day of the show orders totaling more than $1,000,000 had been booked by exhibitors.

Coming Electrical Shows.—An electrical show is to be held in Ardmore, Okla., under the auspices of the Consumers' Light & Power Company on April 7 to 10, inclusive. Montpelier, Vt., will hold one in June, and Worcester, Mass., one in September. The Worcester show will be held in Mechanics' Hall through the co-operation of the Worcester Electric Light Company and local jobbers and contractor-dealers. Indiana and Kentucky have combined for the purpose of holding an electrical exposition at Louisville on Oct. 25 to 30, inclusive, in the Jefferson County Armory, which is one of the largest structures of its kind in the United States. The Electric Club of Louisville is sponsor for the exposition, of which Robert Montgomery, manager of the commercial department of the Louisville Gas & Electric Company, has been appointed general manager.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Institute of Radio Engineers.—On Wednesday evening, April 7, Dr. Louis W. Austin, head of the navy's radiotelegraphic laboratory at Washington, will speak before this institute at the Engineering Societies Building, New York, on "The Reduction of Atmospheric Disturbances in Radio Reception."

New York Section, I. E. S.—"Searchlights in the A. E. F.," by Doraf Wilmot Blakeslee, and "Historical Sketch of Street Lighting," by P. S. Millar, are the titles of the papers to be presented at the April meeting of this section of the Illuminating Engineering Society, to be held on Thursday evening next at the Engineering Societies Building.

Electric Hoist Manufacturers' Association.—The annual meeting of the Electric Hoist Manufacturers' Association was held in New York City on March 18. J. B. Adams of the Franklin Moore Company, Winsted, Conn., was elected chairman of the association; R. H. McGredy of the Shepard Electric Crane & Hoist Company, Montour Falls, N. Y., vice-chairman, and E. Donald Tolles, 52 Broadway, New York City, secretary-treasurer. The next meeting of the association will be held at 9 East Fortieth Street, New York, on April 15.

Proposed Cornell Engineering Society.—A meeting of graduates in engineering at Cornell University will be held on the evening of April 9 in the Engineering Societies Building, New York. The meeting is called by the Cornell Society of Civil Engineers partly with the idea of forming a general Cornell engineering society, now that the different engineering schools at Cornell are to be combined into one general engineering college. The new dean of the combined college, Prof. Dexter S. Kimball, will be one of the speakers.

A. I. E. E., Philadelphia Section.—Dr. Comfort A. Adams will speak before this section at the Franklin Institute on "Electric Welding as Applied to Shipbuilding" on Thursday, April 8, instead of on April 12, as announced last week. On April 12 Frank B. Evans, Jr., of the Bell Telephone Company will discuss "Traffic Engineering" at the Engineers' Club. On Monday, May 10, "students' night," a dinner at the Engineers' Club will be followed by a discussion of "Professional and Financial Aspects of Electrical Engineering," to be participated in by students and graduates of technical colleges.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Amortizing Maintenance Charges.—That an excessive sum paid for repairing the boiler of a public utility should not be charged against operating expenses of any one year but amortized over a period of years was the decision of the Public Service Commission of Missouri in a recent rate-fixing case.

Sale of Surplus Energy Does Not Constitute a Utility Business.—The sale of surplus electric energy of a private industrial concern to a few customers within a limited area does not constitute a public ultility business within its jurisdiction, the Missouri Public Service Commission has declared, where there is no profession of public service, and the mere fact that service is being rendered across a public street is immaterial.

Competing Company Authorized Because of Poor Service.—Declaring that the Lisbon Falls Electric Company has failed in its duty to its community, supplying service "of the worst possible character" and standing "in a defiant attitude" to the public and the commission, the Public Utilities Commission of Maine has authorized the Maine Power Corporation to enter that territory and "furnish electricity for any and all purposes in any part of the town of Lisbon."

Charging for Service Not Actually Rendered.—The Public Service Commission of Pennsylvania has ordered the Greencastle Light, Heat & Power Company to restore to a former customer service discontinued upon his refusal to pay a charge of $1.66 for meter connection after he had moved from one house to another. The commission held that the company did not connect the meter at the complainant's new house and performed no physical service in connection with it.

Public's Interest in Relation of Corporations to Each Other.—In granting approval of the application of the Sierra & San Francisco Power Company for authority to lease to the Pacific Gas & Electric Company all of its properties for fifteen years, the presiding commissioner, listing the proposed additions and betterments which for nearly two years had been deferred by the inability of the Sierra & San Francisco company to sell bonds, but on which, in anticipation of the commission's sanction, preliminary work had already begun, declared that these "will materially improve service and increase power supply, as well as reduce cost of operation. In the opinion of the presiding commissioner, the lease is distinctly in the interest of the public."

Montana Commission Condemns Inadequate Rates.—In granting increased rates to the Range Power Company of Polson, Mont., the Public Service Commission of that state condemns the former schedule, based on franchise requirements, as unsound and improperly balanced. The residence consumer, for instance, paid a maximum rate of 12 cents a kilowatt-hour against 6½ cents paid by merchants, and the company's rate of 1 cent for municipal pumping was below the cost of production. The new general rates provide a sliding scale of from 15 cents down to 6 cents a kilowatt-hour, according to consumption, with a minimum charge of $1.50.

High-Tension Supply to Industrial Plant Authorized.—The New England Power Company has been authorized to build a 66,000-volt branch line from Dunstable to the Nashua River Paper Company's factory at Pepperell, Mass., to supply about 1,500 kw. to this establishment. The local central-station interests, the Pepperell Electric Light & Power Company and the Shirley Electric Company informed the Massachusetts Department of Public Utilities that as their lines are overloaded and they are not in a position to finance the necessary increase of distribution system capacity, no objection would be interposed to the entrance of the New England company's service, provided that the 300 hp. and 450,000 hp.-hr. annual minimum established in the Fitchburg case were applied by the commission in this instance. The commission so ordered.

Principles of Valuation.—The sale price of recently exchanged land almost contiguous to public utility land to be valued is the best evidence upon which to compute the fair present value of the utility's land for rate-making purposes, according to the decision of the Public Service Commission of Missouri in the complaint of the Engineers' Incitation Club against the Union Electric Light & Power Company of St. Louis. Where an electric utility in successful operation in a large community has a value above that of its depreciated physical property, going value is not to be estimated on the accrued deficits of past operation, as losses do not constitute value. Apportionment of the value of conduits and manholes in partial use on the ratio of duct feet occupied to total duct feet of system is preferable to a total trench length percentage where the use of the trench is not exclusive. While due consideration should be accorded all evidence submitted on cost of reproduction as of date of valuation, actual prices, when available, paid for portions of public utility property, except land, and, when not available, unit prices as of the date of construction, or average normal unit prices, are deemed to possess greater weight. Where investment is not accurately disclosed by the books and records an approximate estimate of original cost would seem to be as reliable and perhaps more enlightening than estimates of reproduction under normal conditions or as of the date of the valuation.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Liability for Overflowing of Reservoir.—The owner of an artificial reservoir in no way constituting a nuisance, having been negligent in no respect, is not liable, according to a decision of the Supreme Court of California, for injury to land below by the breaking out of waters through an extraordinary and unprecedented flood. (186 P. 766.)

Constitutionality of Law Governing Flowage Rights.—The Supreme Court of New Hampshire has held that a statute of 1919 providing that public utilities can acquire lands, flowage rights and easements by paying the owner therefor is not unconstitutional as taking property without due process of law, or because under a previous flowage act owners are given compensation and 50 per cent additional, or because it constitutes "class legislation." (108 A. 813.)

Procedure as to Hearings and Evidence Before Commission.—The statutes creating the Railroad Commission of Georgia and giving it power over public service corporations do not, it has been declared by the Georgia Supreme Court, in City of Atlanta vs. Georgia Railway & Power Company, require the commission to afford a hearing in the exercise of its rate-making function, and where in such exercise the commission considers a document on file with it as to the value of the property of a company for which rates are to be prescribed, without formally introducing such document in evidence at a hearing, this will not be sufficient ground for setting aside as void the order of the commission prescribing rates. (100 S. E. 442.)

Powers of Town's Selectmen—Implied Promise to Pay.—In finding against the Van Buren Light & Power Company, which sued the inhabitants of Van Buren, Me., for payment for street lighting under an express or implied contract, the Supreme Judicial Court of Maine held that, the light company's charter limiting the right of a town contracting with it to contract only by the town's selectmen, a contract not merely executed but also negotiated by a committee of persons not selectmen was not binding on the town; furthermore, the court held that, the town having refused payment for nearly a year and the streets having thereafter been lighted by another electric plant, there could, subsequent to such refusal, be no implied promise to pay for lighting from the duplicate system maintained by the plaintiff, evidently without the consent of the town officers. (109 A. 4.)

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Harold K. Munroe, assistant superintendent of power, Stone & Webster companies, Tacoma, Wash., has resigned to become vice-president of the Continental Pipe Manufacturing Company, Seattle, Wash.

Arden B. Holcomb has been appointed general industrial engineer of Crippen & Funk, Youngstown, Ohio. Mr. Holcomb was formerly sales manager of the Moloney Electric Company, St. Louis, and before that was for many years connected with the Frank Adams Electric Company, St. Louis.

Edward L. Sherwood, who has been appointed assistant secretary of the Illuminating Engineering Society in charge of work at headquarters, served during the war as commanding officer of the artillery tractor experimental shop, Ordnance Department, at Detroit, Mich. During the period 1903-1913 he was in the employ of the General Electric Company, first on tests and later as sales engineer. In 1908 he organized the San Francisco district office of the Edison Lamp Works, and in 1909 he was appointed district manager at Cincinnati. He resigned in 1914 to become production manager of the Abbott Motor Car Company, Detroit, Mich. A few months before joining the army he was made manager of the New York branch.

E. L. SHERWOOD

Dr. Albert C. Crehore, a well-known physicist and joint author with Professor Bedell of the college textbook "Alternating Currents," has accepted a position with the Nela Research Laboratories at Nela Park, Cleveland, Ohio. Dr. Crehore will devote his time to furthering his investigations on physical and electrical subjects.

Arthur E. Fitz, an electrical and research engineer formerly with the Connecticut Telephone & Electric Company of Meriden, Conn., has resigned from that company because of ill health and has gone to Terryville, Conn., to recuperate. Mr. Fitz joined the staff of the Connecticut Telephone & Electric Company in 1917 and was made engineer of the material and research division of the company in 1919.

B. F. Snow, formerly of the Portland office of the Pacific Power & Light Company, has been appointed manager of the Hood River (Ore.) office to succeed J. E. Law, who has resigned.

Jacob Augsberger, for ten years chief engineer of the Cannon Falls (Minn.) hydro-electric plant of the Northern States Power Company, died recently from pneumonia following influenza.

Frank H. Golding has resigned as general manager of the Central Power Company, Canton, Ohio, to become local sales manager for the Holmes Automobile Company. Mr. Holmes was formerly manager of the electric light companies at Rockford, Ill., and Atlantic City, N. J.

O. G. F. Markhus, who for many years has held the position of general superintendent of the Idaho Power Company at Boise City, Idaho, has resigned to take up the duties of general manager of the Boise Artesian Hot & Cold Water Company. R. D. King, manager of the Twin Falls division, will succeed Mr. Markhus as superintendent of the company.

Alexander Taylor, for many years manager of works with the Westinghouse Electric & Manufacturing Company, has been made assistant to the vice-president in general charge in all plants of production, stocks and stores. R. L. Wilson has been promoted from the position of general superintendent to be works manager of the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company. E. R. Norris has been appointed director of works equipment in charge of machinery, tools and methods in the various plants.

Charles D. Fawcett, who has recently been appointed assistant professor of electrical engineering at the University of Pennsylvania, was graduated from the University of Colorado in 1911. He then served as instructor at that institution for one year. For two years he worked in the testing department of the General Electric Company and also in the research section of the transformer department. Later he served for several years as instructor in electrical engineering at the University of Pennsylvania, and in 1916 he was appointed assistant secretary of the Illuminating Engineering Society with headquarters in New York. During the war Professor Fawcett served as illuminating engineer for Monks & Johnson, and in this capacity he designed lighting systems for shipyard buildings and ways. Subsequently he was the authorized representative of the Emergency Fleet Corporation in charge of the construction and operation of the ship steel-fabricating plants at Pottstown and Leetsdale, Pa. Upon the completion of the steel fabricating work he resigned to accept his present position at the University of Pennsylvania.

S. J. Lisberger, engineer of the San Francisco district of the Pacific Gas & Electric Company, is now preparing as chairman of the California Utilization Code committee to submit to the Industrial Accident Commission the revision of the old code which has been in effect for some time. The revised code represents the best thought of the leading engineers, contractors and manufacturers of the state. Mr. Lisberger is chairman of the California line code committee, which is preparing a code to cover overhead-line construction adaptable to conditions in that state. He was born in Danville, Va., in 1881 and received the degree of B. S. in E. E. and master's degree in E. E. from the University of Wisconsin. During the year 1903 Mr. Lisberger was connected with the San Antonio (Tex.) Gas, Electric & Traction Company. Since 1904 he has been in the employ of the Pacific Gas & Electric Company, San Francisco, Cal., in the positions of electrical designer, engineer of distribution and engineer for the San Francisco district. In the latter position he has complete charge of all the electric properties in the city—generating stations, substations, distribution lines and transmission lines, and steam heating. One of the particular engineering accomplishments of these years was the laying of two submarine cables across the Golden Gate. These are each 13,250 ft. long, are laid at a maximum depth of 215 ft., and operate at 11,000 volts. Mr. Lisberger during the last few years has served on the engineering committee, Pacific Coast Section, N. E. L. A., and the overhead line and apparatus committees, N. E. L. A., being district chairman of the latter. He has also been Western representative before the Bureau of Standards, Washington, on the investigation concerning the national line code.

S. J. LISBERGER

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies —Notes on Industrial Activities and Business Methods

Motors to Be Standardized for Washing Machines

ADDITIONAL washing-machine wringers and rolls are now being supplied so rapidly that members of the American Washing Machine Association, assembled in Chicago on March 17 and 18, expected their limiting production factor to be changed from wringers to motors in a very short time. It was therefore deemed necessary for the association to do everything in its power to promote the increased output of fractional-horsepower motors. With this end in view a committee was appointed, under the chairmanship of Howard Power of Davenport, Iowa, and with R. D. Hunt, Fairfield, Iowa, and Walter Conlon, Chicago, as members, to draw up specifications for one standard motor which could be used on all washing machines.

The net result of the change in the wringer situation has been to ease up delivery somewhat, principally by the securing of better distribution of wringers to the industry. Deliveries, however, are not by any means good and are being held back considerably by traffic conditions. About 50 per cent of the wringers come from New England, where a recent blizzard tied up traffic, and the congestion in Pittsburgh, Buffalo and Chicago makes it difficult to get parts and raw materials.

Electrical Manufacturers Feel Malleable Shortage

MANUFACTURERS of electrical apparatus and supplies who use malleable iron in their product are hard put to it in many cases to obtain sufficient quantities of this material to keep up their production. According to the American Malleable Castings Association, the foundry capacity is ample to provide for all the known demand, which is now probably considerably in excess of the nation's normal needs. It is believed that manufacturers at present in the malleable business certainly could take care of the demand if shop and molding capacity were the only consideration. Consequently it is not a question of adding more foundry capacity.

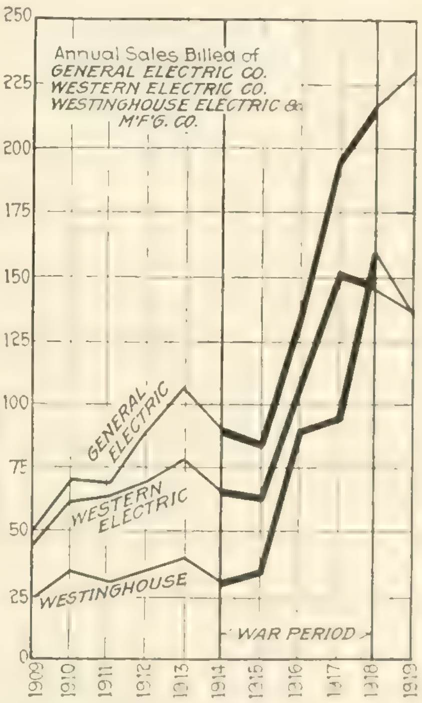
The whole trouble seems to be the scarcity of labor, and it is hardly expected that this condition can readjust itself in a short time. Rather skilled labor is employed in the foundries, and it is there that the shortage exists. It can readily be seen that there is no opportunity of running extra shifts where there are not enough molders to man existing capacity in a single shift.

Electrical manufacturers are not getting all the malleables they have ordered. One manufacturer has had to close part of his shop because of this shortage. Another is allotting his malleable products to from 20 to 50 per cent of each order. One item which is running short is the connector for flexible armored conductor. Brass and bronze, sometimes galvanized, are being used as substitutes at an increase in cost of only 2 or 3 cents above malleable prices. This latter material has advanced to a present price of $43.65 per ton delivered Pittsburgh, which is about $12 a ton higher than a year ago.

Certain malleable companies are not able to take care of their regular customers, much less supply any new customers. Reorders from regular customers, where the old molds are still available in the foundry, are being shipped in four to six weeks. Where foundries have capacity and labor to take on new business shipments are being made in about three months. Normal shipments on reorders are two to three weeks and on new customers' orders from five to six weeks. Where drop forgings are being substituted for malleables shipments are as bad as for the malleables. Extremely heavy demand for malleables from the automobile trade, which is willing to pay premiums to secure deliveries, is taking much of the foundry capacity which could be applied to electrical needs.

Three Largest Distributers' 1919 Sales Total $500,000,000

THROUGH figures which have just become available it is shown that the business of the three largest electrical manufacturers—the General Electric Company, the Westinghouse Electric & Manufacturing Company and the Western Electric Company—for the calendar year 1919 will amount to a total of approximately $500,000,000.



ELEVEN YEARS' SALES RECORD FOR THREE DISTRIBUTERS

The figures of the Westinghouse company are the result of an estimate for the calendar year, as the fiscal year of that company ended March 31. This total figure is less than that for 1918 by just over $22,000,000, which is undoubtedly accounted for by the lessened government requirements following the cessation of the war. On the other hand, commercial requirements in the electrical field at this time are still considerably above the trend of the curves showing the demand over the six years previous to the war. The General Electric Company did the biggest business in its history in 1919 and surpassed in sales all other electrical manufacturing companies. Its volume amounted to $230,000,000, or approximately $13,000,000 over that of 1918. Sales of the Westinghouse company show a decline of $26,000,000, with an estimated 1919 calendar year volume of $134,000,000. Western Electric's sales also declined to $135,722,000 from the 1918 volume of $145,226,000. In the case of Western Electric there was an increase of $6,330,000 in total sales for 1919 if government business be excluded.

Total unfilled orders of the three companies amounted to $215,000,000 on Dec. 31, 1919, which shows an increase of $42,500,000 over the figures of the previous year. General Electric's unfilled orders amounted to $100,000,000, those of Westinghouse Electric to $68,000,000 and Western's to $47,442,000. From the first of the present year unfilled orders have been increasing. A careful survey of Western's prospects for the year 1920 indicates a much larger volume of sales than in any previous year of the company's history, according to its annual report. General Electric's business is now running at the rate of $28,000,000 a month.

Early in 1919 the volume of sales fell off materially and prices of much electrical equipment declined. Before the middle of the year, however, business had picked up appreciably and prices started to rise, until during the last half of the year sales were being made in unprecedented volume at constantly increasing prices. It is reasonable to expect, therefore, that the sales of the Westinghouse company, taken over its fiscal year ended March 31, 1920, will exceed those of the estimated figure of $134,000,000 for the calendar year by possibly five or ten million dollars.

Lengthening Collections Cause More Care in Credits

IN VIRTUALLY every section of the country collections in the electrical industry are not in such good condition as they were at the first of the year. There has been no radical falling off in the situation, but just enough lengthening of collection time to cause the trade to exercise considerable care in financial matters. Money is not so free as it was and in some cases is tight. Call money is high. Early this week call money in New York was 12 per cent, following a renewal rate of 8 per cent. Time money is 8 to 8½ per cent. Actual need of cash, high loan rates, poor transportation of electrical materials during January, February and March and income-tax payments are given as causes for the general slowing up of collections. At the same time, many houses have reported little or no change. The outlook is not considered to be serious.

New York Territory

No general condition of appreciably longer collections has been found. Electrical manufacturers' reports show more optimism than do those of supply jobbers. Little change in collections comes from the former, while the jobbers are having a little difficulty in getting in their money on time. The report in these columns last week covers the situation in this territory, only at this writing in a way still better substantiated.

New England

Collections in general have been falling off since Jan. 1, although in a few cases the opposite is true. As a rule, the total bills receivable as of April 1 probably exceed the figure of Jan. 1 by at least 30 to 40 per cent. Conditions are spotty, however, and it is possible to find an individual jobber who has actually cut $60,000 from his bills receivable during the past two months instead of falling off in his receipts.

Shortage of materials all along the line from factory to consumer is the most serious underlying cause of the present situation in the credit field. New England was very hard hit by the severe weather of the past winter, and freight and express embargoes combined with traffic tie-ups to check and sometimes completely to stall deliveries. Excessive taxation has hurt payments, but impaired deliveries are the most potent factor in retarding collections at present. The discounting of bills is probably decreasing in the main. Considerable difference of opinion exists in regard to the value of the acceptance method, but one jobber who reports individual record collections last week of from $8,000 to $10,000 per day attributes much of his success in expanding remittances to this practice.

There is no question that the jobbers are helping many contractor-dealers to tide over a very disturbed period at this time resulting chiefly from material scarcity and consequent interruption of field work and curtailed financial returns from the ultimate consumer. Considerable effort is being made to secure payments within sixty days of billing where the ordinary methods of negotiation are followed. Now and then time is extended to ninety and even 120 days, but in the main collections and credits are being scrutinized more closely than for some time, and the restrictions being placed by the banks upon loans for speculative purposes are influencing the attitude of both wholesalers and retailers toward more conservative views. Competent observers in the main decry any pessimistic attitude in regard to collections as spring advances and see in underlying conditions the likelihood of improvement during April or May.

The Middle West

Credit is being extended as freely as ever in the Middle West, but for steadily decreasing periods of time. For instance, one electrical apparatus manufacturer said: "Customers to whom we have been in the habit of giving ninety days we have reduced to sixty days; those who have been accommodated for sixty days are now asked to pay in thirty days, and regular thirty-day accounts must now be paid within ten days." Another manufacturer, who makes socket devices, has been in the habit of allowing 2 per cent discount for cash in thirty days, but he is now billing less 2 per cent ten days, thirty days net, and is insisting on prompt payment.

A representative jobber operating out of more than one Middle West city is now collecting, on an average, in forty-eight days against fifty-two days in March, 1919, and thirty-seven to thirty-eight days last fall. This and other jobbers in the territory are now requiring their customers to pay more promptly. The same condition is noted in retail business where the electrical contractor-dealers are using every effort to reduce the time allowed in the payment for washing machines and other time-payment devices.

The shorter time requirements of sellers were not apparently inspired by any fear of the customers' ability to pay. It was because of the actual need of the cash in most instances. The raw-material people have shortened up on the electrical manufacturers, and the strongest companies borrowing in large amounts have to pay in excess of 7 per cent for money with which to discount their bills. To mention just one raw material, steel, it can be said that some of the steel manufacturers require cash in ten days; some attach a sight draft to the bill of lading, and a few require a cash prepayment of 50 per cent of the amount of the order before proceeding to roll the steel required.

The South

Business conditions continue fundamentally sound throughout the section. Bank clearings show an increase from 20 per cent to 40 per cent over the same period last year, and a general optimism prevails that the slowing down in collections is only temporary, the fundamental causes being, first, that at this season of the year large sums of money are required by the rural population to finance agricultural operations, thus causing a tightening up of bank credits to commercial houses; second, that heavy December accounts, payable in thirty to sixty days, have caused drains on contractors' available funds; third, that income-tax payments for which no reserve was set aside have further depleted their cash assets; fourth, that transportation difficulties have slowed up collections all down the line, from the small contractor to the manufacturer.

One representative jobbing house finds no appreciable change in collections within the past sixty days, and cash discount customers have continued as usual. Other houses report increases of from 15 to 25 per cent in past-due accounts over the past few weeks. Their large customers are taking cash discounts only when these are amounting to 2½ to 5 per cent.

West Coast

Although other parts of the country are complaining over credit and collection conditions, they are not very different on the Pacific Coast from what they were several months ago. They are satisfactory rather than otherwise. The average time for collections is about fifty days, and although the income-tax payments may have slowed them up, the optimism resulting from the welcome and despaired-of rains more than balanced this.

Increases and Decreases Shown in New Mazda Lamp Prices

NEW lamp prices have been put into effect by the Mazda lamp manufacturers as of April 1. These prices do not in all cases show an advance and some show a decrease. Increased cost of production has been given by the manufacturers as the reason for the advances, and in this connection greater advances have been placed on frosted lamps than on clear lamps. Complications in the sand blasting have made this process still more costly. The last increase was put into effect Oct. 1, 1918.

In the common run of lamps in the 110-volt to 125-volt type the 10, 15, 25, 40 and 50-watt Mazda B lamps have increased from 35 cents to 40 cents clear and from 38 cents to 45 cents frosted. The 60-watt B has increased from 40 cents to 45 cents clear and from 45 to 50 cents frosted.

Type C lamps show increases and decreases. The 75-watt has gone from 70 cents to 75 cents clear and from 75 cents to 80 cents frosted. No change in price has been applied to the clear types in the 100, 750 and 1,000-watt sizes, but frosted lamps have gone up respectively in these three sizes from $1.15 to $1.20, from $6.75 to $6.85 and from $7.75 to $7.90. On the other hand, the 150-watt C has decreased from $1.65 to $1.55 clear and from $1.70 to $1.65 frosted, the 200-watt from $2.20 to $2.10 clear and from $2.27 to $2.25 frosted. The 300-watt has decreased from $3.25 to $3.15 clear and the 500-watt from $4.70 to $4.60 clear, while their prices, frosted, have not changed.

In addition, advances have been applied to 110-volt mill-type frosted lamps, 250-volt mill-type clear and frosted, 250-volt Mazda B clear and frosted, 250-volt Mazda C frosted and round lamps, tubular lamps, sign lamps, street-railway lamps, frosted Mazda C street series lamps and to other special types.

Metal Market Situation

COPPER continues strong in a market of considerable activity. Most consumers' present needs are pretty well cared for, and there is a lot of interest among them for long delivery. Producers, on the other hand, are not so anxious for positions after June. The spot and nearby price is 19 cents a pound delivered. Some producers have cut this an eighth and even a quarter in a few instances. There is strength also in the outside market, where nearby price is 19.25 cents, but there were not many sales with the seconds asking this price.

Copper wire, net, at the mill is up a half cent to 23 cents, and the copper scraps are also up the same amount to 16.50 to 17 cents. The scrap brasses, too, are up a quarter to a half cent.

There is a freer offering of nearby lead, and sales are being made at a fraction under 9 cents New York, although the first market is still quoted at 9.25 cents.

April zinc is moving better, especially with respect to brass special. This nearby offering is more active than futures.

NEW YORK METAL MARKET PRICES

	March 24	March 31
Copper	£ s d	£ s d
London, standard spot	108 0 0	107 10 0
	Cents per Pound	Cents per Pound
Prime Lake	19 25	19.25
Electrolytic	18 75	19 00
Casting	18 37½	18 50
Wire base	22 50	23 00
Lead, trust price	8 85 to 9 15	8 90
Antimony	10 75	10 50
Nickel, ingot	43 00	43 00
Sheet zinc, f o b. smelter	12 50	12 50
Spelter, spot	8 85	8 80
Tin	60 75 to 61 25	62.50 to 63.00
Aluminum, 98 to 99 per cent	33 00	33 00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16 00 to 16 50	16 50 to 17 00
Brass, heavy	10 00 to 10 25	10 25 to 10 50
Brass, light	8 50 to 9 00	9 00 to 9.25
Lead, heavy	7 75 to 8.00	7 75 to 7 87½
Zinc, old scrap	5 00 to 5 25	5 00 to 5 25

THE WEEK
IN TRADE

ORDERS are pouring into jobbing houses from all directions, with the activity more pronounced in New England and in the Southern states than in other localities. Conditions of labor, which have held up much new building and remodeling work in New York, are much improved owing to the decision of the bricklayers and masons to return to work after being out on strike since the first of the year. Spring construction work is being started in the Chicago district, where building permits for the week total $3,000,000. Stocks are in poor shape in the Northwest and much construction has been started that may be held up unless shipments of needed materials are received.

Transportation terminals are rushed to clear up accumulations of shipments or of freight received. It generally is believed that deliveries are slightly improved.

Price changes have been made on incandescent lamps; the increases vary from 5 to 15 cents, while prices on a few large sizes are down.

NEW YORK

Sales of electrical supplies have fallen off slightly during the past week in the city, although increased sales are reported in the outlying sections of the metropolitan district on account of suburban building. Little was done on private buildings during the first two weeks of March, but since that time the demand has improved.

Improved weather conditions, coincident with the ending of the strike of the bricklayers and masons, are responsible for an increase in sales due to the number of remodeling jobs being started during the past week. New building work has been scarce in the city proper.

Although delivery conditions are much better than during the recent bad weather on certain lines, in general the improvement has been so slight that many jobbers are inclined to believe that, in addition to a car shortage, decreased production during the storm period, owing to raw material shortage, is to a great extent responsible for the small amount of material being received at this time.

Some conduit and flexible armored conductor is coming in, but the amount is so small that it will not have an appreciable effect on the market. Prices have been advanced on several makes of push-button switches.

Rigid Conduit.—Conditions about the same as usual, small amounts being received with majority of stocks cleaned out.

Flexible Armored Conductor.—Shipments are improved but stocks are reshipped as soon as received. No stock on hand is reported by the majority of jobbers. Prices for No. 14 double-strip are $98 per 1,000 ft. for whatever amount jobbers will release. Small quantities are sold at from $110 to $120 per 1,000 ft.

Switches.—Push-button switches manufactured by Bryant, Hubbell, Hart & Hegeman and Seymour have advanced from 31 to 35 cents for single-pole and from 42 to 52 cents for the three-point type.

Fans.—Demand for fans is increasing. Good stocks are being received, but are taken up promptly by dealers. Heavy ordering of the 16-in. size is reported.

Lamps.—Stocks are good in the smaller wattage lamps, but in the larger sizes many jobbers are entirely out. The 100-watt size is particularly scarce, and demand is many times greater than the supply. Shortages and spotty stocks also prevail in the 75-watt, 200-watt and 300-watt sizes.

Batteries.—Stimulated buying has marked the past week, many dealers being in the market for stocks. Shipments are slightly improved.

Vacuum Cleaners.—Business continues good, although in a few instances shortages are reported on attachments. One jobber is short 460 sets of attachments and others advise that attachments are coming in very slowly.

Heaters.—Some jobbers are cleaned out of stocks, while others have small amounts. Increased buying is expected as landlords turn off furnace heat in the spring.

BOSTON

Orders continue to pour in faster than they can be absorbed. Prices are firm, with advances on common sizes of tungsten lamps effective April 1. Stocks are spotty, but deliveries are improving materially as traffic recovers from the effect of bad weather. Severe shortages are still being experienced in porcelain, steel, motors and loom. Collections are less satisfactory, barring exceptional cases. Labor-saving appliances are in great demand and record sales are being made. Central stations are beginning to come into the market for pole-line material. Business is much disturbed in lower New England by dissymetrical policies regarding daylight saving, but the situation is expected to clear during the week. With better weather, upcountry sales work shows considerable improvement from the jobbing standpoint.

Lamps.—Prices advanced April 1 from 35 to 40 cents list on 10-watt to 50-watt tungsten lamps, accompanied by recessions of about 5 per cent on the list price of some of the larger-wattage gas-filled lamps. The demand for lamps is enormous, and some jobbers are unable to obtain satisfactory deliveries. Sign lamps and miniatures are reported plentiful in supply.

Transformers.—Some jobbers are doing a land-office business. Central-station patronage is increasing.

Wire.—Stocks are fairly good, but a shortage of No. 14 rubber-covered wire is reported in Connecticut. This size and type is quoted at $11.50 per thousand in 5,000-ft. lots and $13 for lesser quantities. Weatherproof base ranges from 28 to 30 cents according to quantity. Bare wire is firmer at 24 cents base. Labor troubles in the lower Naugatuck Valley may hamper production somewhat unless soon settled.

Magnet Wire.—This is extremely scarce. One concern in New England has refused orders for over $2,000,000 worth of this material since Jan. 1 and recently purchased silk for insulation at about $31 per pound. The shortage is so great that prices are very unstable.

Flexible Armored Conductor.—Stocks are very low. A representative quotation is $105 for No. 14 single-strip per 1,000 ft., in coil to 1,000-ft. lots.

Non-Metallic Flexible Conduit.—Jobbers cannot begin to meet the demand satisfactorily. The 7/32-in. size brings $37 per 1,000 ft., and the ¼-in. size, $40 to $42.

Metallic Flexible Conduit.—Prices have been withdrawn on account of scarcity.

Lamp Cord.—Cotton-covered cord is hard to obtain. The ordinary No. 10 cord is quoted at $43.70 per 1,000 ft. with discounts running up to 45 per cent for 5,000-ft. lots.

Sockets.—Deliveries are better than usual at this time of year. Stocks are not building up much, but current demands are being met with reasonable satisfaction. In case lots pulls are quoted at 47.5 cents net, keys at 28 and keyless at 26 cents each.

Vacuum Cleaners.—Trade is brisk, with good deliveries. A leading outfit sells to the contractor-dealer for $39, or $46 including attachments, in half-dozen lots.

Washing Machines.—Steady sales characterize the market, and so far the supply meets the demand exceptionally well.

Fans.—Orders are being placed by retailers. Few fans have as yet come to hand, but shipments cannot long be delayed.

Ranges.—Interest in electric ranges is being manifested by the public notwithstanding earlier price advances. The shortage of material is holding back development work in some manufacturing quarters.

CHICAGO

A spirit of questioning the stability of the sum total of orders on books is now beginning to be felt among both jobbers and manufacturers of all classes of equipment. Unquestionably, in order to secure the earliest possible shipment of goods, a certain amount of duplication of orders has occurred. The question is to what extent this duplication exists. The placing of all orders on contract, not subject to cancellation, is being considered by some manufacturers.

No appreciable change in general conditions can be noted, with the exception that buying pressure is probably a little less feverish.. Deliveries are unchanged, simply because they have for some time been about as bad as possible. Manufacturers of all lines complain of raw-material shortage, and makers of hollow ware state that, in addition to being forced to pay excessive prices for steel, they frequently get material of such inferior grade that much expense is necessary in finishing. This also increases the time required in process and further delays deliveries.

Spring construction work seems to be getting fairly under way here, with building permits for the week totaling over $3,000,000.

Industrial Controller Apparatus.—As predicted in this column some time ago, manufacturers of both resistance-wire type and carbon-pile resistor-type equipment have put into effect a general increase approximating 10 per cent. Demand is reported as heavy with deliveries ranging around thirty days.

Protective Apparatus.—With steady demand remaining in excess of production, an advance of about 15 per cent has gone into effect on lightning arresters and other protection equipment. A typical change is that of the Gorton & Daniels line, on which discounts which were formerly 32 per cent have been reduced to 20 per cent, an increase of 17½ per cent.

Circuit Breakers.—Price changes amounting to a sharp increase are reported on circuit breakers, the Cutter Electric & Manufacturing Company having issued new lists and at the same time announced a change in discounts. Their 100-amp., single-pole circuit breaker, formerly priced at $25, is now $42, while an additional 10 per cent discount is given, with similar changes in the entire line. This amounts to an approximate 50 per cent increase.

Meters.—Both Weston and Bristol lines have been subject to recent changes in discount. Weston meters, formerly sold at plus 25 per cent, are now priced to jobbers at plus 35 per cent, and Bristol, previously selling at list, are now plus 10 per cent. Demand in this section is not particularly heavy and deliveries are being made on about thirty to sixty days.

Insulators.—Glass insulators have followed the lead of all other pole-line material in advancing about 11 per cent.

Rigid Conduit.—Delivery conditions show but slight improvement and back orders continue to accumulate. Current list on black conduit in 2,500-lb. lots is, for ½-in., $82.88 per 1,000 ft.; for ¾-in., $109.83.

Farm-Lighting Plants.—Factory output is not at present keeping pace with orders, although jobbers are still able to make deliveries from stock. It is thought that factory additions now under construction will be completed in time to prevent any lengthy delay in deliveries. The Western Electric Company has withdrawn its fifty-hour battery equipment from sale.

Washing Machines.—Dealers are unable to secure machines as rapidly as they desire, and price advances seem to have no effect on volume of sales.

Sewing Machines.—Factories are not keeping pace with orders and in some cases have required jobbers to place contracts covering nine months' needs without cancellation privilege. Western Electric's machines advanced to the following figures on April 1: No. 1, vibrating shuttle type, $60; No. 2, rotary, $80; No. 3, automatic, $86.50, and No. 4, two-spool rotary, $90. Deliveries range from prompt to thirty days.

ATLANTA

With the advent of spring jobbers report the receipt of large increases in orders for all lines of electrical material, while requests for estimates and bids on material required in the near future are reaching unprecedented proportions. Most of these requests are for industrial plant material, but there is a noticeable increase of requests from contractors whose work is devoted largely to the wiring of homes and small commercial houses. Inability of jobbing houses to make the prompt shipments required for the large industrial orders is causing dissatisfaction and a resultant slowing up in the completion of the electrical work.

Strong demand for office and manufacturing space and housing facilities is stimulating calls for construction even in the face of rising prices. Building permits in Atlanta for March already have exceeded the six-hundred-thousand-dollar mark.

While bank clearings continue to show a gain over the same period of last year, some jobbers report that collections are not all that might be desired.

Generating Equipment.—There is a healthy demand from municipalities and small utilities for turbo-generator sets up to 1,500 kw., while the engine-driven alternators continue to move satisfactorily. Demand for the latter article is mostly in sizes of from 30 kva. to 250 kva., three-phase, 60-cycle. Shipments on small turbo-generators are approximately six months.

Conduit.—Electric construction work is suffering from the acute shortage in this item. Only small shipments are received from time to time, and these are entirely insufficient to meet the demand. Prices, if in stock, less than 2,500 lb., black, ½-in., $87.20; 1-in., $177.40; 2-in., $392.20.

Flexible Armored Conductor.—No change is noted. Prices remain steady in the face of the continued shortage, while no hopes of improvement are held out by the jobbing trade.

Sewing Machines.—As predicted, sewing-machine prices advanced 20 per cent as of April 1. Some jobbers have fair stocks on hand, sufficient in their estimation to take care of the demand for the time being at least. Shipments are reported fair.

Wire.—Average supply of weatherproof is not so good as last week. The rubber-covered stocks continue to hold up well. The greatest difficulty is in obtaining the popular sizes of weatherproof, in which sizes deliveries are reported as poor. Price advance of 8 per cent is reported on rubber-covered.

Mangles.—The success attending the use of the large number of washing machines throughout the territory has served to create a brisk demand for the electrically operated mangle. Stocks are moving fairly well, and jobbers report shipments as above the average.

Electric Churns.—The growing popularity of this specialty is to be noted, particularly in the rural districts where farm-lighting outfits are in use. Stocks are good, despite poor factory shipments.

Dry Batteries.—National advertising is probably responsible for the demand continuing to hold up in what is normally a light season. Stocks are reported as only fair and shipments not sufficiently good to permit of the accumulation of heavy supplies for fall trade. Prices, in quantities of from 50 to 125, $38 per 100.

Battery-Charging Outfits.—Starting batteries on the large number of automobiles throughout the section provide an insistent demand for these outfits. Jobbers report a satisfactory turnover, while shipments continue to hold up fairly well.

SEATTLE—PORTLAND

Demand for schedule materials used in building is being sustained. Fractional-horsepower motors and domestic appliances continue strong, and this condition is being met with unusually slow transportation and acute shortage of stocks along virtually every line. Without a doubt conditions as regards stocks in the Northwest are worse today than during the war, for then, in spite of the heavy demands, merchandise could be obtained on priority orders. In spite of this condition, prices are comparatively steady, the fluctuations either way being considered more or less inconsequential.

Marked activity is noted throughout the Northwest in various irrigation projects, both new and revived, and it is certain that a large amount of reclamation work in many districts will be commenced this season.

Jobbers in the Portland territory state that the unusually severe winter weather which has been experienced in the East practically ever since the first of the year is having a marked effect upon production and that this is being reflected in this section at the present time in the shape of decreased stocks and long promises for future deliveries. There have been no marked changes in sales or prices during the past week; in fact, there has been no change for the past five or six weeks that is of any marked importance. The retail trade reports that sales of small appliances are normal for this time of year and that there is a very strong demand for washing machines, even in face of the recent 10 to 15 per cent increase in price.

There are a large number of very large projects in view, but they are developing slowly, due undoubtedly to the uncertainty of the future.

Pole-line hardware, in face of a noticeable increasing demand to care for spring maintenance and some new work, has made an advance of approximately 20 per cent during the past ten days. In Seattle particularly stocks are low and deliveries very slow. The rigid-conduit situation is unimproved and demand is growing stronger each week. At present enough material can be obtained to care for remodeling, but new construction is being retarded. Efforts to replenish stocks apparently have been futile.

Sewing-Machine Motors.—Jobbers in both Seattle and Tacoma report an increasing call for special bracket motors. Stocks are low, but, owing to the recent arrival of fresh consignments, are in better condition than they were several weeks ago. Prices show no recent change.

Wire.—Stocks in the popular sizes show further decreases, and no hope of immediate betterment is cherished. The demand shows increases from week to week. Prices show no change over past few weeks.

SAN FRANCISCO

The chief Pacific Coast difficulty is lack of stock, and this trouble extends to merchandising as well as wiring lines. Household-device campaigns have been held up time and again by stock shortages, and several jobbers state that they are making virtually no new-business drives because of the difficulty in caring for their regular customers.

Freight shipments are requiring about four weeks from the factory, although an occasional carload goes astray. The reported 25 per cent increase in freight has not yet materialized. Get-together meetings of various sections of the California co-operative campaign are planned for April to review the exceedingly encouraging results from last year and plans for this year and for 1921.

Washing Machines.—Difficulties in the washing machine line are lack of stock and lack of experienced solicitors. Many dealers have viewed their prospective results too optimistically, but they now understand that experienced men are needed to get the public into their stores.

Sewing Machines.—Another advance in sewing machines is reported, this time of about 10 per cent, raising the retail price on the vibrating style to $62 each in standard makes. Sewing machine sales have dropped.

Line Material.—Many sales of line construction tools are reported. Jobbers are purchasing in carload lots because of this increased demand.

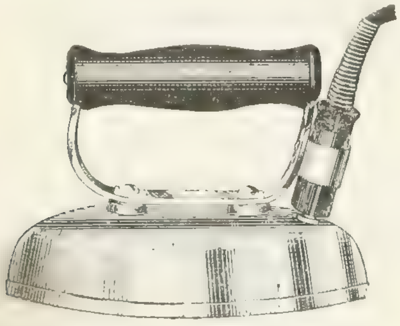
Fixtures.—Hand-in-hand with the improvement in merchandising household devices has come a better method of displaying and selling electrical fixtures. Higher-grade fixtures have replaced the old familiar gilt affairs, and dealers are meeting the increased call for artistic portables with silk or parchment shades.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

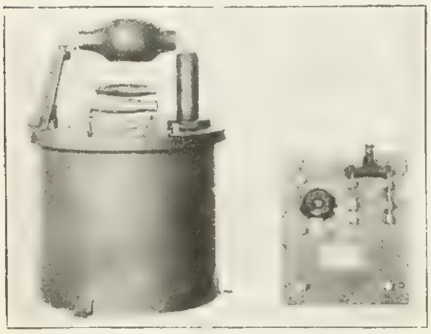
Two-Point Electric Flatiron

A 6-lb., double-point electric flatiron, with two hot points instead of one so that the operator can iron with the backward and forward movements of the iron, is being offered by the Central Flatiron Manufacturing Company, Johnson City, N. Y. This double point will protect the switch plug, the maker says, should the iron be dropped from the ironing board.


FLATIRON HAS TWO POINTS

Portable Oil Tester

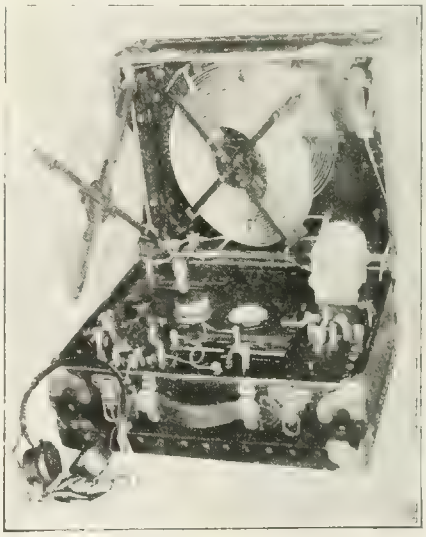
A small, compact, portable oil-testing set has recently been developed by the General Electric Company, Schenectady, N. Y. The set consists of a main testing transformer having a high-potential winding for 25,000 volts, a control auto-transformer and an oil-testing spark gap. It may be had for operation at 110 or 220 volts, 60 or 25 cycles as specified. The oil-insulated testing transformer has a steel tank with composition cover. The control consists of an air-cooled auto-transformer with regulating taps, connected to a selector switch with a dial to give 15, 17.5, 20, 22.5 and 25 kv. on the high-tension winding of the main transformer and a double-pole step-resistance knife switch, all mounted as a unit. The oil-testing spark gap consists of a hard-rubber body molded in one piece with 1-in. disk electrodes. One electrode is movable by rotating and a gage is provided for adjusting the spacing to $\frac{1}{10}$ in.


PORTABLE SET GIVES 25,000 VOLTS FOR OIL TESTING

Light-Weight Portable Radio Set

The Wireless Specialty Apparatus Company, Boston, is marketing a portable radio set weighing 55 lb. and measuring, closed, 10 in. x 15 in. x 17 in. It is said to have a transmission range of 50 to 100 miles and a receiving range of 500 miles. Designed to withstand heavy field service, its features include an improved quench gap, an ammeter, a closed-core transformer, mica condenser and silver-plated tuning coils.

The set can be assembled, it is claimed, in four minutes. A telescopic antenna pole, 40 ft. long, is provided separately and energy is supplied by a gasoline-engine-driven generator for either 32 volts or 110 volts. The generator weighs 130 lb. and is designed for packing on muleback.


WEIGHS ONLY 55 LB.

Insulating Porcelain

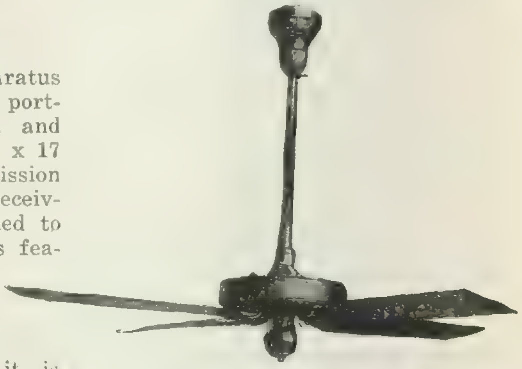
An insulating material made of native clays for use in the same manner as the better known white electrical porcelain has been developed by the Evansdale Clay Products Company, Wheeling, W. Va. This product is said to have all the characteristics of the common electrical porcelain except that it is dark instead of white.

Vacuum Tube Detector and Amplifier

A detector-amplifier and a two-stage amplifier for use at vacuum-tube frequencies have been developed by the International Radio Telegraph Company, New York City. These two units may be used in series.

Direct-Current Ceiling Fan

The Hunter Fan & Motor Company, 34 West Thirty-seventh Street, New York City, is offering for 1920 a new direct-current ceiling fan, patterned in appearance after its type "C" alternating-current line. This new line will be known as type "L" for the plain fan and type "LO" for the ornamental. The fans will be furnished either with or without the adjustable blade feature. They are finished in oxidized copper and are equipped with three-speed switches, maximum 215 r.p.m. and minimum 150 r.p.m. They are rated at 75 watts and are supplied for 110 volts or 220 volts.

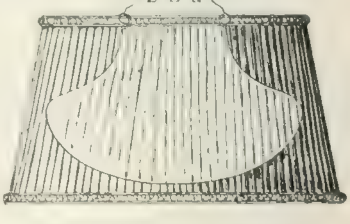


Garage Air Compressor

An electric air compressor for inflating tires has been developed by the United States Air Compressor Company, Cleveland, Ohio.

Dust-Proof Lighting Units

A line of lighting units called "Caso-Lux" is being manufactured by the Cassidy Company, 14 Wilbur Avenue, Long Island City, N. Y. The units are of five types, in 12-in. to 15-in. sizes, for both pendent and ceiling use, for office, store and home. Each unit is designed so that dust cannot affect its reflecting surfaces, the maker says, and has been tested with a pyrometer to insure proper ventilation. Each fixture is wired complete with porcelain socket and packed in an individual carton.


DUST CANNOT SETTLE ON REFLECTOR

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE IDEAL ELECTRIC & MANUFACTURING COMPANY, Mansfield, Ohio, is planning to increase its factory facilities materially this summer and to extend its standard line of machines to include also synchronous machines.

THE WESTINGHOUSE LAMP COMPANY has awarded contract for construction of an extension to its factory at Milwaukee, Wis., to cost about $400,000.

THE M. B. AUSTIN COMPANY, Chicago, announces that the Factory Mutuals Fire Insurance Companies have approved Trico renewable fuses in all capacities up to 60 amp., 250 volts.

THE ROME WIRE COMPANY, Rome, N. Y., has recently authorized an increase in capital stock to $4,000,000 7 per cent first preferred and $5,650,000 common, the shares in each issue being $100 par value. Kidder, Peabody & Company of New York and Boston are offering to the public $1,400,000 of the preferred issue. The proceeds of the sale of $1,400,000 of preferred stock will furnish additional working capital to care for the growth of the plant in Rome and to pay for plant and carry on the business of the Diamond branch of the Rome Wire Company in Buffalo, N. Y. The total quick assets of the company amount to $3,997,680, and the company's surplus is $2,033,118.

WESTERN ELECTRIC MANAGERS' CONFERENCE AT ATLANTIC CITY

THE AMBER ELECTRICAL SUPPLY COMPANY, Chicago, has leased a two-story building, 40 ft. x 189 ft., at 553-55 West Madison Street for a period of ten years.

THE SERVICE STATION EQUIPMENT COMPANY, Chicago, has leased a three-story building, containing 60,000 sq.ft., at the corner of Thirty-seventh Street and South Asland Avenue. The company expects to erect an addition in the rear of the building.

THE WADSWORTH ELECTRIC MANUFACTURING COMPANY, Covington, Ky., has filed notice with the Secretary of State of an increase in capital stock from $100,000 to $150,000.

THE KENTUCKY-WEST VIRGINIA ENGINEERING & ELECTRIC COMPANY, Ashland, Ky., has been organized to do a general engineering construction business, utilizing an armature and machine shop and engaging in wholesale and retail sales of electric supplies. Thompson Pierce of Bluefield, W. Va., is president; C. Biddison of Ironton, Ohio, vice-president and R. F. Carpenter of Ashland, Ky., secretary and treasurer.

STANLEY L. POLACHECK, formerly with the Chas. Polacheck & Brother Company and later with the Milwaukee Electric Company, has opened offices in the First Wisconsin National Bank Building, where he will represent electrical equipment manufacturers. He will cover Wisconsin and the upper peninsula of Michigan, and is in a position to take on a few more live lines.

W. JERRY STANTON has recently become connected with the Ohio Brass Company of Mansfield, Ohio. Mr. Stanton has been connected with the electrical industry for the past twenty years. He was with the General Electric Company for eighteen years, having served in the testing, engineering and sales department. Since that time he has been with the Railway Improvement Company and the National Railway & Appliance Company.

WESTERN ELECTRIC MANAGERS AND EXECUTIVES HOLD CONFERENCE.—Managers and sales managers of the Western Electric Company's distributing organization of forty-five houses and executives from the head offices at 195 Broadway, New York City, held the first general company conference in five years at the Hotel Chalfonte, Atlantic City, N. J., on March 8 to 12. F. A. Ketcham, general sales manager, acted as presiding officer of the conference. The keynote of the conference was "A Larger and More Profitable Business," and it early became apparent that the consensus of opinion was to the effect that this end could be attained. Optimism was the prevailing sentiment not only for the growth of the company's business but for the growth of the electrical industry as a whole

THE CHICAGO ELECTRICAL ENGINEERING COMPANY, Chicago, has established offices at 1,000 Diversey Parkway. The company will deal in electrical apparatus, particularly radio, telephone and telegraph equipment.

THE ROBERTSON SALES COMPANY of Birmingham, Ala., announces that the name of the company has been changed to the Robertson Supply Company, Inc. No change in the personnel or management of the company, it is understood, has been made.

THE DETROIT ELECTRICAL HEATER COMPANY, 1351 Woodward Avenue, Detroit, Mich., manufacturer of electric heating and cooking appliances, is planning to erect a two-story-and-basement plant, 30 ft. x 130 ft., on Conner Avenue, Hamtramck.

THE J. & M. ELECTRIC COMPANY, Utica, N. Y., has filed notice with the Secretary of State of an increase of capital stock from $100,000 to $200,000.

THE HOME ELECTRIC APPLIANCE COMPANY, Pittsburgh, Pa., a Delaware corporation, has filed notice of an increase in capital stock from $10,000 to $50,000 for expansion.

THE SEIFFERT ELECTRIC COMPANY, Evansville, Ind., has increased its capital stock from $30,000 to $100,000.

THE ELECTRIC CONSTRUCTION & MACHINERY COMPANY, Rock Island, Ill., manufacturer of electrical machinery, has increased its capital stock from $5,000 to $25,000.

THE REPUBLIC CARBON COMPANY, Milwaukee, Wis., has increased its capital stock from $2,500,000 to $4,000,000.

THE PERRY ROTARY FIXTURE COMPANY, Meridian, Miss., is planning to equip a plant for the manufacture of motor speed-changing devices.

THE DICTAGRAPH COMPANY, Jamaica, N. Y., manufacturer of electrically operated devices, has awarded contract for a one-story addition, 50 ft. x 144 ft., to its plant at Schooley Place and Chichester Avenue.

THE MICA INSULATOR COMPANY, Schenectady, N. Y., has awarded contract for a new building, 50 ft. x 130 ft., four stories, and for a one-story addition to an existing building. The cost is estimated at about $125,000.

THE AMERICAN BOSCH MAGNETO CORPORATION, Springfield, Mass., has increased its capital stock to $2,500,000.

THE WHITE LILY MANUFACTURING COMPANY, Davenport, Iowa, manufacturer of electric washing machinery, has completed plans for the construction of a new plant on Rockingham Road, consisting of a main building, 80 ft. x 225 ft., and several smaller structures, to cost about $150,000.

THE CHAMPION ENGINEERING COMPANY, Kenton, Ohio, has made arrangements for extensions to its plant which will more than double the present capacity. The cost of the proposed addition is estimated at more than $1,000,000. It will be devoted exclusively to the manufacture of electrically driven traveling cranes.

THE MOE-BRIDGES COMPANY, Milwaukee, Wis., manufacturer of electric fixtures, has increased its capital stock from $40,000 to $100,000. The company contemplates the erection of a new plant during the spr'ng and summer.

THE TRI-STATE ARMATURE WORKS, Memphis, Tenn., recently organized with a capital stock of $50,000, plans to establish a plant for the manufacture of electrical machinery and also to equip a repair department. W. S. Gaden is president.

THE JOHNSON ELECTRIC WASHER COMPANY, Emeryville, Cal., is planning to erect a plant, 120 ft. x 235 ft., to cost about $40,000.

THE COMMONWEALTH BATTERY COMPANY, INC., recently incorporated with a capital of $50,000, will manufacture plates for storage batteries at 17 Elm Street, Rochester, N. Y. The president and general manager is J. Harris of Rochester.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., in its annual statement for the year ended Dec. 31, 1919, shows net earnings for that year amounting to just over $4,800,000 and an accrued surplus to Dec. 31 1919 of $13,347,214.

HERBERT RICE, who has been a member of the sales organization of the Cutter Electrical & Manufacturing Company and who has for some years past been its general sales manager, has resigned to enter the real estate business. Harry F. Darby, who was for many years in charge of the Cutter Company's Chicago office and who more recently has been sales manager of the Ward Electric Vehicle Company, will rejoin the Cutter organization as sales manager with headquarters in Philadelphia. These changes are effective about April first.

HORACE L. FRITSCHLE has been placed in charge of the Chicago office of the Square D Company at 431 South Dearborn Street, Chicago. Mr. Fritschle was formerly located in St. Louis.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, has announced the appointment of Godfrey H. Atkin as manager of its Western district, covering the sales offices, warehouses, service stations and all departments in Chicago, St. Louis, Kansas City, Minneapolis and Denver, with headquarters in Marquette Building, Chicago. Taliaferro Milton is in charge of the Chicago office, succeeding Mr. Atkin. Both appointments were effective March 1.

W. A. LODGE is now connected with the Bussmann Manufacturing Company, St. Louis, Mo., in the capacity of research engineer. He will be in full charge of the engineering department, devoting his time to research and the technical development of the Buss fuse. Mr. Lodge has for the past four years been with the Underwriters' Laboratories of Chicago as research engineer. Previous to his connection with the Underwriters' Laboratories, he was professor of electrical engineering in two universities in the United States and Canada.

NEW DIRECTORY OF COMMERCIAL ORGANIZATIONS. — A revised list of "Commercial and Industrial Organizations of the United States," Miscellaneous Series No. 99, has just been issued by the Bureau of Foreign and Domestic Commerce in bulletin form. This is the first edition of this directory to be published since 1917. Copies can be obtained for 15 cents by applying to any of the co-operative offices of the bureau.

Supply Jobbers' Notes

THE CARTER ELECTRIC COMPANY, Atlanta, Ga., has issued invitations to all its dealers throughout Georgia and adjacent territory to attend the "get-together Carter Electric Company meeting," to be held in Atlanta on April 6 and 7. Several prominent out-of-town representatives of manufacturers are scheduled to attend this meeting.

THE REPUBLIC ELECTRIC COMPANY, 120 East Front Street, Davenport, Iowa, recently organized, has purchased a building, 32 ft. x 145 ft., four stories high, and expects to take possession May 1. The company expects to act as wholesale distributers of electrical apparatus and equipment. Its operations for the present will be devoted principally to territory within a 100-mile radius of Davenport. A comprehensive general supply catalog will be published as soon as its various lines and factory connections have been established. Thomas H. Harris, general manager of the company, has been connected with the electrical industry since 1893, and his experience covers a wide range, including electric light, telephone and street railway construction work and central-station management. More recently he was district manager for both the Post-Glover Electric Company of Cincinnati, Ohio, and the Varney Electrical Company of Indianapolis, Ind.

Foreign Trade Notes

SERBIA PURCHASES GOVERNMENT CABLE.—The director of sale of the surplus property division of the War Department announces that on bids opened on Feb. 24 the Kingdom of Serbs, Croats and Slovenes has purchased approximately 27,250,000 ft. of twisted-pair copper wire in sizes from No. 10 to No. 17 and approximately 1,500,000 ft. of ten and fifteen-pair wire cable, most of which is telephone.

JAPAN NEEDS EQUIPMENT.—Notwithstanding the rapid development of electrical industry in Japan, it is expected that there will be a continued demand for imported high-tension switching apparatus.

AMERICA'S PROPORTION OF CHINESE IMPORTS LOW.—According to the report of the American Chamber of Commerce in China, the United States is exporting to China only 20 per cent of the electrical materials and fittings which that country is importing.

JAPANESE ELECTRICAL EXPORTS AND IMPORTS.—The total value of electrical apparatus manufactured in Japan in 1918 was, according to a Japanese contemporary, $72,000,000. Exports amounted to $10,000,000 and imports to $6,900,000. Apparatus valued at $6,500,000 was exported in the first nine months of 1919.

FOREIGN TRADE CONVENTION.—The seventh national trade convention, called by the National Foreign Trade Council, will be held at San Francisco, Cal., on May 12, 13, 14 and 15. The convention theme is "The Effect of Being a Creditor Nation." The office of the National Foreign Trade Council is at India House, No. 1 Hanover Square, New York City. O. K. Davis is secretary.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An American mechanical and electrical engineer in Cuba (No. 32,345) who is manager of a machinery jobbing house desires to secure agencies for the sale of steam and electrical machinery and equipment.

A firm in Danzig (No. 32,309) is interested in handling an agency on a commission basis for the sale of railway sleepers and telegraph poles. It would like to get into direct communication with leading sawmills.

A sales agency firm in India (No. 32,363) desires to secure the sole representation of manufacturers for the sale throughout India of electrical accessories, electric lamps and telephones.

Trade Publications

SPRAY-COOLING EQUIPMENT. — The Star Brass Works, manufacturing engineers, 3114-28 Carroll Avenue, Chicago, now have ready for distribution their new twenty-four-page bulletin, No. 4-A, covering spray-cooling equipment for the cooling of water from steam and ammonia condensers.

GALVANOMETERS. — "The Galvanometer," by E. F. Northoup is the subject of bulletin No. 11, recently issued by the Pyroelectric Instrument Company, 636-640 East State Street, Trenton, N. J.

SUPERHEATERS FOR STATIONARY POWER PLANTS.—The Locomotive Superheater Company, 30 Church Street, New York, has issued bulletin T-5, covering the use of superheat steam in operating engines and steam turbines. It contains "steam consumption" curves and "superheat" curves for various types of steam prime movers.

TUBES, RODS AND WIRES.—Prices, sizes, etc., of copper and brass tubes, copper, brass and bronze rods and wires are given in bulletin No. 100-1, recently issued by the Standard Underground Cable Company, Pittsburgh, Pa.

ELECTRIC WELDING MACHINERY.—The Federal Machine & Welder Company, Warren, Ohio, has issued several bulletins describing different types of its welding machinery as follows: Bulletin No. 31 covers Federal electric butt welders, Bulletin No. 32 Federal junior type spot welder, Bulletin 33 Federal "Universal" spot welders, Bulletin 34 Federal butt welders, and Bulletin 35 Federal No. 22-A electric tube welder and roller.

GRAPHIC INSTRUMENTS.—The "Esterline Graphic," published by the Esterline Company, Indianapolis, Ind., describes the use of Esterline graphic instruments in the field of transportation.

MOTORS.—The Valley Electric Company, St. Louis, Mo., has issued an illustrated booklet describing its motors. It also gives an account of manufacturing motors from the raw material to the finished machine.

MODERNIZING INDUSTRIES. — The Standard Electric & Elevator Company, Baltimore, Md., has issued an eighty-page booklet entitled "Modernizing America's Industries," suggesting methods for industrial modernization and giving facts that might be of value to officials, managers, production engineers and maintenance engineers interested in America's industries.

New Incorporations

THE JENKS (OKLA.) UTILITIES CORPORATION has been incorporated with a capital stock of $100,000 by A. J. Elliott of Jenks and Fred W. Kopplin of Tulsa.

THE KEYSER (W. VA.) ELECTRIC COMPANY has been incorporated with a capital stock of $125,000 by Louis Gerber, Robert S. Sigley and E. L. Wilson, all of Trenton, N. J.

THE MARTIC-DRUMORE ELECTRIC LIGHT, HEAT & POWER COMPANY of Holtwood, Pa., has been incorporated with a capital stock of $15,000 by Robert H. Long of Drumore, R. D. 1.

THE LITCHFIELD COUNTY MANUFACTURING COMPANY of Winsted, Conn., has been incorporated with a capital stock of $25,000 to manufacture electrical fixtures and brass goods. The company has leased the Goodwin and Kintz plant on Rowley Street. David Goldrich is interested in the company.

THE BOLIVIAN POWER & LIGHT COMPANY of Wilmington, Del., has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $2,000,000 to operate light and power plants, etc. M. L. Roberts, L. A. Irwin and W. G. Singer of Wilmington are local incorporators.

THE MASSEY (MD.) ELECTRIC LIGHT & POWER COMPANY has been organized to install an electric light plant in Massey. L. C. Clark is manager.

THE JACKSON (MICH.) PUBLIC SERVICE COMPANY has been chartered with a capital stock of $600,000 by Joseph H. Brewer, Charles McPherson and Blaine Gavett, all of Grand Rapids, Mich. The company, it is understood, is a reorganization of the Jackson Light & Traction Company.

THE MASTER WELDING COMPANY of Los Angeles, Cal., has been incorporated with a capital stock of $55,000 to manufacture welding equipment. The incorporators are G. E. Torbet and R. A. Jatho, 324 East Fortieth Street, Los Angeles.

THE MODERN ELECTRIC COMPANY of Torrington, Conn., has been incorporated by Luke Carlin, E. B. Van Norden and G. L. Vannais. The company is capitalized at $25,000 and proposes to manufacture electrical products.

THE COMMONWEALTH BATTERY CORPORATION, 17 Elm Street, Rochester, N. Y., has been incorporated with a capital stock of $50,000 to manufacture plates for storage batteries. Linus Herberger is secretary.

THE BURR APPLIANCE COMPANY of Holyoke, Mass., has been incorporated with a capital stock of $250,000 to manufacture and deal in electrical and mechanical equipment. The incorporators are Charles F. Munder of Springfield, Charles D. Haywood and Russell L. Davenport of Holyoke, Mass.

THE KATH ELECTRIC COMPANY of Milwaukee, Wis., has been incorporated with a capital stock of $10,000 by John P. Kinkert and F. W. Kath of Milwaukee.

THE UNION & ELECTRIC MANUFACTURING COMPANY of Cuyahoga Falls, Ohio, has been incorporated with a capital stock of $10,000 by A. E. Sharkey and H. S. Knoch.

THE C. & D. ELECTRIC COMPANY of Stoughton, Mass., has been incorporated by Harry L. Crozier of Brockton, John R. Dykeman and Arthur H. Dykeman, both of Stoughton. The company is capitalized at $25,000 and proposes to manufacture and deal in electrical appliances.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

New England States

AUGUSTA, ME.—The Millinocket Light Company has been authorized by the Public Utilities Commission to issue $74,000 in bonds, of which $25,000 will be used for improvements.

CLARK MILLS, ME.—The Clark Power Company contemplates erecting a power house. Sawyer & Bean, 11 Lisbon Street, Lewiston, are engineers.

ASHLAND, MASS.—Dr Sweet's Root Beer, Inc., 10 Post Office Square, Boston, contemplates building a three-story plant and power house in Ashland.

BONDSVILLE, MASS.—The Boston Duck Company has purchased a site on Swift River for a proposed power plant.

HOLYOKE, MASS.—A transmission line will be built from the municipal electric plant to Willimansett, at a cost of about $15,000.

LANCASTER, MASS.—An extension of the municipal electric lighting system from the town farm to the Lancaster-Leominster line has been authorized.

MIDDLETON, MASS.—The sum of $2,000 has been appropriated for proposed improvements in the municipal lighting system.

SALEM, MASS.—The Salem Electric Company will soon be in the market for a turbine and boilers.

NEW LONDON, CONN—An ornamental lighting system for the business section of Main Street is being considered.

Middle Atlantic States

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company has petitioned the Public Service Commission for permission to increase its capital stock from $1,022,000 to $1,622,000 for expansion and improvements.

CHURCHVILLE, N. Y.—Application has been filed with the Public Service Commission for authority to construct a municipal electric system.

HERKIMER, N. Y.—An addition to the municipal electric plant and the installation of a new equipment at a cost of $160,000 is being considered by the Municipal Commission. Michael Foley is president.

MEDINA, N. Y.—Plans are under consideration by the Town Council for improvements to the electric lighting system.

ROCHESTER, N. Y.—The Alderman & Fairchilds Company of Churchville is considering plans for the erection of a power plant for its paper-box factory.

ROCHESTER, N. Y.—The Rochester Gas & Electric Company has petitioned the Public Service Commission for permission to issue $500,000 of stock for contemplated plant improvements.

SARDINIA, N. Y.—The Holland-Sardinia Light & Power Corporation has applied to the Public Service Commission for permission to operate.

BURLINGTON, N. J.—The United States Cast Iron Pipe & Foundry Company contemplates additions to the power plant at its local works to include one 350-kw., 250-volt, direct-current turbo-generator and a 100-kw. motor-generator set, alternating current, 2,200 volts, two-phase, 60-cycles; direct current, 250 volts. Alexander A. Gettlin is electrical engineer.

BUTLER, N. J.—The Town Council has called for plans for the proposed extension to the municipal lighting plant, to cost about $50,000.

IRVINGTON, N. J.—The Vreeland Motor Company, 407 Elizabeth Avenue, Newark, is receiving bids for construction of a factory on Cort Street, to cost about $300,000. Electrical and mechanical equipment will be required. J. T. Simpson, Essex Building, Newark, is architect

TRENTON, N. J.—The Western Union Telegraph Company has made application to the City Commission for permission to place its system underground on West Hanover Street.

CHESTER, PA.—The Sun Shipbuilding Company plans additions to its plant on the Delaware River in connection with which large quantities of electrical and mechanical equipment will be required. The total cost will be about $3,000,000.

CONNELLSVILLE, PA.—The Paragon Motor Company, 404 Century Building, Cleveland, Ohio, plans to erect two factory buildings, to cost about $500,000, and install electric motors and a crane. F. F. Hockenthal is the company engineer. J. F. Kurtz is president.

PHILADELPHIA, PA.—The Philadelphia Electric Company has completed plans for a substation at Marshall and Noble Streets.

PHILADELPHIA, PA.—Bids are now being received by the Bureau of Water, 788 City Hall, for delivery and installation of one electric traveling crane, three 220-volt, direct-current motors, controllers, limit switch, wiring and switchboard at the Lardner's Point pumping station.

POTTSVILLE, PA.—Preparations are being made by the Eastern Pennsylvania Light, Heat & Power Company for extensive improvements and extensions to its system during 1920, some of which are already under way. The company has recently closed a contract with the Metropolitan Edison Company of Reading for a tie-in with its lines at a point south of Port Clinton, which will necessitate the erection of a three-phase, 60-cycle, 23,000-volt transmisson line, about 16 miles long. The line conductors will be No. 1 solid copper and 45,000-volt insulators will be used so that at a later date the line can be changed to 38,000 volts. This line is under construction. The installation of four additional Coxe traveling grates under four 350-hp. Stirling boilers is contemplated. A 500-gal. Terry turbine-driven centrifugal feed-water pump, a 10-kw. direct-current Terry turbine-driven auxiliary unit for operating oil switches and relays, which unit will also be the source of supply for emergency lighting in the generating station at Palo Alto, and a 100-kw. motor-driven exciter set are now being installed at the latter plant. Three additional 567-kva. transformers will be placed in the Tamaqua substation and two switchboards will be completely rearranged and overhauled. An additional 1,250-kva. synchronous condenser has been purchased and will be installed in the Frackville substations within the next ninety days. W. G. Long is manager of the commercial department.

SCRANTON, PA.—The Scranton Electric Company contemplates the erection of a new machine shop to cost about $30,000.

VARDEN, PA.—Improvements are contemplated by the Varden & Lake Ariel Light, Heat & Power Company, including changing its system from direct to alternating current. New equipment may be needed, including a waterwheel, switchboard, generator, transformers and overhead-line material for about 4 miles of transmission lines. W. W. Kizer is president.

BALTIMORE, MD.—The M. A. Long Company, engineer and constructor, Munsey Building, has been awarded a building contract for the new plant to be erected in this city by the Columbia Graphophone Company of Bridgeport, Conn. A large power plant is included in the project. The total cost is estimated at $2,500,000.

BEECH BOTTOM, W. VA.—The American Gas & Electric Company, New York, N. Y., contemplates additions to its local plant.

FAIRMONT, W. VA.—The Monongahela Valley Traction Company contemplates installing a turbo unit with auxiliaries, to cost $700,000, at the local plant, and also new equipment at its Parkersburg plant.

RICHMOND, VA.—Considerable electrical equipment will be required in connection with the construction of the new club house of the Westmorehead Club, Grace Street. Cost is estimated at $350,000. A. C. Bossom, 680 Fifth Avenue, New York, N. Y., is architect. G. Bryan is president of the club

North Central States

CHICAGO, ILL.—Plans are being prepared by Graham Anderson Probst & White, architects, Railway Exchange Building, for a fourteen-story Federal Reserve Bank and office building to cost about $3,000,000. Considerable electrical equipment will be necessary.

BATTLE CREEK, MICH.—The Clark Equipment Company, manufacturer of motor axles, plans a $5,000,000 factory. Considerable electrical equipment will be required.

DETROIT, MICH.—Motors and other electrical equipment will be required for the new factory of the Blodgett Engineering & Tool Company, Kerr Building. A. E. Harley, 435 Woodward Avenue, is architect.

FLINT, MICH.—Plans are being revised by Malcolmson, Higginbotham & Palmer, architects, 405 Moffat Building, Detroit, for a high school to cost about $1,250,000. Power motors and other electrical equipment will be required.

CLEVELAND, OHIO.—A new street-lighting system is under consideration for Nela Park and Euclid Avenue in East Cleveland.

CLEVELAND, OHIO—Charles Shane, 2147 Ontario Street, will erect a private electric plant in connection with the construction of new twelve-story store and office building to cost $750,000. W. S. Lougee, Marshall Building, is architect.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until April 8 for material and parts for flashlight re-call and signal system for the division of police, department of public safety.

CLEVELAND, OHIO — The Templar Realty Company, 1605 Williamson Building, is having plans prepared by S. H. Weis, architect, 1032 Schofield Building, for an eight-story commercial building, to cost about $500,000. Electric wiring and elevator equipment will be installed.

CLEVELAND, OHIO. — Considerable electrical equipment will be required by the National Acme Company, manufacturer of machinery, 7500 Stanton Avenue, for its proposed $500,000 factory additions. G. S. Rider & Company, Century Building, are architects.

CLEVELAND, OHIO.—Plans are being prepared by W. R. McCormack, architect, East Sixth Street and Rockwell Avenue, for a three-story junior high school to cost about $600,000. Electric motors, stoves and wiring will be installed.

LEBANON, OHIO.—Bids will be received until April 27 by the Board of Trustees of Public Affairs for construction of a complete new municipal electric light plant, to cost about $135,000. Oliver Chenoweth is president of the board.

LISBON, OHIO.—Ohio Gas & Electric Company contemplates the erection of transmission lines to various rural districts.

LONDON, OHIO.—The Ohio Board of Administration, Columbus, contemplates the construction of a $100,000 power house for the new state prison in London.

SALEM, OHIO.—The Salem Lighting Company contemplates spending $175,000 for additional equipment.

TOLEDO, OHIO—The substation of the Toledo Railways & Light Company at the Casino was recently destroyed by fire, the loss amounting to $50,000. The company plans to rebuild immediately on a new site. F. J. Derge is assistant manager.

UHRICHSVILLE, OHIO.—Proposals for building a municipal light plant will be submitted to the voters.

WARREN, OHIO—The Alloy Electrical Steel Casting Company of Massillon contemplates the erection of a new factory building on site offered by the Warren Board of Trade. Electrical furnaces and other equipment will be installed.

JEFF, KY.—The Kermont Coal Company will electrify its mines.

PRAISE, KY.—The Kanawha Elkhorn Collieries, 217 Ellicott Square, Buffalo, N. Y., contemplate installing three 150-kw. direct-current engine-type generators directly connected. R. C. Simpson is general superintendent.

KOKOMO, IND.—The International Engineering & Manufacturing Company, 327 South La Salle Street, Chicago, Ill., plans to establish a plant to cost about $100,000 in Kokomo for the manufacture of electric lighting power plants for farm purposes.

ROACHDALE, IND. — The Roachdale Electric Light Company has purchased the plant of the Ladoga Electric Light Comapny and will connect the two towns with a transmission line.

JACKSONVILLE, ILL.—The City Council has approved plans for construction of a new municipal power house and filtration plant, to cost about $40,000. The city clerk has been authorized to call for bids for same. H. L. Caldwell engineer.

MATHERVILLE, ILL.—The Sherrard Power & Light Company has petitioned the Illinois Public Utilities Commission for permission to construct plant in Matherville.

PEORIA, ILL.—The Staley Manufacturing Company of Decatur will erect a plant to cost $500,000 as the first unit of a contemplated project to exceed $5,000,000

CUDAHY, WIS.—The Federal Rubber Company is planning improvements to its local plant, including the installation of a 4,000-kw. substation (receiving station), air compressors with motors, high-pressure hydraulic pumps and additional motors, aggregating 2,000-hp., for industrial purposes. H. F. Godeke is engineer of steam station.

MISHICOT, WIS.—Plans are under consideration to connect the local electric light plant with the transmission system of the Wisconsin Public Service Company. J. Beyer is president of the local company.

SHEBOYGAN, WIS.—The Cigar Box Lumber & Manufacturing Company is having plans prepared by Juhl & Smith, architects and engineers, Innig Building, for a machine, saw, filing and power house, to cost about $50,000. Electric generators will be installed to furnish all power required. J. Will, 1007 Michigan Avenue, is president.

CHISHOLM, MINN. — The Minnesota Utilities Company of Eveleth plans to enlarge its local generating plant, to cost $150,000.

HUTCHINSON, MINN.—Bonds to the amount of $15,000 have been voted for an ornamental street-lighting system.

ST. PAUL, MINN.—Considerable electrical equipment will be required in connection with the six-story hotel to be erected at a cost of $500,000 by A. H. Heimbach, 467 Roy Street. M. A. Wright, 600 Pittsburgh Building, is architect.

TRUESDALE, IOWA. — Bonds to the amount of $4,000 have been sold for contemplated improvements in the municipal electric lighting system.

ASHLEY, N. D.—Bids will be received by J. Hildenbrand, auditor of McIntosh County, until April 6, for wiring of new court house. Plans may also be obtained from Buechner & Ortht, architects, 500 Shubert Building, St. Paul, Minn.

CANDO, N. D.—The reconstruction of the entire municipal transmission system is being contemplated. F. L. Anders is in charge of the work.

COOPERSTOWN, N. D.—The People's Service Company is having plans prepared for a power plant and additional transmission lines. The cost will be about $275,000. C. Christianson is manager.

RED CLOUD, NEB.—The Municipal Light and Water Department contemplates additions to its distribution system. J. A. Brodferd is superintendent.

OTTAWA, KAN.—The Baptist University contemplates the erection of a power house to cost about $75,000. Washburn & Stoockey, Ottawa, are architects and engineers.

TOPEKA, KAN.—The Pawnee Power & Water Company will issue $37,250 of stock for improvements to its lighting system.

Southern States

HIGH POINT, N. C.—The High Point Hotel Company will erect a hotel at a cost of about $500,000 requiring considerable electrical equipment. W. L. Stoddart, 9 East Fortieth Street, New York, N. Y., is engineer and architect.

KINGSTON, N. C.—The erection of a new municipal electric plant, to cost not more than $300,000, is contemplated. W. C. Olsen, Sumter, S. C., is consulting engineer. J. E. Weyher is superintendent.

RALEIGH, N. C.—The R. G. Lassiter Company is in the market for a 10-hp. to 60-hp. boiler, motors, transformers and trucks, all second-hand.

CHARLESTON, S. C.—Bids will be received until April 15 at the office of the supervising architect, Treasury Department, Washington, D. C., for the installation of a lighting plant and water system at the United States Quarantine Station at Charleston.

AUGUSTA, GA.—The Sibley Manufacturing Company, Goodrich Street, contemplates the erection of a cotton mill, including a water-power plant and dye house. Complete equipment for electrical operation will be installed. J. E. Sirrine, Greenville, S. C., is engineer.

LA GRANGE, GA.—Preparations are being made by the Valley Waste Mills for installing an additional receiving station of about 750 kw. capacity and also a number of new motors. W. H. Jones is manager.

PABLO BEACH, FLA.—The Town Clerk is receiving bids for equipment of power plant, including a 100-125-hp. oil engine, switchboard and generator.

ALCOA, TENN. — The Aluminum Company of America, Oliver Building, Pittsburgh, Pa., contemplates the construction of four additional hydro-electric power dams near Alcoa in connection with the local plant now being erected. A. V. Davis is president.

BIRMINGHAM, ALA.—Plans are being prepared by the Sloss-Sheffield Steel & Iron Company for equipping for electrical operation machinery in coal and iron mines, blast furnaces and a by-products plant in connection with its new works now under construction. The maximum motor load will be about 5,000 hp. to start with. Part of the project will be in operation about June, 1920, and will be completed in June, 1921. Electricity will be furnished by the Alabama Power Company. Martin J. Lide of Birmingham is consulting engineer.

LITTLE ROCK, ARK.—The Arkansas Light & Power Company contemplates the erection of a transmission line to Russellville.

PICRON, ARK.—The Arkansas Light & Power Company of Arkadelphia has purchased the municipal power plant and 40 acres of land for $235,000. Extensive improvements are planned, to include erection of additional transmission lines and a substation in North Little Rock. H. C. Couch is president.

MONROE, LA.—The municipal power and water plant, recently destroyed by fire, is to be rebulit. A Berstein is Mayor.

TULIA, TEX.—A municipal electric light and water plant is under consideration.

WICHITA FALLS, TEX.—The Chamber of Commerce has approved plans for the proposed ornamental street lighting system.

Pacific and Mountain States

SEATTLE, WASH.—The Medical Building Company, Cobb Building, is having plans prepared by Bebb & Gould, architects, at the same address, for an eight-story office building to cost $450,000 and requiring considerable electrical equipment.

SULTAN, WASH.—An additional generating unit will be installed in the municipal power plant. F. I. Anderson is superintendent.

FLORENCE, ORE.—The Florence Electric Company has filed application with the Public Service Commission for permission to increase its rates for reconstruction purposes. The plant was recently destroyed by fire.

FOREST GROVE, ORE.—Bids will be received in April by the Masonic Lodge for construction of a two-story Masonic home, to cost about $230,000. A separate power house will be erected. W. C. Knighton, United States National Bank Building, Portland, is architect.

BISHOP, CAL.—The Southern Sierras Power Company, which recently purchased the property of the Mono Power Company, on Owens River, contemplates extensive improvements, involving an expenditure of over $2,000,000. Work on the first unit is under way. C. H. Rhudy, engineer, is in charge. The plans include a 27,000-hp. hydro-electric development.

HERMOSA BEACH, CAL.—At an election on April 12 the proposal to issue $5,000 in bonds for a street-lighting system will be submitted to the voters.

LONG BEACH, CAL.—The Seaside Investment Company, care of A. B. Benton, 114 North Spring Street, architect, contemplates the installation of a boiler plant and electrical equipment in connection with the construction of the proposed new bath house and hotel.

LOS ANGELES, CAL.—The Los Angeles Railway Company is having plans prepared by C. E. Noerenberg, architect, for a ten-story office building, for which motors and other electrical equipment will be required.

MARE ISLAND, CAL.—The Bureau of Yards & Docks, Navy Department, Washington, D. C., contemplates the installation of a 4,000-kw. turbo-generator at the local navy yard.

SACRAMENTO, CAL.—The State Reclamation Board has approved plans of District 2021 for completing its work of reclamation in the Mildred Island district of San Joaquin County. The contemplated improvements, including new pumping facilities, will cost upward of $300,000.

SAN FRANCISCO, CAL.—H. H. Wadsworth has applied to the State Water Commission for permission to take 200 cu. ft. per second from the middle fork of the Yuba River, Sierra and Nevada Counties, for power purposes, and 700 cu.ft. per second from Yuba River, Yuba County, also for development of power. Project will cost about $2,500,000.

SAN FRANCISCO, CAL.—Application has been filed with the State Water Commission by L. S. Jorgensen, Chronicle Building, for permission to divert 350 cu.ft. per second of water from the middle fork of the Feather River, in Plumas and Butte Counties, for hydroelectric development. Project will cost about $6,000,000. Mr. Jorgensen has also applied to take 450 cu.ft. per second of water from another point in the same river, and the diversion works in this latter development will cost in the neighborhood of $4,500,000.

WILMINGTON, CAL.—The California Barium & Chemical Company, J. O. Sword, Higgins Building, Los Angeles, recently organized with a capital stock of $250,000, plans to erect a group of factory buildings equipped with electric motors, etc. A. C. Martin, 430 Higgins Building, Los Angeles, is architect.

HEYBURN, IDAHO. — Bonds to the amount of $5,000 have been issued for the erection of a municipal power plant.

RUPERT, IDAHO.—The city will operate the Rupert Electric Company's system, which it has just purchased for $37,500. J. C. Lundy is manager.

WASATCH, UTAH.—The Whitmere Oxygen Company of Salt Lake has applied to the state engineer for permission to take 30 cu.ft. per second of water from Little Cottonwood Creek, Salt Lake County, for power.

BILLINGS, MONT.—Bids will be received in April by McIver & Cohagan, architects, 407 Electric Building, for a six-story hotel, to cost about $700,000. Considerable electrical equipment will be required. A. H. Barth, 43 Yellowstone Avenue, is the owner.

LAUREL, MONT.—The City Council is considering improvements in the electric lighting system, estimated to cost $5,500.

SHERIDAN, WYO.—Bids will be received by E. C. Gwillim, city engineer, for furnishing and installing sixty-six ornamental street-lighting posts.

WORLAND, WYO.—The Big Horn Light & Power Company contemplates the installation of two 150-kva., three-phase, 60-cycle, 2,300-volt engine-driven generators, with switchboard equipment and transformers. M. W. Thompson is engineer.

Canada

DES QUINZE, ONT.—An extensive power development is contemplated in connection with a proposed pulp and paper plant, to cost about $4,000,000. M. J. O'Brien of Renfrew is said to be interested.

FENWICK, ONT. — The Pelham Township Council is considering the construction of a municipal hydro-electric system.

HAMILTON, ONT.—J. & J. J. Allen, Richmond and Victoria Streets, have purchased a site on King and William Streets on which they plan to erect a motion-picture theatre to cost about $500,000. Electrical equipment will be required for lighting, heating and ventilating and motion picture machines.

LONDON, ONT.—The construction of a municipal water main and pumping plant, equipped with electric pumps to supply the Canadian Pacific Railway is under consideration. The cost is estimated at $20,000. E. V. Buchanan, Hydro offices, is engineer and manager of waterworks.

TORONTO, ONT.—The Henry Engineering Company, 71 Bay Street, is in the market for a 1,000-kva., three-phase, 25-cycle, 2,200-volt turbine or engine generating unit and a 500-hp. water-tube boiler.

MONTREAL, QUE.—The Shipman Electric Engineering Company, 26 George Street contemplates the purchase of three 75-kva., 550 to 2,200-volt, 60-cycle transformers, and motors ranging up to 100-hp. at 550 volts, three-phase, 60-cycle.

SHERBROOKE, QUE.—The Corporation of the Sherbrooke Gas & Electric Department, which has taken over the property of the municipal electric light plant, contemplates the construction of a 11,000-hp. plant at Westbury and the erection of 2 miles of 50,000-volt line. C. Desbraillet is manager.

Miscellaneous

GUAM, P. I.—The Bureau of Yards & Docks, Navy Department, Washington, D. C., plans to erect power house, pump house, blower house and quarters at the naval radio station in Guam (Specification 4141). Plans may be obtained on deposit of $20 at the above office.

CARBONEAR, NEWFOUNDLAND — The United Towns Electric Company, plans a general expansion in its generating and transmission systems. J. C. Cameron is secretary.

Directory of Electrical Associations

Printed in the First Issue of Each Month

Alabama Light and Traction Association. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

American Association of Engineers. Secretary, C. E. Drayer, Nepecnauk Bldg., 63 East Adams St., Chicago, Ill.

American Electric Railway Association. Secretary, E. B. Burritt, 8 West 40th St., New York City.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, Bethlehem, Pa.

American Institute of Consulting Engineers, Inc. Secretary, F. A. Molitor, 35 Nassau St., New York City.

American Institute of Electrical Engineers. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country. Annual convention, White Sulphur Springs, W. Va., June 29-July 2.

American Physical Society. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

American Society for Testing Materials. Secretary-treasurer, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society. Secretary, H. C. Forbes, 29 W. 39th St., New York City.

Arkansas Utilities Association. Secretary, W. J. Tharp, Little Rock, Ark. Annual meeting, Hot Springs, Ark., April 26-28.

Associated Manufacturers of Electrical Supplies. General secretary, C. E. Dustin, 30 East 42d St., New York City.

Association of Edison Illuminating Companies. Secretary, Preston S. Millar, Electrical Testing Laboratories, New York City.

Association of Iron and Steel Electrical Engineers. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

Association of Municipal Electrical Utilities of Ontario. Secretary, S. R. A. Clement, 190 University Ave., Toronto.

Association of Railway Electrical Engineers. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago, Ill. Annual meeting, Chicago, Ill., Oct. 28-31.

British Columbia Association of Electrical Contractors and Dealers. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C. Annual meeting, Vancouver, B. C., Oct. 19.

Canadian Electrical Association, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St., East, Toronto, Ont.

Colorado Electric Light, Power and Railway Association. Secretary-treasurer, F. O. Safford, Denver Gas & Electric Co., Denver, Col. Annual convention, Glenwood Springs, Col., September.

Conference Club. Secretary, Sullivan W. Jones, 19 West 44th St., New York City. Annual meeting, White Sulphur Springs, W. Va.

Commercial Section, N. E. L. A. Secretary, R. H. Tillman, Baltimore, Md.

Eastern New York Section, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

Electric Hoist Manufacturers' Association. Secretary-treasurer, W. C. Briggs, Shepard Electric Crane & Hoist Co., New York City.

Electric Furnace Association. Secretary, Dr. C. G. Schluederberg, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Electrical Manufacturers' Club. Secretary, F. L. Bishop, Hartford Faience Co., Hartford, Conn.

Electrical Safety Council. Secretary, Dana Pierce, 25 City Hall Place, New York City.

Electrical Supply Jobbers' Association. General secretary, Franklin Overbaugh, 411 South Clinton St., Chicago, Ill., Annual meeting, Del Monte, Cal., May 12-14.

Electrical Supply Jobbers' Association, Atlantic Division. Secretary, E. Donald Tolles, 52 Broadway, New York City.

Electrical Supply Jobbers' Association, Pacific Coast Division. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

Electrical Trade Association of Canada. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Canada.

Electric Power Club. Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

Electric Vehicle Section, N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York City.

Empire State Gas and Electrical Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York City.

Florida Engineering Society. Secretary, J. R. Benton, Gainesville, Fla.

Illinois State Electric Association. Secretary-treasurer, R. V. Prather, Springfield, Ill.

Illuminating Engineering Society. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

Indiana Electric Light Association. Secretary, Thomas Donohue, Lafayette, Ind.

Industrial Electric Heating Association. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

Institute of Radio Engineers. Secretary, Alfred N. Goldsmith, College City of New York, New York.

International Association of Municipal Electricians. Secretary, C. R. George, Houston, Tex.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria Street, Westminster, London, S. W., England.

Iowa Section, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

Jovian Order. Jupiter (president), Arthur J. Binz, Houston, Tex.

Kansas Public Service Association. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

Michigan Section, N. E. L. A. Secretary, Herbert Silvester, Ann Arbor, Mich.

Minnesota Electrical Association. Secretary and treasurer, Meyer Barnert, St. Paul, Minn.

Mississippi Electric Association, affiliated with the N. E. L. A. Secretary, E. S. Myers, Vicksburg, Miss.

Missouri Association of Public Utilities. Secretary-treasurer, F. D. Beardslee, 315 N. 12th St., St. Louis, Mo. Annual convention, Jefferson City, Mo., June 3-5.

National Association of Electrical Contractors and Dealers. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin. Annual convention, Baltimore, Md., Oct. 6.

National Council of Lighting Fixture Manufacturers. Secretary, C. W. Hoffrichter, 8410 Lake Ave., Cleveland, Ohio.

National Association of Electrical Inspectors. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

National Electric Light Association. Executive assistant to president, M. H. Aylesworth, 29 West 39th St., New York City. Annual convention, Pasadena, Cal., May 18-21.

National Electrical Credit Association. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

National Fire Protection Association. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

Nebraska Section, N. E. L. A. Secretary-treasurer, B. H. Conlee, Nebraska Gas & Electric Co., Beatrice, Neb.

New England Electrical Credit Association. Secretary, Alton F. Tupper, 15 State St., Boston, Mass.

New England Section, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass. Annual convention, Kineo, Me., Sept. 14-16.

New Mexico Electrical Association. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

New York Electrical Credit Association. Secretary, Franz Neilson, 120 Broadway, New York City.

New York Electrical Society. Secretary, George H. Guy, 29 West 39th St., New York City.

Northwest Electric Light and Power Association, affiliated with N. E. L. A. Secretary, W. E. Herring, 860 Stuart Bldg., Seattle, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 13-16.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

Oklahoma Utilities Association. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City.

Pacific Coast Section, N. E. L. A. Secretary, A. H. Halloran, Rialto Bldg., San Francisco, Cal. Annual meeting, Hotel Del Monte, Del Monte, Cal., May 17, 18.

Pennsylvania Electric Association, State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

Public Service Association of Virginia. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

Public Utilities Association of West Virginia. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

Radio Club of America. Secretary, T. J. Styles, 1112 S. Curtis Ave., Richmond Hill, Queens Borough, N. Y.

Rocky Mountain Association of Municipal Electricians. President, Lawrence Stone, Denver, Col.

Society for Electrical Development, Inc. General manager, J. M. Wakeman, 29 West 39th St., New York City.

Society for the Promotion of Engineering Education. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

South Dakota Electrical Power Association. Secretary-treasurer, L. V. Schneider, Salem, S. D.

Southeastern Section, N. E. L. A. Secretary-treasurer, Charles A. Collier, Georgia Railway & Power Co., Atlanta, Ga.

Southern California Electrical Contractors and Dealers' Association. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

Southwestern Electrical and Gas Association. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex. Annual convention, Galveston, Tex., May 13, 14 and 15.

Southwestern Society of Engineers. Secretary, C. E. Barglebaugh, 721 First National Bank Building, El Paso, Tex.

Technical and Hydroelectric Section, N. E. L. A. Secretary, W. C. Anderson, 29 West 39th St., New York City.

Toronto Electrical Contractors' Association. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

Tri-State Water and Light Association. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual convention, Atlanta, Ga., May 19-21.

Vermont Electrical Association. Secretary-treasurer, A. B. Marsden, Rutland, Vermont.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

Western Society of Engineers, Electrical Section. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

Wisconsin Electrical Association. Secretary, J. P. Pulham, 1408 First National Bank Building, Milwaukee, Wis.

Record of Electrical Patents

Notes on United States Patents

(Issued March 16, 1920.)

1,333,596. Telephone System; Wallace P. Andrick, Jamaica, N. Y. App. filed Sept. 25, 1917. Bridge holds trunk circuit, a substitute for answering set.

1,333,607. Trolley System; Ora A. Colby, Larimer, Pa. App. filed Feb. 3, 1915. Sliding-contact pantograph for catenary line construction.

1,333,608. Method and Apparatus for Electric Lighting and Starting Vapor Conductors; John W. Dorsey, Winnipeg, Manitoba, Canada. App. filed June 16, 1917. Constant-pressure vapor electric apparatus.

1,333,626. Control Apparatus; Ferdinand G. Moard, Turtle Creek, Pa. App. filed July 3, 1916. Magnetically actuated valves for controlling fluid under pressure.

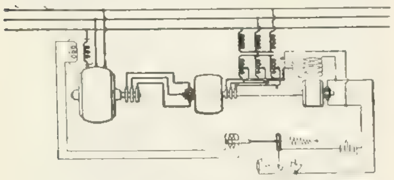
1,333,633. Apparatus for Sterilizing Liquids; Harry B. Rudd, Akron, Ohio. App. filed Sept. 22, 1919. Valve opens when liquid is heated to desired temperature.

1,333,640. Electric Insulator; Guido Semenza, Milan, Italy. App. filed Jan. 23, 1918. Prevents stresses due to expansion or contraction.

1,333,662. Electric Regulator; August Kazenmaier, Stuttgart, Germany. App. filed July 15, 1918. For keeping voltage or current constant.

1,333,664. Speed Control for Induction Motors; Benjamin G. Lamme and Wilfred Sykes, Pittsburgh, Pa. App. filed Oct. 21, 1916. Free from surging and allied harmful phenomena.

1,333,665. Arc Lamp; George M. Little, Pittsburgh, Pa. App. filed Nov. 12, 1915. Prevents fumes from attacking glass or metal parts.



No. 1,333,664. Speed Control for Induction Motors

1,333,698. Spark-Plug Tester; Ernest I. Bass, Cornersville, Tenn. App. filed March 3, 1919. Spark-intensity detector.

1,333,700. Process and Apparatus for Electrical Treatment in the Dyeing of Fibers and Fiber Products and the Dyestuffs and the Product Resulting Therefrom; Jacob E. Bloom, Brooklyn, N. Y. App. filed Dec. 3, 1917. By electrical transference and adsorption.

1,333,701. Manufacture of Loose Compounds; Jacob E. Bloom, Brooklyn, N. Y. App. filed Dec. 3, 1917. Electrically compacting colloids.

1,333,720. Copper-Lead-Smelting Process; Woolsey McA. Johnson, Hartford, Conn. App. filed Oct. 24, 1914. Utilizing thermal energy of fuel and of electricity.

1,333,724. Heating Device by Electricity; Pierre P. Meunier, Lyon, France. App. filed June 6, 1919. Insulating plate acts as screen.

1,333,744. Telephone Transmitter; Edward C. Wente, New Haven, Conn. App. filed Dec. 20, 1916. For sound-wave analysis.

1,333,758. Telephone System; Charles W. Keckler, Newark, N. J. App. filed May 24, 1917. Obtains clear circuit to central office free from interruptions.

1,333,771. Voltaic Cell and Battery; Frederick R. Parker, Chicago, Ill. App. filed Jan. 29, 1910. Connects two or more cells together.

1,333,789. Spark Gap Used in Wireless Telegraphy; Joseph F. J. Bethenoid and Emile F. Girardeau, Paris, France. App. filed Oct. 15, 1915. Synchronic operation of spark gaps in parallel.

1,333,805. Receiver Attachment for Telephones; Samuel H. Hamer, Bellingham, Wash. App. filed Nov. 5, 1918. Supports receiver in proper position from stand.

1,333,836. Art of Producing Charges for Power Devices; Henry Csanyi, New York, N. Y. App. filed Feb. 28, 1918. Decomposing treatment augments oxygen of atmosphere.

1,333,837. Art of Producing Charges for Power Devices; Henry Csanyi, New York, N. Y. App. filed March 2, 1918. Heavier hydrocarbons foundation for content of charge.

1,333,838. Art of Producing Charges for Power Devices; Henry Csanyi, New York, N. Y. App. filed May 13, 1918. Electrolytic cell has spaced plates as electrodes.

1,333,849. Solution of Titanium and Iron Salts and the Process of Preparing Same; Hjalmar Olsen, Christiania, Norway. App. filed May 16, 1917. Pure titanium hydrates precipitated while iron remains in solution.

1,333,892. Parallel-Feeder Protection; Paul Ackerman, Toronto, Ontario, Canada. App. filed Dec. 24, 1917. Isolates faulty feeder from system.

1,333,904. Rail Bond; Edward M. Deems, Forest Hills, N. Y. App. filed Jan. 8, 1919. For signal purposes.

1,333,914. Electric Furnace and Method of Operation; Louis C. H. Groeger, Chicago, Ill. App. filed April 5, 1919. Operated single-phase, two-phase or three-phase.

1,333,933. Electrically Operated Air-Heating Device; Andrew P. Nickols, Bridgeport, Conn. App. filed Oct. 18, 1919. Attached to conduit for raising temperature of air or gas.

1,333,936. Current-Regulating Plug and Socket; Antonio Papini, Philadelphia, Pa. App. filed Dec. 1 1919. Rheostats containing graphite mixed with pulverized mica.

1,333,950. Electric Furnace; Max R. Trembour, Watervliet, N. Y. App. filed March 24, 1916. Of spherical design for minimum power consumption.

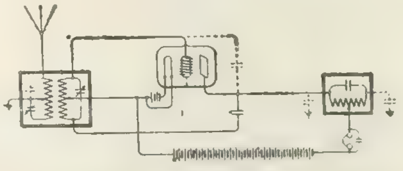
1,334,004. Process for the Treating of Titaniferous Iron Ore; Jacobus van der Toorn, The Hague, Netherlands. App. filed March 25, 1918. Briquettes of titanic iron ore, the carbon and flux subjected to electric flame arc.

1,334,035. Electric Heater for Stock-Watering Tanks; Wilson E. Johnson, Kempton, Ind. App. filed Aug. 16, 1919. Water-tight heater in bottom of trough contains resistances.

1,334,040. Electric Connection; Thomas L. Lee, Rochester, N. Y. App. filed June 12, 1918. Flexible cable attached to socket terminal by plug on end of conductor.

1,334,041. Insulating and Cooling Means for Transformers; Arvid Lindstrom, Wasteras, Sweden. App. filed March 6, 1919. Compressed gas as insulating medium.

1,334,047. Signal for Vehicles; Timothy B. Powers, Brooklyn, N. Y. App. filed Aug. 11, 1919. Illuminated hand signal mounted on rear fenders.



No. 1,334,118. System of Amplification of Small Currents

1,334,077. Semi-mechanical Telephone System; Albert M. Bullard, New York, N. Y. App. filed Feb. 5, 1907. Special signal for revertive calls.

1,334,080. Impulse-Sending Device; Henry P. Clausen, Mount Vernon, New York, N. Y. App. filed Feb. 23, 1918. For controlling automatic telephone switches.

1,334,084. Electric Connection; Farnum F. Dorsey, Rochester, N. Y. App. filed June 12, 1918. Sheet-metal plug.

1,334,087. System for Producing Oscillations; Alfred N. Goldsmith and Julius Weinberger, New York, N. Y. App. filed March 23, 1918. Constants of oscillating system independent of antenna constants.

1,334,093. Telephone-Transmitter Mouthpiece; Jonathan W. Harris, Montclair, N. J. App. filed Oct. 18, 1916. Porcelain body with metal adapter.

1,334,095. Ignition System for Internal-Combustion Engines; George H. Hill (deceased), late of Schenectady, N. Y. App. filed Nov. 5, 1917. Increases spark.

1,334,105. Switch-Controlling System; Alben E. Lundell, New York, N. Y. App. filed June 21, 1916. Places driving circuit under control of electromagnetic speed-controlling device.

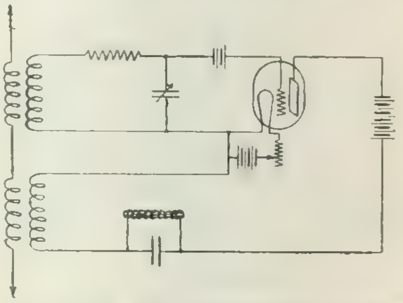
1,334,118. System for Amplification of Small Currents; Chester W. Rice, Schenectady, N. Y. App. filed July 31, 1917. Use of electron discharge relays, detectors or amplifiers for receiving radio signals.

1,334,122. Telegraph System; Adolph R. Swoboda, Newark, N. J. App. filed May 11, 1918. Overcoming zero effects in telegraphic conductors having high electrostatic capacity.

1,334,125. Telephone-Exchange System Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed Aug. 12, 1918. Call-distributing type.

1,334,126. Means for Controlling Alternating Currents; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed April 11, 1918. Control flow of high-frequency currents in circuit or multiply frequency.

1,334,139. Condenser; William Dubilier, New York, N. Y. App. filed Aug. 1, 1918. Prevents failure of insulation at any point.



No. 1,334,165. Electric-Wave Transmission

1,334,140. Condenser and Method of Adjusting the Same; William Dubilier, New York, N. Y. App. filed Aug. 1, 1918. Without damaging elements.

1,334,141. Insulating-Testing Device; William Dubilier, New York, N. Y. App. filed Aug. 26, 1918. Tests dielectric strength and exposes imperfections.

1,334,142. Condenser-Plate Construction; William Dubilier, New York, N. Y. App. filed April 11, 1919. Tough and durable plate, the edge of which is used as terminal.

1,334,146. X-Ray Tube; Francis J. Farrelly and Alfred Greiner, Hartford, Conn. App. filed Oct. 27, 1917. Path of electrical conduction between exterior of positive and negative ends of an X-ray tube.

1,334,150. Electrical Discharge Tube; Charles E. Green and John H. Clough, Schenectady, N. Y. App. filed July 11, 1916. Feeble discharge utilized to prime tube for a heavier discharge.

1,334,160. Continuous Electrical Mechanical Filter; Archibald F. Meston, New York, N. Y. App. filed Feb. 23, 1918. Successively interposes filtering media in path of movements.

1,334,165. Electric-Wave Transmission; Michael I. Pupin, Norfolk, Conn. App. filed Sept. 17, 1915. Production of negative resistance reaction by a system of circuits and its application to compensation of resistance reaction of electrical conductors in order to make them responsive to sustained electrical waves of a predetermined frequency and not responsive to electromotive forces of a disturbing character.

1,334,172. Automatic Closure for Conduit Boxes; Charles S. Ryerson, Norfolk, Va. App. filed Aug. 31, 1918. Spring holds cover.

1,334,258. Electromagnetic Device; Gustave Plaisant, Ealing, London, England. App. filed July 15, 1919. Deflects magnetic lines of force.

Electrical World

The consolidation of Electrical World, Electrical Engineer *and* American Electrician

Volume 75 New York, Saturday, April 10, 1920 *Number* 15

Preparing Against a Drop in Prices

THE Federal Reserve Board's latest report indicates that the peak of high prices has been reached and that a gradual recession may be expected. This prediction, coupled with its statement that "high interest rates and relative scarcity of funds will continue to prevail," should be significant to those engaged in the sale and resale of electrical goods. Prudence would dictate that cash reserves be maintained to cover a large percentage of the present value of goods in stock. Where such reserves are not set up, the jobber, dealer or whoever he may be is in a precarious position, for in no other way can he stand the financial shock that accompanies a drop in prices and remain solvent.

Coal Storage Should Wait a While

WHILE it commends the admonition of the President's commission to store coal in large quantities so as to equalize production, the ELECTRICAL WORLD has this emphatic word of advice for all electric public utilities which must watch their pennies: "Do not attempt to get large storage shipments of coal during April. Store later." Stocks of coal generally are short as a result of the strike. The car supply in many mining districts is far from ample. Production, therefore, is not enough in excess of present-day requirements to permit extensive storage without causing a sharp advance in price.

Too Much Art

THERE is a need for a design of residential lighting fixture which will combine the esthetic conception of the artist with the scientific principles of the engineer. This was brought out in a striking manner by the results obtained from a survey of a typical cross-section of Chicago homes and presented by W. A. Durgin of the Commonwealth Edison Company before a recent meeting of the Chicago Section of the Illuminating Engineering Society. The artistic viewpoint of electric fixtures has been emphasized to the practical exclusion of all engineering considerations in many papers presented before the Illuminating Engineering Society during the past ten years as well as by the popular magazines and the electric fixture manufacturers. Artists have developed few new or especially suitable types. The period design and virtually all other styles of residential lighting fixtures are copies or modifications of old types which were designed for the particular illuminants of their day. Now we have to deal with a flexible light source having high intrinsic brilliancies. Electric illumination is susceptible of highly decorative treatment, and its great possibilities should inspire the development of residential lighting fixtures which will be both pleasing and restful to the eye and especially adapted to scientific lighting.

Increasing Production by Joint Operation

WHERE interconnection of generating plants is accompanied by joint operation, the *matériel* of power production and the labor requirements can often be fitted into the load necessities in such a way as to increase the combined output and lower the unit costs at one and the same time. Joint operation is a decided step in advance over the mere frontier contact of systems which sometimes passes for interconnection. If the plans of the Central Maine Power Company for linking in common operation the major plants of the lower Androscoggin and Kennebec Rivers are approved, it is expected that nearly twice as much energy can be produced in a year as is now obtained or can be obtained by separate operation.

The Commission's Part

MANAGERS, engineers and operators of public utilities may exert themselves to the utmost to build up their properties so as to provide an ever-increasing service to their communities, but without the confidence and support of a progressive public service commission having high ideals of service the net gain will be small. A striking proof of the results of such support by a commission is afforded in California. During 1919 the California Railroad Commission instituted thirteen utility investigations on its own initiative, heard eighty formal complaints, received ninety-two applications to issue securities, seventy applications regarding transfer of properties and 168 for rate increases, made valuations of eight utilities for sale purposes and rendered a grand total of 943 decisions. This was a tremendous task and one carried out with the utmost regard for the interest of the whole people. To the ability and ideals of this body the California power companies owe their present state of healthfulness.

An Educational Need Recognized

ANNOUNCEMENT that Frank A. Vanderlip, former president of the National City Bank, New York City, has been appointed to the faculty of the Harvard School of Business Administration, coming as it does at a time when the low salaries paid to educators have forced many among them to seek other work, is encouraging; for here is at least one man of broad business experience taking that experience back to the college to help develop those in training there. That Mr. Vanderlip will bring to our educational halls a broad conception of economic and financial relations is evident, but it is perhaps not so generally known that he will also bring a sympathetic understanding of the problems of young men, in whom he has always taken a very personal interest. Cambridge is an opinion-making center, and this new association will undoubtedly be one more influence at work to compel recognition of the fact that the business man and the engineer have a growing sense of their responsibility to the public. The public likewise is coming to have a keener appreciation of the value of the business that is founded on ideals of public service.

Coal-Handling Plants

UNDER existing conditions a large store of fuel is becoming more and more important as insurance against transportation troubles. The larger existing plants quite commonly receive run-of-the-mine fuel and do their own work of crushing and sorting. There is little doubt that coal of uniform size is highly advantageous from the standpoint of economic working so that adequate coal-handling apparatus is steadily growing more common. Just what form this should take is a matter to be governed chiefly by local requirements. Some details of the plans adopted in large stations are given in an article in this issue. Of the various conveying apparatus in use, choice must be made according to circumstances, but it appears that where the plant is not cramped for room the belt conveyor is gaining in the field on account of its efficiency and rather moderate cost. The bucket conveyor quite holds its own, however, where conservation of space is important or where for one reason or another there must be a steep pitch on the lift. Now and then other devices are preferable to either, depending on the exact nature of the situation, and sometimes more than one device is used in the same plant. The fuel must generally be received by car or ship and unloaded, stored or carried as required to the crusher, then to the working bunkers, whence generally it is fed by gravity to the stoking apparatus. The routine in working out each of these steps is controlled by the local requirements so that no general rules can be laid down. The fundamental thing is so to choose a conveying system that will permit the fuel to be stored and recovered with as little human labor as practicable and prepared for immediate use subject to the same specifications.

Correcting Telephone Interference

THE telephone line may be said to regard the high-tension power-transmission line in its neighborhood from the same point of view that the lamb regards the lion. When these two types of line circuit lie down together on the same roadway, there is apt to be marked interference. The interference is all from the power line with the telephone line, because the telephone line is unable to interfere with the power line. It is advisable, therefore, to keep the two sets of aërial line conductors as far apart as possible, and when necessity requires them to run in parallel to keep them on opposite sides of the roadway. If this is not practicable and circumstances compel them to be strung from the same poles, then it is important to transpose one or both sets of lines, according to a definitely designed plan, in order to eliminate the interference as far as may be feasible.

We print in this issue an article by Howard S. Phelps giving experiences in correcting cases of telephonic and power-line interference in Iowa. The article will be of interest both to telephone men and to power-distribution men. It may be observed that there is such a thing as a unit of noise in telephony. This unit, if arbitrary and imperfectly reproducible, has its utility. It may also be noted that the cases of interference with ordinary three-phase power distribution lines were corrected without much difficulty. On the other hand, the cases of alternating-current furnace lines and alternating-current series-arc lines gave rise to extra severe interference. This may be attributed, presumably, to the wave form of the alternating current supplied in such circuits, or, to express the same idea in other terms, to the presence of particularly objectionable harmonic frequencies in the currents supplying such loads. One might be tempted to say that both electric furnace lines and electric arc-light lines make it hot for neighboring telephone lines.

Synchronous-Motor Starting

IN THE operation of polyphase synchronous motors the most convenient method of starting them is to bring them up to speed as induction motors unloaded, and then, after exciting their field windings, to throw on the motor load mechanically. This is for the reason that the torque of such motors, when coming up to speed, before synchronism has been reached, is ordinarily much less than their full speed torque when in step.

It frequently happens, however, that the load which the motor has to carry cannot be thrown on after the synchronous speed has been obtained. The load may be of such a nature that it must be accelerated with the motor and carried throughout the entire starting process. In these cases the motor, with its field winding unexcited and connected to the circuit as an induction machine, may be able to start the load from rest and, with a relatively heavy line current, accelerate up to within a small percentage of slip. If the synchronous speed is, say, 720 r.p.m., the unexcited motor may come up to 700 r.p.m., or a little over, and hang on this speed, very ineffectively. In order to bring it into synchronism, it must be accelerated a little more, and this cannot occur on the simple induction-motor principle.

Throwing on the direct-current field excitation at this stage may supply the necessary acceleration and bring the motor into step unless both the slip and the load or its inertia are too great. On the other hand, the acceleration imparted by closing the field switch may be excessive and the motor may be caused to overshoot the synchronous speed vehemently, with subsequent oscillations and current rushes, before the steady régime is reached.

The conditions which occur on and after closing the field switch are discussed in a valuable article by E. E. George which we print in two numbers. It is shown that these conditions are mathematically rather complicated. By making certain reasonable assumptions as first approximations, it is shown that the effect of suddenly throwing on the excitation is to cause the rotor to pulsate pendulum-fashion, according to the theory of elliptic functions. In a particular case, however, if the switch closure is properly timed and the excitation current properly selected, the elliptic function goes over into a limiting hyperbolic case and the motor will accelerate promptly up to synchronism without overshooting or hunting. In all other cases, apparently, there is either insufficient impulse and the machine hunts elliptically below synchronism or there is oversufficient impulse and the machine hunts circularly, alternately above and below synchronism, until the oscillations die out.

It is important to be able to apply the proper excitation at the right instant to bring about the smooth acceleration without hunting. This can only be done when the machine has the proper design characteristics and the load is not too heavy. There is room for much careful and systematic research in this direction, which lies well within the power of the engineering college laboratories. It needs oscillographic study of the line and field currents, for a given load and with varying phases of field application. The observed phenomena will then have to be analyzed in relation to the elliptic-function theory. The results so obtained should, if successful, enable the designers of synchronous motors to improve their motors for the carrying of the heaviest required starting loads.

Automatic Hydro-Electric Generating Stations

A MOST instructive account of the practical workings of several automatic hydro-electric stations is given by T. A. E. Belt in the current issue, his article following the preliminary one contributed by him on Feb. 28. We have more than once had occasion to comment on the usefulness of this kind of automatic operation, and it is a pleasure now to be able to give from the results of actual experience demonstration of the entire practicability and economy of this labor-saving scheme. In its beginning perhaps one may consider the automatic generating plant as a development of the remote control universally used in large stations. It goes quite without saying that any operation which can be performed from a normal switchboard can be performed equally well whether the control board is a hundred feet or miles from the machine control. Distance is merely a matter of the length of the connecting wires. Thus waterwheel gates can be opened and regulated and distant switches operated without departing materially from ordinary switchboard practice. When the remote control is extended over considerable distances simplicity suggests that the whole system of connecting wires can be replaced by the mere control of a single apparatus which shall perform in due sequence a particular series of operations such as are necessary to start a generator and connect it with the circuits. Therefore the actual method of working these stations, as Mr. Belt shows, is the operation of a motor-driven drum controller, not essentially different in principle from the controllers long used in railway service, but with its segments set to perform the ordinary and necessary operations of starting when revolved in one direction and of stopping when revolved in the other.

A particularly striking feature of Mr. Belt's report is that the plants he describes are those which on form, so to speak, would present the greatest practical difficulties; that is, they involve the starting and operation of a generator synchronized with the rest of the system. With the asynchronous type of generator which has been used in a similar way the operations can sometimes be yet more simplified. However, the record of the plants, which Mr. Belt describes shows that, without resorting to anything in the least outside generating station practice, it is perfectly feasible to operate an automatic station with a most insignificant cost of inspection and maintenance—less than 1 per cent of the fixed charges as here shown. This implies that the cost of the power delivered is virtually determined only by the fixed charges themselves.

It has been shown, too, in some of the cases here considered that one can go yet further and make the starting of the automatic station or stations depend on the state of the load or the water, or both. In other words, once the conditions of operation in the development of a series of allied hydro-electric stations are determined, it becomes possible to make their operation in very large measure completely automatic, so that at the main distributing point, where the load dispatcher operates the necessary controls, a very small staff will be able efficiently to control and inspect a group of stations which may be miles apart. Ordinarily, as a matter of convenience, this plan of operation would naturally fall in with the management of stations associated on the same stream at no great distance. When the distances becomes large, running to many miles, it would be desirable for the sake of ease of inspection and general oversight of operations to have the total operating staff distributed at strategic points. The plan of automatic operation thus initiated promises to be of importance in gathering the power scattered along a stream into a coherent whole. There are many instances in which half a dozen plants of a few hundred horsepower find their natural location within a few miles.

Roentgen-Ray Generators in Electrotherapy

THE *Electrician* of London has recently published abstracts of three papers read at a joint meeting of the Institution of Electrical Engineers, the Royal Society of Medicine and the Roentgen Society. It is evident from these papers that much experimental work must be carried on before the therapeutic use of Roentgen-ray tubes can be effectively standardized. The subject is one of great complexity. Some of the difficulties are of technique, others are physiological, others again are of X-ray origin, while still others are electrical. It is no wonder that there should be difference of opinion as to the best methods and apparatus.

In some cases X-ray pictures are needed of deep-seated organs, while in others very little penetration is required. The relation of tube voltage to the penetrating power of the tube has to be found for these different classes. The danger of accidental X-ray burns has then to be considered and the limits of safe exposure have to be established. The relations of the high-tension induction coil or alternating-current transformer in regard to voltage and current in the tube have next to be taken into account. Electrical efficiency in the ordinary technical sense is not of prime importance in these cases, because the efficiency of the tubes is relatively low; but the waste of power in heating the tube unnecessarily has to be carefully avoided.

It is no wonder that very few useful conclusions are reported as having been reached at the meeting. On the other hand, the need is very evident for a considerable amount of steady research work in electrical and X-ray laboratories, in order to introduce definite numerical relations.

Charles Leavitt Edgar

A pioneer in installing Edison lighting plants, an engineer through training, an executive by nature and a master-builder of service and men

OF HIS thirty-seven years of service to the industry, Charles Leavitt Edgar has devoted thirty-three to the engineering and commercial problems of the Edison Electric Illuminating Company of Boston. Early in September, 1887, he was transferred to that company as general superintendent by the Edison Electric Light Company of New York, for which in the capacity of chief engineer he had installed Edison lighting plants throughout New York and Pennsylvania during the three years preceding. Prior to that he had worked for the Bergman Company, a manufacturer of central-station equipment, and for Thomas A. Edison in the testing department of the Edison Machine Works in New York City, taking the latter position in January, 1883, after being graduated from Rutgers College some six months earlier, at the age of twenty-one. After two years with the Boston company, Mr. Edgar was made general manager and soon thereafter vice-president. In 1900, upon the death of Jacob Rogers, he was elected president, the position he still holds. His administration of the Boston company has been characterized by an untiring recognition of the importance of continuous and reliable service, of the value of modern equipment and operating methods, of the essentiality of business acumen in executing company policies, and of the supreme worth of sound public relations. These principles are conspicuous through consolidations of small and inefficient stations into unified and economically operated properties now serving more than 700 square miles of metropolitan and suburban communities in eastern Massachusetts, accompanied by significant developments in wholesaling energy to municipalities, other utilities and industrial plants.

In the execution of company affairs Mr. Edgar has the whole-hearted admiration, esteem and loyalty of his employees, and his personal interest in their welfare has been widely shown. The Edison Employees' Club, its educational and entertainment features have been widely copied, while the general service buildings of the company are unique in scope and function. Mr. Edgar's leadership and constructive counsel are solicited in central-station organization work throughout New England and have also been extended to the National Electric Light Association, of which after serving three terms as vice-president he became president in 1903, and to the Association of Edison Illuminating Companies, of which he was president from 1893 to 1895.

Automatic Hydro-Electric Stations

Operating Expense Has Proved Almost Negligible and Generating Cost Is for Fixed Charges Only—Experience with Two Plants Shows Reliability of the Automatic Devices—Other Stations Will Soon Be Installed

By T. A. E. BELT

Lighting Engineering Department, General Electric Company, Schenectady, N. Y.

VIEW OF PLANT WITH FOREBAY HOUSE IN BACKGROUND

THE general considerations leading up to the design of automatic hydro-electric generating stations were discussed by the author in the Feb. 28 issue of the ELECTRICAL WORLD. More specific information regarding an automatic station and a remotely controlled station which have been in service for some time and a third system of stations which will soon be installed is now offered. Two years of operation of the Iowa Railway & Light Company's automatic station has shown that the cost of inspection and maintenance is a mere fraction of 1 per cent of the fixed charges. The operation has been so satisfactory that pilot wires run to the main or control station for observation of the load on each automatic generator have been found unnecessary. A new plant of 500 kva. which was installed about six months ago in California has been operating satisfactorily since its installation. The design of a series of small plants for operation from storage ponds, when the load on the system is heavy, serves to round out this discussion and to give the status of automatic and remotely controlled hydro-electric stations.

EXPERIENCE WITH IOWA PLANT

On Oct. 2, 1917, the automatic hydro-electric generating station of the Iowa Railway & Light Company at Cedar Rapids, Iowa, was put into operation. The generating equipment consists of three 400-kw., 0.8-power-factor, two-phase, 60-r.p.m., 2,300-volt vertical, waterwheel-driven synchronous genrators, which tie into a system having 20,000-kva. in steam turbo-generators at the main station.

Water for driving the generators is obtained from the Cedar River by means of a concrete dam on top of which are automatic flashboards for raising the water level an additional 3 ft. (0.9m.), making available a total head of 10 ft. (3 m.). The automatic station, which is connected to the steam station by two single-phase, concentric, 600,000-circ.mil cables, 3,000 ft. (900 m.) in length, feeds its entire output into the steam-station bus, from which distribution is made. A motor-operated wicket gate, supplied for each waterwheel, is controlled by a contact-making ammeter by means of which the generator load is regulated. The generators, which have individual float switches set to close their contacts at slightly different water levels, are started in the same sequence as that in which the individual float-switch contacts close. When the water level falls the generators are closed down in the reverse order from their starting; that is, generator No. 3 is closed down first and generator No. 1 closed down last. In the steam generating station are control switches, wired in parallel with the float-switch contacts through pilot wires, by means of which the starting of any automatically controlled unit is made independent of the height of the water in the forebay. The generators may be closed down by opening the control switches, and they cannot be restarted until the control switches are again closed.

Pilot wires carrying the secondary current of current transformers connected in the individual generator leads are run from the automatic generating station to the steam-operated station, so that the load on each generator is indicated at the steam plant. Two years of operation have proved that these pilot wires with their meters are not necessary and that they could have been omitted without decreasing the reliability of operation of the automatic station.

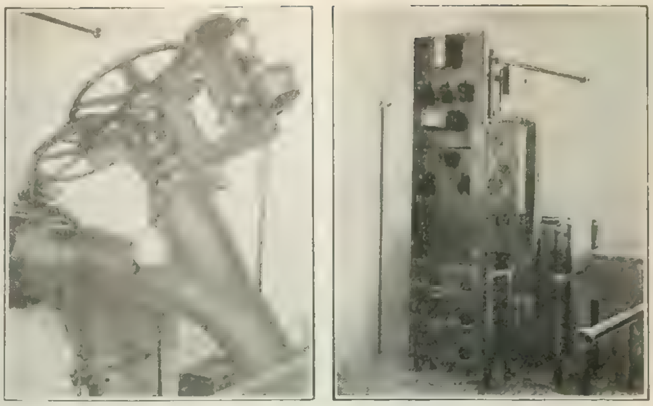
Excitation for the generators is obtained from either one of two induction-motor-driven exciter sets. Each exciter, which has sufficient capacity for supplying three generators, is rated 100 kw., at 125 volts, and is driven by a 2,300-volt, two-phase, 1,200-r.p.m. squirrel-cage induction motor.

At the time of the writing of this article the plant has turned out over 6,000,000 kw.-hr. with a total cost of inspection and maintenance amounting only to a small fraction of 1 per cent of the fixed charges. In other words, the cost of the power delivered by this plant is determined only by the fixed charges.

The correct sequence of operation in the starting of the plant is obtained by properly placed segments on the drum of a motor-driven controller which determines the proper time spacing between the different steps of the starting of the unit and connecting it to the bus.

The closing of the float-switch contacts or of the control switch in the steam plant starts the motor which drives the drum controller. The first segment of the controller to make contact causes a contactor to close, which throws full voltage on the induction motor of one of the exciter sets. In two or three seconds the induction motor, which is properly designed for this starting duty, comes to speed, taking only about six times normal current. The adjustment of the exciter rheostat is such that the exciter builds up to 125 volts.

Soon after the exciter is started another segment of the drum controller causes the motor-operated waterwheel gate to open sufficiently to drive the waterwheel and generator at 70 r.p.m., corresponding to 70 cycles per second. After the gate is partly opened, the controller stops until the generator comes to a speed of 55 r.p.m., when the contacts of a centrifugal switch, mounted on the shaft of the generator, close, thus causing the controller motor to again start. When the controller starts for the second time the generator, without field excitation, is connected to the bus, in series with a reactance, which prevents an excessive flow of current. At the time the generator without field is connected to the bus its speed is approximately 60 r.p.m. The drum controller, which continues to revolve, causes the field of the generator to be excited at a low value, the excitation enabling the generator to pull into synchronism. By the closing of the proper circuits through the drum controller the field of the generator is strengthened to normal value. The reactance in the generator leads is then short-circuited and the controller motor is stopped, leaving the controller in the full running position.



AT LEFT, LIMIT SWITCH (WITH COVER REMOVED) FOR CONTROLLING A WATERWHEEL NEEDLE VALVE. AT RIGHT, SWITCHBOARD PANEL IN ONTARIO COMPANY'S PLANT

As soon as the generator pulls into synchronism a contact-making ammeter connected to a current transformer in the generator leads takes control of the wicket gate, and is so adjusted that the wicket gate opens until the generator delivers full-load current.

The generator operates with a constant excitation, the value of which is adjusted for normal load. When the water level is low and normal kilowatt load of the generator cannot be carried with full gate opening, the generator, because of its overexcitation, takes care of part of the lagging current of the system.

Generators Are Put Into Service in Forty-five Seconds

The starting period of each generator is very short, requiring thirty-nine seconds from the time the waterwheel gate begins to open until the generator is connected to the bus and the starting reactance short-circuited. Within forty-five seconds from the first operation the generator carries full load. Although the starting period of each generator is very short, no mechanical jar is perceptible, and when the generator pulls into step with weak field excitation serious current surges are not experienced.

When the water is low the contacts of the float switch open, which cause the contactors in the generator leads to drop out and so disconnect the generator from the bus. The gate motor then closes the wicket gate and returns the controller to the off position, thus closing

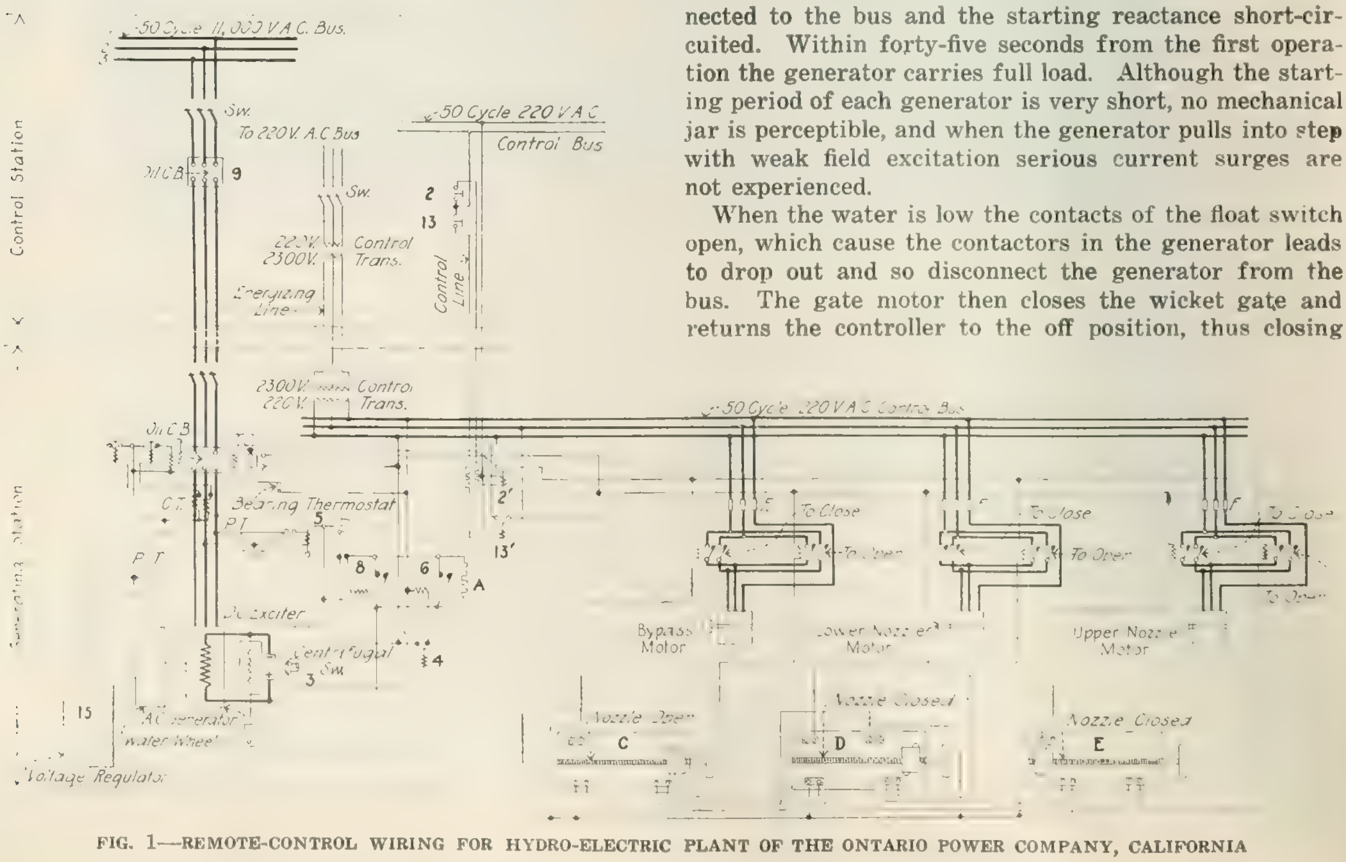


FIG. 1—REMOTE-CONTROL WIRING FOR HYDRO-ELECTRIC PLANT OF THE ONTARIO POWER COMPANY, CALIFORNIA

A COMPLETE GENERATING UNIT IN ONTARIO PLANT

down the generator and the waterwheel. The unit may also be closed down by opening a control switch in the steam station. In case of overheating of the bearings, temperature relays close down the unit in trouble. Speeds and voltage of the generators are determined by the frequency and voltage of the steam station.

Further information concerning the automatic hydro-electric generating station of the Iowa Railway & Light Company may be found in the *Transactions* of the American Institute of Electrical Engineers for 1918 and the Dec. 1, 1917, issue of the ELECTRICAL WORLD.

The remotely controlled hydro-electric generating station which was installed about six months ago by the Ontario Power Company of Ontario, Cal., has been operating satisfactorily since its installation. During this time the maximum load carried by the generator has been about 75 per cent of normal value, owing to insufficient water supply. From the operation of the automatic control equipment at this reduced output, indications are that it will give complete satisfaction under full load conditions. The generator equipment consists of one 500-kva., 11,500-volt, 50-cycle, three-phase generator directly connected to a Pelton waterwheel. Since the new plant, situated about 3.5 miles (5.6 km.) from the company's main generating station, utilizes the entire flow of the stream, provision is made to by-pass the water around the waterwheel when it is not running. By use of pilot wires to regulate the opening of the motor-operated needle valves the operator in the main station has complete control over the load.

DETAILS OF THE CONTROL SCHEME

The upper part of the wiring diagram, Fig. 1, represents the equipment in the main, or control station, and the lower part represents that in the automatic plant. Two small transformers which are connected to the bus in the control station step up the potential from 220 volts to 2,300 volts for transmission to the automatic plant, where it is again stepped down to 220 volts to operate the by-pass and needle valve motors.

The three limit switches, *C*, *D* and *E*, are shown in the position when the station is closed down and the by-pass valve wide open. In order to start the automatic plant, the operator in the main station pulls control switch 2, which energizes relay 2′ in the automatic plant, thus operating the by-pass motor in the correct direction to close the by-pass valve. When the by-pass valve is partly closed limit switch *C* makes contact, closing a cir-

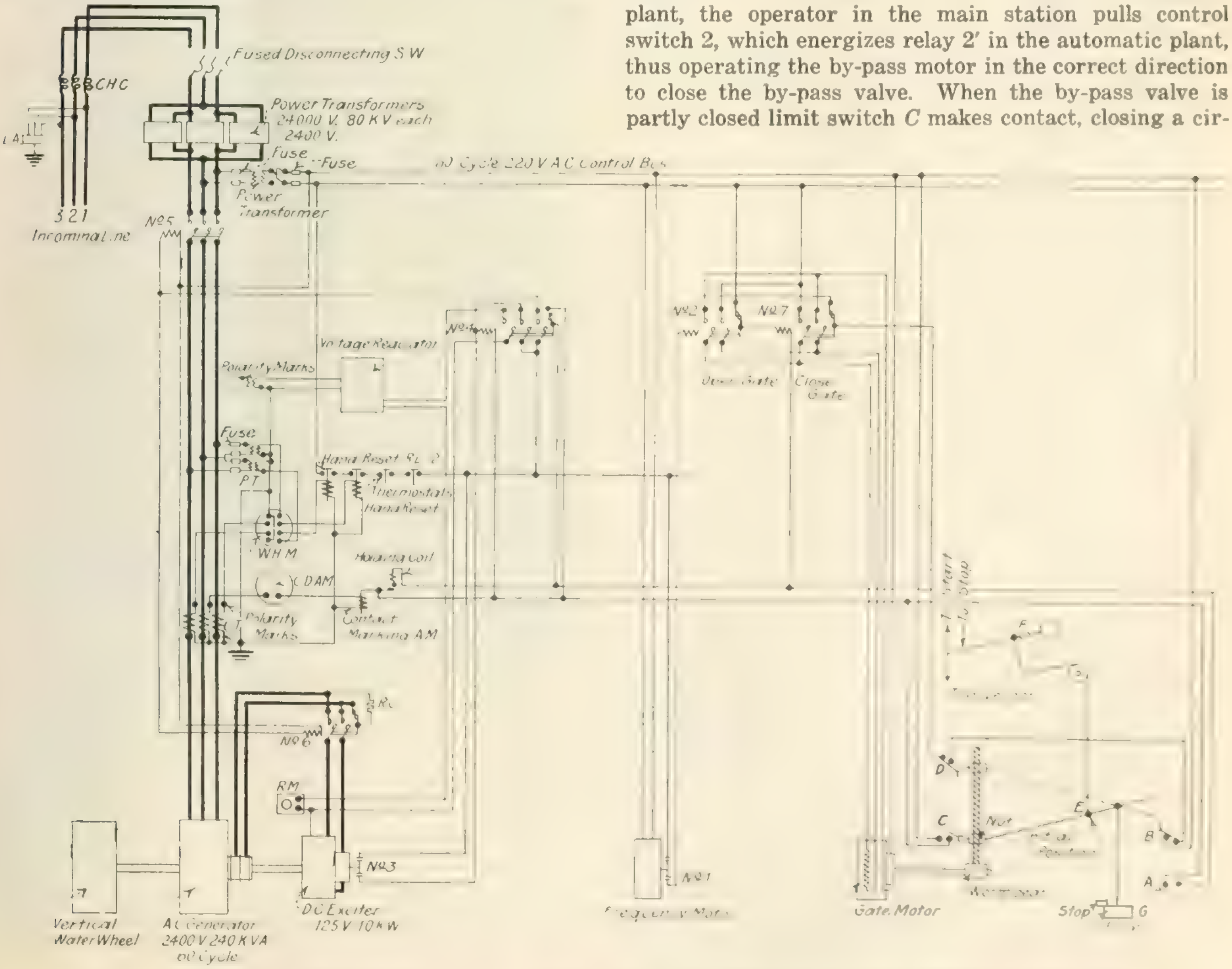


FIG. 2—WIRING FOR HYDRO-ELECTRIC PLANT WHICH WILL AUTOMATICALLY GO INTO SERVICE AT PEAK LOAD

cuit which controls the motor, driving limit switch *D* and its needle valve. The needle valve, which is thus opened, admits water to the waterwheel. By opening control switch 2 the operator may stop the by-pass or needle valves in any desired position.

At stand-still and slow speeds the contracts of centrifugal switch 3 are closed, completing a circuit through relay 4 to close contactor 6. The closing of contactor 6 short-circuits resistance *A*, which is wired in the shunt-field circuit of the exciter, thus allowing the exciter to build up voltage. The voltage regulator 15 is set to hold normal voltage. When the voltage reaches approximately normal value the upper contacts of the contact-making voltmeter 5 open, which removes the short circuit around the coil of contactor 8 and allows it to close, forming a parallel circuit around resistance *A* with contactor 6. From slightly below to 20 per cent above normal voltage the arm of the contact-making voltmeter 5 floats between its upper and lower contacts.

When the generator reaches 80 per cent of synchronous speed the contacts of centrifugal switch 3 open, which gives the control of the equipment to the contact-making voltmeter 5. As soon as the synchronism indicator at the main station shows that the generator is in step, the operator closes oil circuit breaker 9, which connects the automatic plant to the remainder of the system. After the automatic plant is thus synchronized, the load is adjusted by operating control switches 2 and 13 and its value determined by ammeters and an indicating watt-meter.

The limit switches are so arranged that an overlap occurs in the operation between the by-pass valve and the first needle valve and between the first needle valve and the second needle valve. That is, before the by-pass valve completely closes the first needle valve begins to open, and before the first needle valve completely opens the second needle valve begins to open. The reverse operation is obtained during the closing-down period.

If low voltage occurs, owing to a short circuit on the system, contact-making voltmeter 5 operates to drop out contactor 8, thus inserting resistance *A* in the exciter-field circuit, which reduces the generator short-circuit current to approximately normal value. If overvoltage occurs when the automatic plant is not connected to the system, the contacts of the contact-making voltmeter close, dropping out contactor 8, which inserts resistance *A* in the exciter field circuit, thus limiting the voltage of the generator to a safe va'ue by reducing its excitation. In the case of overheated bearings, thermostat relays installed in the bearings cause the station to close down. To prevent overspeed the waterwheel is equipped with deflecting nozzles, which divert the water from the wheel if the speed increases above normal value.

AUTOMATIC EQUIPMENT SOON TO BE INSTALLED

In a proposed automatic system soon to be installed, several low-head water-power plants will be operated. Only one plant, containing one 240-kva., 120-r.p.m., 2,400-volt, three-phase, 60-cycle generator, with a transformer bank to step the potential up to 22,000 volts, is to be installed at the present time.

The automatic station will tie into the transmission system, which is fed by two 150-kva. steam-driven generators. The steam station will be operated at all times, but when the system load demands a greater generating capacity the hydro-electric plant will automatically start. As the water-storage capacity at the several p'ant sites is sufficient only to operate the generators at full load for about two hours, it is desired, when two or more plants are to be operated, to put the station where the pond level is the highest into operation first.

It is assumed in the wiring diagram, Fig. 2, that the high-voltage incoming line is energized; that the load on the steam station is such as to drop the frequency to 58 cycles, and that the water level in the pond is such that limit switch *A* is open and *B* is closed. The frequency motor, which operates at all times, slows down in speed, corresponding to 58 cycles, thereby causing the contacts of its centrifugal switch to close and thus starting the single-phase motor which drives the worm and screw. The screw operates a rigid arm which causes point *E* to move in an upward direction. This movement is transmitted through a flexible cable to the rigid arm *F*, connected to the waterwheel governor by means of a second flexible cable, which operates on a small lever, the movement of which admits oil to one side of the governor piston, causing the waterwheel gate to open.

The waterwheel, with its directly connected generator and exciter, is thus started. When about 90 per cent of synchronous speed is reached the contacts of centrifugal switch 3 close, which cause contactor 4 to close, completing the proper circuits, which, in turn, cause contactors 5 and 6 to close. Thus the generator is connected to full-line potential and the exciter armature to the generator field coils. When contactor 4 closes it also connects the Tirrill regulator across the exciter-field rheostat, causing the exciter to excite the field of the generator, which pulls into step.

The generator, thus properly connected to the bus, carries its share of the system load through the action of the waterwheel governor and maintains the bus voltage at the required value by means of the Tirrill regulator. When the other automatic plants are installed a drop in the system frequently to 58 cycles will cause the contacts of centrifugal switch 1 in all the stations to close and the waterwheels to revolve. Since the position of float *G* depends upon the height of the water in the pond, point *E*, on the arm connecting the float and the threaded nut, takes up different positions for the different water levels in the several automatic plants, and the station where the pond level is the highest is first connected to the line. When it is connected the frequency is raised to normal, which causes contacts 1 in all the automatic stations to open and the motors operating the threaded nuts to revolve in the correct direction to lower the nuts and to close the wicket gates, thus shutting down the waterwheels. This sequence of operation takes place in all the automatic stations except the one which comes on to the line. In this station the load current picks up the contact-making ammeter, which prevents contactor 7 from closing, and thus the station coming on to the line is kept running.

In order that the ponds may not be drained of water, the automatic stations will close down on light load; however, if the automatic station is carrying considerable load when the pond level is low, the float closes limit switch *A*, which shuts down the station. If one station is closed down by low water, another plant starts, provided the load reduces the frequency to 58 cycles.

The generator is protected by overload and bearing temperature relays, which when they operate close down the station. Since each relay is provided with hand-reset contacts, the restarting of the station is prevented until the contacts are reset by hand.

Selecting Electric Haulage Equipment

Factors Considered Are Tonnage, Following Work, Power Supply, Transferring and Maintenance Costs Opinion Divided Between Trolley and Storage-Battery Locomotives in Lake Superior Copper Mines

By R. H. BACON
Formerly Assistant Electrical Engineer Copper Range Company

Tonnage and length of haul are not the vital factors in the electric haulage problems of the copper mines that they are in the handling of coal or iron ore. At the present time the question of selection of equipment is still unsettled as between the storage-battery and trolley types. There are many important factors that enter into a consideration of proper equipment, and the weight given to any item depends on the particular operating conditions. However, the following points must be considered: (1) The necessity for following the work as it advances; (2) the comparative small tonnages to be handled and the fact that grades favor the load; (3) power supply; (4) transferring equipment from one level to another; (5) maintenance costs with unskilled labor.

The battery locomotive is able to follow advancing work to better advantage than the trolley type, and this is particularly important in the case of new openings. However, this advantage is somewhat offset by the fact that ordinary mine labor is fully competent to string trolley and bond track as the work progresses. Mining methods enter into any discussion of this point as a locomotive may operate for months without the necessity for advancing beyond its trolley limits, this being due to the fact that ore is fed down from above by gravity after an extensive opening is once made.

The small tonnage to be handled and the fact that all the loaded hauls are slightly down grade to the shafts make the battery problem comparatively simple. The service from the standpoint of load is therefore not so severe as in other mining fields.

In the Lake Superior district the shafts are 800 ft. (244 m.) to 1,000 ft. (305 m.) apart, and while there are a few vertical shafts the majority are sunk at an angle of from 38 deg. to 70 deg. with the horizontal. Every 100 ft. (30.5 m.) down the shaft a tunnel, or level as it is called in mining parlance, connects with the next shaft over. Depth of shaft is as great as 8,000 ft. (2,438 m.) on this 38-deg. angle. One locomotive will usually handle the rock from any one level, so that it can readily be seen that the total number are spread over a considerable territory when the number of levels becomes as high as eighty or more. In Fig. 1 is shown a typical distribution layout of a part of one shaft.

The unusual depth and the wide distribution of equipment make the question of power supply one of the very important factors. Even at 250 volts the expense of heavy copper feeders is a big item, while at 125 volts it becomes almost prohibitive. In this district as in others there has been some question as to the voltage to be used, owing to the element of danger introduced through the use of 250-volt equipment. Experience in this respect has been varied, one company having operated 250-volt trolley equipment fourteen years without any fatalities, while another company has had several accidents which have been attributed to this cause. The relation between voltage and power supply is important because of the fact that if it is necessary to select 125-volt equipment it is evident that present methods may not answer.

The following methods of power supply are being used or have been tried out: (1) Direct-current plants located on surface and using shaft feeders; (2) direct-current plants located at some central point underground and feeding out; (3) motor-generator sets at every level where locomotives are working.

Plants on the surface and feeding out at 250 volts have given a satisfactory power supply which may be used for either trolley or storage-battery equipment. Locating the main direct-current plant underground at a central point reduces the copper in feeders in case of deep shafts where the workings are all at the lower levels. However, the gain from this is evidently not commensurate with the increased difficulties of supervision, for it means having special operators, whereas on the surface the plant is run as a part of a hoisting plant.

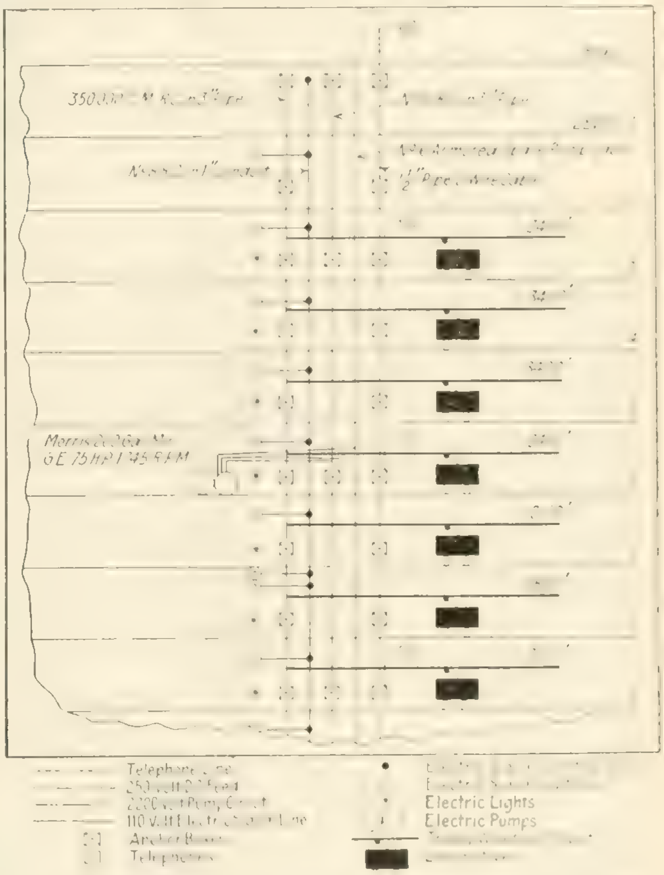


FIG. 1—TYPICAL SHAFT DISTRIBUTION LAYOUT OF A LAKE SUPERIOR COPPER MINE

Motor-generator sets are used in connection with storage-battery locomotives and have for this class of service a distinct advantage due to the close regulation possible with the individual charging set. For 125-volt equipment this has been a very satisfactory solution as

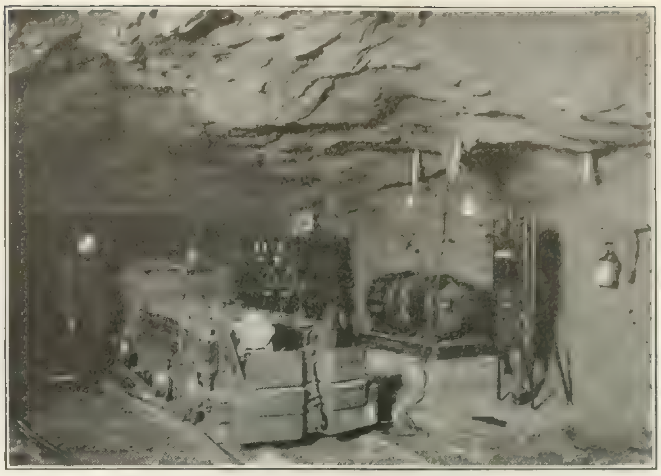
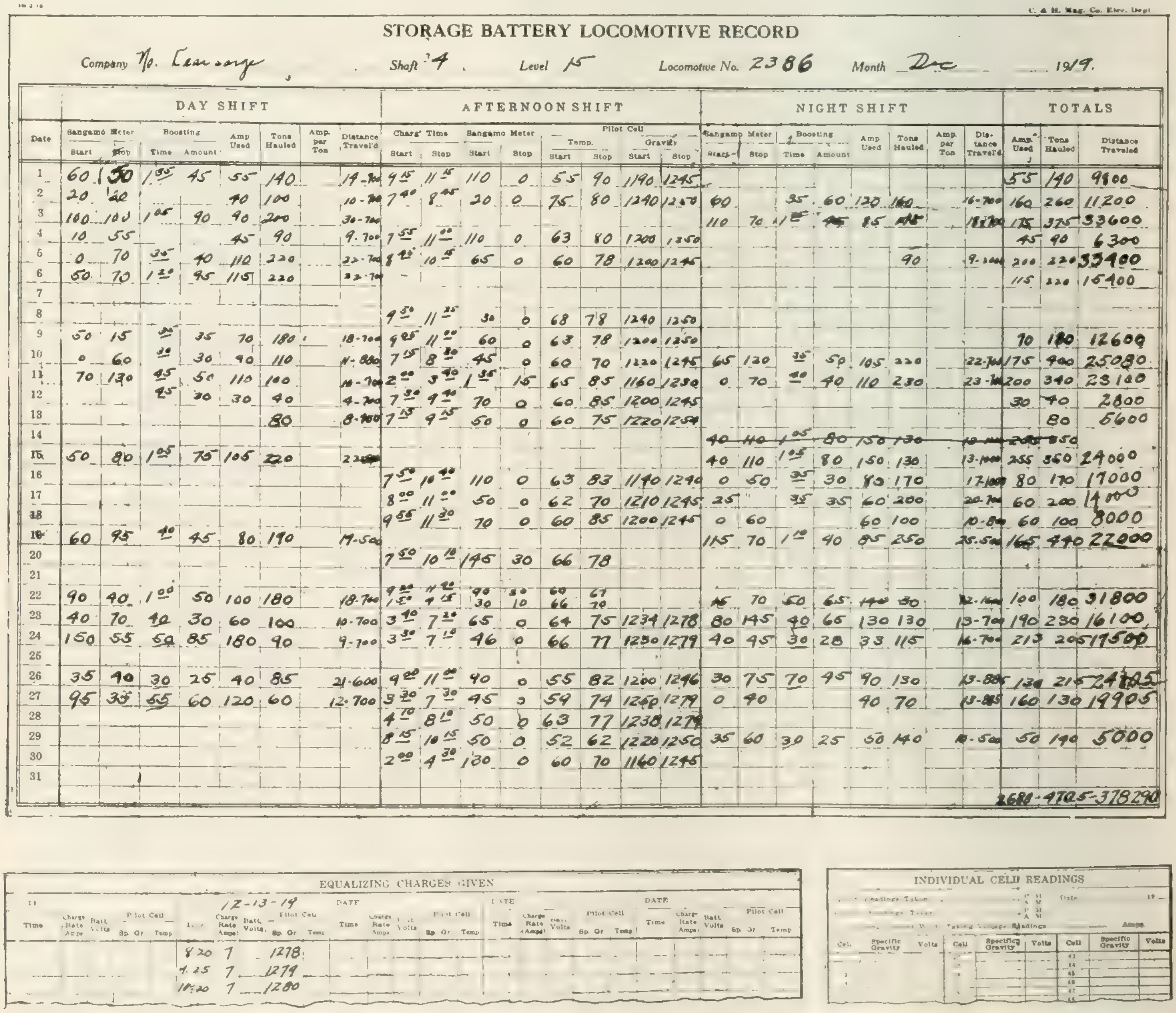


FIG. 2—ONE OF THIRTY-EIGHT UNDERGROUND CHARGING STATIONS USED BY CALUMET & HECLA MINING COMPANY

it has eliminated entirely the question of feeders, since the 2,300-volt motor supply is picked up from other available circuits. As the motor-generator sets are run only for the definite purpose of charging, there may be an actual economy over running a main plant continuously during periods when there may be no locomotives in operation. Transferring equipment from one working location to another is a point that should not be overlooked. In the case of trolley equipment the transfer means the stringing of trolley wires and bonding track. With storage-battery equipment a charging station must be set up, or if charging is done from a feeder, it means the extension of that feeder. The last case, being the simplest, makes the battery type the one preferred. The cost of maintenance with unskilled labor is a factor that has kept a number of companies from considering the storage-battery locomotive. The trolley locomotive requires comparatively little care, and the regular mine labor, accompanied by periodical inspection, keeps things going in good shape. Storage batteries require more exacting care if maintenance costs are to be kept within reason. The Calumet & Hecla Mining Company now has in operation forty-eight storage-battery locomotives and eight 125-volt trolley locomotives



C. & H. Mng. Co. Elec. Dept

STORAGE BATTERY LOCOMOTIVE RECORD

Company No. Kearsarge Shaft 4 Level 15 Locomotive No. 2386 Month Dec 1919.

Date	DAY SHIFT								AFTERNOON SHIFT								NIGHT SHIFT								TOTALS		
	Sangamo Meter		Boosting		Amp Used	Tons Hauled	Amp. per Ton	Distance Travel'd	Charg' Time		Sangamo Meter		Pilot Cell Temp.		Pilot Cell Gravity		Sangamo Meter		Boosting		Amp Used	Tons Hauled	Amp. per Ton	Distance Travel'd	Amp. Used	Tons Hauled	Distance Traveled
	Start	Stop	Time	Amount					Start	Stop	Start	Stop	Start	Stop	Start	Stop	Start	Stop	Time	Amount							
1	60	50	1^{35}	45	55	140		14-700	9^{15}	11^{15}	110	0	55	90	1190	1245									55	140	9800
2	20	20			40	100		10-700	7^{40}	8^{45}	20	0	75	80	1240	1250	60		35	60	120	160		16-700	160	260	11200
3	100	100	1^{05}	90	90	200		30-700									110	70	1^{25}	~~45~~	85	[illegible]		18-700	175	375	33600
4	10	55			45	90		9-700	7^{55}	11^{00}	110	0	63	80	1200	1250									45	90	6300
5	0	70	^{35}	40	110	220		22-700	8^{20}	10^{15}	65	0	60	78	1200	1245						90		9-300	200	220	33400
6	50	70	1^{20}	95	115	220		22-700	–																115	220	15400
7																											
8									9^{50}	11^{35}	30	0	68	78	1240	1250											
9	50	15	^{35}	35	70	180		18-700	9^{25}	11^{00}	60	0	63	78	1200	1250									70	180	12600
10	0	60	^{30}	30	90	110		11-880	7^{15}	8^{30}	45	0	60	70	1220	1245	65	120	^{35}	50	105	220		22-700	175	400	25080
11	70	130	45	50	110	100		10-700	2^{00}	3^{40}	1^{35}	15	65	85	1160	1230	0	70	^{40}	40	110	230		23-700	200	340	23100
12			25	30	30	40		4-700	7^{30}	9^{40}	70	0	60	85	1200	1245									30	40	2800
13						80		8-700	7^{15}	9^{15}	50	0	60	75	1220	1254										80	5600
14																	~~40~~	~~110~~	~~1^{05}~~	~~80~~	~~150~~	~~130~~		~~10-1000~~	~~255~~	~~350~~	
15	50	80	1^{05}	75	105	220		22-[illegible]									40	110	1^{05}	80	150	130		13-1000	255	350	24000
16									7^{50}	10^{40}	110	0	63	83	1140	1240	0	50	^{35}	30	80	170		17-1000	80	170	17000
17									8^{00}	11^{00}	50	0	62	70	1210	1245	25		^{35}	35	60	200		20-700	60	200	14000
18									9^{55}	11^{30}	70	0	60	85	1200	1245	0	60			60	100		10-800	60	100	8000
19	60	95	^{40}	45	80	190		19-500									115	70	1^{10}	40	85	250		25-500	165	440	22000
20									7^{50}	10^{10}	145	30	66	78													
21																											
22	90	40	1^{00}	50	100	180		18-700	9^{00} 1^{50}	11^{20} 4^{15}	90 30	80 10	60 66	67 70			45	70	50	65	140	30		[illegible]	100	180	31800
23	40	70	40	30	60	100		10-700	3^{40}	7^{20}	65	0	64	75	1234	1278	80	145	40	65	130	130		13-700	190	230	16100
24	150	55	50	85	180	90		9-700	3^{30}	7^{10}	46	0	66	77	1250	1279	40	45	30	28	33	115		16-700	213	205	17500
25																											
26	35	40	30	25	40	85		21-600	9^{00}	11^{00}	40	0	55	82	1200	1246	30	75	70	45	90	130		13-885	130	215	24105
27	95	35	55	60	120	60		12-700	3^{30}	7^{30}	45	0	59	74	1260	1279	0	40			90	70		13-885	160	130	19905
28									4^{10}	8^{10}	50	0	63	77	1238	1279											
29									8^{15}	10^{15}	50	0	52	62	1220	1250	35	60	30	25	50	140		10-500	50	140	5000
30									2^{00}	4^{30}	130	0	60	70	1160	1245											
31																											
																									2688-	4705-	378290

EQUALIZING CHARGES GIVEN

DATE					12-13-19					DATE					DATE					DATE				
Time	Charge Rate Amps	Batt Volts	Pilot Cell Sp. Gr	Pilot Cell Temp	Time	Charge Rate Amps	Batt. Volts	Pilot Cell Sp. Gr	Pilot Cell Temp	Time	Charge Rate Amps	Batt Volts	Pilot Cell Sp. Gr	Pilot Cell Temp	Time	Charge Rate Amps	Batt Volts	Pilot Cell Sp. Gr	Pilot Cell Temp	Time	Charge Rate Amps	Batt Volts	Pilot Cell Sp. Gr	Pilot Cell Temp
					8 20	7		1278																
					4.25	7		1279																
					10:20	7		1280																

INDIVIDUAL CELL READINGS

Readings Taken P.M. A.M. Date 19

Readings Taken P.M. A.M.

Taking Voltage Readings Amps.

Cell	Specific Gravity	Volts	Cell	Specific Gravity	Volts	Cell	Specific Gravity	Volts
						43		
						44		
						45		
						46		
						47		
						48		

FIG. 3—PERFORMANCE RECORD OF A STORAGE-BATTERY LOCOMOTIVE

This loose-leaf ledger sheet is filled out monthly for every locomotive in operation. The tables showing equalizing charges and individual cell reading are on the back of the locomotive-record sheet.

of the 4-ton size. Each of the thirty-eight charging stations (see Fig. 2) includes a bank of three 10-kw., 2,300-440-volt transformers. The motor-generator sets are rated at 20 kw. and 1,500 r.p.m. for 25-cycle sets and 1,800 r.p.m. for 60-cycle sets. Trolley locomotives are operating in one of the newer developments and are supplied by a motor-generator set feeding from the surface.

Since battery equipment is handled by unskilled labor the performance of these machines has been studied very closely, as shown by the monthly record of Fig. 3. This chart shows the typical operating conditions for this class of haulage. Mining operations are actually under way during the day shift from 7 a.m. to 3:30 p.m. and during the night shift from 8 p.m. to 4:30 a.m. The afternoon shift is the time for repair work and is available for charging if necessary. It will be noted that it is very seldom necessary to take advantage of this time. The record of charging is entered in this particular section, but as a rule two or three hours are taken out of the regular shift. In this way the regular motorman does the charging.

The Copper Range Company has forty-one 4-ton, 250-volt trolley locomotives in operation. Power is supplied by three direct-current plants, each consisting of a motor-generator set and a steam-driven generator. Shaft feeders are employed to feed the locomotives, the largest being 350,000 circ.mils with a ground return, as is the case in most of the Lake Superior district work. The greatest working depth is about 3,400 ft. (1,036 m.). Routine inspection is followed very carefully, inspectors filling out blanks that are filed in the office for a permanent record. Locomotives are brought to the surface for complete overhaulage every two to three years. The cost of this overhauling is about $150 per locomotive at the present time.

The Quincy Mining Company is operating twenty-nine 4-ton, 250-volt trolley and eight 5-ton, 125-volt storage-battery locomotives. Power is supplied by direct-current plants on the surface. One plant contains two 100-kw. motor-generator sets and the other a 50-kw. set. This company originally operated a plant underground fed by a two-phase, 2,200-volt circuit consisting of four No. 1 rubber-covered wires in an armored cable. On moving the plant to the surface this circuit was paralleled and used for the 250-volt direct-current feed with a ground return. Other feeders are of 300,000-circ.mil rubber-covered wire in pipe. This company operates to a depth of about 7,400 ft. (2,590 m.) on a 58-deg. incline.

Storage batteries are charged from the 250-volt circuit by means of a charging panel on each locomotive and the use of an automatic disconnecting device. Some difficulty has been experienced with loss of batteries through explosions due to the idle curiosity of miners to see what was going on inside at the time of charging. An open-flame carbide lamp is used by the miners, and when this flame is thrown in a battery at the time of charging the resulting explosion bulges out the sides of the Edison cells. This happening is unusual, but it shows the sort of things against which it is wise to take precaution.

By the use of ordinary mine labor for stringing trolley and bonding track this expense has been reduced to a minimum in the installation of trolley locomotives. The cost of this work, as handled by one company, has varied from $160 per 1,000 ft. (305 m.) to $300 per 1,000 ft. during the past five years. When a working level is abandoned this material is salvaged and used again. Bonding is not so important in this class of work since the native-copper-bearing ground has a high carrying capacity. In a great many cases single-rail bonding has given good service when the calculated voltage drop for the single rail would have been excessive.

Energy for operating trolley equipment at the plant has been calculated to be 1.6 kw.-hr. per ton-mile in a plant supplying twenty-six locomotives with an average haul of 1,800 ft. (549 m.) and 3 kw.-hr. per ton-mile in a plant supplying ten locomotives with an average haul of 1,100 ft. (335 m.).

Experiences in Correcting Telephone Interference

How Troubles Caused by Parallels, by Failure of Power Line Equipment and by Electric Furnaces May Be Corrected

BY HOWARD S. PHELPS

DISCUSSION of a number of cases of telephone interference which have been observed in Iowa are given in this article in the hope that the experience may be valuable in other parts of the country. These experiences include the type and character of the exposures and circuits involved, together with an analysis of the disturbing factors and remedies employed in reducing the interference. These have been roughly arranged according to the character of the exposure and the difficulties. In this discussion references to the allowable amount of noise on a toll or long-distance line indicate the amount of noise discernible on such a circuit which, while quite audible, is not sufficient to render difficult a conversation over a connection on a copper line 200 miles (320 km.) in length. This has been taken as 200 noise units. On a rural circuit an allowable amount which will not seriously interfere with its exchange connections or connections to other lines of the same type has been taken as 500 noise units.

Case No. 1 involved a 33,000 volt, three-phase power line of right-angle, triangular configuration having a static wire at the fourth point of the square. It paralleled for 13 miles (21 km.) a phantomed telephone group at an average separation of 50 ft. (15 m.). Five cross-overs within the parallel made the exposure very complicated and irregular. With the electric line energized, with no transpositions in the power line and with regular cross-talk transpositions in telephone circuits, the induction from the balanced components was about 1300 noise units while the disturbance from residuals was very low. A co-ordinated transportation scheme was designed and the telephone circuits were retransposed so that the induction on the circuits was equalized.

However, several errors were made in the location and in the turn of the power transpositions and the inductive effects of the conductors were not properly neutralized. This gave about 500 noise units. The power transpositions were then corrected and the noise was reduced to about 100 units. A phantom telephone circuit which is built up of two regular circuits is much more susceptible to outside influences than a regular circuit, because any unbalance or difference existing between the two circuits tends to equalize itself by flowing through the terminal equipment of the phantom circuit.

In case No. 2 a 33,000-volt, three-phase transmission line which parallels a toll circuit for 6 miles (9 m.) at a separation of 40 ft. (12 m.) was transposed at the time of construction. The disturbance on the telephone circuits was about 100 units. However, when the blade of an open-air knife switch on another transmission line fed from the same transformers became loose and vibrated, establishing an arc on that phase, the disturbance created on the parallel telephone circuits was such that they could not be used at all until the trouble had been cleared. In other cases similar to this the trouble was traced once to a partly defective transformer bushing and once to grounds in the switchboard wiring.

DISTURBANCES FROM ELECTRIC FURNACE LINES

In case No. 3 a 13,200-volt, three-phase line with horizontal construction, conductors unevenly spaced, parallels a heavy, high-grade toll lead for 17 miles (27 km.) at a separation of 55 ft. (17 m.). This particular lead feeds into two towns for regular lighting and power loads. However, a second lead of the same voltage furnishes power for a large two-phase arc furnace through a Scott-connected transformer. A large amount of disturbance has been experienced on the communication circuits from the effects of the peculiar wave forms and harmonics generated by the action of the furnace. These irregularities pass through a bank of transformers connected closed delta at the generating station onto the common 2300-volt busbars and out again through another bank of transformers connected closed delta to the other transmission line which is involved in the parallel. It has been found that co-ordinated transpositions placed in both power and telephone lines reduced the effects of the balanced components or transverse induction to a large extent and to some degree the effects of the residuals, but the results were not sufficient to be satisfactory. It was also found that dividing the station busbars and feeding the two transmission lines from separate generators removed the real main cause of trouble to the telephone circuits, as the induction, with the furnace not in operation, after co-ordinating the transpositions was not severe. It is believed that other reductive measures would be effective, but so far these have not been tried out. These might consist of the employment of resonant shunts at the furnace which would short-circuit the disturbing frequencies, or of the use of a motor generator set at the furnace to prevent any of the irregular characteristics from passing out on to the line.

Case No. 4 involved a 13,200-volt, single-phase tap off a three-phase line paralleling rural lines for several miles which still created considerable interference after being transposed. A one-to-one ratio transformer was cut in where the single-phase line connected to the three-phase system, and as a result it was found that practically all of the differences in the capacity of the line were kept off of the exposed section and the connecting lines were quiet. So far apparently transient troubles on the power system have caused no disturbance on the exposed rural lines.

In case No. 5 a joint telephone and power lead about 1 mile (6 km.) in length carried five open-wire metallic exchange circuits 6 ft. (1.8 m.) below two arms on which operated two sets of three-phase, 2300-volt primaries operating in closed delta. The telephone circuits alone were specially transposed for the exposure. For some time little induction was experienced on the communication lines and the condition appeared to be satisfactory. However, all at once all of the lines which had any connection whatever with the joint lead became very noisy. Investigations showed the entire power system operating satisfactorily. The open wires exposed in the joint lead were receiving a very high induced voltage to ground so that it was impossible to work upon them with comfort. The secondary distribution system, which had a grounded secondary, showed high potential differences between all grounding points, and high potentials existed even between separated points of the earth. By means of a potential transformer and voltage readings of the different phases to ground it was found that one of them was quite heavily grounded. Final investigation showed the insulation broken down in the starting compensator of a 2300-volt, three-phase motor. This motor had been operating constantly all of the time since the trouble started, so had given no intimation of there being trouble at that point.

In another case, No. 6, a 13,200-volt transmission system, consisting of two single-phase lines brought from two transformers connected open delta and carried for about 1 mile on three wires before separating, caused a very large amount of disturbance on all grounded telephone circuits which were working on the same highways. A fourth conductor was added from the station to the separation point, and both single phases were brought in independently to the transformers, which had also been separated from each other on the line side. This reduced the noise to about 600 units. By the use of 1-mile transposition barrels in the power line the disturbance was reduced to 250 units.

CAREFUL ARRANGEMENT OF SERIES STREET LIGHT CIRCUIT

Case No. 7 was one in which series street lighting and 220-volt, three-phase electric circuits were forced on a joint lead on account of trees for about one mile with high-grade long-distance telephone circuits. This arrangement created such a disturbance that telephone service was badly affected. Improvement was made by so rearranging the power circuits that the conductors of the three different phases occupied adjacent pin positions, and the series circuit was rearranged so that both sides of the circuit were on the same side of the telephone lead and occupied adjacent pin positions. The telephone circuits were retransposed according to a special scheme designed to fit the exposure. The result of the work was a reduction of the interference from 700 to about 125 noise units. It might be mentioned here that investigations show that series arc-light circuits cause more than twice the disturbance on exposed communication circuits that incandescent lights do under the same conditions.

This discussion is abstracted from a paper read by the author before a recent meeting of the Iowa Section, N. E. L. A.

RECENT figures concerning the available water power from streams rising in the hills known as the Japanese Alps, of which Mount Fuji is the most famous, place it at 1,930,000 hp., or one-third the total available water power in Japan. Use has thus far been made of 54,000 hp. in the region referred to.

Handling Coal by Using Belt Conveyors

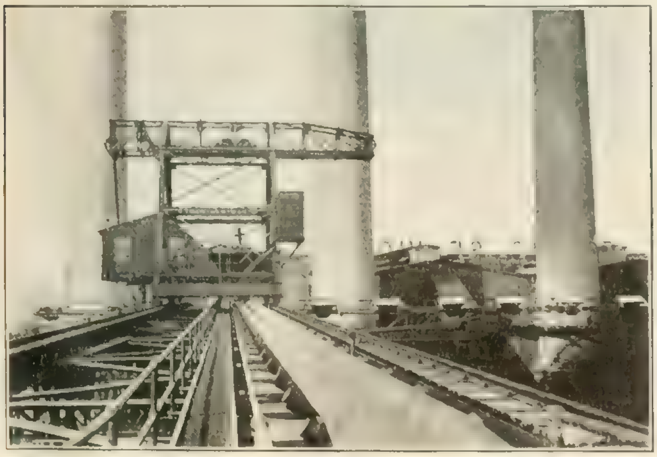
Considerations That Have Influenced the Selection of This Type of Equipment in Modern Plants—Examples from Installations Now Being Completed in the Middle West and the East

COAL-HANDLING EQUIPMENT OF THE MARION (N. J.) STATION OF THE PUBLIC SERVICE ELECTRIC COMPANY OF NEW JERSEY

IN SMALL plants it is usually conceded to be cheaper to pay for shovelers than to buy mechanical coal-handling equipment. Their labor is usually most efficient when it can be used on coal handling part of the day and on ash handling the remainder. However, in most central stations which require more than 50 tons per hour it will usually be found more economical in the long run to use mechanical coal-handling apparatus, especially in the face of present labor prices.

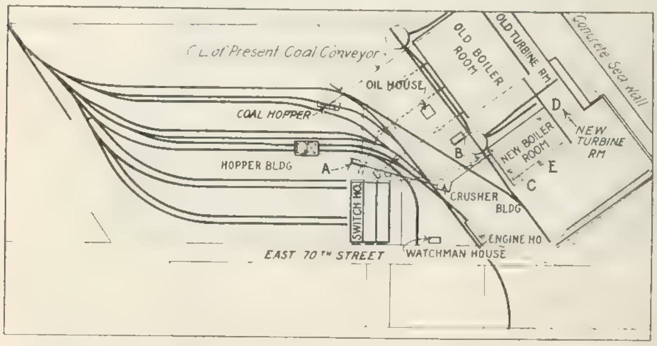
The problem is to decide what type of coal-handling equipment will be bought and not whether labor can supplant mechanical means. Bucket carriers, belt conveyors, cranes equipped with buckets, flight conveyors and skip hoists in their various forms and sometimes in combinations are the equipments from which the choice can be made. At the present time the belt conveyor seems to be gaining in prominence. Several central stations now building or just completed have selected belt-conveying equipment for their new plants. A large factor in this choice is that electric transmission has developed so that the plants can be built away from the center of the city and where space is available for belts. When plants were built near the load center real-estate prices and the physical limitation of property lines were thought to preclude the use of belts. Moreover, belts were not then being actively advocated by any manufacturers. Since then ways have been devised of getting belts into very limited space.

The limiting capacity of belt carriers is about 2,000 tons an hour with present standard apparatus. With bucket carriers the size of the material to be handled is

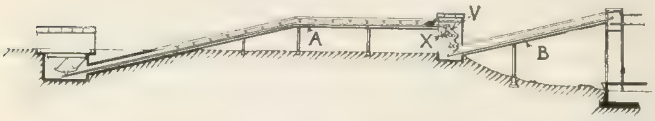


TRAVELING TOWER EQUIPPED WITH BUCKET FOR RECLAIMING COAL AT MARION STATION

PARALLEL TRUNK-LINE CONVEYORS AT MARION THAT FEED CONVEYORS RUNNING OVER BUNKERS an important element, as is also the height of the lift. Authorities differ as to limiting heights, but pin pressures become large enough to cause concern at around 75 ft. to 100 ft. (22.5 m. to 30 m.). The largest central-station installations now operating have capacities of about 200 tons an hour. Important features of such equipment are that it is housed entirely within the building and that the same carrier can be used for handling both coal and ash. There is a growing tendency to do away with this dual use of equipment, however, because handling abrasive ash increases the cost of maintenance. The modern idea seems to be to use the bucket carrier for the coal and to discharge ash directly into railroad cars if possible. The comparative costs of belt and bucket apparatus are difficult to judge for general cases because local conditions play so large a part. It is quite true that if only machinery costs were to be considered the belt equipment would be comparatively inexpensive, but when the space, the permanent housing and the support structures are all considered there is little or no saving in first cost. Maintenance data are misleading unless all actual conditions surrounding the use of the equipment are known. There are installations of both kinds of apparatus on which maintenance has been surprisingly low over a long term. The users of belts claim, however, that for power-plant work, where ease of repair is essential, belts are superior. This is because a belt usually shows sufficient signs of wear to enable it to be easily repaired before it actually breaks and because belt splices can be made in less than one hour. Failure of bucket-carrier apparatus should be detected by adequate inspection. It is only when this equipment falls that serious results follow, for then its own weight destroys much of it. The wisdom of replacing sections of partly worn chain is a questionable practice. A completely new chain is usually more economical.



PLAN OF CLEVELAND ILLUMINATING COMPANY'S COAL-HANDLING FACILITIES



CROSS-SECTION OF CONVEYOR SHOWN IN PLAN OF CLEVELAND ILLUMINATING COMPANY

The skip hoist and the flight conveyor are lesser competitors for central-station attention than the belt or bucket apparatus. For certain applications, however, the skip hoist is meeting with favor. Where space is very limited and where low initial cost is a large factor it is successful. A skip hoist with a 1-ton bucket will deliver 60 tons of coal an hour over a 100-ft lift. If it is used on coal alone, maintenance cost should be low. Control schemes that have been worked out to use with skip hoist make it easy to operate. The flight conveyor usually finds application where inclines are too steep for belts, that is, where angles greater than 17 deg. to 20 deg. to the horizontal are encountered. Cranes equipped with buckets are usually worked out for special applications where conditions such as periodic high water and the like are to be contended with.

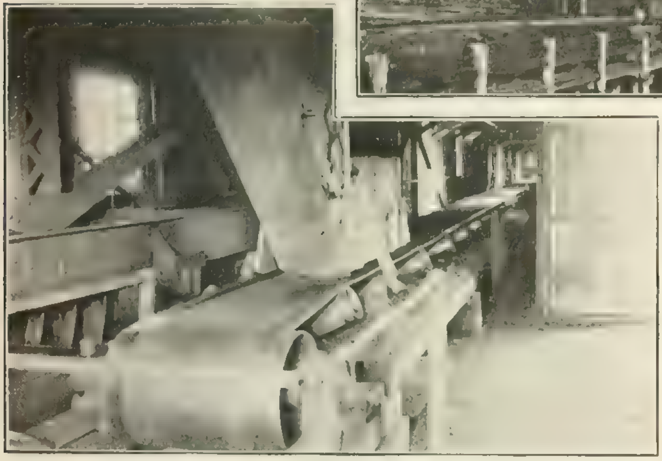
Coal Handling Should Be Considered in Broadest Sense

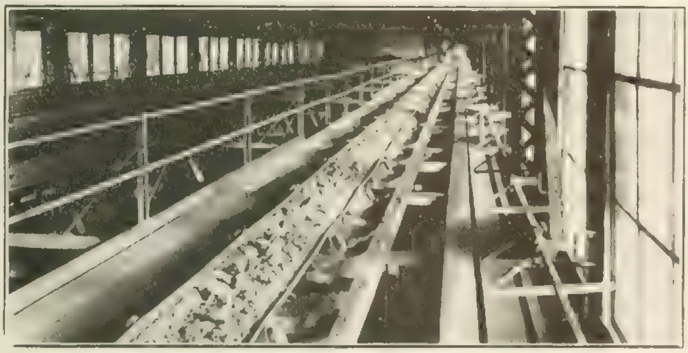
As has been indicated, there is a tendency for central-station engineers to pay more attention to the equipment that lifts the coal to the bunker than to any other part of the coal-handling equipment. It is thought that this method of thinking sometimes operates to the detriment of the central-station company and that greater consideration of the problem as a whole would be preferable. If this is done, the proper relation between the unloading plant, reclaiming apparatus, coal-preparation equipment, hoisting mechanism, etc., will be the better appreciated. In order to show definitely what these relations are in modern plants, discussions of a few of the newer installations are given. These include the 1918 addition to the Lake Shore station of the Cleveland (Ohio) Electric Illuminating Company, the new station of the Lorain County Electric Company, Elyria, Ohio, and the Acme Power Company of Toledo. A few facts about a larger installation at the Marion plant of the Public Service Corporation of New Jersey are also included.

The Cleveland installation is a good example of how a large job may be worked out. While for the present it will serve only a 50,000-kw. addition to the station, it will eventually be able to handle other plant extensions also. For this reason its rated capacity of 350 tons an hour may appear large at first glance. Generally speaking, the equipment consists of two 150-ton track scales placed over a 30-ft. x 40-ft. x 12-ft. (9-m. x 12-m. x 4.2-m.) track hopper with two outlets which were dug about 550 ft. (165 m.) from the plant. The track hopper is made of steel plate lined with tile. The only apparatus in the pit beneath the hopper is a duplex shaking feeder with its 15-hp. driving motor installed beneath the two openings to feed the coal uniformly to the belt conveyor "A." This belt, driven by a 75-hp. motor, carries the coal at a speed of 350 ft. per minute (1.75 m. per second) to the preparation plant between the hopper and the plant. This idea of concentrating all coal preparation apparatus at a single point and in a building above ground is thought to be excellent practice. Unless lack of space makes it necessary, it is believed by some companies to be poor engineering to locate coal-preparation equipment in the pit beneath the track hopper.

Coal Preparation Plant at Cleveland

The preparation plant consists of two grizzlies and two 36-in. x 48-in. (90-cm. x 120-cm.) adjustable crushers driven by a single 150-hp. motor with arrangements to bypass fine coal that does not need preparation. For instance, if run-of-mine coal is received, conveyor "A" will discharge onto single grizzly "V." This grizzly will take out all coal under 4-in. (10-cm.) lump. The oversized coal goes to the upper crusher. The coal passing through the single grizzly is delivered onto the eight-shaft grizzly marked "X." All material under ¾ in. (1.8 cm.) will pass through this grizzly and the oversized material will join the material coming from the upper crusher and will be delivered into the lower crusher. The product from the lower crusher and that passing through the eight-shaft grizzly will be delivered onto conveyor "B."





COAL-HANDLING APPARATUS AT FIFTY-NINTH STREET STATION OF INTERBOROUGH RAPID TRANSIT COMPANY, NEW YORK

Top, general view of towers from which barges are unloaded by buckets.

Left center, conveyor running from dock to power house.

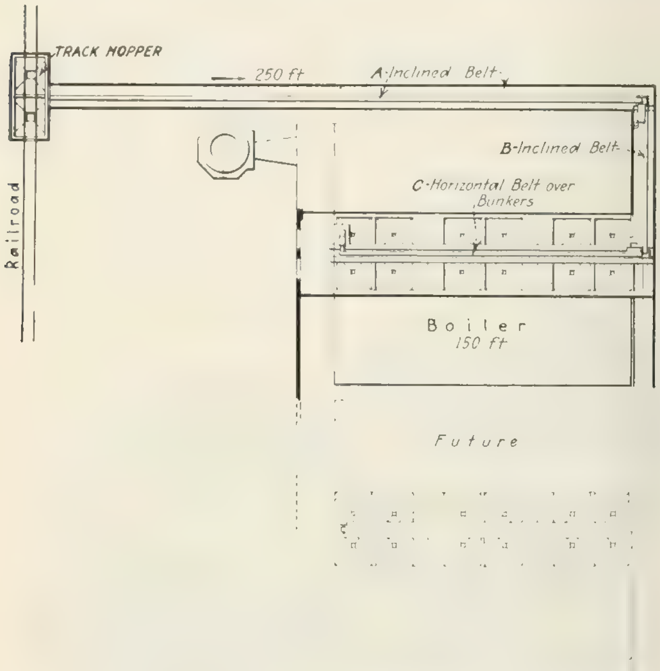
Right center, one of the inclined conveyors running to the top of the station.

Bottom, belt conveyor over bunkers

When stocker-size coal is received a removable plate will be placed over the single grizzly; flopper gates will be raised and the coal conveyor "A" will, therefore, pass directly onto conveyor "B" without operating the two crushers or the grizzlies. In the event that the upper crusher is not operating, then one flopper gate will be raised and all the material passing over the single and eight-shaft grizzlies will be delivered direct to the lower crusher. In the event that the lower crusher is not to operate, then the other flopper gate is turned so that the material coming from the upper crusher and from the eight-shaft grizzly will bypass the lower crusher. All the conveyor belts outside the building are housed in substantial structures inclosed with corrugated asbestos board, which was available at the time when corrugated iron was not. Precast concrete slabs were used as flooring materials under the belt to catch dirt. The belts operate on standard idlers and are driven by rubber-covered pulleys. Once inside the building, the coal can go either straight ahead to feed one row of boilers or can be turned at right angles over conveyor "C" to feed the second row of bunkers under conveyor "E." Automatic self-propelling trippers are installed on conveyors "D" and "E." All of the belts were bought 36 in. (90 cm.) wide in the interests of standardization. When the plant is extended more conveyor belts parallel to "D" and "E" will be added and "C" will be extended to feed them. On the belt "B" a 50-hp. motor is used and on belts "C," "D" and "E" a 25-hp. motor for each.

One of the features of the Cleveland installation is the location of the track hopper. It is so placed that the unloading point for incoming coal is central with relation to the yard. The amount of tail track and head track being about equal reduces the switching charge to a low figure. Another feature is the coal-preparation plant, which is notable for its completeness. It is believed that the idea of more carefully preparing coal to a proper size will grow. The Cleveland installation is also notable for its large capacity. The company had had quite favorable experience with coal-conveying belts, however, and felt justified in installing equipment for the ultimate plant. The operating engineers of the company stated that the greatest trouble they had ever had with belts came in very cold weather when the coal was inclined to slide on the belt at the point where it was loaded. This was easily overcome by sweeping a small amount of water onto the belt. It froze there and roughened the surface. Molasses was also tried, but water was more successful. Proper feeding conditions will also overcome slippage. The ash is discharged through industrial cars that are unloaded into skip hoists which elevate the ash into overhead steel tanks.

The installation of the Lorain County Electric Company will illustrate the case of a smaller plant built where space for conveying equipment was comparatively limited. The equipment will handle 100 tons of coal an hour. Here the coal is received in standard cars, from which it is dropped into a track hopper. In this case the 30-in. x 36-in. (50-cm. x 90-cm.) crusher, driven by a 30-hp., 720 r.p.m. motor, is installed beneath the track hopper. Limitations imposed by space made this necessary. In this case it was not so objectionable, since the contour of the ground made it necessary to excavate only a little for the crusher pit. Moreover, the installation of the crusher bin insured preparation of all coal before it went on the belts. This effected a saving in size of equipment. The shaking feeders in this pit are driven by a 15-hp. motor. Conveyor "A," which elevates the coal nearly to the top of the power house, is about 265 ft. (80 cm.) long and rises at an angle of about 16.7 deg. It is driven at a speed of 315 ft. per minute (1.5 m. per second) by a 15-hp. motor. Coal drops by gravity from conveyor "A" to conveyor "B." These belts operate at right angles to each other. Conveyor "B," which is about 65 ft. (1.9 m.) long and rises at an angle of 18 deg., is driven by a 7.5-hp. motor. When the coal falls on the conveyor "C" it has gone through a complete reversal of direction of travel. It is this arrangement that has helped save space. Conveyor "C" is about 130 ft. (39 m.) long and is driven by a 7.5-hp. motor. In all cases 20-in. (50-cm.) belts are used and spur-gear speed reducers are employed between the motors and the rubber-covered driving pulleys.



SCHEMATIC LAYOUT OF COAL-HANDLING EQUIPMENT OF LORAIN COUNTY ELECTRIC COMPANY

The use of these speed reducers is one of the features of the Lorain job. They permit the use of high-speed motors and are expected to eliminate noise and to reduce maintenance cost, as they operate submerged in oil. In commenting on the selection of belt conveyors for the Lorain plant one of the engineers said: "Belt conveyors were installed rather than other types because, like centrifugal pumps, they are coming more and more into power-plant work on account of their low maintenance cost.

"By means of belt conveyors large carrying capacity is combined with low power consumption. Belts usually take 50 per cent of the power used by other conveyors. So the problem of the engineer is really to see whether or not belt conveyors can be employed as all things are in their favor."

UNIT PLAN ADOPTED AT TOLEDO PLANT

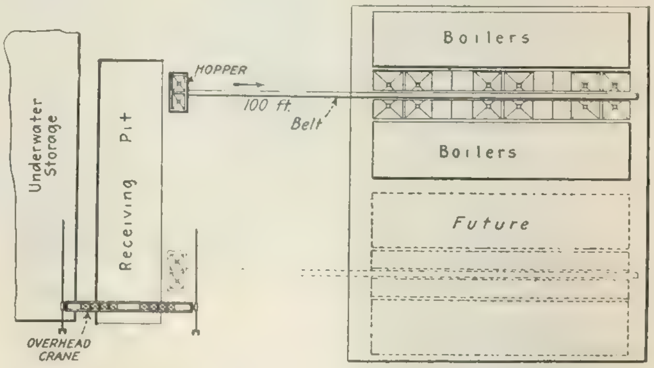
At the Toledo plant of the Acme Power Company the conveying equipment as well as the remainder of the station will be installed on the unit plan. The underwater storage, the receiving pit and the overhead crane or cranes will be used in common for all banks of boilers.

The remaining equipment, including the elevated hopper, shaking feeder, crusher, belt and tripper, will be installed as a unit for each battery. Each unit will be rated at about 125 tons per hour. The belt will be 24 in. (60 cm.) wide and will rise for a distance of 110 ft. (33 m.) at an angle of 15 deg. The level stretch over the bunker is about 270 ft. (81 m.) long. A Merrick weight meter is installed on the belt. A feature of this installation is that it is laid out on the unit plan and all apparatus has been kept well above ground.

MARION, N. J., HAS ELABORATE INSTALLATION

The Marion plant of the Public Service Company of New Jersey is an example of a more elaborate installation. The storage yard lies on a plot of ground parallel to the boiler room. Coal from barges or railroad cars is carried by inclined-belt conveyors and delivered to trunk-line belt conveyors, both of which run parallel to the boiler house. The trunk-line conveyor delivers to five belt conveyors over the coal bunkers, each of which is equipped with an automatic tripper for discharging the coal. Reclaiming is accomplished by a 3-ton grab bucket, operated by the traveling tower carried on the top chords of the bridge, as shown in the illustration on page 835.

The trunk-line conveyors are reversible and are equipped with double trippers to permit unloading the coal in whichever direction the conveyor belt may be running. An extension to the trunk-line conveyor parallel to the storage pile makes it possible to receive the reclaimed coal at any point along the storage pile. The conveying system at this plant is thought to be extremely flexible. Coal may be sent simultaneously from both barges and cars to the bunkers and to the storage field. It is possible to send coal to the bunkers from barges, cars and storage and also to store reclaim coal at the same time. All of the equipment is electrically operated.



LAYOUT OF COAL-HANDLING EQUIPMENT OF ACME POWER COMPANY

Synchronous Motor Starting Problems—I

Effect of Applying Direct-Current Excitation While Starting by Induction-Motor Action
Development of Theory of "Pull-In" Torque and Fundamental Equation for Same
Advantage of Direct-Connected Exciter or Automatic Switching

By **E. E. GEORGE**
A. L. Drum & Company, Philadelphia, Pa.

IN THE ELECTRICAL WORLD of March 1, 1919, the writer discussed the procedure advisable in starting synchronous motors as induction machines. In that article the statement is made that for simple, safe and sure starting of a standard modern machine the field circuit should be excited from the armature of a direct-current generator or exciter driven by the synchronous motor. Such a connection produces a motor magnetization roughly proportional to the square of the speed. The basis for such procedure involves, in addition to the factors considered in the above article, the peculiar effects of direct-current excitation at speeds below synchronism.

The ability of a synchronous motor to start and to pull into synchronism with a heavy load is a highly valuable quality, and its physical basis should be understood by designers and operators. The speed-torque curve of a synchronous motor has four critical points, the lowest of which limits the capacity. The induction-motor torque at zero speed may be too low. The highest speed reached by the motor without excitation may not be near enough to synchronism to take advantage of the accelerating torque supplied by direct-current excitation, which torque, if applied at the proper point during the slip cycle, increases exponentially as the speed approaches synchronism. The direct-current torque may not be high enough, with regard to rotor inertia, and load inertia, and resistance, to swing the speed up to synchronism. The design of the magnetic circuit may be such that the machine cannot hold the load at synchronous speed after reaching there with it.

This last condition is that of synchronous motor action only and has long been well understood. The first and second are conditions of induction-motor action which are well understood theoretically, although designers have been content until recently to equip a synchronous motor with a "squirrel-cage" winding that would start the motor only when practically unloaded. The torque characteristics of the latest development—double windings—are admirably presented in a series of articles by Theodore Schou in the ELECTRICAL WORLD of April 26 and May 3, 1919.

This article will analyze the third condition—the effect of direct-current excitation at sub-synchronous speeds. A variety of opinions on this subject will be found in print. Some manufacturers say that the application of excitation reduces the starting torque, others say that it does not affect it, while yet others advise the early application of excitation when starting heavy loads. One prominent author states that a synchronous motor cannot attain synchronism except by the help of external torque. This statement, however, was made before the advent of the oscillograph or of the self-excited synchronous motor now furnished commercially in fractional horse-power sizes by certain manufacturers. Other authors state that the hysteresis effect pulls the rotor into synchronism, although it is evident that the hysteresis loss is zero at synchronous speed for sinusoidal wave forms on a balanced polyphase circuit. Many engineers believe that the unequal distribution of magnetic material in a spool-wound rotor is the only factor to be considered in accounting for pull-in torque. This effect is sometimes considerable, but a slot-wound rotor also has a pull-in torque which cannot be explained by varying magnetic reluctance.

TORQUE DUE TO DIRECT-CURRENT EXCITATION

The torque due to direct-current excitation can be resolved into two components—one a *continuously negative torque,* varying only with the speed, and one an *alternating* torque, of slip frequency, varying sinusoidally with the space, in pole pitch, or electrical measure, between the rotor and stator magnetic field axes, but with a distortion of *time* form due to the pulsation in velocity and change in average velocity.

It is evident that hysteresis, eddy current and induction-motor effects cannot steadily accelerate the rotor to synchronism, because the friction and windage losses increase with the speed and the above effects approach zero toward synchronism. We shall neglect the tendency in spool-wound rotors, whether excited or not, for the unequal distribution of rotor iron to cause a periodic distortion of the air-gap flux tangentially, with a synchronizing torque, due to the longitudinal tension of the flux possessing a tangential component. This effect increases as the slip decreases, but is usually only significant on motors starting with light load and almost reaching synchronism from the induction torque alone.

From the above it is seen that the ordinary self-starting synchronous motor, without excitation, will run at an induction speed, ω_e (usually within 2 per cent of synchronism). The angular velocity from zero to ω_e will at all times increase as a linear function of the difference between the accelerating torque and the load-and-loss torque. Forced oscillation cannot take place, as there is no appreciable pulsating or alternating component in the torque of a polyphase induction machine, and we will assume that the loss and load torques are constant, or a linear function of some power of the rotor speed, ω_m. Free oscillation cannot take place until the rotor is excited, as free oscillation requires a periodic interchange of potential and kinetic energy. That is, when at a location of zero potential a body must have a velocity different from that of its source of potential. It is evident that a force which is a function of velocity alone, and not of space position, is a non-conservative force, so that a body cannot possess potential energy by reason of its velocity being different from its stable or steady value. Polyphase induction-motor torque is not a function of a space position or angle, so there can be no hunting or surging of rotor velocity. Accordingly, the rotor will accelerate smoothly to a constant induction speed, ω_e, and run there as long as the effective torque remains zero. The application of excitation introduces a continuously negative component, which merely lowers the speed slightly, and an alternating component, which produces an oscillation in rotor velocity, consisting in general of a free and a forced vibration.

Chances of Reaching Synchronous Speed When Field Switch Is Closed

Neglecting all forces except inertia and this alternating torque component, the effect of excitation may be studied under three general cases. The upper and lower limits of the pulsation in velocity may be anywhere between zero and synchronous speed, ω_g. Both limits are a function of the exciting current I_d, the speed ω_e when excitation is impressed, and the angle ρ_e between the rotor and stator magnetic field axes when excitation is impressed.

Case I.—Under the most favorable condition: With $\rho_e = \pi/2$ and I_d such that the natural frequency of vibration of the rotor is in resonance with the slip $(\omega_g - \omega_e)/2\pi$ the speed will increase to synchronism exponentially in one bound. Although, as shown later, the time of reaching synchronism is theoretically infinite, the slip decreases to one-tenth of its initial value $(\omega_g - \omega_e)$, in less than one initial slip cycle $t = 2\pi/(\omega_g - \omega_e)$. In this case the rotor reaches synchronous speed gradually and there is no pulsation in velocity or primary current afterward, as is sometimes noticed in starting.

Case II.—Under less favorable conditions the velocity may not reach synchronism but pulsates isochronously as an elliptical function of the rotor space angle ρ_m. The time-average value may be above or below ω_e, and the average rotor velocity is accordingly higher or lower than before impressing excitation.

Case III.—Under some conditions I_d may be greater than necessary to just swing the velocity up to ω_g exponentially, and it will reach ω_g in a finite time less than one initial slip cycle, and with a surplus of potential energy such as to initiate a free vibration of natural frequency about synchronous speed. Losses usually damp out this vibration in a few seconds. The pulsation in primary current due to this pulsation in velocity after pull-in is often noticed in starting, indicating that the moment of impressing excitation was not as fortunate as it could have been.

When ρe is between 90 deg. and 270 deg., the initial torque is positive, and the first "half" cycle of velocity pulsation will be above ω_e. When ρ_e is between 270 deg. and 90 deg. (or − 90 deg. and + 90 deg.) the first "half" cycle will be below ω_e. Except when ρ_e is 0 deg. or 180 deg., the first and second "halves" of the cycle are not equal in time duration, amplitude or time-average value. If ρ_e is between 0 deg. and 180 deg., the positive cycle will have a greater amplitude and duration than the negative, and the average velocity will increase above ω_e. If ρ_e is between 180 deg. and 360 deg. (or − 180 deg. and 0 deg.), the negative cycle will have the greater amplitude and duration, and the average velocity will decrease below ω_e. When ρ_e is 90 deg. the duration and length of the negative cycle will be zero. When ρ_e is 270 deg. the length and duration of the positive cycle will be zero. Except when ρ_e is 270 deg., there is always a value of I_d high enough to swing the velocity up to synchronism at the peak of the positive "half" cycle. Any greater value of I_d will bring the velocity up to synchronism ahead of the positive peak value, and the excess of energy will cause it to overshoot the mark and oscillate about ω_g with a circular harmonic vibration at natural frequency.

With I_e constant, the vibrations about ω_e are isochronous—the time of a *whole* cycle, measured from (ρ_e) to $(\rho_e + 360$ deg.$)$, is constant—and the amplitudes are constant, so that the speed must reach synchronism during the first positive "half" cycle of pulsation if it ever does. When I_e is just sufficient (for the given value of ρ_e) to bring the velocity to synchronism, the curve of time against rotor angle is a $\log_e$ tangent curve of $[(\rho_m/4) + (\pi/8)]$ and is asymptotic to $\rho_m =$ 270 deg. The curve of time against slip is likewise exponential, being a hyperbolic secant curve, and tangent to $(\omega_g - \omega_m = 0)$ at infinite time. However, ρ_m reaches 260 deg. in less than one initial slip cycle, so that pull-in may be considered practically completed. The slip decreases to 0.086 of its value at ω_e, in one initial slip cycle, so that synchronous speed may be considered practically attained. The aforesaid value of I_d may be denoted as the exponential or asymptotic value. When $\rho_e = 90$, the asymptotic value of I_d is a minimum and may be called the "critical" value.

As the excitation flux of a synchronous motor is limited by magnetic saturation as well as by the maximum excitation voltage, and the limit of this flux may be the limiting condition of starting torque, it is essential to utilize I_d to the best advantage; that is, to use the critical value. *In other words, a synchronous motor will start more load if excitation is impressed when the axis of the rotor magnetic field is 90 deg. behind that of the stator than for any other rotor angle.* This value of ρ_m is easily located in practice. The induced current in the field windings is a function of the angle ρ_m. $i_a = -\sqrt{2}\, I_a \cos \rho_m$. When $\rho_m = 90$ deg. the induced current is zero and approaching a positive value. If the field circuit is closed, through a discharge resistance, before excitation, an ammeter in the field lead will read this induced current. A zero-center meter is preferable. The direction of reading for direct-current excitation should be considered positive. The field switch should be thrown from the resistance side to the power side just as the current passes through zero to a positive value. The switch should not be thrown until the machine has reached its maximum induction speed for that load, which will be denoted by the time of the needle swings becoming constant. The excitation current should be proportioned to the load to be started. If too little is used, the line current will pulsate violently, and the field ammeter needle will oscillate with a much longer duration of time on the positive swing than on the negative, indicating that the machine is not "pulling in." If too much excitation be used, the line current will pulsate violently, but the field ammeter needle will oscillate with equal-timed positive and negative swings. Of course, after excitation the axis of the swings will be at some positive value and not at zero on the meter, owing to the superposition of the direct excitation current on any induced current. Equal-timed swings indicate that the machine is oscillating about synchronous speed. Because of losses these free oscillations usually die out quickly, while forced oscillations due to insufficient excitation continue unchecked. After the speed is steady, the excitation can be adjusted to bring the power factor to the desired operating value.

The foregoing summary is strictly true only where the load resistance is negligible compared with its inertia, where the impedance between the motor and the generator is large, where the initial slip is very small, and where the excitation current reaches its final value instantly. However, the procedure outlined is satisfactory for many practical cases. For other cases the best value of ρ_e may be found by experiment. The time constant of the rotor field circuit may be very large (comparable with the time of an initial slip cycle) and the torque will be a function of $(1 - e^{-\alpha t})$ $(-\cos \rho)$ instead of $(-\cos \rho)$. ρ_m is also an exponential function of t, when ρe is 90 deg. Without solving the differential equation for the case of appreciable field inductance, it may be deduced from the principle of least work that the *equivalent* value of ρ_e will be more favorable than the actual value as the effect of ρ_e approaches zero, because the torque at ρ_e approaches zero with high field inductance.

The general effect of high load torque, low line impedance, powerful squirrel-cage windings and the flux transients due to variations in the rotating field is to make the torque a function of $(\cos^2 \rho)$ instead of a function of $(-\cos \rho)$. In other words, the torque tends to become high and of long duration when it is positive and low and of short duration when it is negative, so that the value of ρ_e is not as important as in the theoretical case, where the positive and negative torque angle wave forms are symmetrical. (This does not imply that the torque-time, time-angle or velocity-time curves are symmetrical.)

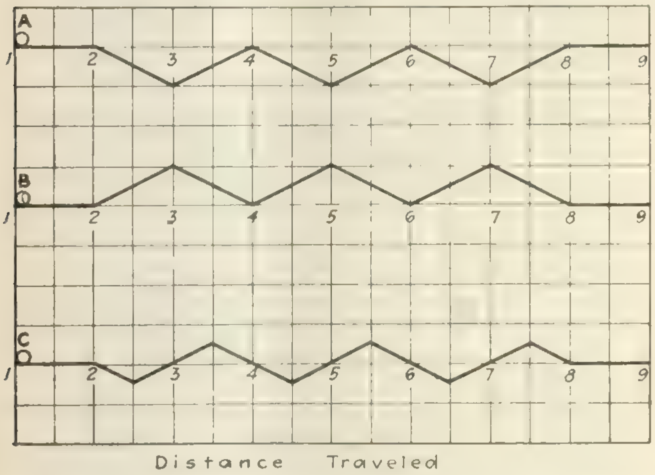


FIG. 1—VARIATION IN AVERAGE VELOCITY CAUSED BY ALTERNATING TORQUE IMPRESSED AT DIFFERENT PHASES

VALUE OF AUTOMATIC SWITCHING

In starting heavy loads the slip at maximum induction speed on 60-cycle circuits may be so high that it is difficult to shift a double-throw field switch manually at the proper point of the slip cycle. A polarized current relay, with a suitable time limit, in the field circuit may be set to trip at the desired point of the slip cycle after the frequency has dropped low enough to let the time limit operate. The contacts on the relay may control the solenoid-operated field switch. On large high-voltage machines, the field switches should be double-pole, double-throw oil circuit breakers, for other reasons, and these can easily be adapted to automatic control. In the issue of March 1, 1919, the writer described the relay wiring for making the change-over to running voltage automatic. This change-over should be made after excitation has been introduced and after the pulsation in the field circuit has entirely ceased.

Because so little is generally known as to the effect of the slip angle at excitation upon the "pull-in," the average operator pays no attention to it, and often also changes over to running voltage without even glancing at the line or field ammeter to see if the machine is in step. To his mind the starting operation is successful if the breakers stay in and the machine stays on the foundation. He notices that sometimes the speed comes up without a jar and the meter needles slide gently over to their final position, while at other times the rotor vibrates as if it was badly out of running balance and the line and field ammeter needles hammer both stops a while before settling down to final position. Or, occasionally, the machine refuses to come into step, or the breakers trip out, and he has to start all over again, usually with a different setting of the exciter rheostat. The operator need not be blamed for all this. The installation or operation engineer has had no data and could get none from the manufacturer's test engineer to instruct the operators properly—or to provide automatic control for difficult switching.

ADVANTAGE OF USING DIRECT-CONNECTED EXCITERS

If the field be excited from a generator whose speed is proportional to that of the motor, and the field be connected to the generator armature *before* starting the motor, ρe has no meaning, and the highly satisfactory results known to be obtained in practice with this method can only be accounted for on the theory that the principle of least work operates to let the speed reach synchronism in the shortest possible time and without an excess of potential energy.

If the motor were excited from a source of constant voltage, the continuously negative torque component (which is proportional to the speed and to the *square* of the exciting current) would either prevent the rotor from starting or would hold the speed so low that the alternating component could not produce an appreciable pulsation in speed.

Because the torque is a linear cosine function of the rotor angle ρ_m and has symmetrical positive and negative values, it may be difficult to see how the value of the integral of the velocity-time curve over a slip cycle can have almost any value, depending upon ρ_e. Fig. 1 illustrates the variable effect of an alternating acceleration and deceleration upon an otherwise constant velocity. Consider three *frictionless* trains A, B and C (represented by a single wheel) *coasting* at equal velocity on three level tracks between points 1 and 2. Arriving at the point 2 at the same moment, they encounter a series of equal grades in each track. A first meets a down grade sufficient to double its velocity by the time it reaches point 3. It loses its increase in velocity above ω_e on the upgrade to point 4. This continues till it reaches point 8, when it proceeds on the level track at its original velocity ω_e. However, its average velocity between points 2 and 8 has been $1\frac{1}{2}$ ω_e, as it varied from ω_e to 2 ω_e. Considering B, it first meets an upgrade sufficient to reduce its velocity to zero by the time it reaches point 3. It gains its original velocity on the way to point 4. Its average velocity is $\frac{1}{2}$ ω_e, as it varies from 0 to ω_e. The average velocity of C is ω_e, as it varies from $\frac{1}{2}$ ω_e to $1\frac{1}{2}$ ω_e. A will be the first to reach 8, and B the last, although they started at the same time and ended on the same level they started on.

This discussion will be completed in an early issue of the ELECTRICAL WORLD.

Readers' Views and Comments

Electric Drive for Deep Oil-Well Drilling

To the Editor of the ELECTRICAL WORLD:

SIR: In the ELECTRICAL WORLD for March 20 I note an item on page 692 referring to electric drilling of oil wells to depths of 3,900 ft. to 4,000 ft. In California several wells have been successfully drilled to these or greater depths by electric power. There is not only no question about the practicability of this method but it is even more successful than drilling with steam engines.

The Shell Company of California has drilled three wells in the Montebello field in Los Angeles County to depths of 3,600 ft., 3,800 ft. and 4,200 ft., respectively, and the same company in the Ventura County field has drilled one well to a depth of 4,200 ft. and another to a depth of 4,412 ft. Joseph B. Dabney has drilled another well in Ventura County to a depth of 3,800 ft. At the present time, in Ventura and Los Angeles Counties, there are at least twenty-two electrically driven oil-well drilling rigs in operation by ten different oil companies, in territory varying in depth from 2,500 ft. to 4,500 ft. All of these drilling motors are rated at 75 hp.

Notwithstanding the above facts, in the mid-continent and Texas oil fields there are many oil men who doubt the practicability of electric drive for drilling in deep territory, but this is due partly to their being unaware of the developments in California and largely to the fact that they are naturally extremely conservative and consequently slow to adopt any variation from the old-established methods. W. G. TAYLOR.

Schenectady, N. Y.

Better Salaries for Young Engineers

To the Editor of the ELECTRICAL WORLD:

SIR: I was interested in the editorial on "How Manufacturing Companies Can Teach the Teacher," printed in the ELECTRICAL WORLD of March 13. This aspect of the relation between manufacturing companies and technical schools touches upon economic considerations. Certainly the teacher, at present rates of pay, cannot afford to accept such offers as are now being made by certain companies to come to their factories to spend a month or more in studying their products.

My interest in the above article, however, was rather from the standpoint of our students—meaning all technical graduates. The starting wages offered to them are too low. These young men spend a great deal of money and from four to six or more years preparing to take up work in the engineering profession. After graduation they are offered from $90 to $100 per month—emphasis being placed upon the "experience pay" which is considered by the employer as part of the man's compensation. It is true that this experience is very helpful to the man. He may be likened to a sponge—he quickly absorbs the engineering theories and facts that go to make him a competent engineer. But is it not equally true that the employer should recognize that this man has spent money and time for the benefit—potentially, if not primarily—of the concern with which he associates himself? And if this is recognized, certainly the period following the absorption should bring a salary not based on the starting wage. Unfortunately, the employer often seeks to encourage prospective employees by a reference to the fact that certain bright young men after a few years' experience have "doubled their initial salaries!" Which means that a trained professional engineer receives $180 (more or less)—considerably under the average wages paid monthly to the skilled mechanic.

The present year, as the graduation period approaches, brings every indication that our seniors will find plenty of jobs. Salaries from $100 to $200 per month are available. In general, the "experience" positions are considered more desirable by both faculty and students. We must recognize, however, that under the present scheme of wage adjustment the "experience" job means a lower wage—not temporarily but permanently.

The employer can do much to gain public recognition of the value of the engineer. He can do much to encourage the teacher in his honest attempts to produce qualified technical men. But where and when is the start to be made? C. D. FAWCETT.

Philadelphia, Pa.

Graphite Versus Amorphous Carbon Electrodes for Electric Furnaces

To the Editor of the ELECTRICAL WORLD:

SIR: In the discussion on electric furnaces by H. L. Hess on page 497 of the Feb. 28 issue of the ELECTRICAL WORLD the statement is made in the first paragraph that the Hess Steel Corporation of Baltimore considers the direct-arc type of electric furnace the most satisfactory for refining. The comment which I have to make is on the sentence which reads: "In addition, relatively little radiated heat is absorbed by the walls and roof, particularly if carbon electrodes are used, because they have an 'umbrella' effect that partially shades the roof and walls and forces the heat downward."

Our experience has shown that the slow oxidation of graphitic carbon results in graphite electrodes tapering very little near the bath, and the shape is blunt rather than sharply pointed as with amorphous carbons. The diameter of graphite electrodes at the point is much larger in proportion than the point of the carbon electrode for which it is substituted. Therefore the "umbrella" or protecting effect to the roof claimed for the larger-diameter carbon electrodes is of small advantage. During the melting-down period the cold scrap is dark and absorbs heat rather than reflects it. It is only during the refining period, when the metal is molten, that reflection damages the roof materially. The slightly increased area of the carbon electrodes as compared with graphite electrodes as a protective effect is so small that it is not worth considering. The greater distance of the arc from the side walls and the increased strength of the roof between electrode holes using graphite electrodes are of much greater advantage.

If the arc playing from the bottom of an electrode remained continually at the center, some protection from reflection might be experienced; but it is well known that the arc jumps from one point to another at various angles and probably 95 per cent of the time is playing from the periphery of the electrode. For this reason there is reflection from the arc to the roof even when using large electrodes.

Experience has shown that the side walls of the furnace are damaged with large carbon electrodes in the holders. By using graphite electrodes the arc plays at a greater distance from the side walls and their life is increased.

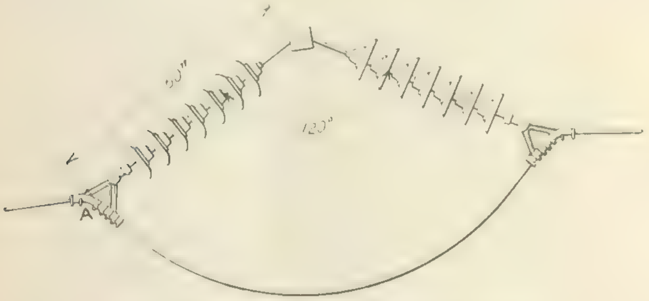
The life of the roof depends almost entirely on its strength between electrodes, as this is the area which burns out and weakens first. Using the smaller-diameter graphite electrode gives the greatest possible distance between roof holes and strengthens the roof, so that an increased life is the result.

LYMAN C. JUDSON.
Acheson Graphite Company, Niagara Falls, N. Y.

Electrical Stress on Insulators at Strain Towers

To the Editor of the ELECTRICAL WORLD:

SIR: I was very much interested in the article of "Analysis of Insulator Practice" in the March 6 issue of the ELECTRICAL WORLD. On page 546 I note a paragraph which contains this statement: "While no company has admitted the belief, it is likely that some are still influenced by the old theory, not yet disproved, that a dead-end point is subjected to unusual electrical stresses."



INSULATOR STRINGS AT A STRAIN TOWER

Consider the circuit formed by the strain insulators and conductor loop at a strain tower as shown in the illustration. Assume a No. 0 conductor, 0.324-in. diameter and 84-in. spacing. The conductor makes between the two strain clamps a circular arc of one-third turn and besides passes through the strain clamp at A, which is in effect passing through a tube of iron. The choking effect of such an arrangement is well known qualitatively, but it is difficult of evaluation quantitatively. This effect I will dismiss with the simple statement that it adds to the reflecting power of the transition point.

For the 60-cycle current the reflecting power of such a transition point is entirely negligible, but consider for a moment a traveling wave of high frequency running upon the line. The reflecting power of such a transition point for waves of very high frequency has been studied rather carefully, and the effect of such a point is not difficult of evaluation. It is well known that the effect of a transition point wherein the square root of L/C increases is to produce a standing wave at that point in the transmission line fed by the incoming traveling wave and that the reflection takes place without reversal, causing a peak of potential at or near the transition point. The traveling wave may be a wave of voltage between the conductor and ground, between the conductor and any one other conductor, or between the conductor and the other two conductors, but in any case the phenomenon is the same in a qualitative sense. For quantitative evaluation we will take the wave running simply on the conductor considered alone.

The inductance of the one-third turn may be evaluated by means of Maxwell's or Kirchoff's formulas and for the conditions assumed is 833 CM (1 henry $= 10^9$ CM) with an arc length of one meter.

The inductance of a straight conductor to a traveling wave is $L = l(\frac{1}{2} - 2 \log_e{}^r)$, wherein l is the length of conductor and r is the radius of conductor and L the coefficient of self-induction, all expressed in CM. For the cable under discussion per meter length this gives 88.6 CM.

The capacitance between the wire and neutral per meter length is:

$$C = \frac{0.0388^2}{1609 \log_{10} \frac{b}{a}}$$

(where b = distance between wires, centers and a = radius of conductor)

$$= 8.88 \times 10^{-6} \text{ mf.,}$$

and this is the same for the meter length of loop as the spacing does not change.

Summarizing:

$L = 88.6 \times 10^{-6}$ millihenries.
$C = 8.88C10^{-6}$ mf.
$L_1 = 833 \times 10^{-6}$ millihenries.
$C_1 = 8.88 \times 10^{-6}$ mf.

Mr. Cohen has shown[1] the relations between the incoming, reflected and transmitted waves at a transition point.

In this case we can consider the transition point as a lumped inductance transition, and we have:

$$\frac{A_1 - A_2}{A_1} = \frac{2\left(\frac{L_1}{\sqrt{LC}} - \frac{\sqrt{LC}}{C_1}\right)}{\left(\frac{L_1}{\sqrt{LC}} - \frac{\sqrt{LC}}{C_1}\right) \quad \sqrt{\frac{L}{C}}},$$

which, when the substitutions are made, gives:

$$\frac{A_1 - A_2}{A_1} = 1.79.$$

This simply means that to the normal frequency voltage stress on insulators in such positions we may have added 179 per cent of any high-frequency traveling-wave voltage that may be started on the line. As is well known, the effect of such combined high and normal frequency waves is to give a stress on the insulating apparatus equal to the sum of their individual stresses. Thus it will be seen that, even neglecting the choking effect of the iron strain clamp completely surrounding the conductor, the electrical duty of the line unit of a string of insulators in the usual strain-tower arrangement is greater than the duty of the end unit of a suspension string on the same line. I think the fact that the selection of an insulator string involves a careful study of the duty of the unit next the line is too often lost sight of.

While the actual accuracy of such an evaluation is, of course, questionable, still in a general way it will indicate the fact that there is an increased duty placed on the end unit of a string in a strain position.

W. D. A. PEASLEE,
Electrical Engineer Jeffery-Dewitt Insulator Company,
Huntington, W. Va.

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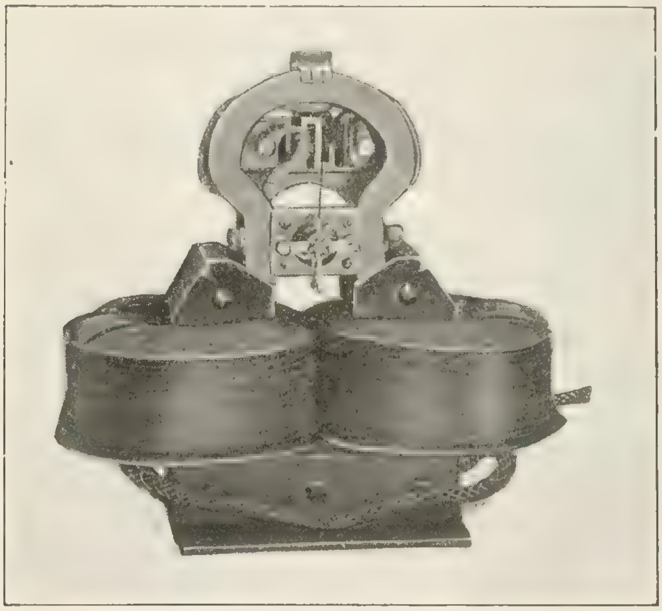
[1] Reprint of Publication No. 114, Bureau of Standards, Washington, D. C., Feb. 27, 1909.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Filings in Meter Avoided by Magnetizing After Assembly

TO AVOID the trouble caused by the presence of filings in the air gap of a meter the device shown here is used to magnetize the meter after assembly. By employing the device the meter may be assembled before its magnets are magnetized, and hence the magnets hold no filings to stop the free swinging of the moving coil. After the meter has been assembled and blown free from dust it is placed on the electromagnet and the electromagnet coils are energized from a 240-volt direct-current circuit for an instant.



MAGNETIZING METER AFTER ASSEMBLY

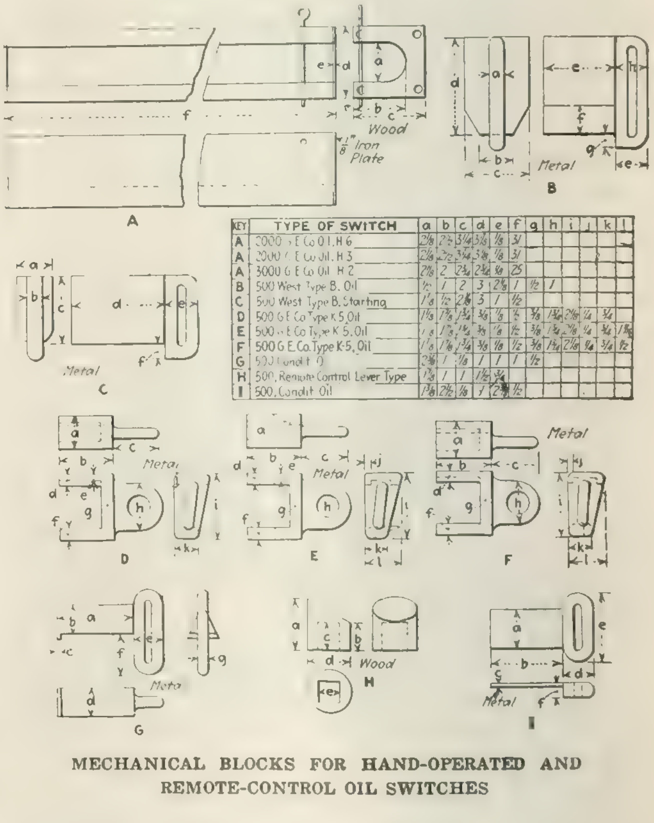
Orange, N. J. VICTOR H. TODD.

Station Accidents Prevented by Use of Switch Blocks

SAFETY for central-station workmen and protection of equipment which is being installed or repaired can be guaranteed only by the enforcement of an exact and careful system that will affect all workmen and operators. Of course, the system has to be developed according to the needs of each station, but the main object everywhere is to prevent the energizing of circuits on which men are working. In Philadelphia the system is briefly as follows: After an examination of the apparatus to be repaired the department which is to do the work reports to the load dispatcher the equipment involved, the nature of the work and its probable duration. The load dispatcher determines the necessary blocking and enters this information on a permit card. He then directs the operators at all stations involved to do the necessary blocking. The operator at the station where the work is done makes a copy in duplicate of the load dispatcher's permit and gives the original to his assistant, who blocks the necessary equipment and hands the permit to the workman. Then, assured that all stations have properly blocked the circuits involved, the load dispatcher directs the work to commence.

Oil switches and their control switches are blocked mechanically. The knife switches of the control circuit are opened and tagged with a red blocking tag. Potential transformer fuses are opened and tagged to prevent energizing the apparatus through the insertion of a plug in a meter receptacle.

In one station all compartments are locked, with but one key to each compartment. A green indicating lamp which burns only when the oil switch is open is installed in each disconnecting-switch compartment so as to be visible through the wire-glass door panel. After opening the disconnecting switches red blocking tags are attached. Where necessary the precautions of grounding or short-circuiting are taken.



KEY	TYPE OF SWITCH	a	b	c	d	e	f	g	h	i	j	k	l
A	2000 G.E.Co. Oil, H 6	2 1/8	2 1/2	3 1/4	3 1/8	1/8	31						
A	2000 G.E.Co. Oil, H 3	2 1/8	2 1/2	3 1/4	3 1/8	1/8	31						
A	3000 G.E.Co. Oil, H 2	2 7/8	2	2 3/4	2 1/4	1/8	25						
B	500 West Type B, Oil	1/2	1	2	3	2 1/8	1	1/2	1				
C	500 West Type B, Starting	1 1/8	1/2	2 1/8	3	1	1/2						
D	500 G.E.Co. Type K 5, Oil	1 1/8	1 7/8	1 3/4	3/8	1/8	1/2	3/8	1 3/4	2 1/8	1/4	3/4	
E	500 G.E.Co. Type K 5, Oil	1 1/8	1 7/8	1 3/4	3/8	1/8	1/2	3/8	1 3/4	2 1/8	1/4	3/4	1 1/8
F	500 G.E.Co. Type K-5, Oil	1 1/8	1 7/8	1 3/4	3/8	1/8	1/2	3/8	1 3/4	2 1/8	1/4	3/4	1/2
G	500 Condit Oil	2 3/8	1	1/8	1	1	1	1/2					
H	500, Remote Control Lever Type	1 1/8	1	1	1 1/2	3/4							
I	500, Condit Oil	1 3/8	2 1/2	1/8	1	2 3/8	1/2						

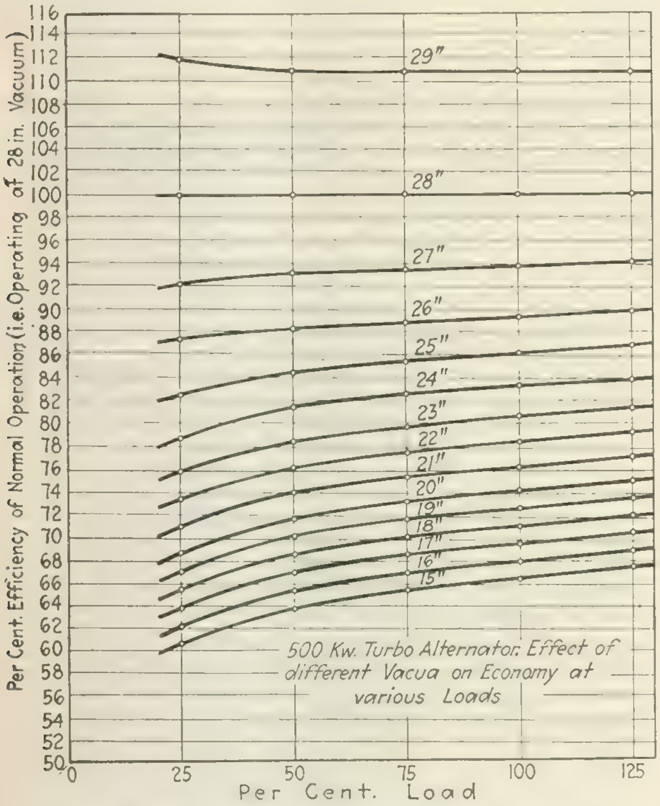
MECHANICAL BLOCKS FOR HAND-OPERATED AND REMOTE-CONTROL OIL SWITCHES

In case more than one department is working on the apparatus, separate permits are issued and separate red blocking tags are used. No tag is removed until all departments have reported "Clear" and the load dispatcher orders the removal of all blocks and restores the equipment to service. **Walter C. Wagner.**

Philadelphia, Pa.

Economy Falls 11 Per Cent When Vacuum Drops Two Inches

Eleven per cent decrease in economy for a drop of 2 in. (58.0 mm.) from the rated 28-in. (711-mm.) vacuum has been observed in tests on 500-kw. multistage high-pressure steam turbines. Corresponding losses occur at other vacuums showing that any fall in vacuum is accompanied by relatively high economy losses. Each curve of the accompanying chart is plotted to show conditions that may be expected at different vacuums with 25 per cent to 125 per cent of full load on the turbine. The economy for all loads at 28-in. vacuum is represented as 100 per cent, while for a lower vacuum the percentage of normal economy is shown by the vertical ordinates. While some designs of turbine will give different results from those shown, they are indicative of the losses that may be expected in any case with poor vacuum. Lack of vacuum not only results in loss of driving power but allows the steam to become an actual drag on the wheel.



POOR EFFICIENCY RESULTS FROM LOW VACUUM IN TURBINE CONDENSER

Among the causes of poor vacuum are leaky condition of air pumps, turbine packing boxes and exhaust piping, warm or insufficient condensing water and defective condenser. A small torch may be used to hunt leaks in vacuum apparatus as the flame will be drawn in if held near a leak. Some condenser paint should be kept on hand for stopping the leaks that are found. The ordinary spring gage is not reliable for vacuum measurement and a mercury column should be used. It is a fact that the vacuum can be roughly determined by feeling the exhaust pipe with the hand. A temperature of 101 deg. F. (43 deg. C.) corresponds to a 28-in. vacuum—30-in. (762-mm.) barometer—and as the normal temperature of the human body is 98 deg. F. (41 deg. C.) any wide variation from 101 deg. F. can be noticed on touching the pipe. **Thomas Hall.**

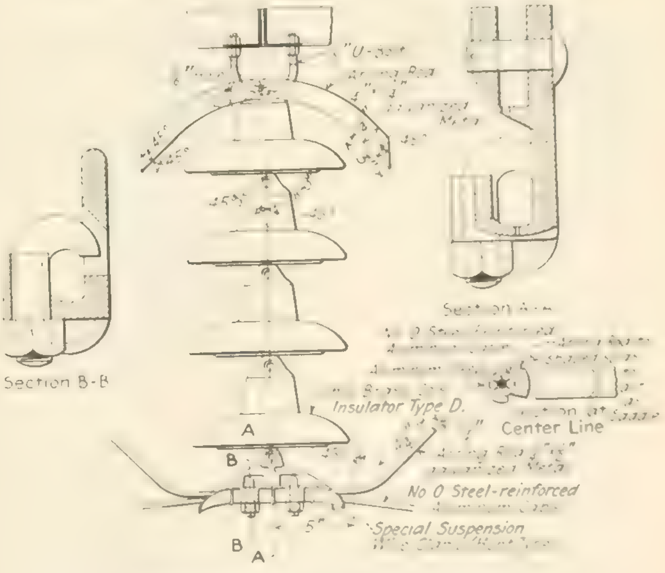
Ridgway, Pa.

Arcing Rods Shorten Time of Outages on Transmission Line

Although arcing rods on transmission-line insulators do not always decrease the number of interruptions, they do decrease the duration of flash-overs and thus save many insulators. When a discharge occurs over the horns the particular phase is automatically tripped and the arc is broken. The operator immediately throws the line in service and the line operates normally. The following table shown gives the outages for three years on the 66,000-volt lines of the Peninsular Power Company, Madison, Wis., which are protected with horns:

Number of Thunderstorms in Year	Duration of Storms, Hours	Number of Interruptions	Duration of Each Interruption in Seconds
19	1–65	4	1
20	½–24	5 1 1	1 5 *
14	1–6	5	1

* One interruption of several hours caused by tower being blown down



ARCING RODS AND SPECIAL CLAMP USED ON 66,000-VOLT LINES

The latest design of the rods, as shown in the accompanying drawing, consists of rods and a clamp (designed by the writer) made of galvanized steel. An aluminum sleeve is used to protect aluminum conductors from possible damage that may be due to the pressure of the steel clamp.

These rods have been very satisfactory and have often shown severe burns while the insulators were not damaged. **Henry H. Hunt.**

Madison, Wis.

Wire Rheostat Submerged in Water for Testing Large Generators

A RHEOSTAT for testing generators of large size should be constructed more substantially than the ordinary water barrel used for smaller machines. One type is described here that answers the purpose quite satisfactorily. For the rheostat which is shown at the right iron wire or other resistance wire is wound on a skeleton wooden frame which fits into an oil barrel. Such a rheostat can dissipate as much as 100 kw. provided that a steady stream of water from a $\frac{3}{4}$-in. (2-cm.) hose is kept flowing into the barrel. It is advisable to provide a separate disconnecting switch and fuse for each barrel if several rheostats are used in parallel. For a fuse, copper wire may be used, the proper size for which may be obtained from the table given here. For finer adjustments of current one rheostat may be made with several elements of small wire, each controlled by a separate switch. (See rheostat at left.)

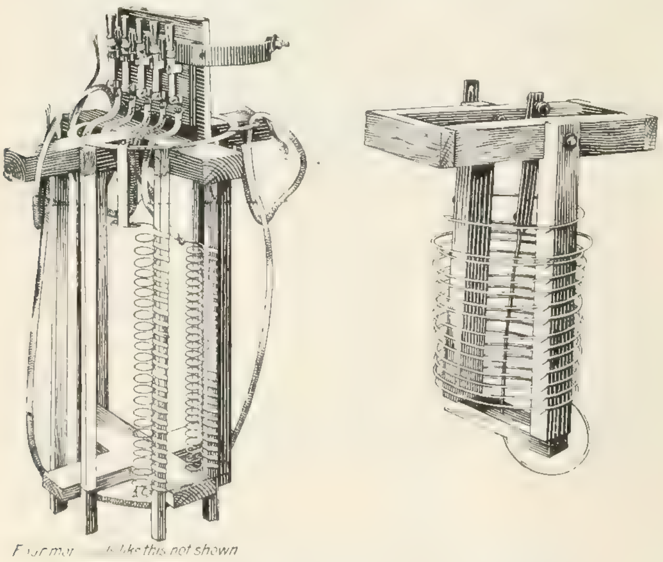
CARRYING CAPACITY OF IRON WIRE IN AIR AND WATER

(For German silver divide length by 1.6; for "Advance" wire divide by 3.8; for "Nichrome" wire divide by 7.5.)

B & S Gage	Feet per lb.	Rating in Air (Amp.)	Feet in Air for 110 Volts	Rating in Water (Amp.)	Feet in Water for 110 Volts
20	369	2.5	594	36	25
18	232	3.6	673	51	29
16	146	5.1	750	72	32
14	92	7.2	840	103	36
12	58	10.1	941	145	40
10	36	14.4	1,054	205	45
9	33	17.2	1,103	245	47
8	25	20.4	1,354	292	58

COPPER-WIRE FUSES

Wire Size, B & S	Fusing (Amp.)	Wire Size, B & S	Fusing, (Amp.)
30	10	18	80
28	15	17	100
26	20	16	120
25	25	15	140
24	30	14	160
22	40	13	200
21	50	12	240
20	60	11	280
19	70	10	330


Four more like this not shown

WIRE RHEOSTATS USED IN PLACE OF WATER BARRELS

For the coils, iron wire is cheaper in first cost, but it has the disadvantage of corroding quickly. Besides, the resistance alloy wires can be shorter on account of their higher specific resistance. The table gives the length of iron wire necessary for certain loads at 110 volts, and if other metal is used the length given in the table should be divided by the factor shown above the table.

Cleveland, Ohio. JAMES DIXON.

Making Street-Light Fixtures Dust-Proof

THE cost of cleaning globes forms a large item in the maintenance of street lighting. With the ordinary ventilated fixture, dust collects much more rapidly on the inside of the globe than on the outside and the necessary frequency of cleaning depends on this inside deposit. The Department of Gas and Electricity of Chicago has made some experiments on fixtures with the ventilating ducts closed in order to determine the economy of an air-tight fixture that would exclude all dust. It was found that the temperature of the lamp was increased only by a small percentage and that the life of the lamp would not be seriously diminished.

For making the test the fixture was placed in a wooden box about 10 ft. (3 m.) square and 6 ft. (2 m.) high, painted dull black inside. By means of a fan the air inside was kept at a temperature of 100 deg. F. (38 deg. C.), which was thought to be the worst condition possible in practice. The lamp temperature was measured by a thermostat placed inside the globe near the bulb opposite the lamp filament.

Two fixtures were tested, each equipped with a 600-cp. lamp. When the air ducts were closed the lamp temperature in a copper-jacketed fixture having two entrances for air and one exit rose from 335 deg. F. to 369 deg. F. (170 deg. C. to 187 deg. C.). In a cast-iron fixture having only one air duct at the bottom and one at the top it rose from 358 deg. F. to 364 deg. F. (168 deg. C. to 183 deg. C). It was decided that this small rise in bulb temperature would not be accompanied by sufficient rise in filament temperature to shorten seriously the life of the lamp.

As a result of the tests a number of entirely closed cast-iron fixtures were made and put in service. These have been operating only about 1,000 hours, and as the life of the lamps was formerly 2,200 hours, actual figures on lamp life are not available, but no unusually short lives have been noted. However, the results in reducing cleaning have been very satisfying. The lamps are now operated three months without the necessity of cleaning, while formerly they had to be cleaned in three weeks to six weeks.

The data in this article were presented by Henry Nixon, Deputy Commissioner of Gas and Electricity, Chicago, at a recent meeting of the Chicago Section of the Illuminating Engineering Society.

Trouble Caused by Sweating of Pulverized Fuel Bins

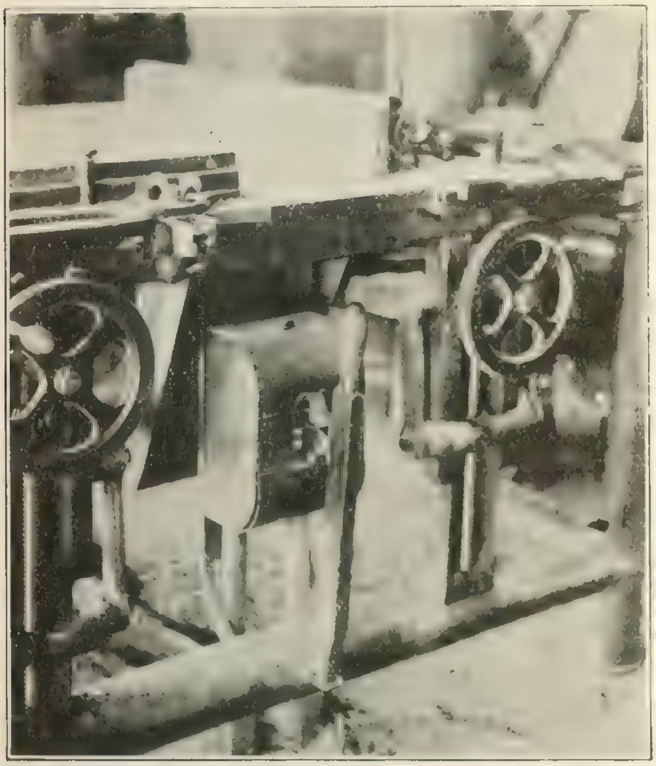
CARE must be exercised when using pulverized-coal-burning systems to guard against moisture, since the fuel will absorb it readily. On one occasion the Milwaukee Electric Railway & Light Company found moisture in the pulverized coal used at its Oneida Street plant, and an investigation disclosed that cold air from an open window just above the bins caused them to sweat on the inside. After this window was closed the trouble disappeared.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

Switch on Circular Saw Operated by Knee

A WOODEN lever which can be operated by the knee of a workman instantly shuts off the power in case of emergency in a Salem (Mass.), carpenter shop. The handle, which is of 1-in. x 1.5-in. (2.5-cm. x 3.7-cm.) wood, fits in an eye on the base of the frame, a ¼-in. (6-mm.) pin forming the bearing. This handle is connected to the motor switch which is mounted above. In case of danger or accident the operator pulls the handle out with his knee, which instantly opens the motor circuit.



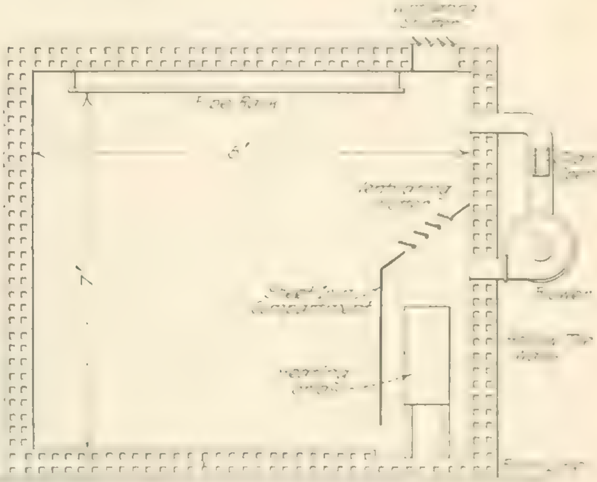
OPERATOR'S KNEE THROWS OUT SWITCH IN CASE OF EMERGENCY

Varnish-Baking Oven Has Easy Circulation and Temperature Control

FOR baking transformers, armatures and coils an oven has been constructed by the testing department of the Sanitary District of Chicago which has ample room to handle the large apparatus operated by the company. The feature of the furnace is the easy manner in which its temperature and air circulation are controlled over wide ranges. When this oven was built in 1917 it was estimated to cost $400. The oven measures inside 6 ft. (1.8 m.) in width, 8 ft. (2.4 m.) in length and 7 ft. (2.1 m.) in height. The brick walls and top have a lining of hollow tile and a 4-in. (10-cm.) air space. Asbestos cement was used throughout the construction. An opening 4 ft. (1.2 m.) wide and 8.5 ft. (2.5 m.) high is covered by double doors of sheet iron with asbestos packing between the inside and the outside metal plates.

The heating elements consist of three Simplex grids set on the floor and inclosed in a galvanized-iron compartment extending across the end of the oven. At the bottom of the compartment there is an opening, and in the top, over each grid, is set a regulating shutter operated from the outside. The grids are connected to a 220-volt line by separate switches and take respectively 30 amp., 20 amp. and 35 amp. The 20 amp. grid is generally used to maintain a temperature of 100 deg. C. for baking insulating varnish. In order to bring up the temperature quickly when the oven is cold the other grids are used. The maximum temperature obtainable is 135 deg. C., which is employed for oxidizing core laminations after they have been dipped in coal oil.

For ventilation and circulation a draft fan driven by a ⅙-hp. motor sends air downward through the grid compartment. By opening a sliding door in the pipe fresh cold air is admitted to the oven, a shutter at the top of the oven allowing the used air to escape. The opening for cold air is rarely used except to cool the oven in case it is accidentally overheated. The shutters in the grid compartment are closed unless it is desired to operate without the fan. The usual practice when baking transformer coils is to close both sets of shutters and operate the fan for only ten minutes every hour. Small coils and other objects to be baked are fastened to two pipes which are hung from the roof of the oven. The larger transformers and motors are rolled in on trucks which are left inside during the baking. For the sake of

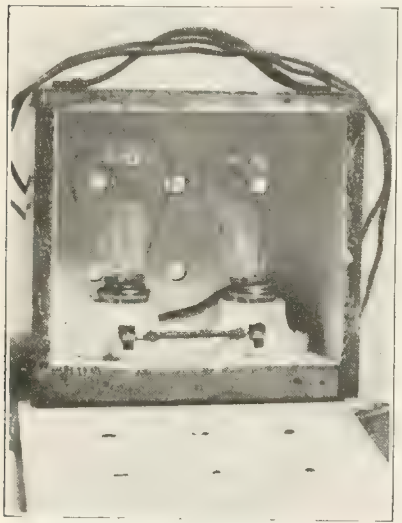


SECTION THROUGH VARNISH BAKING OVEN

economy enough work is allowed to accumulate to fill the oven before baking. A transformer to be impregnated is heated to 100 deg. C. and then dipped in a clear, thin varnish which is at the same temperature. It is baked six hours at a temperature of 100 deg. C., after which it is given a second dipping in the same varnish. The third dipping is in black insulating varnish, and the last is in air-drying, oil-proof varnish. The transformer is baked at 100 deg. C. after each dipping. Transformers treated in this manner have been tested and have been inspected by cutting them open and the results have been perfectly satisfactory. Every part of the insulation is impregnated.

F. DE MUTH,
Testing Engineer.
Sanitary District, Chicago.

Test Lamps Are Inclosed in Portable Boxes to Prevent Breakage



WOODEN BOX PROTECTS TEST LAMPS; ONE SIDE OF BOX IS REMOVED TO SHOW INTERIOR

BY MOUNTING its test lamps in a protective box an industrial plant in Canada has been able completely to eliminate the breakage usually experienced when unprotected lamps are used for test purposes. Holes are drilled in the sides of the box so that the lighted lamps may be seen from the outside and adequate ventilation will be obtained. The inside of the box is painted white and one side is removable to allow easy replacement of the bulbs. A leather strap fastened to the top of the box is used for carrying it. Series-connected 16-cp. carbon-filament lamps are used and protected by a fuse inside the box.

L. E. WOOD.
Glasgow, Scotland.

Simple Method for Balancing a High-Speed Rotor

FOR correcting an unbalanced high-speed motor the following "cut-and-try" method of a Western shop has been found satisfactory: The main difficulty in correcting a motor operating at high speed is that the direction in which the shaft tends to pull away from the true center of revolution may not be exactly toward the heavy spot in the rotor. For this reason preliminary tests with a very heavy added unbalancing weight are made to determine the direction in which the shaft will bend with regard to the weight. Before adding the weight a true section of the shaft must be located by slowly turning the rotor by hand while holding a pencil on a steady rest so that its point just touches the shaft. If no true section can be found, a small section is made true. Then this section is chalked and a weight is fastened to the rotor which will throw the motor considerably out of balance. The motor is then brought up to a speed at which vibration due to this weight begins to be quite noticeable. The speed is noted and the high spot on the shaft is marked by means of the pencil. On stopping the machine the pencil mark will probably be found not on the side of the shaft nearest the weight. The difference in position is noted; say, for instance, it is 45 deg. ahead of the weight. Then to continue the test this weight is removed and the motor is again run at the same speed and the high spot, due this time to the unbalance of the rotor itself, is again marked. If the previous run showed the mark 45 deg. ahead of the weight, then the second mark can be assumed to be 45 deg. ahead of the unbalancing spot of the motor itself. A small balancing weight is therefore fastened to the motor directly opposite the place where this unbalancing spot is thought to be.

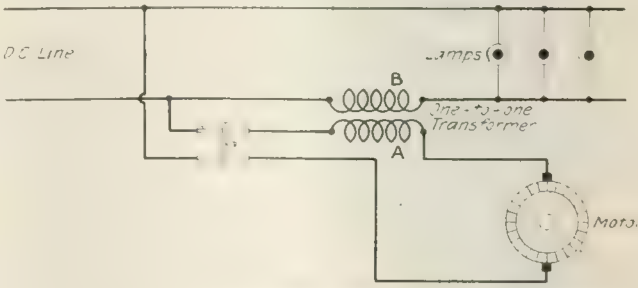
If another run at the same speed shows that the motor has less vibration than originally, more balancing weight is added until with further addition of weight vibration starts to increase again. The same process is then followed on the other end of the motor. This, however, may not completely eliminate vibration and the operations may have to be repeated on each end. After vibration has been overcome at this speed the machine is slowly brought up to normal speed. If vibration is still present, the operations are repeated at a speed higher than the first one until finally there is no vibration at full speed.

For making these corrections most high-speed rotors are provided with screw holes to receive headless balancing screws. After these screws have been correctly inserted it is advisable slightly to mash the threads of the holes to prevent the screws backing out. In using this method it is well to keep a carefully written log of all observations and not to rely on memory.

Cleveland, Ohio.
JAMES DIXON.

Special Transformer Prevents Lights Flickering on Direct-Current Circuit

TO PREVENT flickering of lights on a direct-current circuit when a load is suddenly thrown in parallel with them a one-to-one transformer connected as shown in the drawing has given good results. With this arrangement when the motor is connected to the line the sudden rush of current through the coil *A* induces a voltage in the coil *B* which overcomes the momentary drop in voltage across the lights caused by closing the motor circuit. The proper size of this transformer is about 15 kw. for each 75 kw. of load added by the motor.



ONE-TO-ONE TRANSFORMER USED TO PREVENT FLICKERING OF LIGHTS

In investigating this voltage drop which occurs when a load is added to a direct-current circuit, oscillograph tests and mathematical calculations conducted by A. L.

Ellis and B. W. St. Clair of the General Electric Company proved that there exists a drop sometimes to zero voltage for a very short length of time that is independent of the size of the line wires. This explains the common flickering of lights connected to a circuit on which an elevator is run even when the line conductors are of large size. The conclusions, which are borne out by experience, were that compounding the generator will not limit the flickering but will even tend to increase it. A low-resistance inductance coil in series with added load will improve the conditions, but the "impulse" transformer connected as shown here is better.

How Factory Feeders Were Supported on Poles Fastened to Buildings

BY MEANS of wooden poles fastened to the side of the buildings and home-made cable clamps supporting three-conductor cables, 80 per cent of the cost of interior conduit construction has been saved in the factories of the Simplex Wire & Cable Company and the Simplex Electric Heating Company, Cambridge, Mass. The 30-ft. (10-m.) poles carrying the 2,300-volt and 550-volt factory circuits are fastened to the reinforced-concrete columns of the buildings by means of three 1-in. (2.5-cm.) bolts through the 8-in. (20-cm.) square pole bases. The spans vary from 70 ft. to 100 ft. (21 m. to 30 m.). The cables were specially designed for this service, the 2,300-volt run shown in Fig. 2 consisting of three No. 2 (34-sq.mm.) copper conductors surrounded by a $\frac{3}{32}$-in. (2.4-mm.) wall of varnished cambric in each case, with jute filling. Outside this is a $\frac{1}{16}$-in (1.6-mm.) varnished-cambric jacket overlaid with a $\frac{1}{16}$-in. jute serving and an armored covering of No. 8 (8.4-sq.mm.) galvanized-iron wire. This cable weighs about 6 lb. per foot (9 kg. per m.), or about 2 lb. (3 kg.) less than a lead-covered cable to give equivalent service, and sections which have been in service outdoors above the factory for about seven years have given no trouble from moisture.

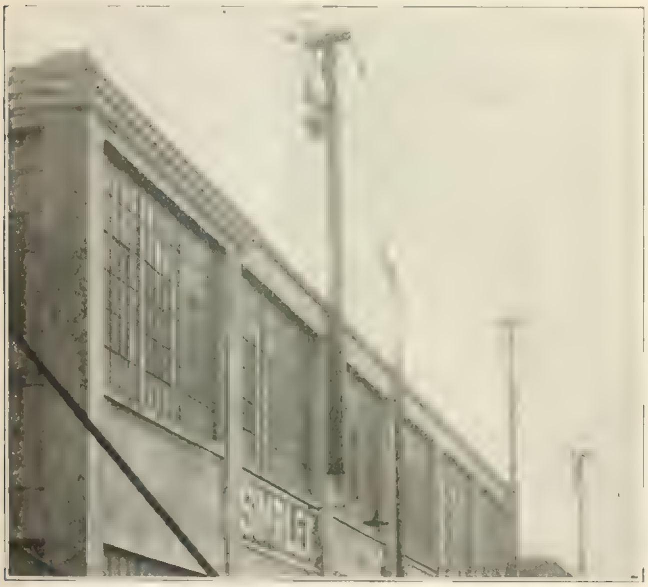


FIG. 1—WOOD POLES FASTENED TO BUILDING AND CARRYING 2,300-VOLT AND 550-VOLT FACTORY CIRCUITS

The supporting of these cables is effected by special clamps built by the company engineers. These clamps are from 14 in. to 16 in. (50 cm.) long and consist of steel hydraulic pipe sawed in halves. The halves are gripped around the cable armor by steel straps, bolted together at their ends. Four straps are provided for the clamp in the foreground of Fig. 2, the end straps being extended to receive an iron shackle looping through a turnbuckle, which in turn is fastened through the crossarm of the carrying pole. The steel sleeve or sawed pipe sections are ridged to prevent the straps from slipping. The strain upon the cable is equalized by turning the straps at different angles and by the liberal length of the clamping sleeve. The armor of all overhead cables is grounded. An extra length of cable is shown at the cross-arm in Fig. 2 for future use in connection with sectionalizing switches if desirable. It is estimated that this overhead construction cost less than 20 per cent of the expense which would have been entailed had interior conduit been used. Besides, it was objectionable from an insurance standpoint to install circuits operating at 550 volts and 2,300 volts inside the building.

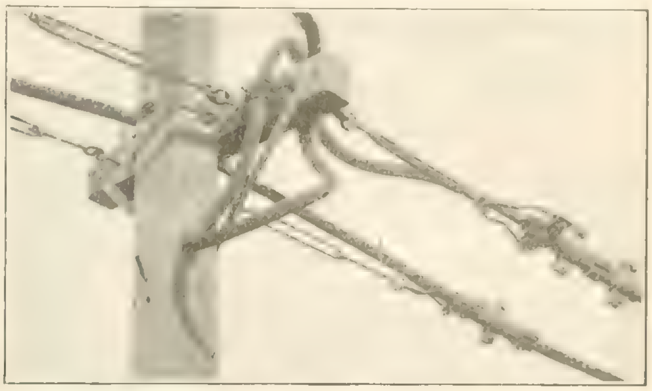


FIG. 2—METHOD USED TO SUPPORT WIRE-CLAD THREE-CONDUCTOR CABLES BY SPECIAL CLAMPS

Restoring Worn Batteries by Repeated Charge and Discharge

LEAD storage batteries that have deteriorated somewhat can usually be restored to some extent by repeated charge and discharge at full rate, using the same source of current and resistance that is used for charging. Low-voltage batteries of 6 volts or 12 volts are usually charged through a bank of lamps, but very few electricians discharge them at the proper rate, because they cannot find suitable resistors of sufficient capacity and reasonable price. However, special resistance is not necessary. By reversing the battery terminals and allowing the line current to flow in the reverse direction the lamp bank used ordinarily for regulation may be used for discharging. The lamps will have the sum instead of the difference of the line and battery voltages impressed on them and will burn very brightly, but 110-volt lamps on a 110-volt circuit with a 6-volt battery will not be damaged. The discharge current will increase over the charging current in the ratio of the increased lamp voltage, and it may therefore be necessary to cut out a few lamps. Of course, energy is taken from the line at the same rate as for charging, but the saving of investment, time and space, ease of operation and accuracy of control overbalance the cost of energy.

Chicago, Ill. E. E. GEORGE.

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

How Securities of One Utility Are Maintained at Par

IN THE March issue of *Wire and Pipe*, the house organ of the Union Electric Light & Power Company, St. Louis, Mo., mention is made of the fact that any stockholder can dispose of his holdings through the company for their par value. During a period of sixty days ended in February thirty-four stockholders brought 603 shares of stock to the company for resale. Most of these stockholders were heavy taxpayers who wanted to sell their holdings in order to purchase bonds which, though they bear less interest, are tax-free.

The company's security department resold the 603 shares to 144 new investors. These were mostly people with comparatively small incomes, for whom the 7 per cent dividend on the company's stock is tax-free since it is not subject to the state income tax and the company pays the 4 per cent normal federal income tax. The company was compensated for its part in the transaction by getting 144 customer partners in place of thirty-four. This policy of the company seems to protect its stockholders adequately and makes it virtually impossible for a broker to obtain its stock at less than par value except possibly through exchange for inferior stocks.

Important Points in Selling Electric Ranges

HERE are a number of selling points for electric ranges, given by M. C. Osborn, a heating expert of New Britain, Conn.:

First—Get the co-operation of the whole central-station force, for the sake of the service; in other words, sell to them first.

Second—If range and water-heater salesmen are employed, sell to them before sending them before the public.

Third—Make installations at "a price" in each neighborhood or in each block. These installations, if properly installed, will prove to be your best salesmen.

Fourth—Office demonstrations are necessary for the purpose of selling during the pioneer stages. Home demonstrations become unnecessary after a number of users are on the line.

Fifth—Newspaper advertising has been found to be most productive in obtaining results and is less expensive in the end. Other forms of advertising should be used, however, in the shape of personal letters, manufacturers' literature and "follow-up" advertising.

Sixth—Time payments, with a price for old equipment, have proved effective.

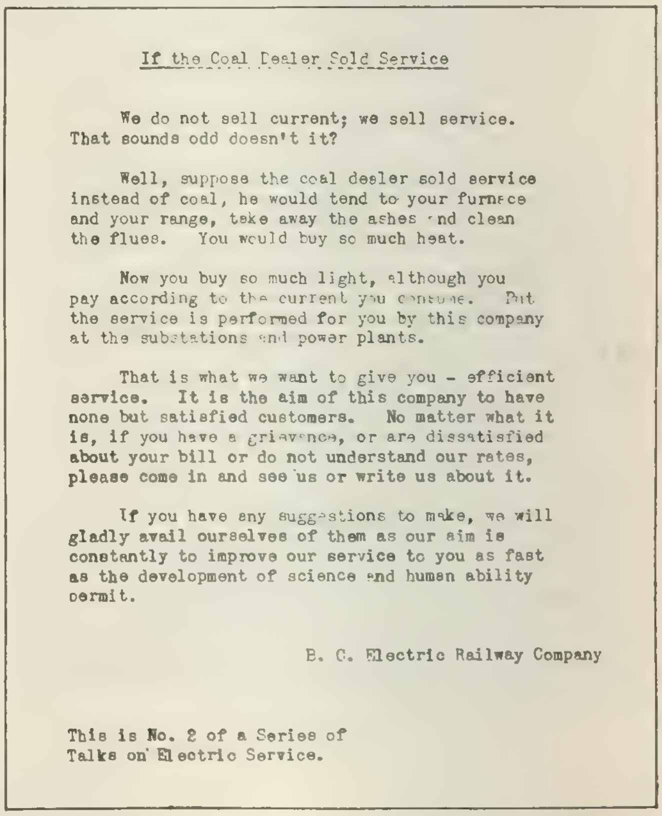
Seventh—Special campaigns controlling the price, such as sales in the winter months to keep the operating department employed during the entire year should be instituted.

No minimum for this service is necessary, as it has been found in the sale of 2,500 ranges and 1,700 water heaters that the purchasers are the best satisfied of all consumers.

How Light Bills Are Used to Promote Good Will

By J. Lightbody

IF THERE is one communication from a public utility which the customer reads, it is the monthly bill. Advantage is taken of this fact by the British Columbia Electric Railway Company, Ltd., Vancouver, B. C., to print a special message to customers on the backs of its monthly bills. These messages or talks cover such subjects as complaints that may arise, an explanation of the company's service under the title "If the Coal Dealer Sold Service," an advertisement of household labor-saving devices, an explanation of the reasons for larger lighting bills in the winter than in summer, and a defense of good lighting.



If the Coal Dealer Sold Service

We do not sell current; we sell service. That sounds odd doesn't it?

Well, suppose the coal dealer sold service instead of coal, he would tend to your furnace and your range, take away the ashes and clean the flues. You would buy so much heat.

Now you buy so much light, although you pay according to the current you consume. But the service is performed for you by this company at the substations and power plants.

That is what we want to give you - efficient service. It is the aim of this company to have none but satisfied customers. No matter what it is, if you have a grievance, or are dissatisfied about your bill or do not understand our rates, please come in and see us or write us about it.

If you have any suggestions to make, we will gladly avail ourselves of them as our aim is constantly to improve our service to you as fast as the development of science and human ability permit.

B. C. Electric Railway Company

This is No. 2 of a Series of
Talks on Electric Service.

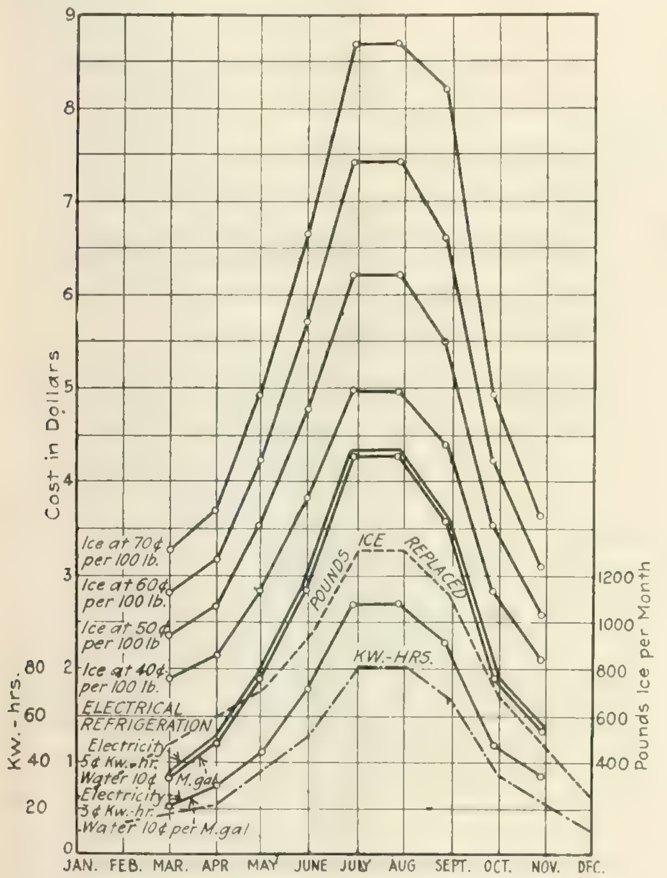
ONE OF THE SEVERAL FORMS OF MESSAGES TO CUSTOMERS PRINTED ON THE BACK OF MONTHLY BILLS

Eight of these talks have been prepared to date, and the company feels that the plan has proved so satisfactory that the practice will be continued.

Revenue and Load Furnished by the Home Electric Refrigerator

ELECTRICALLY driven domestic refrigerating machines have been found to represent a class of central-station business which will increase revenue per kilowatt of demand and improve the load factor without increasing investment in lines, transformers, meters, etc. Furthermore, the use of this ¼-hp. device has a tendency to shift the residential peak from winter to summer, as shown by the following table of residential kilowatt-hours consumed per month for the average home in which a refrigerating machine is likely to be installed:

	Lighting	Refrigeration	Total
Average summer months...	20	90	110
Average winter months....	42	20	62



KILOWATT-HOURS REQUIRED TO REPLACE ICE BY MECHANICAL REFRIGERATION

These curves were obtained from the use of ice and electric refrigeration in a high-grade 175-lb. stock refrigerator box. The temperature in the food compartment was from 50 deg. to 60 deg. with ice and 44 deg. to 48 deg. when the refrigerating machine was used.

Records of numerous refrigerating installations show that the July and the August consumptions usually vary from 80 kw.-hr. to 100 kw.-hr. in the average home, with an occasional machine running up to 125 kw.-hr. or 150 kw.-hr. The machines are often shut down for two or three months in winter, but if the refrigerator box is placed where the room temperature is over 60 deg. F. (15 deg. C.) the machine will be used to some extent throughout the year.

These refrigerating machines will consume an average of 550 kw.-hr. or more per year, which at 5 cents per kilowatt-hour will amount to an annual revenue of $27.50 per machine. Several cities now have 100 to 300 of these machines in service, and in view of the present development of the business it is not unreasonable to expect soon as many as 1,000 machines on the lines of a single company.

Residential customers are not the only "prospects" for these machines. Electric refrigerating machines can also be used to build up the revenue from rural lines. In outlying districts, where the electric rates are usually higher than in the cities and the delivery of ice is more uncertain, the use of the refrigerating machine has a field even in temperate climates but more especially in the warm zones.

This information, compiled by H. L. Lincoln, sales engineer of the Isko Company, Chicago, was presented before the convention of the Oklahoma Utilities Association at Oklahoma City, Okla.

Cost of Furnishing Rural Service

IT IS generally agreed that the cost of supplying rural electric service is usually made up of the following items: (1) Fixed charges, including maintenance, taxes and insurance; (2) service, including cost of energy supplied, meter reading and billing, and service to customer.

The farmer usually finances the entire cost of the necessary line extension, the transformer and the secondaries serving him. Consequently there will be no interest on investment and no depreciation.

A well-constructed line of 30-ft. (9-m.) Northern cedar poles and not less than No. 6 (13.3 sq.mm.) copper wire will probably last for from fifteen to twenty years. This may vary in different localities, owing to soil conditions, storm centers, etc., but, as based on the experience of an Ohio company, it costs 5 per cent of the original cost of such a line to maintain it properly. If the company owns the line, taxes and insurance against liability, etc., amounting to about 2 per cent, must be added. This makes a fixed charge of 7 per cent against the cost of giving service, or $70 per year per $1,000 worth of line.

Records of twenty-five farmers near Sidney, Ohio, taken over a period of a year, show an average use of 30 kw.-hr. per month. If this energy is sold to the farmer and metered on his premises, there will be the following service cost to supply each farmer, in addition to fixed charges:

276 kw.-hr. core loss of 2-kva. transformer at 3 cents per kilowatt-hour, delivered....................	$ 8.28
Meter reading and billing........................	1.20
Service to customer, such as driving out and fusing up transformers after a storm.................	6.00
Energy consumption, 360 kw.-hr., at 3 cents per kilowatt-hour	10.80
Total service cost per customer per year..........	$26.28

On a 1-mile (1.6-km.) line costing $1,000, and to which four farmers are connected, the total annual central-station cost, based on the foregoing assumption, would be as follows:

Seven per cent maintenance charges...............	$ 70.00
Service charges, $26.28 per customer..............	105.12
Actual cost of supplying 1,440 kw.-hr. to four farmers	$175.12

This is equivalent to $43.78 per year per farmer, or $3.66 per farmer per month, as the actual cost of supplying the service. On the basis of this cost of service a central station would be fairly well protected with a rate of $1 per kva. of rated transformer capacity (minimum $2) plus 10 cents per kilowatt-hour. Under the conditions outlined above this schedule would make the four customers' individual monthly bills be $5, made up of a service charge of $2 and an energy charge of $3.

This would leave a profit of $1.34 per month, but if the consumption per customer averaged only 10 kw.-hr., there would be a loss of 0.66 cent per customer per month. Under this rate it therefore behooves the central station either to insist on at least four customers per mile of lines (estimated to cost $1,000) or else to raise the fixed charge per customer to a point where it would be protected against loss by non-use of service. However, if profit is to be made off rural business it is necessary to educate customers to the use of all available energy-consuming devices.

This information was presented by D. O. Vaughn, manager of the Sidney (Ohio) Electric Company, before a recent meeting of the new-business corporations committee of the Ohio Electric Light Association at Dayton.

Baltimore Company Modifies Plan for Retiring Employees

FOUR important changes have been made by the Consolidated Gas, Electric Light & Power Company of Baltimore, Md., in the plan for the retirement of employees, known as its pension system, which was established in 1912. These changes are as follows:

1. The period of service is reduced from twenty to fifteen years in case of physical disability which prevents a continuance of employment.
2. The minimum allowance is increased from $15 to $20 per month.
3. The basis upon which the pension allowances are figured now provides for the use of the average pay for the last five instead of ten years preceding retirement.
4. Monthly allowances will hereafter be figured on the basis arrived at by the provident committee of the company at its meeting on Feb. 13. This provides for a readjustment of the amounts paid to the men so that their allowances will be increased in accordance with the increases in average wages paid for the five-year period ended Dec. 31, 1919. The management makes this change to offset the high cost of living.

On the present retirement roll there are forty-one men, nine of whom are among the original twenty-six retired on March 1, 1912. During the eight years the plan has been in force, seventy-one employees have been retired and the company has paid to them a total of $106,543.82, which is an average of $13,317.85 a year. At the close of the year 1919 the roll carried forty-three names. Since that time two deaths have been reported, reducing it to forty-one names. It is estimated that the pensions during 1920 will amount to about $22,000.

The following letter received from the oldest employee on the retired list is typical of many which show how the company's policy is appreciated:

> Your very kind communication of the 24th inst., inclosing check, duly received, informing me that the province committee of the company had increased my pension allowance. I can hardly express myself as to your kindness and generosity in this matter. At my age, eighty-eight years, it is so helpful, and I can never be sufficiently thankful and grateful.
>
> I beg you, gentlemen, to accept my everlasting thanks and gratitude; your kindness and liberality will ever remain with me and be in my recollection. With my best wishes for the success and prosperity of the company and good health of you all, my good friends, I am ever yours faithfully, RICHARD N. BOWERMAN.

Normal Reserve of Supplies Is Not Improper Hoarding

BY "KASANDRA"

HOARDING, like profiteering, is an invidious word, and no central station likes to be accused of conduct that is contrary to public policy. Now, it is clearly the duty of each central station to keep on hand an adequate supply of coal, of lamps, of copper and cables, of meters, of fuses and of supplies in general. An adequate supply means enough not only for normal needs, but for emergencies. What is the difference between this and hoarding? Hoarding and saving are, according to the dictionary, almost synonyms. What therefore is the test as to whether saving or laying in supply for emergencies is good management or is immoral hoarding?

Is not the answer that wise saving and the laying in of an adequate supply is praiseworthy, and, on the other hand, is it not time to realize that the bad kind of hoarding punishes itself and that laws to punish hoarding are unnecessary evils?

If an individual or company lay in a stock when supplies are scarce and prices high and then does not use this stock, it naturally is the one to suffer. If it disposes of its stock at its cost (the cost in this case is high), its hoarding has done no harm. If it disposes of its stock at a loss after the emergency has passed, it suffers a loss. The only question is as to whether any additional punishment is needed besides the loss which is inherent in improper hoarding.

Sometimes we have the case of the man or company who buys at low prices and hoards until the prices are high, then makes a profit. Is not this, however, an entirely legitimate profit? The man who buys at low prices sustains the market when it is weak and prevents the low prices stopping production altogether, and this alone helps diminish scarcity later.

Then when the emergency and scarcity come the hoard is placed on the market and prevents prices going higher and also prevents still more scarcity. The man who hoards and makes a profit does a great public service because, whether he uses his hoard himself or whether he sells it, he provides a supply at the time of scarcity instead of demanding a further supply for himself, as he would surely be entitled to if he had not hoarded. He has made a profit, but only because he was wiser than his fellows, and in any case he has done the public a service which his fellows have not done.

The importance of saving and preparing for emergencies by hoarding supplies of coal and lamps and meters and all supplies is so much the duty of central stations that we should all be very careful to educate ourselves and the public to the idea that wise hoarding is always proper. Hoarding supplies which we use or which we put on the market at times of scarcity is always proper.

The only improper hoarding is to lay in supplies at high prices, and not use them, perhaps later disposing of them at a loss. This kind of hoarding punishes itself because the man or company that commits it loses money.

If, however, there is any attempt by a law or by public sentiment to forbid or even discourage hoarding, the result is that wise saving and hoarding is discouraged and the public is injured.

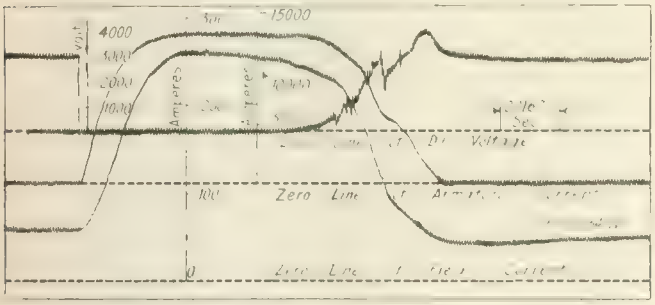
Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Mechanical Design of Large Turbo-Generators.—M. A. Savage.—It is said that one pound of material in the present 5,000-kw. turbo sets does the work required of five pounds in the first 5,000-kw. set built in this country. Stator construction has reduced itself to the simplest form as the requirements of rigidity, light weight and flexibility are best fulfilled by such a design. However, high speeds and increased capacities have introduced real difficulties in the construction of rotors. The centrifugal stresses have necessitated the use of a solid forged rotor, and in the largest machines it has been desirable to use a three-piece rotor because of the great length and weight of a solid one-piece forging. Ventilation, which is of prime importance in the modern turbo-generator, is briefly referred to in this article.—*General Electric Review*, February, 1920.

Three-thousand-Volt Motor-Generator Sets.—David Hall.—These motor-generator sets were built for use on the electrified systems of the Chicago, Milwaukee & St. Paul Railroad. Each set consists of a 2,800-hp., three-phase, 60-cycle, 2,300-volt, 514-r.p.m. synchronous motor which drives two direct-current, 1,500-volt, shunt-wound, commutating-pole, compensated generators, the armatures of which are connected in series to give 3,000 volts. The motor is installed between the two generators, with one exciter for the motor and one for the generators, all mounted on the same shaft. It is said that the success of high-voltage direct-current equipment may be held to hinge upon commutation. Consequently in the design of these generators great care was exercised to embody every feature that would assist in the obtaining of inherently good commutating characteristics. In severe short-circuit tests the current is reported to have reached values of twenty times normal without flashing over. The photograph shows what took place in one of these tests in which the generators operating at 3,000 volts were short-circuited with no resistance in the external circuit except the necessary connections and circuit breaker, representing the greatest shock that it was possible to impose upon the generator. The oscillogram shows that from the moment of short circuit the current increased at the rate of about 1,250 amp. every thousandth of a second, reaching 5,000 amp. in 0.004 second, 10,000 amp. in 0.010 second, and a final current of 13,000 amp. in about 0.020 second. The circuit was completely opened in one-tenth of a second from the time of closing. Oscillograms of further tests are shown in the article.—*Electric Journal*, January, 1920.



OSCILLOGRAM OF SHORT-CIRCUIT TEST AT 3,000 VOLTS

On the Origin of Certain Accidents and Breakdowns in Electrical Machinery.—C. W. Worral.—In citing a number of cases where severe breakdowns followed carelessness in construction, use of low-grade insulating material and apparently insignificant faults of design, the author urges the necessity to study during operation the condition of insulation in electric machinery, and if a fault occurs, not merely to repair it but to seek its origin and get to the root of the trouble, thus preventing a recurrence.—*Revue Générale d'Electricité*, Nov. 22, 1919.

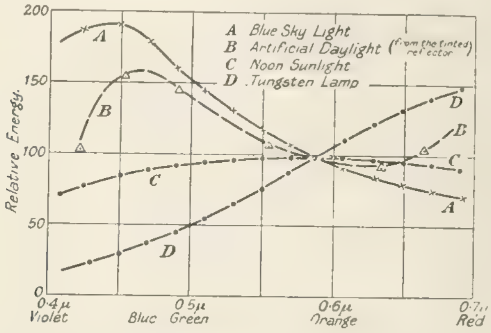
A High-Current Transformer.—A furnace transformer of remarkable proportions has recently been built by the Brown-Boveri Company. The transformer is rated at 15,300 kva. at a primary voltage of 20 kv. and gives a secondary current of 52,000 amp. A photograph of this transformer is exhibited which clearly shows the peculiar arrangement of the secondary windings, whereby eddy-current losses are cut down and reactance drop is kept at a few per cent. The windings are reinforced by sturdy coil-spring clamps, enabling the entire winding to be slipped off the core for repairs.—*Elektrotechnische Zeitschrift*, Nov. 6, 1919.

Lamps and Lighting

Modern Street Lighting.—How to obtain the best light with the minimum of expenditure is considered in this article. Distribution curves of sources of light of good character are considered in connection with the distribution obtained in the street under different conditions of spacing.—London *Electric Times*, Jan. 5, 1920.

Application of Industrial Lighting Codes.—This article contains a rather complete statement of the state lighting codes as well as the federal regulations governing the lighting of shipyards, arsenals and other government properties which were established during the war. The state codes which are included are Wisconsin, New York, New Jersey and Pennsylvania. These codes are considered with special reference to the recent progress which has been made and include extensive discussions.—*Transactions I. E. S.*, Dec. 30, 1919.

Some Notes on Lighting in the Textile and Clothing Industries.—J. S. Dow.—In textile industries, as in others, the fundamental principles of good lighting are: (1) Sufficiency of illumination on the work; (2) reasonable constancy and uniformity of illumination over the area of work; (3) the placing or shading of sources so that the light from them does not fall directly on the eye of the worker, either when engaged on his work or when looking horizontally across the workroom; (4) the placing of lights so as to avoid inconvenient extraneous shadows on the work. In view of the fact that it is important to match colors in textile industries the writer advocates the greater use of artificial daylight. A chart is given showing the distribution of energy in the visible spectra of various illuminants compared with that of the "Sheringham daylight." It is said that with the Sheringham artificial daylight either north white skylight, blue skylight or diffused sunlight can be imitated.—London *Electrician*, March 5, 1920.



DISTRIBUTION OF ENERGY IN THE VISBEE SPECTRA; CURVE "B" IS THE SHERINGHAM DAYLIGHT

Generation, Transmission and Distribution

Electric Extra-Pressures and Systems of Protection.—L. LOMBARDI.—In the present article the results of the experiments made by the aid of an artificial line upon the Campos and Petersen dischargers are reported. The Campos system has shown itself efficient in the case of traveling waves with a steep front of short wave length; for long waves the protection was found insufficient. The two systems of Petersen dischargers gave quite satisfactory results, especially the second, in which both resistance and inductance are inserted between the neutral point of the main and the ground, the inductance being so chosen as to furnish a lagging current equal to the leading current due to the capacity of the line.—*Science Abstracts, Section B*, Dec. 30, 1919. (Abstracted from *Elettrotecnica*, Oct. 5, 1919.)

The Development of Electric Supply to Textile Mills.—W. BROWNING.—A general discussion of the advantages of electric drive, consideration of the problem whether or not to electrify the mills, and in case of electrification whether power should be generated at the plant or purchased.—London *Electrician*, March 5, 1920.

Electric Power Supply of Southern Textile Mills.—J. E. SIRRINE.—In twenty years the number of mills in the Carolinas, Georgia, Alabama and Tennessee has increased 311 per cent, and in the past ten years alone this increase has been 43 per cent. The writer gives information concerning the hydro-electric generating plant furnishing the energy for the textile mills. The aggregate of the hydro-electric plant in this vicinity is 500,000 kva. and steam auxiliary stations are rated at 150,000 kva., making a total developed capacity of 650,000 kva. The power companies own undeveloped water-power sites with a probable aggregate capacity of 450,000 hp.—*Mechanical Engineering*, March, 1920.

Water Power of the World.—A general survey of the water-power situation in Europe with a special reference to recent installations and present projects. An interesting table assigned to French sources gives the following figures to indicate the approximate potential water-power resources of the different countries in Europe: Great Britain, 963,000 hp.; Germany, 1,450,000 hp.; Switzerland, 1,500,000 hp.; Spain, 5,000,000 hp.; Italy, 5,500,000 hp.; Sweden, 6,750,000 hp.; Norway, 7,500,000 hp.; France, 9,000,000 hp. It is claimed, however, in Italy that Italian resources have been increased to the value 7,500,000 hp. on account of the territory taken from Austria-Hungary during the war.—*Beama*, January, 1920.

How Bituminous Coal Can Be Safely Stored.—H. H. STOEK.—A careful discussion of the best methods of storing various kinds of bituminous coal with special reference to fire risk. Special consideration is given to the advisability of choosing the ground properly and to the question of whether or not to segregate coal of different sizes.—*Coal Age*, March 18, 1920.

Traction

Some Methods of Regenerative Braking in Alternating-Current Traction.—L. MONATH.—After some introductory remarks touching upon the development of regenerative braking, the author describes in detail the systems employed by the Allgemeine Elektricitäts-Gesellschaft and by Oerlikon. A critical comparison of these two systems leads to the conclusion that the A. E. G. method of letting some of the driving motors feed back into the supply system as a separately excited generator is electrically the superior one, since it permits regeneration with a remarkably high power factor and therefore gives high efficiency. Direct measurements made by the author indicate that up to 70 per cent of the braking energy may be utilized in form of feed-back power. The Oerlikon method, which is based upon the Behn-Eschenburg patents, has, however, the advantages of greater simplicity and a better utilization of the full motor capacity.—*Elektrische Kraftbetriebe und Bahnen*, Oct. 4, 1919.

Last Stand of the Reciprocating Steam Engine.—A. H. ARMSTRONG.—It is said that the reciprocating steam engine is gradually disappearing from the industrial field, and indications point to a similar movement in the propulsion of ships. The author foresees an era of electrification in the steam-road field as the trend of real progress. The success of the Chicago, Milwaukee & St. Paul Railway electrification warrants the belief that this method of haulage could be used to advantage beginning with terminals, mountain grades and congested districts. Although treated in a broad way, the recommendations may be well applied to specific cases where roads are confronted with heavy expenditures for improvement of existing facilities. A table gives the possible saving by this electrification as follows: Total ton-miles with steam, 1,215,400,000,000; reduction by electrification, 146,000,000,000; total ton-miles with electricity, 1,069,400,000,000; kilowatt-hours at 40 watts, 42,776,000,000; coal on basis of 2½ lb. per kilowatt-hour, 53,500,000 tons; equivalent railway coal, 1918, 176,000,000 tons; saving by electrification, 122,500,000 tons. Other important electrifications of railways are also discussed. Paper presented at Schenectady Section, A. I. E. E., Feb. 20, 1920.

Cog-Wheel Drive for the Berlin Rapid Transit.—E. C. ZEHME.—It is proposed to electrify the main local railway lines of Berlin in order to take care of the steadily increasing traffic. The plan calls for utilization of present rolling stock, with the addition of powerful electric locomotives. It has been suggested that the use of cog-wheel drive for a distance of 150 yd. to 200 yd. (140 m. to 180 m.) immediately outside the stations would make it possible to speed up acceleration so that a maximum of forty-five trains per hour could be reached without surpassing safe limits of maximum velocity. The author criticises sharply the whole system of using electric locomotives for local traffic and emphasizes in particular the serious practical difficulties of the proposed high-speed cog-wheel system. Instead of this the use of ordinary motor cars, whereby the driving force may be distributed over the entire length of the train and the natural frictional adhesion will be sufficient to insure satisfactory acceleration, is recommended.—*Elektrotechnische Zeitschrift*, Nov. 6, 1919.

Installations, Systems and Appliances

Large Outdoor Switches and Transformers.—S. Q. HAYES and W. A. COATES.—Attention is called to the fact that until recently outdoor substations were in use in America only, but recently the first outdoor oil-switch equipment has been installed in France, Italy and Spain, on the Las d'Oo 120,000-volt project, the Pescara 80,000-volt plan and the Cataluna scheme respectively. Other installations at these voltages are also in course of building.—London *Electrician*, Feb. 20, 1920.

Electric Steel Furnaces of the Induction Type.—JEAN ESCARD.—Furnaces of the resistance and arc types must be supplied with a very high current at a low voltage —3,000 amp. to 5,000 amp., at 50 volts or 60 volts. In the induction type of electric furnace the molten metal constitutes the secondary of a transformer, and although the current in this single-turn secondary may be of the order of several thousand amperes, the primary winding usually is fed at 4,000 volts to 6,000 volts and the furnace takes a primary current of about 200 amp. or 300 amp. Such furnaces are now built for capacities of up to 30 tons. The power consumption is about 400 kw. for a 3-ton furnace, 600 kw. for a 5-ton furnace and 800 kw. for a 7-ton furnace. To avoid excessively law power factor, frequencies down to 5 cycles or even 3 cycles are employed. The author describes and discusses in detail the many types of induction furnaces which have been developed in Sweden, France and Germany. These, although similar in principle, differ considerably in detail. Special attention is given considerations of output, and an analysis is made of power consumption and cost of operation.—*Revue Générale d'Electricité*, Dec. 13, 1919.

Electrophysics and Magnetism

Frequency Transformation.—In an invention of Ernst F. W. Alexanderson a method of transforming an alternating current of a given frequency and of utilizing the current thus transformed for radio purposes is involved. This scheme is described by the use of a diagramatic representation.—*Wireless Age*, January, 1920.

Thermo-Electric Force of Some Alloys.—M. A. HUNTER and J. W. BACON.—The authors have previously reported on the electrical resistivities of some binary and ternary alloys of iron, nickel and copper with chromium and manganese. They now study the thermo-electromotive forces of these alloys at different temperatures up to 900 deg. C. Some very useful alloys for thermocouples were found.—*Engineering and Science Series No. 11, Rensselaer Polytechnic Institute.*

The Algebra of Ionic Valves.—W. H. ECCLES.—This paper may be characterized as one suitable to be used as a general introduction to the theory of vacuum valves, considering both the two electrode and three electrode tubes.—London *Electrician*, Feb. 13, 1920.

Electrochemistry and Batteries

Bronze Plating.—F. C. MATHERS and STANLEY SOWDER.—Bronze, a copper-tin alloy, can be plated or electrodeposited from the oxalates of copper and tin dissolved in ammonium oxalate or from a mixture of potassium copper cyanide, potassium stannate, potassium cyanide and potassium hydroxide. The bath containing cyanide is better. A careful adjustment of the relative quantities of copper and tin in the baths is necessary. Most trouble is caused by the poor corrosion of the bronze anodes.—Paper presented before American Electrochemical Society, Boston, April 8, 1920.

Hydrogen Ion Concentration in Dry Cells.—H. D. HOLLER and L. M. RITCHIE.—Measurements were made of the potential of a manganese dioxide electrolyte prepared from certain manganese ores, or a chemically prepared manganese dioxide mixed with fine Acheson graphite. The object was to test these various materials and the relation of their potentials to the concentration of hydrogen ions in the solution in contact with it. It was found that this potential was, in the case of the native ores, a logarithmic function of the hydrogen ion concentration; in the case of the chemically prepared oxide there was no such relation. The cause of this difference is not investigated or discussed. In the case of using the native ores logarithmic relation referred to serves partly to explain variations in the open-circuit voltage and polarization with time.—Paper presented before American Electrochemical Society in Boston, April 8, 1920.

Units, Measurements and Instruments

The Induction Meter.—E. BIFFI.—The induction electric meter is the alternating-current meter most in use. The author has, therefore, studied the theory and construction of such meters. The influence of the distance between the magnetic poles of the pressure and current electromagnets and the braking effect upon the revolving disk due to the magnetic fluxes generated by them are especially considered. Since the variations of pressure and frequency affect the accuracy of the apparatus, the author thought out a device for diminishing these errors. This device consists in allowing the flux generated by the pressure coil to pass through a magnetic shunt, an adjustable part of it being highly saturated, so that the reluctance of the shunt increases when the pressure increases or the frequency diminishes. Means for obtaining the exact phase displacement of 90 deg. between the pressure and the magnetic flux generated by it, as well as the means to annul the breaking action of the current coil flux, are described. A new shape of induction meter embodying all the improvements was constructed by the author. This meter allows of obtaining a maximum error of ± 3 per cent when the power varies between 1 per cent and 150 per cent of the maximum, the power factor between 1 and 0.25, and the pressure and the frequency between ± 15 per cent of the normal value. The driving torque at full load was 6 gm.-cm. for an aluminum disk weighing 25 gm. and 10 gm.-cm. for a disk weighing 40 gm. The pressure circuit absorbs 1 watt. The minimum load that will start the meter is some thousandths of the full load.—*Science Abstracts, Section B*, Oct. 31, 1919. (Abstracted from *Elettrotecnica*, Aug. 25 and Sept. 5, 1919.)

News in Brief

Summary

of Important Happenings in the Industry During the Week

Spring building has commenced with a rush and jobbers are besieged for materials. Much activity is noticed in New England, in the South and in the West. Shipbuilding is to be renewed in the Northwest. Timely rains and better labor conditions are reported from San Francisco. Greatly increased lumber production has been brought about in the South. Everywhere dealers are clamoring for material.

Jobbers' hopes for a banner month of April have been damped by the harbor strike in New York and by the switchmen's strike in Chicago.

Both a freight and an express embargo have been declared at Chicago, where six weeks' accumulations of shipments are piled up.

Owing to the continued shortage of small motors, two different interests are reported as seeking large factory space in Ohio and Wisconsin for manufacture of motors.

Conduit manufacturers are not all in accord with price advances. Only one has so far issued card 45, showing an increase of eight points over No. 44. Conduit fittings are reported as being next in line for an advance in price.

Porcelain knobs, tubes, etc., have again advanced in price. The latest increase is 30 per cent, and manufacturers will accept orders subject only to mill conditions.

Electric ranges have sold particularly well during the past month. Demands cannot be supplied as factories have orders for more than a year ahead. Prices have advanced 15 per cent.

A noticeable activity in extending central-station service to the rural districts is reported from the South.

There will be a strong representation of the National Electric Light Association at the annual convention of the United States Chamber of Commerce at Atlantic City on April 27-29, where several matters of great importance to the electrical industry will come up for discussion.

Threatened shortage of fuel oil on the Pacific Coast, with an increase of 25 cents a barrel in its price, has led the Railroad Commission of that state to take action intended to suggest the necessity of legislation to bring the price of oil under public regulation.

Opposition to "home rule" for public utilities was voiced before the convention now drafting a new state constitution for Illinois by B. J. Denman, president of the Illinois Electrical Association, who dwelt on the economical public service furnished by the electric supply companies by means of interconnection.

Samuel Insull before the Western Society of Engineers urged that engineers should speak out fearlessly on public questions in the interests of efficient government.

Reservations for the special trains to be run to the Pasadena convention of the N. E. L. A. are coming into headquarters at a rate which indicates a record-breaking attendance.

Calvert Townley, president of the American Institute of Electrical Engineers, speaking to the Electrical World, protests against the limitation of electrical utilities to a return of 8 per cent, which, he declares, will, under the financial conditions now obtaining, lead to a deterioration in service.

A special committee on superpower systems has been appointed by President Townley of the A. I. E. E. W. S. Murray is the chairman.

Uniform classification of accounts for public utilities will be discussed by the National Association of Railroad and Public Utility Commissioners' committee on that subject at a meeting in the rooms of the Public Utilities Commission of Illinois on April 21. The National Electric Light Association will have representatives present.

Electrical interests are taking an active part in the "Own your home" campaign, which is to culminate in an exposition at the Grand Central Palace, New York, in the first week of May.

A. Emory Wishon, president of the Pacific Coast Section, N. E. L. A., has arrived in the East and will address a number of meetings along the lines of his "self-interest" plan for promoting electrical development.

Through the committee on valuation and return, representing three state utility associations, electric, street railway and gas, the public service companies of Illinois are urging that valuation should be computed on the basis of present costs.

One hundred applications for charters for electric utilities in the western part of Pennsylvania are now before the Public Service Commission of that state.

Enforcement of the Oregon Industrial Lighting Code by the State Commissioner of Labor has begun.

Seattle is planning to sell $1,000,000 of city light and power bonds direct to the public without employing brokers.

Three dollars is a fair price for Pittsburgh steam mine-run coal and similar grades under present conditions, according to John H. Jones, president of the Bertha Coal Company.

Daylight saving bills have been passed by the Massachusetts Legislature and the Rhode Island House.

Progress in overcoming atmospheric interference with radio service was reported at Wednesday's meeting of the Institute of Radio Engineers in New York.

Interconnection on the Pacific Coast is to be extended by the closing of a 30-mile gap between Everett and Mount Vernon, Wash., thus increasing the total interconnected load in the Pacific territory from 230,000 kw. to 350,000 kw. This is inclusive of the systems of the Bellingham district and southwest British Columbia.

Electrification of those portions of road running over Tennessee Pass and Soldier Summit and of three tunnels under the Continental Divide is planned by the Denver & Rio Grande Railroad.

Confirmation of plans for nationwide power development by a new corporation, as reported in Eastern newspapers, is lacking.

Crane motor and control standards are being perfected by a committee representing prominent electrical manufacturers in connection with the Material-Handling Machinery Manufacturers' Association.

A committee to further the stabilization of the coal industry has been appointed by the American Institute of Mining Engineers.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Insull Exhorts Engineers to Speak Out on Public Questions

MANY of the foolish claims of politicians could be successfully refuted before harm was done if engineers would give the public the benefit of their training and experience instead of shrinking from this responsibilitys, as they have been in the habit of doing. This was the basic thought running through an address delivered by Samuel Insull, president of the Commonwealth Edison Company, at the first of a series of monthly luncheon meetings of the Western Society of Engineers, Chicago, last week.

Mr. Insull said that years ago engineers should have informed the public of the advantages to be gained from electrical interconnection of generating systems, but in the past engineering bodies have been too prone to say, "That is for the benefit of the large interests," without giving such questions proper consideration. "It should be the mission of engineers to keep politicians from saddling schemes of inefficiency upon the people," Mr. Insull continued, "but in order to do this intelligently engineers must supplement their scientific knowledge with a study of the underlying principles governing these questions."

Mr. Insull paid a tribute to his commercial organization when he said that it was principally due to the engineering of selling that, with 2½ to 3 per cent of the population of the country and 3 per cent of the total capital invested in central stations, Chicago generated more than 5 per cent of the energy and collected 6 per cent of the gross revenue of the central-station industry.

Big Demand for N. E. L. A. Convention Specials

RECORD-BREAKING attendance at the forty-third convention of the National Electric Light Association in Pasadena, Cal., May 18 to 22 inclusive, is forecast by the number of reservations being received at association headquarters in New York. Not only is space in the three special trains to be run from the East being rapidly filled, but arrangements have had to be made for special cars from many cities where members already have signified their intention of attending the convention in numbers sufficient to make this necessary.

At present plans have been perfected for special cars at Boston and Chicago to be attached to the "Red Special," which is the thirty-day *tour de luxe*, with a probability that another car will be attached at Detroit. At Pittsburgh, Chicago and Omaha cars will be attached to the "Pink Special," and cars for attachment to the "Blue Special" will be chartered at Chicago, Kansas City and Denver. In addition to these special trains, the Pacific Northwest members will attend in numbers sufficient to necessitate the chartering of another, to start from Seattle. The Southwestern members expect to have sufficient representation to require the chartering of at least one special car, and possibly two, to be attached to a regular train.

George W. Elliott, master of transportation, has appointed the following as assistants in charge of reservations for the "Red Special": Charles B. Burleigh, General Electric Company, Boston; J. C. McQuiston, Westinghouse Electric & Manufacturing Company, East Pittsburgh; A. H. Manwaring, Philadelphia Electric Company, Philadelphia; Godfrey H. Atkin, Marquette Building, Chicago; Robert Sibley, *Journal of Electricity*, San Francisco; Charles A. Collier, Georgia Railway & Power Company, Atlanta, and Thomas O. Kennedy, Denver Gas & Electric Light Company, Denver. Assistant masters of transportation in charge of the "Pink Special" reservations are: J. C. McQuiston, East Pittsburgh, Pa., and William Pedrick, Jr., 263 Fifth Avenue, New York; in charge of the "Blue Special" reservations: Frank H. Gale, General Electric Company, Schenectady, N. Y., and Neil Mooney, Grand Central Terminal, New York.

Daylight Saving Mix-up Clearing in the East

DAYLIGHT-SAVING troubles are gradually being ironed out in the East. The Massachusetts Legislature sent a daylight saving act to Governor Coolidge Monday, and indications are that he will sign the bill. The Rhode Island House passed a similar bill on Wednesday. The attempted repeal of the New York State law has been postponed until next week. Indications are, however, that Governor Smith will veto any repeal of the act by the Legislature. The New Jersey Legislature is withholding action on daylight saving pending a final decision in New York. Hartford and New Britain, Conn., which went upon a daylight-saving schedule March 29, returned to standard time April 4 as a result of local dissatisfaction with the mixed schedule in effect between the railroad lines and these communities.

Strong Utility Representation for Chamber of Commerce Meeting

SEVERAL matters of importance to the electrical industry will come up for discussion at the annual convention of the United States Chamber of Commerce at Atlantic City, N. J., April 27 to 29, and the National Electric Light Association will have strong representation at that meeting.

Among the topics submitted for discussion is a proposal for legislation to prevent strikes or lockouts in public service corporations by making employees "public servants" and providing for the settlement of disputes.

President R. H. Ballard has appointed John W. Lieb, vice-president of the New York Edison Company, as national councilor for the N. E. L. A., and R. E. Breed, president of the American Gas & Electric Company, as vice national councilor, and also has appointed the following as delegates to the convention: William F. Ham, president Potomac Electric Power Company, Washington, D. C.; J. B. McCall, president, and W. H. Johnson, vice-president Philadelphia Electric Company; Thomas N. McCarter, president Public Service Electric Company, Newark, N. J.; M. S. Sloan, president Brooklyn Edison Company; F. W. Smith, vice-president and general manager United Electric Light & Power Company, New York City; H. A. Wagner, president Consolidated Gas, Electric Light & Power Company, Baltimore, and T. W. Wilson, vice-president and manager Wilmington & Philadelphia Traction Company, Wilmington, Del.

Investigation of New York Resources Being Made

AN INVESTIGATION into the resources of the State of New York is being made by W. Barclay Parsons, consulting engineer, New York City. The investigation has not gone far enough for any report to be made at present. However, questionnaires have been sent out to power companies in the state involving among other things the character of power and lighting service and the generating equipment to supply this service now operating at various frequencies. This information, it is understood, will be of interest in case it is found necessary to interconnect systems operating at different frequencies.

Reported Plans Under Way for Nation-Wide Power Development

A REPORT to the effect that production of a vast amount of electric power for sale to railroads and cities is planned by a new corporation, to be known as the Electrical Power Company, has appeared in several prominent Eastern newspapers this week, but a diligent search by the ELECTRICAL WORLD for information about the backers of this reported movement proved fruitless. The reports state that prominent railroad, copper and electrical interests are engaged in promoting the enterprise.

According to the reports it is proposed to utilize "mountain streams, tidewater and low-grade coal at the places of original supply," and the project, besides being "nation-wide, may include Canada."

Use Interconnection to Fight Local Regulation in Illinois

HOME rule of public utilities was opposed as unfair by B. J. Denman, Moline, Ill., president of the Illinois Electric Association, in an address last week to the Illinois constitutional convention which is drafting a new constitution for the state. The delegates were shown a map of all the interconnected electrical systems of the state in order to emphasize the necessity of state-wide rather than city regulation of utilities. Mr. Denman told the delegates that it was the savings in investments and operating costs brought about by the interconnecting of the different systems that had made it possible to supply the public today with service at not more than 10 per cent in excess of the rates of 1911. The extensive transmission systems now made it possible for thirteen companies to supply service efficiently to 662 communities, and the speaker contended that local control would therefore be unjust, unsatisfactory and uneconomical.

Enforcement of Oregon Industrial Lighting Code Begun

GENERAL distribution of the Oregon Industrial Lighting Code, but recently off the press, has just been completed, and the increased interest in illumination is shown by the relatively large number of orders for foot-candle meters. This code, which was drawn up by a commission of three, consisting of V. H. Haybarker, representing the electrical workers; F. C. Knapp, representing the manufacturers, and F. H. Murphy as electrical engineer, was adopted by the Commissioner of Labor and became effective July 28.

No attempt has been made to enforce the law, which will be the duty of the Commissioner of Labor, until now; but inspectors will begin right away a systematic inspection of industrial plants, following this inspection with recommendations for proper illumination.

To Discuss Uniform Accounting for Utilities

REPRESENTATIVES of the National Electric Light Association and the American Gas Association will meet the committee of the National Association of Railroad and Public Utility Commissioners on uniform classification of accounts at the rooms of the Public Utilities Commission of Illinois on April 21. This committee, of which there are seven members, headed by O. O. Calderhead, tariff expert of the Public Service Commission of Washington, was appointed at the Indianapolis meeting of the commissioners' association last October. It will be urged at this meeting that all state commissions adopt the same uniform classification of accounts for the electric light and power utilities and for the gas utilities. The N. E. L. A. will present for consideration the association's uniform classification on which considerable time has been put by the industry's leading accountants.

Uniform classification of accounts is in vogue in almost all states for telegraph companies, telephone companies and street railway systems, the I. C. C. classification having been adopted.

It is understood that the committee will report its findings back directly to the state commissions.

The N. E. L. A. committee will include R. W. Symes, chairman of the Accounting Section of the association; William Schmidt, Jr., chairman of the committee on classification of accounts; M. H. Aylesworth, executive manager, and Fred W. Herbert, superintendent of the service department.

"It has been recognized for some time by both the commission and the utilities," said Mr. Aylesworth to an ELECTRICAL WORLD representative, "that uniform classification of accounting should prevail beacuse of the number of electric light and power companies that operate in more than one state. The present arrangements result in much confusion. It is with this attitude that the commissioners of the country are undertaking to bring about a standard classification of accounting which will be acceptable to all of the state commissions and which will mean the saving of many thousands of dollars now spent by public utilities, an expenditure with which the consuming public is necessarily concerned."

The Massachusetts Department of Public Utilities, which held a meeting this week to consider a uniform classification of accounts, was requested by the central stations of the state to defer action until after the report of the committee of the National Association of Railway and Public Utility Commissioners.

Western Electric Issues $25,000,000 Five-Year Bonds

THE Western Electric Company is issuing $25,000,000 five-year 7 per cent convertible gold bonds. At the option of the holder these bonds may be converted, between April, 1922, and October, 1924, into 7 per cent cumulative preferred stock of the company.

Charles G. Du Bois, president of the Western Electric Company, stated to a representative of the ELECTRICAL WORLD that the proceeds from this issue will be used in part to retire bank loans, leaving the company free of floating debt. It will also provide the company with ample working capital and much needed extensions to its plants to take care of the present volume of business, which has increased in all departments.

Goodwin and Chase Speak to Big Meetings in the South

CO-OPERATION among the electrical fraternity received a great stimulus from the tour just completed by W. L. Goodwin and S. A. Chase through the principal Southern cities. These gentlemen report that much enthusiasm was evidenced at each of the meetings that have been held, the principal ones being in Jacksonville, New Orleans, Birmingham, Memphis, Chattanooga, Atlanta, Columbia and Charlotte.

On Friday, March 27, they spoke in Atlanta to the largest gathering in the Southeast and were received most enthusiastically by 237 representatives of the industry. Following a dinner at the Kimball House, Mr. Goodwin concluded the exposition of his plan at a meeting of contractor-dealers held the next morning at the Chamber of Commerce.

Representatives of all lines of the industry were present at the dinner as well as representatives of the local press. That the latter were favorably impressed by Messrs. Goodwin and Chase's talk was evidenced by the publicity given them and their plan by all of the local papers. A little later in the month they expect to leave for the Pacific Coast.

Committee to Further Coal Industry Stabilization

AS a part of its program of stabilization of the coal industry the American Institute of Mining Engineers has appointed a co-operation committee to its coal and coke committee, including operators, consumers and consulting engineers. Among those on the co-operation committee are W. S. Murray, who has been so active in urging the installation of the Boston-Washington super-power zone; L. P. Breckenridge, professor of mechanical engineering, Yale University; David Moffit Myers, consulting engineer, and George Otis Smith, director of the Geological Survey.

Fair Price for Pittsburgh Steam Coal $3, Says Operator

IN VIEW of the interest being taken by electric light utilities in the price of coal as a result of the 27 per cent increase in miners' wages which became effective April 1, a statement in the current issue of *Coal Age* by John H. Jones, president Bertha Coal Company, on a fair price for coal is significant. Mr. Jones stated that for certain high grades of coal he would consider $3 per ton a fair price for Fairmont and Pittsburgh steam mine-run and coal of the same quality from other districts. In the central fields, he stated, the prices should run from $3.50 to $3.75 for thin-vein coal of low volatility.

Mr. Jones pointed out that the coal men were on trial. Coming as it does so soon after ending of federal control, this statement may easily be taken to mean that far-sighted coal operators will, at least for some time, urge conservatism in advancing coal prices.

Seattle Plans to Sell Bonds for Municipal Project to Public

SEATTLE'S Corporation Counsel, Walter F. Meier, is preparing a resolution providing authority for the sale of $1,000,000 of city light and power bonds direct to the public without the intervention of brokerage firms. The bond sale will be a part of the light and power bond issue of $5,500,000 authorized by the City Council two years ago to finance the city's Skagit River power plant project and of which $1,500,000 have been sold. At a recent conference the city officials informally agreed to offer the bonds for sale over the counter to individual subscribers, and Mr. Meier was instructed to draft the resolution. It is proposed to open the sale early this month and close it about May 15. The bonds, which may be purchased in denominations from $100 up, are payable in six to twenty years and bear 6 per cent interest. Mr. Meier was also instructed to proceed at once with the condemnation of certain lands in Whatcom and Skagit Counties necessary for construction of a railroad spur to the proposed power site from Rockport on the Great Northern Railroad.

Wishon to Tell "Self-Interest" Story in the East

A. EMORY WISHON, president of the Pacific Coast Section, N. E. L. A., and general manager of the San Joaquin Light & Power Corporation, Fresno, Cal., arrived in the East this week to tell his "self-interest" story,[*] which has aroused so much favorable interest on the Pacific Coast. Mr. Wishon plans to be in the East until May 1, during which time he expects to address meetings of electrical interests, bankers, "rotarians," etc.

The program as at present laid out includes an address at the April 12 luncheon meeting of the New York Electrical League. He will address the Rotarians in New York on the twenty-second. He is scheduled to speak under the auspices of the General Electric Company at Schenectady and at a meeting of the Electrical interests of Pittsburgh. Talks before the executives of the Western Electric Company and before the editors of the McGraw-Hill Company, publishers of the ELECTRICAL WORLD, are also being arranged.

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[*] Mr. Wishon outlined this plan in the ELECTRICAL WORLD for Dec. 13, 1919, page 1060.

Radio Progress Against Atmospheric Interference Reported

RECORDS in the reception of messages from high-power European stations show that several methods of reducing atmospheric interference are reasonably effective. A direct comparison of these methods, however, is difficult because the local conditions play such a large part in the results. This information was brought out in New York last Wednesday in a paper by Dr. Louis W. Austin, head of the United States Naval Radio Telegraph Laboratory, Washington, D. C. This paper, entitled "The Reduction of Atmospheric Disturbances in Radio Reception," was read before the Institute of Radio Engineers by the secretary, Dr. A. N. Goldsmith, in the absence of Dr. Austin.

The records were obtained at Lakewood, using the Weagant system of static reduction; at Belmar, where a system devised by A. Hoyt Taylor was installed; at Otter Cliffs, near Bar Harbor, Maine, and at Anacostia, near Washington. When the discussion was opened by John V. L. Hogan, the president of the institute, a great deal of evidence was forthcoming from the members concerning the origin and nature of static interference. The meeting was one of the best attended this year.

Crane Motor and Control Standards Drawn Up

AT THE annual meeting of the board of governors of the Material-Handling Machinery Manufacturers' Association, held in New York on April 6, Charles F. Lang, president of the Lakewood Engineering Company, was elected president of the association; Rumsey W. Scott, Otis Elevator Company, was elected vice-president; Lucian C. Brown, Elwell-Parker Electric Company, was re-elected treasurer, and Zenas W. Carter was elected secretary and manager. The general crane committee, composing representatives of virtually all crane manufacturers in the United States, met on March 29 to develop standard crane specifications for half-gantry electric traveling cranes, with special reference to the thirty cranes to be installed on the 1,100-ft. (330-m.) piers on Staten Island, New York. On April 5, a committee composed of representatives of the General Electric Company, the Westinghouse Electric & Manufacturing Company, the Cutler-Hammer Manufacturing Company and the Electric Controller & Manufacturing Company determined on the complete data for half-gantry electric traveling cranes, motors and controllers which should be considered as the standard adopted by the association for such wharf or pier cranes. It is expected that these specifications will be made public in a few weeks.

Large Number of Companies Seek Pennsylvania Charters

AT THE end of March there were before the Pennsylvania Public Service Commission 100 applications for charters for electric utilities to operate in the western part of the state. This, it is reported, is the largest number of applications ever before the commission at one time. In some instances plans for developments of fair size are reported to be under consideration. In a number of the applications charters are asked for territory already granted to corporations the rights of which are questioned because of failure to build. This question is now before the Attorney-General of the state. The right to plead war conditions as a reason for failure to build is being attacked.

Stone & Webster Declare Public Utility Outlook Encouraging

THAT the tide has turned in favor of electric utilities in the minds of the investing public is set forth in a recent statement made by Stone & Webster, which points out that operating costs appear to have reached their maximum level in 1919 as affected by war conditions, and that short-term notes are rapidly giving way to more permanent issues. A hopeful note is even sounded for the future of electric railways. Electric light and power companies, the report states, have demonstrated an ability to readjust rates and operating conditions to offset increases in operating expenses and continue a satisfactory return on the investment. Furthermore, improved methods of operation are introducing economies which will at least partially offset increases in costs of labor and materials.

It is pointed out that more money was raised for public utilities during 1919 than in any year since 1913, and the following table is presented to show what proportion of the financing was done through the medium of bonds, notes and stocks in that period:

	Bonds	Notes	Stocks	Total
1914..	$195,000,000	$107,000,000	$43,500,000	$345,500,000
1915..	149,000,000	137,000,000	38,000,000	324,000,000
1916..	383,000	114,000,000	45,000,000	159,383,000
1917..	148,498,200	145,645,600	69,069,470	363,213,270
1918..	167,995,000	261,563,900	22,044,750	451,603,650
1919..	272,335,300	252,408,500	66,108,890	590,852,690

Figures showing what proportion of the above was for purposes of refunding and what for new construction are not available, but, the analysis says, it is certain that the demand for increased service and consequent additions to plant is constant and of large volume.

Reports of a large number of electric light and power companies operating in almost every state in the Union indicate that the increase in gross earnings from 1914 through 1918 from additional business and from increases in rates was at least sufficient to offset the increases in operating expenses—the latter governed by factors entirely beyond the control of any management. Figures for many of these companies for 1919 are not yet available, but, judging from such as are at hand and from the earnings of the companies under Stone & Webster management, the company feels that it is safe to predict a most reassuring improvement in the earnings of these companies throughout the country.

The advantages of water-power developments, it is pointed out, have been emphasized to a still larger degree than the business of other central power stations, because to water-power companies have accrued the benefits of their relatively small use of labor and fuel; in addition, the rising cost of power produced by steam has increased the salable value of hydro-electric power.

"The pre-war judgment of investors, therefore, that no business rests upon a more secure foundation than that of the electric light and power companies," the report concludes, "has been proved during the extraordinary stress of the last five years. The intrinsic soundness of these companies should be fully realized, and the difficulties encountered by street railways should not overshadow the whole public utility field."

N. E. L. A. Adds More Than 2,000 Members During Year

MORE than 2,000 members have been added to the National Electic Light Association since last November by the membership committee of its Pacific Coast Section. This is shown by a preliminary report made April 1 by Harry M. Sessions, chairman of the committee, to President R. H. Ballard of the association. The campaign just concluded brings the total of Class B memberships above 1,800 in California alone.

Higher Rates Defended by Maryland Commission

THE annual report of the Public Service Commission of Maryland, just issued, contains some pertinent observations on present-day conditions as they affect the public utilities of the country. Commenting on the well-nigh universal belief of twelve or fifteen months ago that the peak of high prices had been reached and that a gradual decline would be witnessed, and on its complete confutation by what has actually occurred, the commission points out that while most mercantile and manufacturing enterprises have been able to pass on to the ultimate consumer the increased cost of production, the utilities could be saved from threatened bankruptcy only by increases in rates. The settled policy of the commission has therefore been to permit the utilities under its jurisdiction to earn "a fair return on the fair value of their property used and useful in service to the public," where such property is economically and efficiently managed, and in return for this to require such utilities to render adequate service reasonably required by the public.

The commission declares its belief that "the vast majority of our citizens realize that any factor that helps these utilities inures even to a greater extent to the public interest and benefit, and further, while the commission realizes that some individuals have been critical of increases in rates allowed, yet it feels that the general public holds that its interests have been better safeguarded and served by enabling the utilities to continue rendering adequate service."

To Promote Training of Young Men for Executive Positions

THE first definite steps to foster the training of men in the technical colleges for executive and management work in the industries were taken at a meeting of the Technology Clubs Associated in Philadelphia on March 26. At this meeting representatives of the industries outlined in considerable detail the training required in the colleges to fit men for management work. It was recognized that this training must be of a broader nature than that which is now offered in the technical schools. It is not the purpose to train them for specific positions or industries, but rather to specify the broad training required for the upbuilding of executives.

In attendance were officers of seventy of the great corporations of the United States and about a hundred college executives. Among those corporations which have definitely entered into the plan by subscribing $2,500 each are the American Telephone & Telegraph Company, the Standard Oil Company, the Victor Talking Machine Company, the United Gas Improvement Company, the Goodyear Rubber Company, the Du Pont and Hercules Powder Company, the Eastman Kodak Company, and the Philadelphia Rapid Transit Company. The Pennsylvania Railroad's representative also announced that this company would contribute financially in support of the plan.

At the morning session the meeting was addressed by Mayor Moore of Philadelphia, Dr. Hollis Godfrey, president of the Technology Clubs Associated; Louis F. Musil, treasurer of the H. L. Doherty Corporation; Dr. Samuel P. Capen, chairman of the American Council of Education, and Col. B. A. Franklin, vice-president of the Strathmore Paper Company. At the afternoon session there was a general discussion of the specifications which the industries are working on to indicate to the colleges what training is essential for the development of management personnel.

Public Loses by Inadequate Return, Says President of A. I. E. E.

REGULATION of rates for electric service which arbitrarily limits the return on invested capital to not more than 8 per cent regardless of what the prevailing interest rate for investment capital may be will defeat its own end, is the opinion of Calvert Townley. president of the American Institute of Electrical Engineers and vice-president of the Westinghouse Electric & Manufacturing Company. He pointed out to a representative of the ELECTRICAL WORLD that the public, through the public utility commissions, has fixed the price which it will pay for service. The public expects that service to be maintained at the same high standard, but at the price which it paid four or five years ago before fuel, labor and materials had reached unheard-of levels and when investment capital could be had for 5 or 6 per cent. Instead of receiving the same quality of service, the public will be the loser and will receive a class of service which is commensurate with the price it pays. To understand that this will be true one has only to observe the effect the same policy has had both on the steam railroads and the street-railway systems.

"Fundamentally it is wrong," said Mr. Townley, "to write into the laws for public utilities a stipulated interest rate which they may earn, because they must compete with other industries for their capital. Money is a commodity and must be purchased at market prices just as must fuel or any other material necessary to the conduct of a business. The owner of a commodity has the right to fix his price for that commodity or sell it to the highest bidder. Electric utilities whose rates are so regulated that they are permitted to earn not to exceed 8 per cent on invested capital cannot go into the present money market and obtain new capital on this basis. The investor demands a higher rate of interest. To make the badly needed extensions and additions to their systems electric utilities must have new capital and will be forced to accept the necessity of paying the present high rates for money. The regulatory bodies also will have to accept this fact and allow the utilities an increased rate of return sufficient to attract the required capital."

Mr. Townley further pointed out that the demand for electric service, which has resulted in a power shortage in almost every section of the country, could not be met by the electric utilities until they were assured of an adequate return on the investment that is necessary to meet this demand. The sentiment of the public must be changed, and it must realize that in order that the electric utility shall deliver the high standard of service demanded it must be allowed to earn a return on its investment which will provide for proper maintenance of plant and property, including depreciation and replacement, and over and above these items show earnings which will be attractive to investors. The disposition of the commissions to limit the return to 8 per cent does not permit the electric utilities to compete successfully with other industries in bidding for new capital, and, Mr. Townley concluded, unless the regulatory bodies at once take steps to remedy this condition the service to the public may be expected to deteriorate rather than improve.

International Chamber of Commerce Announced

THE International Chamber of Commerce, projected at the International Trade Conference at Atlantic City last October, will be formally organized, it is announced by the Chamber of Commerce of the United States, at Paris during the week of June 21. Invitations have been sent out by the American group of the international organization committee to business and industrial associations asking them to name delegates to participate in the organization meeting.

The specific aims of the organization, as outlined by the committee on organization, are: To create a permanent international headquarters to centralize all data concerning economic subjects and social conditions and the facts relating to the respective needs, present production and future possibilities of each country; to act as an instrument of co-ordination which will suggest trade regulations and legislative measures to facilitate and encourage the development of economic commerce; to inform public opinion through the publication of facts with regard to business conditions and through the dissemination of views of technical experts and business men; to put at the disposal of all official organizations the reports and conclusions prepared by these experts.

Electrical Interests Active in "Own Your Home" Campaign

ELECTRICAL interests are taking an active part in the national "Own your home" campaign. This week J. M. Wakeman, general manager of the Society for Electrical Development, was appointed chairman of the electrical industries committee of the "Own your home" exposition to be held in Grand Central Palace, New York, May 1 to 8. P. L. Thomson, Western Electric Company and chairman of the adequate-outlets division of the Advertising and Publicity Service Bureau of the National Electric Light Association, has been chosen as vice-chairman of this committee. The other members will be representative of all the various electrical interests.

This committee, besides having a booth from which will be distributed educational literature of a neutral character, will supervise the proper placement of electrical appliances in the exhibits. It will also see that the wiring of the "model house" is properly installed and that each room is equipped with suitable electrical appliances. The necessity for sufficient and convenient outlets will be emphasized by the committee.

California Railroad Commission Investigates Price of Oil

ALTHOUGH the Railroad Commission of California has no authority to regulate the price of oil, it felt it to be its duty a short time ago to ask the Standard Oil Company concerning the reasons both for an advance in gasoline and for the increase of 25 cents a barrel in the amount charged for fuel oil, which plays so important a part in the electric utility business.

In reply to this request K. R. Kingsbury, president of the Standard Oil Company, gave three principal reasons for that company's action: (1) The rapidly approaching exhaustion of petroleum products and crude oil on the Pacific Coast, the available supply in stock being less than 13,000,000 barrels, which at present rates of consumption would be exhausted in a year, leaving a shortage of 25,000 or more barrels a day; (2) the possibility of the California market being drained because of lower prices there than prevail in other parts of the country; (3) the need of increased production, which would follow higher prices. "Considerations of profit," Mr. Kingsbury said, "did not enter into our price advance. Our action was designed simply and solely to protect the fuel oil and gasoline supply of the Coast and to stimulate the production of crude oil."

Chairman Edgerton of the commission asserted that the action of that body was intended to call attention to the need for legislation that would give to some public body the authority to fix the price of oil.

Utilities of Illinois Urge Valuation at Present-Day Costs

MORE than forty million dollars is needed this year to pay for extensions and improvements to the local utilities of Illinois, according to the joint committee on valuation and return representing the Illinois State Electric Association, the Illinois Electric Railways Association and the Illinois Gas Association, and failure to obtain this new capital will materially retard the normal growth and development of the communities served by these utilities.

"Cities and communities thrive and prosper only as their public utilities are able to expand to meet the increased demands made upon them," the committee continues. "Today every live city in Illinois is demanding more and better service from its public utilities. The expansion and extension of present facilities necessary to meet this demand require the investment of large amounts of new capital."

The committee recommends that in valuation cases the utilities should submit appraisals of physical property based on the cost to reproduce new at prices prevailing at the date of inventory and that the commission be urged to adopt such an appraisal as the present value of such physical property.

It is further recommended that if the commission or any other party to the proceedings submits an appraisal based on the original cost, or cost to reproduce at any other period than the present, the utility should produce evidence showing the difference between the purchasing power of the dollar used in such appraisal and the purchasing power of the dollar current at the present time, so that the commission shall be able to weigh properly the probative force of the respective appraisals.

Among other recommendations of the committee are that the utilities should oppose a deduction of any amount for accrued theoretical depreciation; that the utilities should insist upon a full and fair allowance being made for the going value of property; that evidence be introduced showing the necessity for a rate of return sufficient to attract capital under competitive conditions; that public utility companies itemize in detail all valuations submitted and request that the Public Utilities Commission should itemize its findings accordingly and include therein in detail all elements considered; that particular stress be laid on the necessity of a sufficient amount of working capital, so that the property may be efficiently and economically operated; that public utility companies offer evidence in support of adequate "replacement reserve," and that in presenting rate cases public utility companies request the commission to make adequate allowance for abnormal situations by the establishment of a contingent reserve.

One Per Cent Coal Saving Means $3,000,000 a Year

ADDRESSING the members of the Eastern Section of the Pennsylvania Electric Association at Philadelphia on March 25, Joseph B. McCall, president of the Philadelphia Electric Company, expressed his optimism over the outlook for electrical utilities based on the increase in business during 1919. He urged greater economy and efficiency in the use of coal, explaining that a saving of 1 per cent of the 50,000,000 tons of coal used by central stations would amount to an increase in revenue of $3,000,000 annually.

"Grounding of the Neutrals of Alternating-Current Secondary Systems" was the title of a paper presented by P. H. Bartlett of the Philadelphia Electric Company. Discussion of the paper by members from various companies emphasized the fact that, while it is almost universal practice to ground the neutrals of secondaries, difficulty has been experienced in securing a satisfactory grounding device where it is impossible to connect to the city water pipes.

H. B. Vincent, commercial engineer of Day & Zimmerman, Inc., read a paper on "Customers' Appliance Repairs," which was in the nature of a questionnaire, asking for discussion of the different phases of the problem by the members present. The opinion of the members was that repairs should be made with as little delay as possible to prevent loss of revenue. Repairs made free of charge, unless necessitated by actual defect of material, it was the consensus of opinion of those present, should be discouraged.

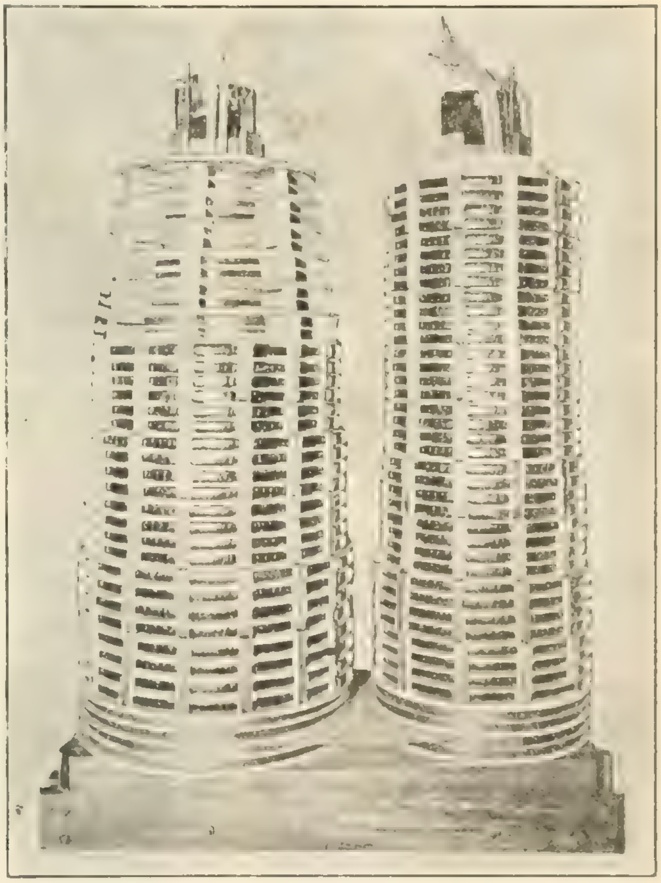
Customer Denied Service on Refusal to Pay Underwriters' Fee Wins Suit

ON THE third hearing of a suit brought by Paul G. Tismer against the New York Edison Company for refusal of service based on the plaintiff's omission to furnish the company with a certificate from the Board of Fire Underwriters asserting the safety of his equipment, the New York State Court of Appeals has overruled the Appellate Division of the Supreme Court, sustaining the Trial Term and finding against the company. The plaintiff refused to pay the fee of $2.50 necessary to obtain the Underwriters' certificate and merely furnished the company with a certificate of approval from the City's Department of Water Supply, Gas and Electricity and a letter signed by the chief inspector of the Board of Fire Underwriters to the effect that on payment of its inspection fee a certificate would be issued.

The Court of Appeals, asserting that the Board of Fire Underwriters is a voluntary association which the company might select as its agent but for whose opinion it could not force a customer to pay, held that, in the absence of a contention by the company that the installation was unsafe or a clause in the agreement that the customer should pay the fee, the law had been complied with. "Submission is due," it observed, "not to those whom custom may point out as competent to advise but to those whom the law has designated as empowered to command," and in this case the "constituted authorities" of the statute were the officials of the city department.

The law provides damages for refusal of service in the amount of $10 plus $5 additional for every day in which it has been withheld. The plaintiff waited until the last day of the three years' constitutional limit before bringing his suit.

Transformer for 600,000-Volt Testing Laboratory at Purdue



High-voltage equipment has just been installed, tested and calibrated at Purdue University, Lafayette, Ind. The A. I. E. E. standard sphere gaps were used for reference in the calibration of tertiary coils and crest voltmeter. The apparatus was found to operate very satisfactorily, the secondary voltage being readily increased by even increments to values in excess of 600,000 volts. Two series of commercial insulator tests have also been completed, including dry flash-over, rain flash-over and puncture of high-voltage pin-type insulators. Prof. C. Francis Harding is head professor of electrical engineering at Purdue University.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Norwood, Ohio, May Sell Municipal Plant.—The City Council of Norwood, Ohio, has passed, with the approval of the Mayor, an ordinance for the sale of the municipal electric lighting plant, the power house of which was destroyed by fire.

Classification of Accounts.—A meeting has been called by the Massachusetts Department of Public Utilities for April 17 to consider a reclassification of accounts of gas and electric companies to be made effective July 1 next if practicable.

Course in Safety Engineering.—The Massachusetts Division of University Extension has prepared what is believed to be the first complete technical course of study in America on safety engineering, designed for safety engineers, managers, superintendents and foremen of industrial establishments.

General Electric Increases Interest on Employees' Bonds.—Increase of the interest rate from 6 to 7 per cent on its employees' investment bonds has been announced by the General Electric Company. Since these bonds were originally offered, $1,750,000 have been subscribed for by the employees.

Energy Consumption in British Cities.—Figures recently published show that, omitting London, Manchester ranks first among British cities as a consumer of electrical energy, having produced 184,000,000 kw.-hr. last year. Sheffield produced 161,000,000, Glasgow 145,000,000, Birmingham 141,000,000, and Liverpool 72,000,000.

Signal Corps Men Preferred.—The Westinghouse Electric & Manufacturing Company has notified the Chief Signal Officer, U. S. A., that Signal Corps men who during their enlistment complete the course at Camp Alfred Vail with the grading of "excellent" will be given special attention upon their discharge from the service if they apply for work with that company.

Water-Power Development in Wisconsin.—The Little Wolf Power Company has applied to the Railroad Commission of Wisconsin for a permit to construct a dam on the Little Wolf River in Waupaca County and to build a station for the generation of electrical energy to be distributed to the city of New London and vicinity. The average operating head of the proposed dam will be about 21 ft. There is a drainage area of about 500 square miles above the site, and it is estimated that about 2,400,000 kw.-hr. can be developed by the installation of machinery rated at 1,050 kva.

Electrical Possibilities in Brazil.—The total hydraulic power available in Brazil is estimated by the Rio de Janeiro *Times* at nearly 6,728,000 hp., or about 5,000,000 kw. Among the sources from which this power could be derived are: Guahyra Falls, 1,058,400 kw.; Paulo Affonso Falls, 1,031,940 kw., and Umbupunga Falls, 328,545 kw.

Water-Power Conditions in New England.—Water conditions have improved so much in lower Connecticut that the Waterbury steam plant of the Connecticut Light & Power Company can now be shut down during a large part of the day, the load being carried by the new hydro-electric station at Stevenson. Conditions are also much better on the New England Power and Turners Falls systems.

Substation on Runners Provides Temporary Service.—In midwinter a fire at the Oldtown (Me.) pumping station necessitated an emergency transformer installation. Two 100-kva. transformers were rushed to the spot by the Bangor Railway & Electric Company and installed on a sled in time to supply house-lighting service by 7 p.m., only nine hours after the local equipment was destroyed.

Electric Railway Statistics.—The McGraw Electric Railway Directory for February, 1920, has just been issued. It gives up-to-date information on more than 900 electric railways of the United States, Canada and Mexico, including the name of the company, financial affiliation, points reached, executives and chief operating men, power plant and substation equipment, location of repair shops, amusement parks reached, miles of track and details as to rolling stock. The new edition, which has been completely revised, includes also a list of electrical railway associations, national and state railroad and public utility commissions, with the personnel of each; a numerical index to electric railway companies and an alphabetical list of more than 8,000 names of men connected with the railways. Figures for mileage, track extensions and reconstruction in 1919 are printed. The book is published semi-annually, February and August, at $7.50 per annum, by the McGraw-Hill Company, Inc., Tenth Avenue and Thirty-sixth Street, New York.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

I. E. S., Philadelphia Section.—Preston S. Millar is scheduled to address this section on Friday, April 16, his topic being "Daylight Saving."

Electric Club of Chicago.—A dinner-dance in honor of the returned soldier and sailor members of this club was given at the Morrison Hotel, Chicago, on April 6.

American Physical Society.—A regular meeting of this society will be held at the Bureau of Standards, Washington, on Saturday, April 24, with sessions also on the day before if necessary.

National Safety Council.—The Engineering Section of the National Safety Council will hold its spring conference at the Engineering Societies Building, New York City, on April 27. Sidney J. Williams, 168 North Michigan Avenue, Chicago, is secretary.

A. I. and S. E. E., Pittsburgh Section.—On May 22 an inspection trip to the works of the Trumbull Steel Company at Warren, Ohio, will be made by the members of this section of the Iron and Steel engineers. William F. Rese will read a paper on the electrical installation at the plant.

New York Electrical League.—A. Emory Wishon, the general manager of the San Joaquin Light & Power Corporation and president of the Pacific Coast Section of the National Electric Light Association, is to speak before the New York Electrical League on Wednesday next, April 14.

A. I. and S. E. E., Philadelphia Section.—On May 1 the meeting of this section of the Iron and Steel engineers will be devoted to "general ideas and discussions," every active member being invited to prepare a paper on the subject pertaining to the application of electricity to the iron and steel industry.

Kansas State Association of Electrical Contractors and Dealers.—The semi-annual meeting of this association is to be held in Kansas City, Mo., on Monday and Tuesday, April 26 and 27, in connection with the meeting of the Missouri State Association. W. L. Goodwin and S. A. Chase will speak.

Pennsylvania Electric Association.—The noon-day luncheon of the western geographic section of this association, which, as previously announced, is to meet at the William Penn Hotel, Pittsburgh, on April 21 to discuss power-factor topics, will be addressed by A. W. Thompson, president of the Philadelphia Company, and A. M. Lynn, president of the West Penn Power Company.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Abandoning Unprofitable Branch Line.—The Arizona Corporation Commission has refused permission to the Ray Electric & Telephone Company to abandon unremunerative service on a branch line, setting forth that the income of the entire system is adequate, that the branch line was inaugurated on the company's own initiative and that the service has been available for many years and the community has been led to rely upon it.

Distance of Free Extensions.—By agreement between the Public Utilities Commission of the District of Columbia and the Potomac Electric Power Company the latter has agreed to extend underground wiring 35 ft. and overhead wiring 250 ft. without charge in order to furnish electricity to new customers. These distances are less than those proposed by the commission, but they are more than twice the distances to which the company has been extending its service without cost in the past.

Donation to Attract New Customer.—In an investigation into the accounts of the Albion (Ill.) Electric Light & Gas Company, conducted for rate-making purposes, an item of $500 paid to a fund raised to induce a certain manufacturer to start a factory in the city was found charged to operating expenses. The Illinois Public Utilities Commission decided that this was a proper charge but that the amount should have been amortized over a series of years as the benefits from the new customer would be continuous.

Just and Reasonable Return.—A return of 4.6 per cent on electric utility property is less than reasonable, in the judgment of the Public Service Commission of Missouri, expressed in its finding on the complaint of the Engineers' Incitation Club against the Union Electric Light & Power Company of St. Louis, to a utility compelled to pay average annual interest charges of 6.18 per cent. State regulation in protecting the property of the investor and the interest of the public in proper and adequate service should result in a return sufficient to attract necessary new capital.

What Constitutes a Proper Minimum Charge?—The Bloomington (Wis.) Electric Light & Power Company applied to the Wisconsin Railroad Commission for a uniform rate of 10 cents a kilowatt-hour, with a minimum charge of $1.50 a month instead of $1 as formerly. The commission granted the 10-cent rate, but placed the minimum charge at $1.25, saying: "While there is no question that the rates provided here will not under present operating conditions provide a full return, there is question as to whether the service is worth $1.50 a month throughout the year to many customers and there is the further question of whether or not an attempt should be made to provide a full return to this plant."

Increased Rates Authorized Despite Contract with Municipality.—The Board of Aldermen of Atlanta, Mo., in November, 1916, entered into a twenty-year contract with a local firm to supply the municipality with electricity at a maximum rate of 15 cents a kilowatt-hour. This contract, the Missouri Public Service Commission holds, does not prevent the commission authorizing an increase of 2 cents a kilowatt-hour, which it holds to be proper in the case of a utility earning 3.8 per cent on an estimated valuation made in the past and confronted with a condition where increased costs of operation have advanced in excess of the proposed increase in rates.

Location of Meter — Installation of Wires.—A customer of the Mohawk Edison Company protested to the Public Service Commission of New York, Second District, against regulations of the company making it obligatory to place the meter in the cellar and to inclose the service wires in metal conduits. The commission found that, while the meter must be so placed as to be readily accessible without danger to an employee of the company desiring to read or inspect it, the company cannot insist on its being placed in the cellar without rendering itself liable for illegal requirements. A compulsory rule for the inclosing of the wires in metal conduits, on the contrary, is entirely within the right of the company, which is responsible for the safety of the connection. The complainant was therefore sustained in his first contention and was overruled in the second.

Wrong Method of Billing Residence Customers.—A method of billing residence electric lighting service and commercial lighting service over one meter on the basis of the total maximum demand calculated separately for each class of service is wrong, according to the decision of the Public Utilities Commission of Illinois in a complaint against the Commonwealth Edison Company of Chicago. Empty sockets, the commission holds, should not be rated in determining maximum kilowatt-hours under a schedule requiring such determination from the rated capacity in watts of the connected installation, nor is an electrical company which reserved the right to determine a customer's maximum demand only by the installation of a meter or by the inspection of the premises justified in changing the base of a consumer's bill on the mere report of its lamp department to its meter department that the consumer has increased the watts in his connected load.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Duty of Employer in Insuring Safety.—A master is not required, according to a decision of the Court of Appeals of Kentucky, to furnish absolutely safe appliances, the full measure of his duty being discharged when he exercises ordinary care to furnish appliances which are reasonably safe. (218 S. W. 305.)

Ordering Operation at a Loss Unconstitutional.—In Brooks-Scanlon Company vs. Railroad Commission of Louisiana, the United States Supreme Court has declared that any order by a public service commission or injunction by a court that compels operation at a loss is in violation of the federal Constitution. (40 S. C. R. 183.)

Rate-Making Powers Never Delegated by Implication.—The power of the state to fix the rates to be charged by public utilities is never delegated by implication, the Supreme Court of the State of New York declares, and no municipality, board or commission may exercise such power unless it is clearly and unmistakably granted by the state. (180 N. Y. S. 304.)

Private Contracts Must Yield to Public Welfare.—In Edison Storage Battery Company vs. the Board of Public Utility Commissioners the New Jersey Supreme Court has held that where a public utility company increases its rates to take effect on a fixed date and the commission, on hearing, modifies but does not suspend them, an order affirming the modified rates, to take effect at the date fixed by the company, will not be set aside on certiorari. Private contracts as to rates, the court also observes, must yield to the public welfare, and the state may fix a just and reasonable rate without regard to the rate that is reserved in the contract.

Duty of Electric Power Company to Eliminate Inductive Interference.—Suit having been brought by the Dakota Central Telephone Company against the Spink County Power Company because of interference, the Supreme Court of South Dakota found that where a telephone company using low-tension current and the earth as a return circuit first occupied a highway and was followed by an electric power company whose high-tension current interfered with the telephone lines the power company must bear the expense of installing a metallic return circuit in the telephone lines to eliminate electromagnetic induction, though there is no duty on the part of the power company to remedy faulty construction of the telephone lines. (176 N. W. 143.)

Men of the Industry

Changes in Personnel and Position—Biographical Notes

James D. Mortimer, who has resigned as president of the North American Company and its subsidiaries, effective Nov. 1, received his early training in the utility field in the Northwest under Sidney Z. Mitchell. In 1902, when Mr. Mitchell was general manager of the Tacoma (Wash.) Railway & Power Company and was also interested in the Puyallup hydro-electric development, Mr. Mortimer, who came from the University of California, was made superintendent of power. When Mr. Mitchell came East to head the Electric Bond & Share Company he brought Mr. Mortimer with him, and he was made successively engineer, manager of operating department and a vice-president. In 1909, when the Electric Bond & Share Company became interested in the bonds of the Telluride Power Company operating in Utah and Colorado, Mr. Mortimer was sent out to report on the property. While engaged in that work he came in contact with the late James Campbell, president of the company and also of the North American Company, whose chief properties are in St. Louis and Milwaukee. Mr. Campbell was so impressed with the work of Mr. Mortimer that he induced him to join the staff of the North American Company in 1911, and Mr. Mortimer became president of the Wisconsin properties and a vice-president of the holding company. In 1914 Mr. Mortimer became president of the North American Company, succeeding Mr. Campbell, who acted as chairman of the board until his death a few months later. Although Mr. Mortimer is better known in the electric railway than in the electric light and power field, his administration of the power properties in St. Louis and Milwaukee has been eminently successful. Mr. Mortimer was born in Elmhurst, Ill., forty years ago.

J. D. MORTIMER

J. R. Geary of the International General Electric Company, who is also the director of the Tokyo Electric Company, has received the "fourth order of merit with the Rising Sun" as an acknowledgment of his services to Japan during a residence of fifteen years.

Paul R. Duffey, formerly supervisor of power plants of Potomac District, U. S. R. R. A., with office at Hagerstown, Md., has been appointed chief inspector of motive power, maintenance of equipment department, Western Maryland Railroad, with headquarters at Hagerstown, Md. Mr. Duffey will also be supervising officer of all power plants on the Western Maryland system and subsidiary lines. Mr. Duffey entered on his new duties March 1.

Theo. Schou, formerly professor of electrical engineering at the University of Iowa and later consulting engineer for the Electric Machinery Company, Minneapolis, Minn., is now connected with the Ideal Electric & Manufacturing Company, Mansfield, Ohio, in the capacity of chief engineer. Mr. Schou has specialized in the design of synchronous motors, being recognized as one of the foremost authorities in this field. He will develop a new line of synchronous machines for the Ideal Electric & Manufacturing Company. Mr. Schou has contributed a number of articles to the ELECTRICAL WORLD during the past few years on the design and manufacture of synchronous machines.

W. E. Herring, since 1913 industrial agent of the Puget Sound Traction, Light & Power Company, Seattle, Wash., has resigned to accept a position on the engineering staff of Stone & Webster in Boston. From 1909 to 1913 he was water-power engineer for the Forest Service with headquarters at Portland, Ore., having jurisdiction over water powers of Oregon, Washington and Alaska. Before that he was chief engineer of the Forest Service, with headquarters at Washington, D. C.

W. E. HERRING

James T. Hutchings has resigned as president and general manager of the Rochester (N. Y.) Gas & Electric Company to become assistant general manager of the United Gas Improvement Company at Philadelphia. Mr. Hutchings was born at Amherst, Mass., Feb. 18, 1869, and was graduated from the Massachusetts Agricultural College at Amherst in 1889. He immediately entered the employ of the Thomson-Houston Electric Company. In November, 1890, he became connected with the Germantown (Pa.) Electric Light Company as assistant superintendent. He remained in that position until April, 1891, when he became assistant superintendent of the West End Electric Company at Philadelphia. Upon the consolidation of that company in 1893 with other companies to form the Philadelphia Electric Company he was appointed superintendent. He was advanced to the position of assistant electrical engineer, which he held until June, 1904, when he accepted the superintendency of the electrical department of the Rochester Railway & Light Company. In 1909 he was made general manager of that company and on June 1, 1917, was promoted to be vice-president and general manager. On Dec. 20, 1918, he was elected president of the company to succeed Harry E. Andrews, who died on Dec. 1 of that year. Mr. Hutchings has been largely responsible for the physical growth of the Rochester company during his administration. A number of the company's generating stations have been built under his supervision, and the development of the distribution system for gas and electricity has been worked out under his direction. This work has called for the consolidation of nine separate and distinct distribution systems operating at various frequencies and voltages in furnishing street and commercial lighting service. Another noteworthy feature of his work in Rochester has been the influence he exerted in creating a loyal spirit among employees and a friendly feeling toward the company by the public. Mr. Hutchings took up his new duties April 1. Robert M. Searle, heretofore vice-president of the company, has been elected to succeed Mr. Hutchings.

J. T. HUTCHINGS

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler
and Jobber of Electrical Equipment and Supplies —Notes on Industrial Activities
and Business Methods

High-Tension Insulators in Good Demand

MANUFACTURERS of high-tension insulators have their hands full taking care of orders for shipment during the next six months. In general quotations are being made on a basis of shipment in four to six months, but there is still a certain amount of capacity, small, it is true, which can be turned over to care for special rush orders by moving ahead short time orders on which a slightly longer shipping date would make no difference to the buyer.

The best orders are coming from outside the country. Payments are being made on the basis of cash on bill of lading, although some European countries are seeking longer terms. Italy and France are very active in this field. The high cost of fuel in these countries is undoubtedly a great factor in the expansion of high-tension lines at this time. An order of 70,000 suspension units is being filled for shipment to Japan, for operation on 154,000 volts. It may be interesting to note here that an order for 10,000 units for this development has been placed in Japan. Among the orders for South America is one for 30,000 units of the 70,000-volt suspension type, destined for the Andes. Inquiries, too, for export trade are received in good volume.

The domestic market, with the exception of a very few cases, possibly a half dozen, confines its activity to maintenance orders. These orders, however, are running into good volume as is witnessed by the long shipping dates quoted.

Factory production is reported at a little higher rate than earlier in the year. Labor is still regarded as the controlling factor in production, and its turnover is still rather high. Malleable shortage is giving considerable trouble in some plants, although at least one manufacturer reports a good supply coming from the foundry which has been his source for a good many years.

Prices on high-tension insulators were advanced from 10 to 20 per cent by at least one manufacturer, while others have reported no advance since early in the year.

Farm Service Opens Manufacturing Opportunities

ELECTRICAL manufacturing companies which are watching closely the developments in farm lighting are confident that this field is opening up opportunities. These come not only in new applications for heating and motor-driven appliances but also in lines of supplies designed especially for farm service. The new market for appliances has been so well visualized that it may be passed with the statement that development work is proceeding at a surprising pace.

In the supply lines, however, the situation as the electrical manufacturer sees it is different. In equipping the 32-volt installations, sockets and switches ordinarily used for 110-volt service were used. Because they were liberally designed they stood the severe service for a while. But right now the farm-lighting dealers are beginning to learn that a serious error was made in using this 110-volt material. Hurry-up calls for service men are reaching the dealers in such quantities that investigations as to the causes have been made. These inquiries show that it is not the plants which give the trouble. It is the 110-volt electrical equipment.

The cause for this is, of course, easily understandable. A flatiron is the heaviest load an ordinary socket usually handles. On a 110-volt circuit an iron uses between 5 amp. and 6 amp. Operating at 32 volts the same iron takes between 17½ amp. and 20 amp. Such severe overloading was bound to end in trouble. The remedy, it seems, lies in the production and sale of a line of 32-volt heavy-duty sockets, feed-through switches, plugs and receptacles. A few manufacturers' models of these devices are now being shown around among the trade. An attachment plug in this stage of development was shown at a recent meeting of farm-plant dealers and created very favorable comment. It was of a parallel-blade type with the blades staggered to give increased clearance for wiring. While the blades are very heavy, the receptacle will also accommodate an ordinary 110-volt parallel-blade attachment plug.

Surveys which manufacturers have made of this field indicate that when these 32-volt lines come into production they will find a receptive market. Demand, it is thought, will come not only from the farm-plant dealers and electrical retail trade but also from the makers of appliances who wish to equip their devices with plugs which will break heavy currents.

Analysis of 1919 Electric Motor Exports

THE value of electric motors exported from the United States during 1919 was far in excess of the value of any other type of electrical apparatus sold to foreign buyers, last year's exports of this product amounting to $10,635,476. This is $1,843,167 in excess of insulated wire and cable exports, the next most important item of electrical goods sent out of the country. Fig. 1 indicates that the rate of exportation of electric motors was fairly uniform throughout the year, with the exception of June, when a total value of $1,562,521 was recorded. The average monthly rate of exportation was $886,289.

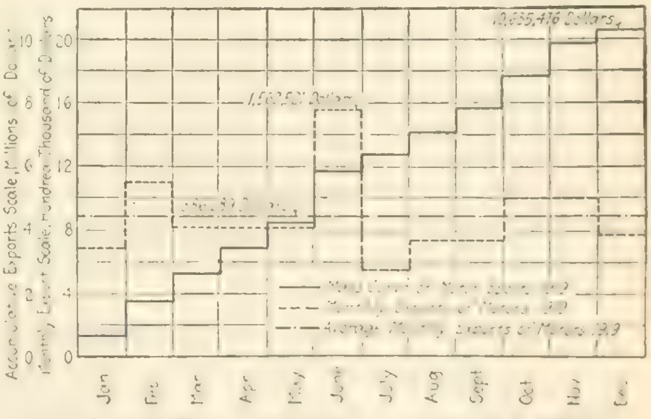


FIG. 1—MONTHLY VARIATIONS IN VALUES OF ELECTRIC MOTOR EXPORTS

Data compiled by the ELECTRICAL WORLD indicate that the value of electric motors imported by Canada from the United States was a third more than that imported by any other country, with a total of $1,611,317. Japan and England were second and third, with $1,067,949 and $877,478 respectively. Fig. 2 shows the relative value of exports to various countries importing motors the value of which was in excess of $100,000. A detailed study of the figures for countries actively involved in the war indicates very clearly the rate of rehabilitation of their industries. Belgium did not import any electric motors until April, but the monthly exports to that country gradually increased after April until in November and December the totals were $71,078 and $47,401 respectively. France, notwithstanding the probable largely increased local production of all types of electrical apparatus since the armistice, imported electric motors valued at $591,227 in 1919, the December imports being $58,793. England showed a remarkable increase in this line of imports, the figures for January and November being $20,898 and $424,043 respectively. Taking into consideration only such countries as imported $100,000 or more of this class of American electrical goods, continental America accounted for $3,968,235 worth, or 40 per cent; European imports totaled $2,200,599, or 22 per cent, and the remaining $3,680,707, or 38 per cent, went mostly to Japan, Australia, British India and China.

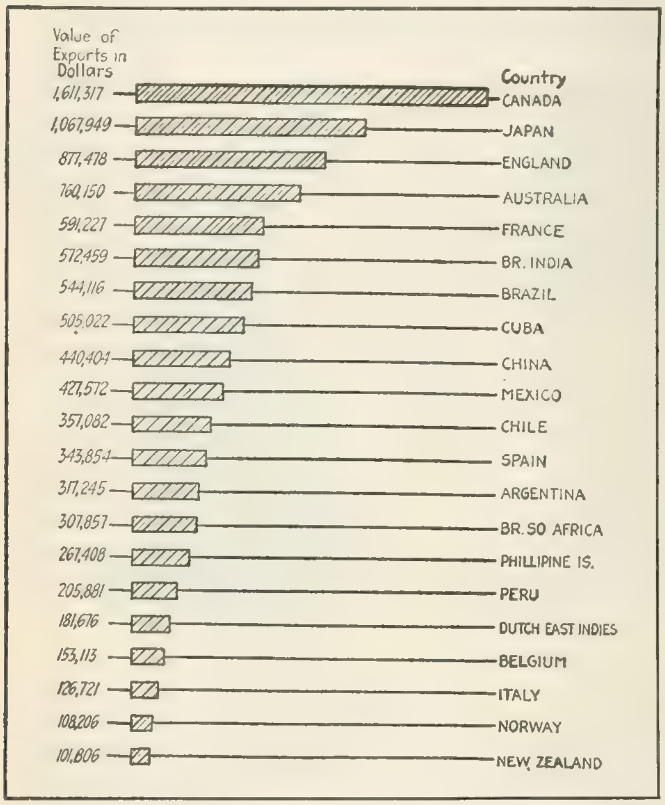


FIG. 2—EXPORTS OF AMERICAN ELECTRIC MOTORS TO FOREIGN COUNTRIES

The above figures are based on export statistics issued by the Bureau of Domestic and Foreign Commerce for 1919.

Possibilities of Fractional-Horsepower Motor Business

THE demand for fractional-horsepower motors in industrial fields is growing so rapidly that one of the leading men in that branch of the business predicts that within five or six years the industrial demand will catch up with and perhaps surpass the demand for household appliances. This statement was made with the full realization of the great possibilities of electric refrigerating machines, electric dishwashers and other devices which are being developed to swell the demand in the domestic field. The idea is still prevalent that the fractional-horsepower motor business depends primarily on the demand for electric washing machines, but this does not seem to be borne out by the figures. Records of American manufacturers show an output of some 200,000 fractional-horsepower motors per month against a production of about 60,000 electric washing machines in the same length of time. Furthermore, one of the large manufacturers has unfilled orders on hand for upward of 1,000,000 motors and the washing-machine manufacturers have been able to electrify only 70 per cent of their combined output.

There is a potential application for fractional-horsepower motors wherever labor is done by hand, and the electrification of hand tools is advancing steadily. In a particular engine factory one man with an electrically driven socket wrench replaced nine men with hand wrenches. Bench planers, breast drills, screwdrivers, valve grinders, precision grinders and many tool-room tools are among those that have already been successfully electrified. The horsepower rating of the motors required by some of these tools is beyond the fractional-horsepower class, but the speeds used are so great that in many instances the regular fractional-horsepower motor frames are used.

Under normal conditions it usually took about a year to break into the manufacturing end of the fractional-horsepower business because the majority of prospective customers came under one of the two following classifications: Those who had signed up with some one else for a year's supply of motors and those who were developing machines and wanted sample motors with which to experiment. In either case it would take about a year to get tangible results. Now, however, the demand for motors is so great and the supply so limited that any manufacturer who can make deliveries can get orders. Manufacturers have noticed that their fractional-horsepower business has not been affected by panics and business depressions to anything like the extent of other lines.

The Danger of Pyramiding Orders

FRESH evidence comes in every day that business as it is now carried on is on an unsound economic basis. It has come to the point where in many lines, and among them are parts of the electrical industry, manufacturers talk glibly of production booked up months ahead and of the inability to accept orders for nearby delivery. Nor do these manufacturers, except perhaps in a few isolated instances, take the trouble to inquire into the genuineness of the incoming orders. Were a careful and unbiased study made it is doubtful whether any bonafide unfilled orders would be found; certainly, at least, the situation as it is now so generally understood would be greatly clarified. By far the bulk of the excess demand comes from covering or pyramiding of orders. For instance, a jobber in the Eastern steel district, needing a certain amount of conduit, wired an order for double that amount to three manufacturers. Had he received all that he had called for he wouldn't have had room enough for it in his warehouse.

If all of the electrical jobbers in New York were to receive all of the goods they have ordered, it was stated last week by one who should know, there wouldn't be enough spare warehouse space in the city to take care of it.

A prominent department store buyer wanted from two to six toasters. He placed an order for fifty. A jobber in New Jersey orders three carloads of washing machines every time he sells one carload. A manufacturer of an industrial device employing in its make-up a $\frac{1}{10}$-hp. motor placed an order with each of at least three manufacturers for more motors than he needed during the year and then went out into the resale market and picked up a few to keep him going along.

A small buyer of magnet wire placed three orders of $10,000 each for magnet wire when his own annual requirements were about $5,000 worth.

A dealer needed 250 switches, on which deliveries are long. To be sure of getting them at the earliest possible moment he placed orders with from three to five different jobbers for the full quota of 250 switches. Each of the jobbers, thinking that the order was bona fide and knowing that the factory was hard pressed, thought that the factory might scale down its order and ship only part of it. As a safeguard against such a contingency the jobbers each doubled the quantity for order, so that the total order which finally reached the manufacturer was for from 1,500 to 2,500 switches.

There are only a few of the electrical jobbers who have not engaged in this practice of ordering far and wide and heavily. At the first evidence of a slackening in the market, however, these jobbers can be expected to run for cover. Then heavy cancellations must necessarily follow.

It is doubtful whether manufacturers will enforce non-cancellable contracts very generally. There does, however, seem to be a demand on the part of the manufacturers for some way to meet such a situation. A policy of demanding so much down or within, say, ten days of the placing of an order before booking it, to be forfeited in case of cancellation, might prove effectual, but there is no evidence of its having been used, at least to any considerable extent.

Midwest Jobbers Feel Producers Should Guard Market

WITHOUT the development of any new factors of moment, trading in the Middle West continues on as heavy a scale as heretofore. Orders placed continue to exceed in amount goods shipped, and no improvement in deliveries is noted. A slight tightening of credit is observed, or rather a more definite policy of holding buyers to original credit terms, besides also a more strict adherence to discount dates. This policy is being adopted to offset in a measure the more or less reckless buying which is persisted in. Jobbers are a unit in recognizing the fact that orders are being placed in excess of actual requirements but feel that the manufacturer is the one who should be particularly on guard, as the jobber is more or less helpless in the matter. In order to sell a jobber must have stock; in order to maintain stock he must at present order many months in advance, and the manufacturer, with his broader knowledge of the possibilities of national consumption, should be careful, the jobbers feel, not to plan output in excess of ultimate total national need.

Metal Market Situation

THE recent interest in copper has subsided to some extent and the market has taken on a quieter aspect. The London market is quiet because of Easter holidays and the unsettled European situation. Producers' domestic prices are from 19.00 cents to 19.25 cents for April delivery, the nominal price being 19.25. Some large sales were made at 19.00 cents. The outside market was dull and reflected a somewhat weaker tone. There is more anxiety to sell in this market than to buy, and some offerings were made at one-quarter of a cent under 19.00 and little disposition to take. Producers' third quarter quotations have been set down at 19.50 cents a pound.

There has been a stiffening in the lead market, and the former price of 9.25 cents, below which some buying was recently done, is again the holding price. Supply is still low and not adequate for the demand.

Zinc in the London market is a little quieter. Several sales in fair volume have been made and for the most part producers' April and May supplies are well cared for. Domestic demand is light.

NEW YORK METAL MARKET PRICES

	March 31			April 7		
Copper	£	s	d	£	s	d
London, standard spot	107	10	0	105	0	0
	Cents per Pound			Cents per Pound		
Prime Lake	19.25			19.25		
Electrolytic	19.00			19.00		
Casting	18.50			18.62½		
Wire base	23.00			23.00		
Lead, trust price	8.90			9.25		
Antimony	10.50			10.50		
Nickel, ingot	43.00			43.00		
Sheet zinc, f.o.b. smelter	12.50			12.50		
Spelter, spot	8.80			8.85 to 8.95		
Tin	62.50 to 63.00			62.00		
Aluminum, 98 to 99 per cent	33.00			33.00		

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.50 to 17.00	16.50 to 17.25
Brass, heavy	10.25 to 10.50	10.25 to 10.50
Brass, light	9.00 to 9.25	9.00 to 9.25
Lead, heavy	7.75 to 7.87½	7.50 to 7.75
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

SPRING building has commenced. It is noticeable to a greater extent in the West and South than elsewhere. Demands made upon jobbers for conduit, wire, armored conductor and other materials have been tremendous and, if shipments improve, jobbers will do a record-breaking business this spring. In Chicago and in Buffalo a strike of railroad switchmen is hampering the already badly delayed shipments. New York and the East are suffering as the result of the harbor strike, which includes not only boat hands but freight handlers as well. Jobbers in the metropolitan district so far have not suffered except for lamps, conduit, flexible armored cable and porcelain, but should the strike continue another week nearly all the jobbers will be affected.

Timely rains and improved industrial conditions have bettered conditions in San Francisco. In Seattle shipbuilding on a large scale is to be renewed. There 1,000 building permits were issued during March, and one of the largest jobbers reports business for the month 30 per cent ahead of March, 1919. Atlanta is suffering from a lack of material, although building is being carried on upon a larger scale than heretofore. Lumber production is improved, although it has not been noticeable as yet owing to the car shortage.

Pipe manufacturers are not all in accord with further price advances. So far only one manufacturer has issued card 45, the others still holding to No. 44.

Price changes are general, schedules having been revised on a large number of products.

NEW YORK

Easily the most important factor in the past week's activity has been the freight and express tie-up caused by the harbor strike. While some jobbers have not felt the pinch as yet, others find it impossible to do much business on account of having lamps, conduit, porcelain, lamp cord and other much-needed materials tied up on the Jersey shore. To aggravate matters practically all of the incoming material already has been sold, and purchasers unable to get delivery are attempting to fill their needs elsewhere.

Much building construction is planned but unless conduit, armored conductor and other necessities are received in larger volume than at present, the work no doubt will be delayed. An embargo has been placed on freight into, through and out of Buffalo.

Numerous price changes are announced this week. Among the products mentioned are included conduit, cotton webbings, silk insulation, lighting glassware, ranges, lamp guards and porcelain.

Flexible Armored Conductor.—The situation remains unchanged. Several jobbers have been successful in buying some stock from the surplus materials department of the United States government but at prices as high as or higher than those being paid to manufacturers. Factory conditions are reported as improving gradually.

Conduit.—Some conduit is being received but not in sufficient quantity to be of much assistance to jobbers. One manufacturer has issued a new card, No. 45, effective April 1, which shows an advance of eight points over card No. 44. Other manufacturers have failed so far to issue a new card, feeling that the price limit already has been reached.

Insulating Materials.—Business is active and the demand continues to be greater than the supply. Cotton webbings have advanced 5 per cent and silk insulation 20 per cent. Friction tape is 45 cents in 1,000-lb. lots and 48 cents to 55 cents in 100-lb. lots depending on grade ordered.

Lighting Glassware.—Volume of business is increasing and good sales are reported. Ivanhoe-Regent has advanced its prices, amounting to 20 per cent on the list.

Lamp Cord.—This is being received in good volume by a number of jobbers but will all be used in filling back orders.

Ranges.—Sales are increasing in greater volume than ever before. Dealers are crying for ranges, but deliveries are showing only slight improvement. Orders are booked more than a year ahead for factory capacity. An advance of from 10 to 15 per cent was made April 1 on account of increased costs of labor and materials entering into the manufacture of ranges, hotel and restaurant equipment.

Lamp Guards.—"Loxon" lamp guards have advanced 30 cents a dozen on list. Quotation on 110-volt size in 5-gross lots is $2.40 per dozen; on 220-volt size, $2.55 per dozen.

Porcelain Material.—Commercial porcelain, such as tubes and knobs, is having a heavy sale. Shipments are better on this material, but the potteries are oversold and manufacturers will give no delivery quotation. Price changes on porcelain went into effect April 1, the average increase amounting to 30 per cent.

Fractional Motors.—Prices are not being quoted by General Electric on motors of less than ½ hp. direct-current and single-phase. Capacity for washing-machine motors is taken for more than a year ahead.

BOSTON

Orders continue at full tide. Stocks are very low in porcelain, rigid conduit and non-metallic flexible conduit. Freight shipments are improving, and in some cases faster service is being obtained in this way than by express. Prices tend to harden, tape being up and also pull sockets. A new card with higher quotations on rigid conduit is expected soon. Jobbers' deliveries into Maine from Boston stocks are growing better and some small material is being shipped advantageously into Connecticut from Boston by motor trucks. Collections are none too good, though no serious complaints are heard. Industrial activity is intense; at least six new large jobs were reported this week and several smaller ones are to be started at once.

Sockets.—Pull sockets are quoted at 50 cents net, in case lots, an advance of 2.5 cents. Keys and keyless remain steady at 28 cents and 26 cents respectively. Stocks are in good condition.

Wire.—Stocks are quite satisfactory, owing to moderate demand. Rubber-covered wire is quoted at $11.50 per 1,000 ft. in 5,000-ft. lots and at $13 in smaller lots. One jobber has received 2,000,000 ft. of this material within a few days. Weatherproof and bare wire are steady on 29-cent and 24-cent basis, respectively.

Porcelain Fittings.—One of the worst shortages in the history of the New England trade is reported. Scarcity of nails prevents shipment of "Nail-it" knobs. Tubes, cleats and blocks are low. Prices are being quoted as of time of shipment.

Lamp Cord.—Prices are steady on No. 18 cotton-covered at $43.70 per 1,000, list, with discounts up to 45 per cent, but comparatively little of this material is to be had.

Tape.—Prices are stiffer at 60 cents a pound on ¾-in. black tape. Tape is now higher than rubber compound.

Ridgid Conduit.—Car shortages are pushing prices up toward a new card, which will probably be 10 per cent over existing quotations. Larger sizes of pipe are reasonably plentiful, but in both black and galvanized ½ in. and ¾ in. the market is hard hit.

Flexible Armored Conductor.—An advance to $110 per 1,000 ft. is reported on No. 14 single-strip. Some of the larger stockrooms are cleaned out of this material.

Non-Metallic Flexible Conduit.—Little loom is to be had, but so much is on the way from the factories that in three or four weeks much improvement is expected in the supply. Prices are steady, Monday's quotation being $37 per 1,000 ft. for $\frac{7}{32}$-in. and $40 for ¼-in. loom in coil to 1,000-ft. lots, subject to change on delivery if not in stock.

Motors.—Second-hand dealers are buying new motors but find deliveries unsatisfactory. The demand for motors of moderate size is enormous. Prices are firm and stocks low.

Cross-Arms.—Prices are stiff, with advances from 12 cents to 17 cents per foot since Jan. 1. Buying is moderate.

Poles.—Fair stocks of cedar poles are reported. New line construction is opening up only gradually, although some important interconnections are calling for new material.

Washing Machines.—Trade is brisk, with deliveries suffering from the shortage of wringers. Prices are steady.

Vacuum Cleaners.—The demand holds up vigorously. In a representative case one jobber received 204 cleaners Monday and 200 were shipped to customers before night. Parcel post shipments to retail customers are being utilized.

CHICAGO

Transportation difficulties are combining to annoy both jobbers and manufacturers in the Chicago district. In addition to freight embargoes which affect shippers in all parts of the country a local express strike has for some time hampered shipments of finished products and also to a certain extent interfered with receipts of parts and raw materials. The ban on freight shipments to New England is particularly damaging, as large quantities of material are being held in shipping rooms because of it. This has been accumulating for two months. The shut-off of express facilities bothers Chicago shippers on account of the great possibility that a customer ordering shipment by express will obtain his supply from some other source and that the delayed shipment will be subject to cancellation.

The long-continued shortage of motors is having the effect of promoting new sources of supply. It is reported that certain financial interests in Milwaukee (as yet unnamed) have purchased one of the idle breweries at that point and are installing equipment with a view to beginning the production of motors on a large scale about July 1. An Ohio concern is also reported to have decided on the erection of a large motor factory here. Such promotions undoubtedly depend on the availability of needed raw materials.

The local construction field remains very quiet. The sum total of building permits for the week is slightly in excess of $1,000,000. Rather heavy buying is expected from the railroads in the course of their re-equipment subsequent to their return to private ownership, but as yet nothing unusual has developed.

Magnet Wire.—This continues to be the worst item among the wires on which to secure deliveries. Jobbers do not seem anxious for business when shipping date from the mill ranges from six months to a year.

Lamp Cord.—Stocks remain practically at zero, as dealers' receipts are not keeping pace with new orders. Deliveries range from four to six months and some manufacturers decline to accept new business. One-thousand-foot lots are listed at $24.25, coil lots at $26 and less-than-coil lots at $36.

Loom.—Existing stocks are very low and demand is a little off. Shipments from factories are not in sufficient quantity to replenish stocks, however, and jobbers are unable to name delivery dates. No price change has occurred for some time, 1,000-ft. lots of $\frac{7}{32}$-in. loom being quoted at $35.50 and of ¼-in. at $37.

Line Material.—In general, this material remains quiet in comparison with all other items in the electrical line. The severe tornado of a week ago necessitated the replacement of some 2,500 poles in this vicinity, but withdrawals were mainly from operating companies' emergency stocks, no effect being felt on market conditions.

Locust Pins.—As anticipated, jobbers' list on locust pins has followed the lead set by manufacturers, an increase of more than 15 per cent going into effect this week. Current quotations on 1½ in. x 9 in. is, for 1,000 or less, $56.25; in large quantities, $46.80 per 1,000.

Lamps.—A brisk demand is felt. Purchases by the railroads have been particularly heavy, special locomotive equipment being very low in stock as a result. Some shortage is also felt in the more common sizes in domestic use.

Farm-Lighting Sets.—The issue of March 27 noted increased prices of Delco-light sets. It should have been stated that these changes do not go into effect until May 1. Until that date the old list remains in effect.

Electric Non-ferrous Metal Furnaces. — Manufacturers report very good demand for this equipment, several furnaces having been recently sold. The 500-lb. size is most popular. Deliveries are being made in about eight weeks.

ATLANTA

Inability to obtain material in quantities is becoming a chronic complaint. Orders are being received by all jobbing houses in volumes larger than heretofore reported, the increase being due principally to the opening up of the spring building season. Car shortage is causing a great deal of difficulty in the receipt of supplies, principally lumber, the production of which has materially increased in the last thirty days, permitting the accumulation of increased mill stocks. However, transportation difficulties reported above prevent the distribution to building centers in sufficient quantities.

Although labor conditions throughout the section have been comparatively satisfactory to date, the Georgia Railway & Power Company having settled the wage dispute of the railway employees and arrived at a new wage schedule for all electrical workers, the union plumbers, painters and some allied trades have voted to strike for the closed shop. They claim they will be supported by a sympathetic walkout of other trades. If the strike materializes, building activities in Atlanta will suffer.

Conduit.—Demand for conduit is even heavier than heretofore reported, but no improvement in shipments is to be noted. Small quantities of pipe are being received from time to time which serve in part to relieve the acute situation. Three months is the average promise of shipment.

Non-Metallic Flexible Conduit.—The market on this article is closed. Manufacturers' agents report their factories sold up for a year, with little hopes for increased production. Small shipments on orders placed in the early fall are received but immediately absorbed by back orders.

Metallic Pole Brackets.—Jobbers report a very fair demand and greater use by central stations. Local stocks are in fair condition, while shipments are reported satisfactory. Prices, three-pin, 25 cents; two-pin, 15 cents.

Flexible Armored Conductor.—The shortage is still acute, despite the receipt of several small shipments in the past ten days. General conditions are rendered worse by the difficulty being experienced in obtaining the necessary fittings for use with this material. Small stocks of fittings or none at all are to be found in the territory.

Sockets and Rosettes.—Sockets and rosettes are scarce. Poor deliveries coupled with strong demand have served to deplete local stocks to the vanishing point. Prices, lots of 500, key sockets, 40½ cents; pull-chain sockets, 73 cents; rosettes, 18 cents.

Distributing Transformers.—Stocks have been badly broken up in the past few weeks, and only a nominal supply of the popular sizes is to be had, despite fairly good shipments of from three to four weeks.

Poles. — Car shortage and weather conditions in the Northwest are given as the reason by local jobbers for their inability to make any deliveries on white cedar poles. Juniper poles, on which shipments are fair, are being substituted for white cedar. Prices, 30-ft. pole, 8-in. to 10-in. butt, $6.25.

Wire.—Long shipments, quoted at six months, are causing local stocks to become badly depleted. One jobber reports inability to obtain shipments of weatherproof, his stocks of Nos. 6, 8 and 10 being completely exhausted. Prices are steady, rubber-covered on 28-cent base, weatherproof on 29-cent base, although a price increase is rumored.

SAN FRANCISCO

Building permits for March totaled as follows in the three principal California cities: San Francisco, $2,759,000; Los Angeles, $3,076,000; Oakland, $687,000. As a matter of comparison, the respective 1919 figures were: San Francisco, $896,000; Los Angeles, $1,122,400; Oakland, $494,700. Disturbing thoughts about the future find no place in California's activities, for there is more business than can be taken care of. In view of rather meager shipments from the factories there is, on the contrary, a healthy sign for renewed optimism in very timely rains and quieter industrial conditions. A threatened strike of the linemen and electrical workers of the power companies for an increase of 33⅓ per cent per day in the San Francisco Bay region has been deferred for a month. The Pacific Gas & Electric Company claims that with the present rates it cannot pay the advance, and it will refer the matter to the State Railroad Commission with a hope of higher rates as a solution.

Lamps.—The recent 15 per cent price advance in Mazda B lamps will make no difference in Coast conditions. It will simply intensify the present leaning toward Mazda C lamps, which are becoming more and more the household standard. A gratifying increase in the sales of lamps with such ratings as 100 watts and 200 watts is also observed. The delivery situation is good.

Heating Devices.—There is no question of demand but only of supply, for Eastern factories are anywhere from three to nine months behind in their orders. Some manufacturers will not accept percolator orders until the present factory congestion is loosened.

Metal Molding.—The Coast has been well supplied with metal molding and fittings. Business shows no marked increase or change except in Los Angeles, which is outselling the rest of the Pacific Coast by about two to one.

SEATTLE—PORTLAND

In Seattle during the month of March there were approximately 1,000 building permits issued, representing in value an increase of 100 per cent over totals of March, 1919. Strikes in the building trades in Spokane and Yakima have tied up construction work to a large extent. Immediate resumption of shipbuilding activities in Seattle is assured on a large scale. Seattle jobbers and dealers as a whole report that the past week's business shows little if any change over a few weeks back. Volume has been retarded to a considerable extent because of poor stocks and failure in deliveries. Several of the largest retail stores report a further increase in demand for washing machines, vacuum cleaners, toaster stoves and other labor-saving devices. Schedule material demands are daily increasing in face of an acute stock shortage.

Electrical supply jobbers who are located in the Portland district report a very marked slowing up in volume of business. Collections are tightening up to a noticeable degree. It takes considerably more effort at present time to get collections than it did two weeks ago. Credit is not being extended with the same freedom as characterized it in the past, and the prediction is that it will be still further curtailed in the near future. This seems to be the general report, although there are a few returns indicating that the credit situation is unaffected as yet.

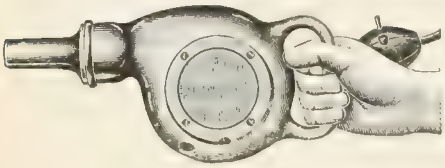
The feeling has been expressed that the Northwest may have possibly reached the crest in the business situation at the present time and may be in for a downward trend. The retail business does not seem to have been affected in the same manner. One of the largest retail electrical stores in Portland reports business for the month of March as being at least 30 per cent better than a year ago and that tax conditions have apparently had no affect upon sales thus far. Indirect reports from some of the large department stores indicate that buying has fallen off very noticeably during the past few weeks. Price changes are announced for lamps, effective April 1. There is a general readjustment of prices, increases being reported for small lamps while there will be decreases on some of the larger types of Mazda lamps.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Portable Blower

A portable blower with fan and motor inclosed is being offered by the Clements Manufacturing Company, 601 Fulton Street, Chicago. This device, which is designed for blowing dust from electrical machinery, furniture, etc., is made of aluminum and weighs 6 lb. It is delivered with 25 ft. of cord for attaching to an electric light socket.


FOR BLOWING OFF DUST

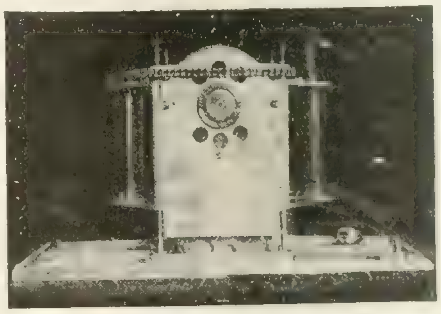
Bowl-Enameled Lamp

The bowl-enameled lamp now standardized by the National Lamp Works of the General Electric Company is a Mazda C lamp with a white enamel superficially applied to the bowl of the bulb. The enamel reflects light toward the base of the lamp and appears, from the outside, as a soft, white, eggshell surface. When lighted, a bowl-enameled lamp can be viewed from the tip end at close range without discomfort, say the manufacturers, so that glare is reduced. The enamel is durable, it is claimed, and will not chip off, nor will acid fumes affect it. When lamps are burned in the usual tip-down position the enamel will not discolor during the life of the lamp. A bowl-enameled lamp can readily be washed in warm water. Because of its smoother surface the new lamp does not collect dirt so readily as a frosted lamp. They are made in 100, 150, 200 and 300-watt sizes in the 110-volt class and in 100, 200 and 300-watt sizes in the 220-volt class.

ENAMELED BOWL REDUCES GLARE

Portable Machine for Flat Sanding

A portable flat-sanding machine recently placed upon the market by the Universal Machine Products Company, 320 North Ervay Street, Dallas, Tex., is designed to be used for the finishing of large assembled pieces. The sanding wheel is driven through gears by means of a Westinghouse universal motor which can be supplied with energy from a lamp socket. The depth of cut made by this machine is adjustable by turning the handle on the left. The entire machine weighs only 20 lb.


PORTABLE SANDING MACHINE OPERATED FROM LAMP SOCKET

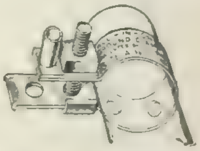
Automatic Control Panel

A new automatic control panel for motor-generator sets is manufactured by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. It consists of the necessary circuit breakers, switches, relays, fuses and recording instruments mounted on slate panels carried on a floor-type frame. The primary equipment of the control panel consists of a hand-operated oil circuit breaker provided with inverse-time overload attachments, a phase-failure and phase-reversal relay and an automatic starter of the auto-transformer type. This is to be used with induction motors, but the same general equipment with a few slight changes can be used with motors of the synchronous type. On the direct-current side a knife switch, voltmeter and ammeter with the necesary fuses and an automatic reclosing circuit breaker are provided.

With the remote-control switch "on," the controller may be operated by merely closing the main-line oil circuit breaker, or the breaker may be left closed and the equipment operated by means of the remote-control switch. The closing of the main circuit breaker effects the closing of the phase-failure and phase-reversal relay unless one or more of the phases are open or reversed, in which case the abnormal condition must be removed from the line before the relay will close.

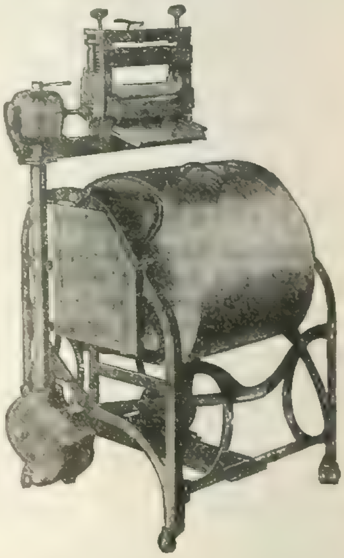
Conduit-Grounding Clamp

A new type of ground clamp for use with rigid or flexible conduit in sizes up to 3 in. has been developed by the Fairmount Electric & Manufacturing Company, 59 Woodland Avenue, Philadelphia. This new code "All-in-One" clamp has a heavy copper band to be tightened around the condit by one bolt and has a socket soldering lug for attaching the ground wire.


GROUND WIRE IS SOLDERED IN LUG

Oscillating Washer with Screened-End Bottom

An oscillating tub with a raised screen-end is incorporated in the electrically driven washer recently placed upon the market by the Surf Manufacturing Company, Milwaukee, Wis. The tub is oscillated seventy-two times a minute by a Westinghouse splash-proof motor through gears, all of the moving parts being inclosed. All control levers for motor, tub and 12-in. swinging wringer are at the top of the frame. A positive latch holds the wringer rigid in all positions. The motor is prevented from overload by a safety clutch on the main driving shaft.


DRIVEN THROUGH GEARS BY SPLASH-PROOF MOTOR

Compact Electric Ranges

The Simplex Electric Heating Company, Cambridge, Mass., is just placing on the market two new designs of electric ranges, Nos. 25 and 29. The No. 25 range, or apartment-house type, is only 29½ in. long, 36½ in. wide and 22 in. deep, which is a saving in length of 21 in. over the No. 27 range of this company, with no reduction in cooking capacity. The oven is equipped with a 2,000-watt broiler and a 1,200-watt bottom heater is placed centrally below the flat section, the latter carrying three 1,200-watt plates. Vertical elevated switch panels with indexes are provided with a central fuse cabinet and receptacle for flatiron or other device. The No. 29 range meets the demand for a larger equipment than the No. 27 and has a separate broiling compartment with 2,000-watt heater and an additional hot closet or plate warmer. Four hot plates of 1,200 watts rating each are provided. This range is 57 in. long, 22 in. deep and 54½ in. high. The No. 25 range will easily cook for four to seven and the No. 29 for ten to twelve.

APARTMENT HOUSE TYPE

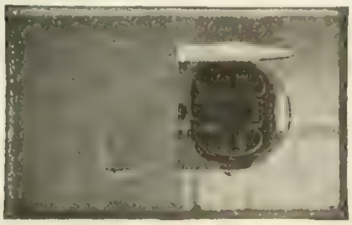
Automotive Equipment

A new line of automotive starting motors and lighting generators has been developed by the Westinghouse Electric & Manufacturing Company. The chief feature of these new motors and generators (which are known as type PW) is the construction of the frame and the commutator end bracket. In the older type the frame was short and the bracket cylindrical. In the new type the frame is extended and the bracket is flat. The brushes, which are mounted on the bracket, are housed within the extension of the frame. Openings in the frame (covered ordinarily by an easily removed steel band) give access to the commutator and brushes. This construction, the manufacturers say, provides additional mechanical strength to the machine. The brushes and commutator are especially accessible, and the brushes can be renewed without taking off the bracket.

The generators, which are of the third-brush type, are said to have an additional advantage in that the position of the third brush can be adjusted from the outside without removing the bracket. This is accomplished by mounting the brush on an arm which is pivoted around the bearing housing and is firmly held by screws on the outside of the end bracket. When these screws are loosened the arm and the brush can be turned through any desired angle. These motors can be supplied for cradle, flange or sleeve mounting and with either inboard or outboard screw pinion shifts.

Duplex Receptacle with Hinged Doors

A duplex receptacle with two individual hinged doors is being made by the Bryant Electric Company, Bridgeport, Conn. When the receptacle is not in use the closed doors are even with the surface of the plate. A thumb "index" is provided for easy opening of each door. This device, known as the "Spartan duplex receptacle No. 25, with plate No. 579," is for use with two bladed plugs of parallel or tandem style.



HINGED DOORS COVER EACH RECEPTACLE

Radio Ammeter

Under type T-A-W, the Roller-Smith Company, New York City, has put out a new radio ammeter for radio telegraph and radio telephone use. The manufacturers say the instrument is so designed that it can be used equally well on radio-frequency current, audio-frequency current and direct current, and that satisfactory performance and service is insured through its predominating characteristics of ruggedness of construction.

RUGGEDNESS IS CHARACTERISTIC

Electric Incubator

An electric incubator especially designed for city and suburban poultry raisers has recently been put on the market by the National Incubator Company, Racine, Wis., under the trade name of "Grant." It has a capacity of seventy-five eggs and is heated by means of two electric light globes placed in the top compartment. Between these globes and the lower egg chamber is a steel plate which retains and distributes the heat. A thermostat regulates the heat and keeps it at 103 deg. all the time.

Notes on Recent Appliances

Self-Starter for Slip-Ring Motors

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has developed an automatic starter with a speed-regulating handle for use with slip-ring motors.

Automatic Charging Panel

For the automatic charging of mine locomotives having Edison storage batteries a panel has been designed by the Cutler-Hammer Manufacturing Company of Milwaukee.

Vacuum Cleaner with Gear-Driven Brush

A new vacuum cleaner equipped with a gear-driven brush has been put on the market under the trade name "Universal" by Landers, Frary & Clark, New Britain, Conn.

Farm-Lighting Plant

A small home-lighting plant, with batteries, switchboard and instruments, is being offered by the Radiant Manufacturing Company, Sandusky, Ohio.

Thermal Demand Meter

A new line of thermal-demand instruments consisting of indicating watt-demand meters for alternating-current circuits and ampere-demand meters for alternating and direct-current circuits has been put out by the Westinghouse Electric & Manufacturing Company.

Candle-Length Socket

A new push socket of the candle-length type is being manufactured by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution
Together with Trade Personals and Notes on Foreign Trade,
Jobbers' News and New Trade Literature

THE SHAW INSULATOR COMPANY, 5 Kirk Place, Newark, N. J., manufacturer of insulating materials, has leased a three-story factory at 10 Kirk Alley for extensions to its works.

THE STEEL CITY ELECTRIC COMPANY, 1207 Columbus Avenue, Pittsburgh, Pa., contemplates a two-story addition, 48 ft. x 55 ft., to its plant.

THE BROWN INSTRUMENT COMPANY, Philadelphia, manufacturer of pyrometers, thermometers, tachometers, indicating and recording instruments, is erecting two new buildings, one for the manufacture of recording thermometers, the second for a research department, at a cost of $100,000.

THE COOPER CORPORATION of Cincinnati, Ohio, recently organized with a capital stock of $3,000,000 to take over and consolidate the properties of the I. J. Cooper Rubber Company and the Cooper Storage Battery Company, both of Cincinnati, and the Giant Tire & Rubber Company, Findlay, Ohio, is perfecting plans for additions to the Findlay works and storage-battery plant.

THE DOMESTIC ENGINEERING COMPANY, Dayton, Ohio, manufacturer of electric lighting plants for isolated service, has started on the construction of its proposed addition, 100 ft. x 130 ft., to cost with equipment about $500,000.

THE NATIONAL METAL PRODUCTS COMPANY, Chicago, has acquired the factory of the former Crown Commercial Car Company, at Western Avenue and Hampton Road in North Milwaukee, Wis. The buildings are being remodeled for the manufacture of light-weight illuminating fixtures. Later on a brass foundry, 80 ft. x 200 ft., will be erected.

THE K-B SPOTLIGHT COMPANY, Los Angeles, Cal., is having plans prepared by Gordon LeBarr, architect, Stimson Building, Los Angeles, for a one-story plant at 8508 South Park Avenue for the manufacture of high-power electric lighting apparatus.

DELCO-LIGHT'S $60,000 CONVENTION

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has just announced that all of the motor prices quoted previous to February, 1920, have been withdrawn. Owing to the depleted condition of the New York and St. Louis stocks of small motors of types regularly carried in stock, and on account of the long deliveries which must be quoted on a great many types of apparatus, it has been impracticable to issue a new motor price book. However, the company's stocks still include a number of different types of apparatus which can be furnished promptly, and early production will make available additional types, on which prices will be quoted promptly on request.

DELCO-LIGHT ANNUAL CONVENTION BRINGS OUT TWELVE HUNDRED MEN—R. H. Grant, general manager of the Delco-Light Company, Dayton, Ohio, stated to the 1,200 distributers, dealers and salesmen who assembled for an annual sales conference March 18, 19 and 20 at Dayton, Ohio, that a sales organization of 10,000 men can handle all of the farm-lighting plant business in the United States. Like those of former years, this convention found its interest centered in three leaders: Colonel E. A. Deeds, president, and R. H. Grant, general manager of the Delco-Light Company, and C. F. Kettering, vice-president of the parent organization, the General Motors Company, in charge of research and development. Conventions of farm users of Delco-Light plants are believed to be an indispensable adjunct to the dealers' sales campaigns. It was brought out that on May 1 the cost of the Delco-Light plants will be increased. This change in prices is attributed largely to the increase in cost of materials. It is apparent that no shortage of plants has forced it, for the company has been making immediate deliveries, and at the time of the convention had on hand 2,000 plants ready to ship. Such a condition of delivery is in itself interesting in these times, but it becomes doubly so when it is considered that the company has produced over 100,000 ¾-kw. plants in the first four years of its history.

THE AMERICAN EVER READY WORKS, Long Island City, N. Y., is organizing a $10,000 cash prize contest which will open June 1 and will close on Aug. 1. The company states that since the announcement of the Ever-Ready sales program, including the $10,000 contest, on Jan. 1, the demand for Daylo goods has smashed all records. The factory was prepared to furnish goods for double Daylo sales during 1920, yet the demand is shooting past this high-water mark.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has announced that the proposed factory extension between plants Nos. 1 and 2, on the former Leffel property, has been indefinitely postponed. Possession of the Leffel property is expected in about sixty days. The present buildings, it is stated, can be utilized with comparatively few changes for some of the company's work and will make possible more immediate increases in production than can be attained through the construction of an addition, which could not be completed within a year.

THE GENERAL ELECTRIC COMPANY is considering the construction of an addition to its Fort Wayne (Ind.) Edison lamp plant this summer. The new plant will be erected at the corner of Holman and Clinton Streets, and will be 150 ft. x 375 ft. Space has been assigned in new building for recreation rooms for employees, to include a swimming pool, basketball hall, gymnasium, club rooms, billiard hall, shower baths and bowling alley.

CHARLES C. PHELPS recently became associated with the Uehling Instrument Company, 71 Broadway, New York City, combustion engineers, as well as manufacturers of CO_2 recording equipment and other fuel economy apparatus. He is devoting most of his attention to research work in connection with the efficient combustion of fuel oil in boiler furnaces. Mr. Phelps, a mechanical engineer from the Stevens Institute of Technology, has spent several years studying power-plant problems and for five years of this period he was connected with the Ingersoll-Rand Company, manufacturer of power-plant equipment and pneumatic machinery.

LANDERS, FRARY & CLARK, New Britain, Conn., manufacturers of electric heating and cooking specialties, have completed plans for a one-story addition to their plant, 50 ft. x 104 ft., to cost about $25,000.

THE CRESCENT INSULATED WIRE & CABLE COMPANY, Taylor Street, Trenton, N. J., has awarded contract for a three-story addition to its plant, 50 x 150 ft., on North Olden Avenue, to cost about $40,000.

THE PITTSBURGH LAMP, BRASS & GLASS COMPANY, Liverpool Street and River Avenue, Pittsburgh, Pa., manufacturer of metal electric and gas fixtures, etc., plans to build an addition to its plant, to cost about $20,000.

THE UNION INSULATING COMPANY, Parkersburg, W. Va., is planning to erect a new plant, 80 ft. x 216 ft., to cost about $100,000.

THE MARATHON ELECTRIC MANUFACTURING COMPANY, Wausau, Wis., contemplates extensions and improvements, including the installation of new machinery for the manufacture of small motors and motor-driven utilities. The company has increased its capital stock from $75,000 to $250,000.

THE MASTER ELECTRIC COMPANY, 460 Bacon Street, Dayton, Ohio, recently incorporated with a capital stock of $50,000 to manufacture pumps and other motor-driven machinery, is expected to begin operations within thirty days.

THE NATIONAL CARBON COMPANY, Eighth and Brannan Streets, San Francisco, Cal., has awarded contract for an addition to its plant, 175 ft. x 275 ft., to cost about $60,000.

THE CHICAGO PNEUMATIC TOOL COMPANY, Chicago, has announced that on March 31 its general offices were transferred from Chicago to the Chicago Pneumatic Building, a new ten-story building erected exclusively for the company at 6 East Forty-fourth Street, New York City. The change was accomplished without appreciable interruption to business over the week end. The Chicago district sales branch, previously in the Fisher Building, has been moved to new quarters at 300 North Michigan Boulevard. The Chicago service branch, formerly at 521 South Dearborn Street, has been consolidated with the sales branch at the new address. J. L. Canby, Chicago district manager, will serve the Chicago and Milwaukee territories.

CHARLES F. OVERLY has recently been appointed general manager of sales of the Structural Tool Company, Cleveland, Ohio. For years Mr. Overly was connected with the manufacture of pneumatic tools and formed the Overly Industrial Tool Company, becoming its president. Upon the formation of the Structural Tool Company, Mr. Overly's company combined with the new corporation. The company's new plant is on West 106th Street, Cleveland.

THE COMMERCIAL TRUCK COMPANY OF AMERICA, Philadelphia, has recently increased its capitalization to $4,000,000. Of the $1,750,000 first preferred, the company now has access to $1,000,000 cash paid in. The $250,000 second preferred is the original stock, also paid in. In addition, there are 2,000 shares of common stock, no par value. The company is about to build a one-story additional factory of 100,000 sq.ft. on a 15-acre plot at Fifth Street and Hunting Park Avenue, Philadelphia. This will permit of increase in the productive capacity five times because of better re-routing of the product in course of construction. Edward R. Whitney is president, Fred M. Sayre is vice-president and Frank E. Whitney is secretary and treasurer. The company is placing new agents in Baltimore, Buffalo, Boston and Pittsburgh.

THE ELECTRICAL MANUFACTURERS' EXPORT CORPORATION was recently incorporated in New Jersey as a holding company of the Electrical Manufacturers' Export Association, a New York Association. Capitalization is given as $100,000. The association has offices in fourteen principal cities of both hemispheres and is opening up three more offices. It acts in the interests of American electrical manufacturers only.

THE D. & W. FUSE COMPANY'S name has been changed to the D. & W. Fuse Works of the General Electric Company, Providence, R. I.

THE WELLMAN-SEAVER MORGAN COMPANY'S manufacturing sales department, which handles the company's sales of rubber equipment and machinery, and which is in charge of L. N. Ridenour, moved on March 31 from the company's Akron office to its general offices at 7000 Central Avenue, Cleveland, Ohio.

Supply Jobbers' Notes

THE LEWIS ELECTRIC COMPANY, Massillon, Ohio, has been incorporated with a capital stock of $10,000 for the purpose of selling electrical machinery and supplies, as distributer and manufacturers' representative in central and eastern Ohio. The company will also operate an engineering department to look after the laying out and installation of equipment furnished by its clients. The officers are: J. C. Lewis, president; D. R. Lewis, secretary, and M. J. Lewis, treasurer.

Foreign Trade Notes

GERMANY RESUMES SHIPPING TO ARGENTINA.—The first German merchant vessel entering the port of Buenos Aires with a general cargo of German goods since 1915 carried 42 cases of electric fittings, 56 cases of electric motors and 115 cases of incandescent lamps.

ELECTRICAL EQUIPMENT IN DEMAND IN PERU.—Because of the increasing tendency to utilize electrically driven machinery in Peru, oil and gas-driven sets are in demand. There should also be a good market for all electrical goods, including generating sets, storage batteries, carbons, electric motors, ventilating fans, insulators, lamps, meters, telegraph and telephone apparatus, wire and cable, electric bells and accessories.

GENERATING SETS FOR CUBA. The use of electric power in sugar mills in Cuba is increasing, and there is a good market for generating sets, electric motors and fittings. While the American mill owners in the island prefer American equipment the Cubans, it is stated, desire an open market. There is an increasing field for supplies of fittings for house lighting. Not only private residences but also clubs and the numerous hotels install the most costly fittings, for which there is a great demand.

THE BLUEBIRD MANUFACTURING COMPANY OF CANADA has established its head office and factory in Brantford, Ontario, and will commence at once operation in plant No. 1 of the Motor Trucks, Ltd., which the company has already taken over. Actual production will begin within ninety days. The present plans, it is understood, provide for the erection of a plant that will eventually exceed the output of the parent organization at St. Louis, Mo. J. B. Detweiler, formerly manager of the local plant of the Steel Company of Canada, will be president of the new company.

INCREASE IN ELECTRIC PLANTS IN NEW ZEALAND.—There is a brisk demand for equipment for electric plants, motors and supplies of all kinds in New Zealand. Good progress is being made with the government hydro-electric developments at Hora Hora and Lake Coleridge, and plans are being prepared for hydro-electric developments at Waikaremoana and for electric transmission lines to Gisborne, Napier, Wairarapa and to the South Island. Provision is being made for extensive increases in equipment of all local supply stations, and the demand for machinery, particularly for the development of water power, is especially urgent.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm of merchants in Italy (No. 32,389) desires to purchase and to secure an agency for the sale of electrical supplies, etc.

A company in India (No. 32,372) desires to be placed in touch with dealers and manufacturers of electrical supplies.

A merchant in Canada (No. 32,402) desires to secure a distributing agency for farm electric lighting plants.

Trade Publications

FARM SERVICE EQUIPMENT.—Schweitzer & Conrad, Inc., Chicago, has issued bulletin No. 106, covering its S. & C. farm service equipment.

INDUSTRIAL LIGHTING. The Benjamin Electric Manufacturing Company, New York, has issued bulletin No. 15, describing the Benjamin dome reflector, R L M standard, for industrial lighting. Bulletin No. 17 covers its different methods of industrial lighting and gives illustrations of its different reflector units, etc.

PHYSIO-THERAPY.—The use of the Burdick deep therapy lamp in connection with physio-therapy is covered in bulletin No. 1, issued by the Burdick Cabinet Company, Milton, Wis.

RUBBER INSULATED WIRE.—The Hazard Manufacturing Company, Wilkes-Barre, Pa., has issued a booklet giving a general description of the manufacture of rubber-insulated wire.

ELECTRICAL SUPPLIES. The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is distributing its annual catalog of electrical supplies for 1920. The book is cloth-bound, contains 1,456 pages and is thumb-indexed. A general outline of the company's industrial motors, controllers, railway equipments and power and marine machinery is also included. This catalog replaces all catalogs issued heretofore on details and supplies.

ELECTRICAL APPARATUS.—The B. F. Sturtevant Company, Hyde Park, Boston, has issued a sixty-page illustrated catalog No. 264, covering its motors from fractional-horsepower sizes up to 50 hp. Generators up to 600 kw., steam-turbine sets, gasoline-engine generating sets, commutating pole turbo-generators, inverted rotaries, balancer sets, propeller fans and many special applications of electrical apparatus are illustrated and described.

FRACTIONAL-HORSEPOWER MOTORS.—The General Electric Company has issued several bulletins describing different types of its fractional-horsepower motors as follows: No. 61,509 covers type RSA (1/12-hp. to [illegible] hp.); No. 61,510, type SA ([illegible] hp. to ¼-hp.); No. 61,511, type SD (1/30-hp. to ¾-hp.); No. 61,512, type SDA (1/200-hp. to [illegible] hp.).

FLANGED AND SCREW FITTINGS. The Reading Valve Fittings Company, Reading, Pa., has issued a catalog of steel and iron flanged and screwed fittings and flanges.

IRONING MACHINES.—Methods of using the Thor ironing machine are described in a sixteen-page booklet issued by the Hurley Machine Company, 28 East Jackson Boulevard, Chicago.

New Incorporations

THE SCOOBA (MISS.) ICE, LIGHT & POWER COMPANY has been chartered with a capital stock of $17,000 by E. L. Gilbert, G. C. Boyd and B. D. Baillard.

THE RODHALL POWER COMPANY of Tarboro, N. C., has been incorporated with a capital stock of $250,000 by W. A. and B. M. Hart, both of Tarboro, and H. M Leslie of New York.

THE PERRYTOWN (TEX.) PUBLIC UTILITIES COMPANY has been incorporated by C. E. Whippo, J. F. Mead and F. P. Rogers. The company is capitalized at $25,000.

THE UNITED ELECTRIC WELDING COMPANY of Norfolk, Va., has been incorporated with a capital stock of $[illegible]. The officers are L. F. Smith, president, and S. Halder, secretary.

THE ELECTRIC TOOL COMPANY of Petersburg, Va., has been incorporated with a capital stock of $200,000. W. H. Poole is president.

THE STENZ ELECTRIC COMPANY, [illegible] West Water Street, Milwaukee, Wis., has been incorporated by Peter P. Stenz, Albert A. Stenz, M. J. Zander and Adolf Hafne. The company is capitalized at $40,000 and proposes to manufacture electrical equipment in addition to jobbing and retailing.

THE KENTON ELECTRIC COMPANY of Kenton, Ky., has been incorporated with a capital stock of $10,000 to manufacture electrical appliances. The incorporators are Bayard and Charlton Thompson and A. C. Johnson.

THE FRANKLIN ELECTRIC COMPANY of Louisville, Ky., has been incorporated by C. B. Ketcham, T. W. Voils and W. G. Hesser. The company is capitalized at $50,000 and proposes to manufacture electrical equipment.

THE PILOT PACKING COMPANY of New York, N. Y., with a capital stock of $50,000, has been incorporated by H. S. and C. S. Fitzgibbons and J. I. Taylor, 1 Water Street, New York. The company is capitalized at $50,000 and proposes to manufacture engines and power plant supplies.

THE EBTTALYITE INCANDESCENT LAMP COMPANY of New York, N. Y., has been incorporated with a capital stock of $100,000 to manufacture electric lamps. The incorporators are [illegible] and R. Press, 119 West 114th Street, New York.

THE INTERNATIONAL ELECTRIC COMPANY of Waynesburg, Pa., has been incorporated with a capital stock of $100,000 to manufacture electrical equipment. The incorporators are J. A. Hullings of Waynesburg, Harold Jackson and W. L. Jordan of Pittsburgh.

THE PRIMOAL PRODUCTS CORPORATION of Philadelphia, Pa., has been organized with a capital stock of $10,000 to manufacture electrical machinery. The incorporators are: Scott Cummings, 1618 Green Street; Emile Brock, 5373 Gainor Road, Philadelphia, and John M. Broomall, 19 East Second Street, Media, Pa.

THE IGNITION SPECIALTIES COMPANY of New York City has been chartered with a capital stock of $50,000 to manufacture automobile ignition equipment by O. R. Gischow, C. Fay and S. H. Kunstlich, 24 Mount Morris Park West, New York.

THE EAST KENTUCKY LIGHT & POWER COMPANY of Somerset, Ky., has been incorporated with a capital stock of $10,000 by S. D. J. and Olive H. Dunlap and H. H. Gabbert.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

LISBON, ME.—At a special town meeting held recently the proposal to enter into a contract with the Maine Power Company for a period of five years was approved by the voters. Arrangements are being made by the power company to erect temporary wires to furnish the service.

LUBEC, ME.—The Water and Light Commissioners have been authorized to construct a municipal electric light and power plant and purchase material for same.

TOPSHAM, ME.—Work has begun on the substation to be erected at the local pulp mill of the Pejepscot Paper Company. About 100 hp. will be used in the mill at first, to be increased later.

PORTSMOUTH, N. H.—The Rockingham County Light & Power Company contemplates an addition to its power plant, to cost about $25,000.

LEEDS, MASS.—The Nonotuck Silk Company is considering the installation of three steam boilers and one 300-hp. gas producer. S. F. Southwick is electrical engineer.

NEW BEDFORD, MASS.—The City Manufacturing Company will soon let contract for addition to its power plant, including pump rooms, oil rooms, etc.

NEWTON, MASS.—Bids will be received by the City Clerk until April 20 for a school building to cost about $500,000. Perry & McNaughton, 19 Congress Street, Boston, are architects.

NORTH ADAMS, MASS.—The reconstruction of the street-lighting system is under consideration.

NORTH WEYMOUTH, MASS. — The Weymouth Light & Power Company of East Weymouth has been granted permission to lay conduits for wires on various local streets.

MERIDEN, CONN.—The Southern New England Telephone Company of New Haven contemplates the erection of a new exchange on West Main Street, Meriden.

STAMFORD, CONN.—Contract has been awarded by the Duane Sugar Refining Company for an addition to the power plant at its local works to Dooling & Menlon, 7 South Third Avenue, Mount Vernon, N. Y. The cost of the plant, including equipment, is estimated at about $200,000.

WATERBURY, CONN.—The trustees of St. Mary's Hospital will soon award contract for a five-story building requiring considerable electrical equipment, to cost about $500,000. L. A. Walsh, 51 Leavenworth Street, is architect.

Middle Atlantic States

BROCKPORT, N. Y.—Plans are under consideration for the installation of a new fire-alarm system.

FILLMORE, N. Y.—The Fillmore Electric Company has applied to the Public Service Commission for permission to purchase the local plant of the Genesee Valley Power Company.

HAMBURG, N. Y.—The Depew & Lancaster Light, Power & Conduit Company of Lancaster has petitioned the Public Service Commission for permission to erect an electric light plant in this city.

ITHACA, N. Y.—Plans prepared by Gibb & Waltz, architects, for the new chemical laboratory for Cornell University, to cost with equipment about $1,555,000, have been approved.

NEW YORK, N. Y.—The New York Edison Company will soon let contract for construction of a three-story transformer station at 421-423 East Sixth Street, to cost about $60,000. The company also contemplates the erection of a transformer station on Inwood Avenue at a cost of $100,000. W. Whitehill, 32 Union Square, is engineer.

POTSDAM, N. Y. The Village Board is considering the installation of ornamental lamps in the business district, to cost about $7,500.

ROCHESTER, N. Y.—The Eastman Kodak Company contemplates the erection of a new power plant to cost $199,000, in connection with proposed extensions, involving an expenditure of about $500,000.

ROSSIE, N. Y.—The Public Service Commission has granted George N. Wilson and associates permission to construct and operate an electric light and power plant in Rossie.

CHATHAM, N. J.—Bids will be received by the Board of Public Works until April 15 for furnishing and installing an engine and generator in the municipal electric plant.

JERSEY CITY, N. J.—Francisco & Jacobus, 511 Fifth Avenue, New York, N. Y., engineers for a new power station for the Continental Candy Company at Jersey City, are in the market for three boilers, two engines and two generators of 200 kw. capacity each.

PEQUANNOCK, N. J.—The installation of a new electric street lighting system in the Riverdale district is under consideration.

TOMS RIVER, N. J.—Plans, it is reported, have been prepared by the Ocean County Electric Company for the construction of a hydro-electric plant. It is proposed to develop 2,500 hp., at a cost of about $500,000. Edmund S. Fritz of Philadelphia, Pa., is president.

TRENTON, N. J.—Plans are under consideration by the City Commission for the installation of new fuel economizing equipment at the municipal pumping station, to cost about $10,000.

ALLENTOWN, PA.—Extensions and improvements to the street-lighting system in the Fifteenth Ward are under consideration by the City Council.

BETHLEHEM, PA. — The Bethlehem Steel Company contemplates the construction of a new one-story motor-house addition to its plant, to cost $10,000.

JOHNSTOWN, PA.—A four-story power plant and laundry will be erected at the Women's Memorial Hospital, to cost about $40,000.

PHILADELPHIA, PA.—Plans have been prepared for a new power plant for the Abrasive Company, James and Fraley Streets. L. T. Byers is general manager.

PHILADELPHIA, PA.—Contract has been awarded by Sears, Roebuck & Company of Chicago, Ill., to Irwin & Leighton, 126 North Twelfth Street, for construction of a power plant, to cost about $400,000, including equipment, in connection with its new works on the Roosevelt Boulevard, near Adams Street.

PHILADELPHIA, PA.—Contract has been awarded by the American Manufacturing Company, Water and Morris Streets, for the construction of a large plant, to be located on Shunk Street, between Swanson and Front Streets, to cost about $700,000, to the Turner Construction Company, 242 Madison Avenue, New York, N. Y. The work will include a two-story manufacturing plant, two warehouses, a power plant, machine shop and auxiliary buildings.

NEWARK, DEL.—A bill has been introduced in the State Legislature authorizing extensions and improvements to the municipal electric light and water plant, to cost about $75,000.

BALTIMORE, MD.—The Emery Steel Casting Company contemplates the installation of an electrical steel furnace in connection with alterations of the Pabst Brewery property, which it recently acquired.

CENTREVILLE, MD.—The construction of a new municipal electric light plant is under consideration.

DENTON, MD.—The installation of a municipal electric light plant, to cost about $40,000 is under consideration.

ELKTON, MD.—The Board of Commissioners contemplates municipal improvements to include electric power plant, water system and filtration plant. Estimated cost is $40,000.

GREENSBORO, MD.—The new plant of the Helvetia Milk Condensing Company, now under construction, will be equipped with electric motor-driven machinery. The company will generate its own power. The headquarters of the company are in Highland, Ill.

CHARLESTON, W. VA.—Prices on electric power plant equipment are desired by Mountain Eagle Collieries Company, 207 Charleston National Bank Building.

MARTINSBURG, W. VA.—Hagerstown & Frederick Railway Company, Hagerstown, Md., contemplates erection of a 22-mile, 33,000-volt transmission line to Winchester, Va. M. A. Pooler is general manager.

BEDFORD, VA.—Bonds to the amount of $150,000 have been voted for improvements to the hydro-electric plant and waterworks system.

FREDERICKSBURG, VA.—The Northern Neck Railway & Power Company contemplates the construction of an electric railway from Fredericksburg to a point on the lower Rappahannock River, a distance of about 100 miles. The company was recently incorporated with a capital stock of $5,000,000. The charter of the company also provides for the operation of an eletric light and power plant.

WAKEFIELD, VA.—A special election will be held to vote on issue of $20,000 in bonds to install a municipal electric lighting system.

WARRENTON, VA.—The Warrenton Electric & Ice Company is planning to erect an ice plant.

WASHINGTON, D. C.—Bids will be received at the Machinery and Engineering Materials Branch, Munitions Building, Washington, until April 15 (circular ME-193) for furnishing one storage battery, three slate panels, one switchboard panel and motor-generator set.

WASHINGTON, D. C.—Bids will be received at the office of the purchasing agent of the Post Office Department, Washington, D. C., until April 27, for furnishing electrical supplies, including motors, carbons and fuses, for the use of the postal service from time to time during the fiscal year beginning July 1, 1920, and ending June 30, 1921.

WASHINGTON, D. C.—Bids will be received by the Machinery and Engineering Materials Branch, Munitions Building, Washington, D. C., until April 13 (circular ME-191), for furnishing 290 mounting for retardation coils, one telephone battery, 300 ft. paper-insulated cable, 750 ft. power cable, 420 ft. power cable and forty-one card holders for telephone switchboard.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer of the army, Washington, until April 16 (circular 4743-2CP), for furnishing twenty type TE-4 equipments; until April 15 (proposal 2916-2CP), for twenty 1-kw. motor-generators; until April 20 (circular 2852-17CP), for 100 power boards; until April 17 (circular PR 2915-CP), for twenty time-interval panels and twenty time-interval apparatus; until April 17 (circular 2919-4CP), for twenty portable telephones; twenty desk telephones, and twenty plotter sets of telephones. Further information may be obtained at the above office.

North Central States

ESCANABA, MICH.—Arrangements have been made by the Escanaba Paper Company for the construction of a fourth dam on the Escanaba River at Boney Fails, 18 miles above No. 3 at Chandler Falls. The proposed dam will cost about $1,000,000 and will develop an additional 6,000 hp. Work will soon be started on the erection of a transmission line to the new dam site and the construction of a spur track to the dam location by the Escanaba & Lake Superior Company.

IVORYDALE, OHIO—The Procter & Gamble Company is contemplating the installation of a new power unit. Energy is supplied by the Union Gas & Electric Company. G. A. Hausske is electrical superintendent.

LIMA, OHIO—The proposal to issue $150,000 in bonds for construction of a municipal electric light plant and installation of new machinery in the waterworks system will soon be submitted to the voters.

MILLERSBURG, OHIO.—H. E. Pyers of Pittsburgh, Pa., has applied to the City Council for a franchise to establish an electric light and power plant in Millersburg.

CLINTON, IND.—Plans are being prepared by the Wabash Valley Electric Company for a new electric light and power plant. The Hoosier Engineering Company of Indianapolis is engineer.

NOBLESVILLE, IND.—Plans have been prepared by the Burdick Tire & Rubber Company of Chicago, Ill., for the construction of a new 500-hp. power plant at its local works.

TELL CITY, IND.—Bonds to the amount of $10,000 have been authorized for proposed improvements in the municipal electric plant.

CHICAGO, ILL.—Plans are being prepared by G. C. Nimmons & Company, architects, 120 South Michigan Avenue, for a nine-story general merchandise building to be erected by Sears, Roebuck & Company at a cost of $2,000,000.

PEORIA, ILL.—The Rozell Ice Cream Company is planning to enlarge its plant. New equipment, including a 700-hp. boiler and a turbo-generator of about 600 kw. capacity, will be installed. Herman F. Markley is chief engineer.

SHERRARD, ILL.—The Sherrard Electric Light Company has petitioned the Public Utilities Commission for permission to extend its transmission line to Reynolds and to supply electricity to the Reynolds Light & Power Company.

TAYLOR RIDGE, ILL.—The West Rock Island Power Company has petitioned the Public Utilities Commission for authority to issue $20,000 in capital stock. Allen J. Miller is president.

FOND DU LAC, WIS.—The Kelsey-Brewer Company of Grand Rapids plans the construction of an electric light and power plant. J. H. Brewer is president.

LADYSMITH, WIS.—The L. E. Myers Company of Chicago, Ill., has selected a site for its proposed power dam at Big Falls on the Flambeau River, several miles above Ladysmith.

WHITE FISH BAY, WIS.—Plans are being prepared for a municipal lighting system by A. J. Sweet, Palace Theater Building, Milwaukee.

RED WING, MINN.—The City Council has approved a $350,000 bond issue for the construction of a municipal electric light plant. The bonds will not be sold at this time.

ST. PAUL MINN.—The Bureau of Street Lighting, Department of Public Utilities, contemplates the installation of single-standard electric ornamental street lighting system, to cost over $100,000. F. L. Powers is commissioner.

CARTHAGE, MO.—Improvements to the municipal electric light and water plant, to cost about $100,000, are under consideration.

EDINA, MO.—The property of the Edina Light Company has been purchased by L. A. Nickell and R. V. Bartow. Improvements will be made to the electric and ice plant. Line extensions will also be made to adjoining towns.

HOLBROOK, NEB.—Extensions to the municipal electric light plant are under consideration.

JOHNSON, NEB.—The installation of a municipal electric lighting system in Johnson is under consideration. It is proposed to erect a transmission line either to Auburn or to the Graf terminus of the Tecumseh lighting system.

Southern States

CAROLEEN, N. C.—Plans are being prepared for extensions to the Henrietta Mills of Caroleen, to cost about $3,500,000. The plans provide for more than doubling the present output of the plant. Electrically driven machinery will be installed.

TARBORO, N. C.—The Rodhill Power Company, recently organized, is planning to build a power plant, to cost about $125,000.

CHARLESTON, S. C.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until April 15, for a lighting plant and water supply system at the local United States quarantine station.

GEORGETOWN, S. C.—Bonds to the amount of $50,000 have been voted for purchase of the local electric light plant to be owned and operated by the municipality.

FLINTSTONE, GA.—A. E. Yates is building a new plant in Flintstone and may purchase an electric power plant for same within the next thirty days.

REYNOLDS, GA.—Bonds to the amount of $35,000 have been voted for construction of a municipal electric light plant.

WINTER GARDEN, FLA.—Bids will be received by W. A. Ginn, engineer, until April 23, for construction of a municipal electric light plant, waterworks, pumping station, etc., including installation of pumps, oil engines, generators, switchboard, exciters, etc.

CHATTANOOGA, TENN.—The Thatcher Spinning Company contemplates increasing its power plant equipment by 100 per cent during the coming year. Electricity is supplied by the Chattanooga Railway & Light Company. R. Paul Clark is superintendent.

CASTLEBERRY, ALA.—The Castleberry Utilities Company, recently incorporated, plans the construction of electric light and ice plants. R. A. Baird is secretary.

MULGA, ALA.—The Woodward Iron Company contemplates the installation of a larger fan, one 500-kw. rotary converter and lighting the entire camp. W. L. Blocker is electrical engineer.

BALD KNOB, ARK.—The Arkansas Hydro-Electric Company is considering erecting a transmission line from its dam on the Little Red River to Bald Knob, a distance of seven miles.

PINE BLUFF, ARK.—Extensive improvements are contemplated and under way by the Arkansas Light & Power Company in the rice belt, involving an expenditure of about $350,000. The work includes a 33,000-volt transmission line from England to Stuttgart, 24 miles long, to cost about $80,000; also the erection of about 130 miles of distribution lines in the Stuttgart and Lonoke fields, which will carry from 6,000 volts to 12,000 volts. Power will be furnished to about twenty new rice wells.

COLUMBIA, LA.—Voters have approved a bond issue for construction of municipal electric light and water systems.

MONROE, LA.—The municipal electric light, power and waterworks plant was recently destroyed by fire, causing a loss of about $175,000. At present the city is without electric service. The plant, it is understood, will be rebuilt.

BAY CITY, TEX.—The Texas Public Service Company contemplates the construction of a new ice plant in Bay City, to cost about $60,000. New equipment, including two large boilers, electric generator and machinery for a 15-ton ice plant, will be installed.

TEMPLE, TEX.—The Southland Oil Company is rebuilding and electrifying its cottonseed crushing plant at an approximate cost of $60,000. E. A. Dill is engineer.

Pacific and Mountain States

BREWSTER, WASH.—The Okanogan Valley Power Company contemplates extending its transmission lines from Tonasket to Oroville, a distance of 17 miles.

CHEWELAH, WASH.—Work, it is understood, will soon begin on the construction of the proposed high-tension transmission line from the Long Lake plant of the Washington Water Power Company of Spokane to Chewelah, where it will connect with the power line of the Stevens County Light & Power Company. The line will be about 35 miles long and will supply electricity to the mining and magnesite plants in the Chelewah district. A. H. Sperry of Spokane is president of the Stevens County company.

KALAMA, WASH.—The North Coast Power Company is planning to rebuild its transmission lines between Kalama and Woodland, at a cost of about $20,000.

OLYMPIA, WASH.—Bids will be received by the State Capitol Commission until April 13 for construction of power house, to cost about $100,000. Wilder & White, 50 Church Street, New York, N. Y., are engineers.

SEATTLE, WASH.—The Puget Sound Traction, Light & Power Company has awarded a contract to the Westinghouse Electric & Manufacturing Company for equipment for an automatic substation near Martha Lake, to cost about $50,000. The contract also calls for improvements at the Cedar Valley substation. The company plans to move its present Hall Lake substation from Snohomish County to Ronal Station, just inside of the King County line.

VANCOUVER, WASH.—Plans are under consideration for the erection of forty arches studded with electric lamps in the business section of the city.

HOLLYWOOD, CAL.—Estimates are being prepared by the Bureau of Power and Light of the Public Service Department for the proposed post lighting system in Hollywood.

LOS ANGELES, CAL.—The City Council has been asked for appropriations to cover cost of installing complete single-standard lighting systems in Westlake and Hollenbeck Parks. The plan calls for forty-one lamp posts in Westlake and forty in Hollenbeck Park.

SAN DIEGO, CAL.—Contract for the construction of the steam and electric distributing system and installing power plant at Marine Brigade Post has been awarded to the Thomas Haverty Company of Los Angeles, at $190,000.

SAN FRANCISCO, CAL.—The Alpine Evaporated Cream Company, 112 Market Street, contemplates the installation of a 300-hp. Corliss engine and a 225-kva. alternating-current generator. J. P. Meyenberg is vice-president and general manager.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company contemplates the construction of a power house below Spaulding dam, utilizing the fall of the South Yuba Canal. A 1,500-kw. generating unit is to be installed.

SAFFORD, ARIZ.—Estimates are being prepared by the Water Users' Association of Safford for construction of power plant above the Brown dam, to cost about $1,000,000.

COLORADO SPRINGS, COL.—The Council has engaged George G. Anderson of Los Angeles, Cal., to prepare plans and estimates for the proposed municipal electric light plant.

DENVER, COL.—Application has been made to the Colorado Utilities Commission by Clyde B. Spangler and H. L. Thompson, both of Denver, for permission to construct a hydro-electric plant on the Rio Grande River between Del Norte and Creede. The proposed plant will serve Del Norte, Center, Creede, Saguache, San Luis and other towns and villages.

MONGOLLON, N. M.—The Mongollon Mines Company is considering a hydro-electric installation to furnish power for its silver mines. S. J. Kidder is manager.

Canada

BASS RIVER, B. C. — The Dominion Chair Company is considering plans for the installation of on electric light plant. R. Starratt is manager.

KOOTENAY, B. C.—The South Kootenay Power Company contemplates the erection of an electric transmission line from Grand Forks to the Rock Candy mine at Lynch Creek this summer. Improvements at its Cascade electric plant are also under consideration.

MASSETT, B. C.—The Massett Timber Company, 744 Hastings Street, West Vancouver, is considering the erection of a pulp and paper mill on a local site to cost about $1,000,000. F. S. Beckley is general manager.

VANCOUVER, B. C.—The British Columbia Electric Railway Company is considering changing the voltage on Frazer line from 600 volts to 1,200 volts. The cost, including substation equipment, is estimated at $500,000. J. I. Newell is engineer.

WINNIPEG, MAN.—Tenders will be received at the office of C. J. Brown, city clerk, addressed to the chairman of the committee on fire, water, light and power, until April 19 for furnishing switchboard panels at the city light and power terminal station. Specifications may be obtained at the office of the City Light and Power Department, 54 King Street.

TORONTO, ONT.—Trinity College contemplates building a group of two and three-story college buildings, to cost about $1,000,000. Darling & Pearson, 2 Leader Lane, are architects.

LAKE MEGANTIC, QUE.—The municipality will soon call for tenders for construction of a dam on the Chaudiere River capable of developing 500 hp. The cost is estimated at $225,000. N. A. Givard is engineer.

MONTREAL, QUE.—The date for receiving tenders for furnishing and installing transformers and switching equipment for the low-level pumping station, Waterworks Department, Point St. Charles, has been extended from March 31 to April 12. A. E. Doucet is Director of Public Works.

ST. JACQUES, QUE.—The local electric power house and dam was recently carried away by the flood.

MOOSOMIN, SASK.—Tenders will be received by George S. Page, town clerk, Moosomin, until May 5, as follows: A—For furnishing and erecting internal-combustion engines; B—for furnishing and installing generators, exciter, switchboard, street-lighting apparatus, transformers, meters, etc.; C—for one oil storage tank; D—for poles, wire and line material; E—for erection of electric pole transmission line; F—for construction of power station and cooling station. Plans and specifications may be seen at the office of the town clerk, Moosomin, and at the office of Murphy & Underwood, consulting engineers, Saskatoon

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until April 22, for furnishing copper cable, storage batteries, cable and bells, receptacle boxes, condulets, circular loom or conduit, cut-outs, conduit elbows, hard-horn fiber, electrical fixtures, renewable fuses, lamp guards, electric water heaters, pipe forcing jacks, blinker keys, sockets, switches, etc. Further information relating to this circular (No. 1359) may be obtained at the above office

Record of Electrical Patents

Notes on United States Patents

(Issued March 23, 1920)

1,334,276. Contact-Terminal Bank; Arthur H. Adams, Sparkill, N. Y. App. filed March 31, 1916. For rotary automatic switches.

1,334,294. Telephone-Exchange System; Alfred H. Dyson, Montclair, N. J. App. filed Jan. 30, 1917. Seizure of selected line by switching device controlled by arrangement common to several switching devices.

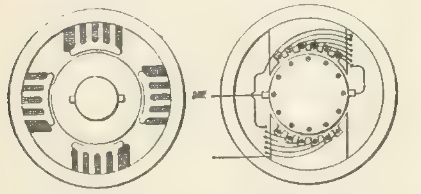
1,334,298. Magneto; Harry F. Geist, Racine, Wis. App. filed Jan. 8, 1917. Armature-wound type.

1,334,300. Telephone-Exchange System; Charles L. Goodrum, Brooklyn, N. Y. App. filed Sept. 11, 1916. Associating characteristic tone generators with test circuits for subscribers' lines.

1,334,307. Telephone System; Alben E. Lundell, New York, N. Y. App. filed Dec. 29, 1916. Indicating arrangements for semi-automatic telephone system.

1,334,308. Telephone-Exchange System; Alben E. Lundell and Arthur B. Sperry, New York, N. Y. App. filed May 28, 1918. Trunk circuits of one exchange extended to second and by selective switching to third exchange.

1,334,311. Telephone System; William H. Matthies, Hackensack, N. J. App. filed Dec. 27, 1916. Centralizes all intercepted service positions of multi-office systems at one office.



No. 1,334,832. Dynamo Electric Machine

1,334,319. Telephone Attachment; Henry J. Richards, Brooklyn, N. Y. App. filed May 12, 1917. Receiver attached to ordinary desk.

1,334,321. Loading Coil and Method of Constructing Same; William J. Shackelton, Scotch Plains, N. J. App. filed Aug. 9, 1918. Mutual inductances between several windings closely balanced to prevent cross-talk under severe service conditions.

1,334,419. Electrolytic Cell; Urlyn Clifton, Doornfontein, Johannesburg, Transvaal, South Africa. App. filed Nov. 5, 1918. Applicable to precipitation of gold and silver from cyanide solutions.

1,334,422. Electrically Driven Clock; Henry E. Warren, Ashland, Mass. App. filed March 3, 1916. Maintains amplitude of swing of pendulum substantially constant.

1,334,423. Indicator for Electrically Driven Clocks; Henry E. Warren, Ashland, Mass. App. filed Jan. 4, 1917. Arm with pendulum action controlled by current drives clock for moving indicating device.

1,334,447. Telephone-Exchange System; Charles L. Goodrum, New York, N. Y. App. filed Sept. 14, 1917. For machine switching.

1,334,452. Automatic Selective Telephone System; Ruben C. M. Hastings, Columbus, Ohio. App. filed March 10, 1915. Provides automatic shunting, selecting and signaling mechanisms.

1,334,502. Variable-Frequency Dynamo-Electric Machine; Alfons H. Neuland, San Francisco, Cal. App. filed Aug. 8, 1916. Controlling apparatus, speed of which is varied and adjusted to supply motors with current of proper frequency and voltage at different speeds.

1,334,504. Lifting Magnet; Frank I. Parker, Milwaukee, Wis. App. filed Feb. 24, 1910. Improved space efficiency, light weight, easily removed for inspection and repair, and with supply leads adequately protected.

1,334,531. Means for Controlling the Operative Field of Magnets; Howard S. Folker, Mill Valley and Daniel M. Bidstrup, Oroville, Cal. App. filed Feb. 24, 1919. Varies field of permanent magnet.

1,334,571. Electric Metal-Working Apparatus; Elihu Thomson, Swampscott, Mass. App. filed Aug. 28, 1918. Transformer supplies heavy electric current to clamps through flexible leads permitting free movement of workholders.

1,334,590. Process and Apparatus for the Electrical Fixation of Nitrogen from Air and the Products Resulting Therefrom; Jacon E. Bloom, Brooklyn, N. Y. App. filed Aug. 21, 1918. Increases velocity of nitrogen fixation and amount of fixed nitrogen without material increase of cost or time.

1,334,668. Oxygen and Hydrogen Generator; Gustave Miller, Los Angeles, Cal. App. filed June 17, 1919. Open-ended pipes constitute anodes and cathodes, providing a maximum area of electrodes for generation of gases.

1,334,675. Magneto; Pierre J. R. Postel-Vinay, Paris, France. App. filed Jan. 30, 1919. Method of assembling rotary inductors.

1,334,691. Brazing Car; Frank P. Dahlstrom and Charles R. Sturdevant, Worcester, Mass. App. filed Sept. 3, 1919. Rotary converter on car changes 800 direct-current voltage to 350 alternating current, and welding transformer converts latter voltage from 3 volts to 6 volts for brazing bonds to rail.

1,334,709. Lamp Socket; Harry J. Morey, Syracuse, N. Y. App. filed July 13, 1918. Prevents unauthorized removal of lamp.

1,334,719. Permanent Hair Waving Device; William Szlanyi, New York, N. Y. App. filed Nov. 7, 1919. Central rod upon which hair is wound from outer ends.

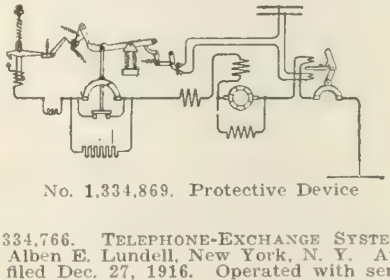
1,334,735. Controlling Device; Edgar H. Clark, New York, N. Y. App. filed July 3, 1917. Switching system responsive to impulses transmitted from a distant point.

1,334,750. Selecting Switch; Charles L. Goodrum, Brooklyn, N. Y. App. filed Feb. 27, 1917. Places operating parts under tension while being actuated and restores circuit-controlling means to normal position.

1,334,755. Telephone-Exchange System; Gordon S. Hoffman, Buntingville, Cal. App. filed May 31, 1917. Electromagnetically operated switching for branch line operable to control connection between branch and main line.

1,334,756. Method of and Apparatus for Electric Welding; John W. Holt, Cleveland, Ohio. App. filed April 24, 1916. Welds copper or metal of equal conductivity by concentration of entire current in jaws and dies holding work.

1,334,759. Electromagnetic Clutch and Brake; William C. Huebner, Buffalo, N. Y. App. filed July 6, 1916. For power transmission in mills, groups of machines and individual drives on automatic machines.



No. 1,334,869. Protective Device

1,334,766. Telephone-Exchange System; Alben E. Lundell, New York, N. Y. App. filed Dec. 27, 1916. Operated with senders of type used in semi-automatic power-driven systems.

1,334,767. Sender-Testing System; Alben E. Lundell, New York, N. Y. App. filed Dec. 30, 1916. Testing automatic when operated accurately, but stops test when incorrect operation occurs.

1,334,774. Motor-Control System; Robert H. McLain, Schenectady, N. Y. App. filed Sept. 27, 1918. For motors of the slip-ring type employed for operating hoists.

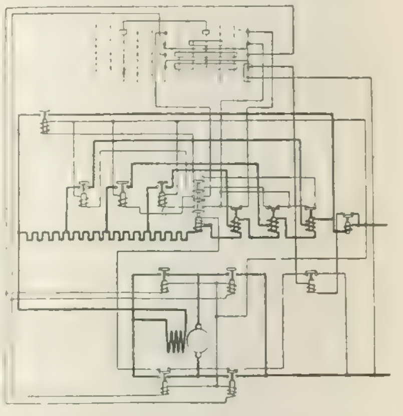
1,334,799. Socket or Receptacle; Howard R. Sargent and Theodore A. Koch, Schenectady, N. Y. App. filed Jan. 27, 1914. Prevents theft or unauthorized interchanging.

1,334,802. Insulator Clamp; John Schneider, Elizabeth, N. J. App. filed April 22, 1919. Adapted mounted upon head of a standard insulator.

1,334,809. Electric Resistance Furnace; Jules Simon and Paul F. Sarron, Lyon, France. App. filed Nov. 13, 1918. Chemical reactions effected by continuous circulation of hot gases forming a cycle.

1,334,820. Electrode; Knut Tornberg, Lynn, Mass. App. filed Aug. 28, 1918. Ilmenite available in place of rutile for magnetite electrodes; operated at higher currents.

1,334,831. Dynamo-Electric Machine; Sven R. Bergman, Nahant, Mass. App. filed Jan. 16, 1917. Motor starts engine on battery and generator is driven by engine for charging battery.



No. 1,334,919. Motor Control System

1,334,832. Dynamo-Electric Machine; Sven R. Bergman, Nahant, Mass. App. filed Jan. 16, 1917. Alternating-current or direct-current field winding compensates for armature reaction and produces exciting flux.

1,334,833. Connecting Device for Storage Batteries; Joseph Bijur, New York, N. Y. App. filed April 1, 1915. Parts fit tight and do not deteriorate.

1,334,835. Flashlight; Lucius S. Bryant, West Palm Beach, Fla. App. filed June 11, 1918. Lever switch on base of casing.

1,334,849. Electric Battery; George B. Fraley, Debruçe, N. Y. App. filed May 28, 1918. Primary of two positive elements, secondary a storage element, with shifting device to convert into primary battery after exhausting charge.

1,334,850. Electrical Conductor; Henri George and Jean Hebert, Paris, France. App. filed Jan. 31, 1919. Tungsten wire sealed in quartz at both ends of tube used to hold vacuum or pressure.

1,334,854. Operation of Arc Lamps; Arthur L. Hadley, Fort Wayne, Ind. App. filed Aug. 14, 1915. Alternate operation of two or more lamps supplied from single generator.

1,334,868. Speed Regulator; Harry A. Laycock, Schenectady, N. Y. App. filed Feb. 6, 1917. Disconnects motor when undesirable high speed is reached.

1,334,869. Protective Device; Jesse J. Linebaugh, Schenectady, N. Y. App. filed Nov. 23, 1916. Two breakers to open one side for abnormal condition up to a predetermined amount and second breaker to open other side for conditions above this amount.

1,334,875. Storage-Battery Grid and Method of Making Same; Lawrence J. Pearson, Willow Grove, Pa. App. filed June 19, 1918. Close-grained cast-metal grid prevents warping.

1,334,877. Support for Contact Rails; Herbert B. Taylor, Rochester, N. Y. App. filed Sept. 21, 1915. Insulated ramp for automatic train-control systems.

1,334,918. Ignition Magneto for Internal-Combustion Engines; Eugene Malivert, Paris, France. App. filed April 25, 1917. Special mounting of movable pole pieces.

1,334,919. Motor-Control System; Leonard Miller, Whitefield, Pa. App. filed Nov. 26, 1919. Automatically shunting portions of starting resistor in accordance with current conditions obtaining in motor circuit.

1,334,936. X-Ray Apparatus; Harry F. Waite, New York, N. Y. App. filed Jan. 31, 1919. Portable set with tube and parts immersed in oil.

Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 75 New York, Saturday, April 17, 1920 *Number* 16

Intensify Local Load Development

THE high cost of new construction emphasizes the continuing importance of concentrating central-station sales efforts upon prospective customers as near existing feeders and mains as possible. It is human to long to conquer attractive distant fields and to minimize opportunities close at hand. Extra-system demands must be met if the public wants service sufficiently to pay its total cost, but meanwhile "close-in" work must be pushed with enthusiasm.

Imitation of Research

PRESIDENT PRITCHETT of the Carnegie Foundation for the Advancement of Teaching in his annual report makes some stinging comment on university research. "Much of that which has gone on in American universities under the name of research," he says, "is in truth only an imitation of research upon which great sums have been expended." He also insinuates that universities ought to render some account of their stewardship before seeking additional millions. It is well known that the great industries of this country have, for the most part, had to rely on the efforts and discoveries of their own research laboratories for improvements in the art. The government itself received greater aid from these sources during the war than from the universities. While the latter did render excellent service, they by no means met expectations. Self-examination, which Dr. Pritchett suggests, might improve matters; but a more effective cure for the conditions complained of is for captains of industry to associate themselves intimately with this branch of university work. Otherwise it will continue to drift aimlessly.

Corporations and Legal Technicalities

THE accusation has often been made that the laws are full of technicalities and "jokers" that defeat the ends of justice by making plain the path of the corporation-loving judge who desires a pretext for finding in favor of "big business" and against the community or the humble individual plaintiff. No such motive could possibly have actuated the highest court of New York State in awarding damages aggregating about $5,000 to the proprietor of an electric installation comprising eleven lamps to whom service had been refused by the central-station company because he would not furnish a certificate of safety from the Board of Fire Underwriters. Doubtless the law's technicalities were on the plaintiff's side, and he was within his rights in waiting till the last possible moment to bring his suit so as to recover the utmost dollar; but those who hold that the courts should go behind the letter of the law and decide cases on the grounds purely of equity or presumed legislative intent must admit that here is an instance where the contrary procedure did not help the side commonly supposed always to be the one to benefit from legal technicalities.

International Aspect of Trade

THERE seems to be a very general idea that this country has developed sufficient buying power to absorb in domestic trade that portion of its production which is in excess of the essentials Europe must have. However, the possibility of European countries taking advantage of the international exchange situation to undersell American manufacturers in this market appears to have been overlooked. If this practice were to become general for any length of time, the entire electrical business would be affected by the curtailment of manufacturing operations which might be expected to follow. From the motive of self-protection if not of patriotism the industry should therefore consider the fundamental factors involved and should co-operate with those in other branches of industry who are trying to determine how to meet the situation created by the decline in foreign exchange.

Electric Furnace Operation

AT THE joint meeting of the American Institute of Electrical Engineers and the American Electrochemical Society last week in Boston electrochemists, metallurgists and electrical engineers gave ample testimony to the economic service of the electric furnace in the production of steel and ferrous and non-ferrous alloys. The one thing that is now uppermost in their minds is maximum production in electric furnace operation, the need of trained operators and sufficient practical operating data to make it possible to obtain uniform results in small as well as large installations. Here is a new problem for the electrical engineer, the electric furnace manufacturer and the metallurgist. There were evidences at the Boston meeting that its solution will be promptly furnished.

Adequate Interconnection

THE mere linking up of adjacent electric service systems by tie lines entirely unrepresentative of the generating and transmission capabilities thus brought into relation affords little real test of operating value. Maximum efficiency of interchange involves trunk-line connections between major plants, with carefully planned equipment selected on the basis of a sound financial analysis of latent resources. Interconnection often may be handled piecemeal without implying poor engineering, but more than a bare electrical contact between systems must be provided.

A Street-Lighting Need

A CONSTANT-POTENTIAL multiple system of street lighting has advantages over the series system from practically every point of view except that of control, and it is mainly because there is no satisfactory and efficient method of switching the lamps on and off that the multiple system has not been more widely adopted. This fact was brought out very forcibly in a recent paper by Ward Harrison, read before the American Institute of Electrical Engineers. He pointed out that it is often cheaper to keep multiple lamps burning continuously than to install the series system or the multiple system with proper provision for switching.

The conditions of multiple distribution require the development of a system of switch control, operated without pilot wires and without clock mechanism, but so arranged as to be actuated at will from the station or control point. Existing equipment has been adapted to the use of the multiple system up to the present, but the time has arrived when a means of switching should be developed to meet the special requirements of multiple street lighting. When this has been accomplished an untouched field for street lighting will be opened up in both town and country, and it should then be no more difficult to add street lamps to a distributing system than it is to add residential customers. As long as the fixed charges on the investment required with the present series systems of street lighting are much more than actual cost of energy plus lamp or electrode renewals the full expansion of the business of street and highway lighting cannot be expected.

Transformers for Electric Furnaces

A PAPER read before the British Institution of Electrical Engineers on transformers for electric furnaces was recently abstracted in our Digest of Electrical Literature. Such apparatus is not yet thoroughly standardized, and a consideration of some of its features is therefore especially pertinent. The fundamental peculiarities of a furnace transformer are that it requires a variable voltage ratio and a relatively very low voltage secondary of enormous current capacity. With these requirements come difficulties of design. The author of the paper before us believes, although his conclusion is not universally accepted, that the voltage regulation changes should be made on the high-voltage side. This certainly involves less trouble in design than attempting to regulate the secondary, although possibly the booster may, in at least some instances, provide a way out of the difficulty. The main troubles are those concerned with the very high current values required. The secondary leads should be as short as possible to avoid losses and pretty thoroughly split up and interleaved to escape as far as possible mutual inductive losses and parasitic currents. These are likely to be particularly heavy in such circumstances and are not infrequently complicated by magnetic material thoughtlessly inclosed.

Then, too, the extreme currents are liable to breaking and their sudden variation puts mechanical stresses on the structure of a magnitude difficult to realize until they are figured out. Such limitations on design really have an important bearing on the future of the electric furnace. If the operation of a 40-ton furnace, for example, is concerned, a total transformer capacity somewhere about 8,000 kva. is likely to be called for, which in a two-phase furnace will run to between 40,000 amp. and 50,000 amp. per phase. This amperage would probably have to be divided between four electrodes, even using those of the largest size. Some designers have favored increasing the number of phases, but little has yet been accomplished along that line, promising though it is. Raising the voltage means a struggle against heat problems. With all this there must be a steady effort to improve the power-factor conditions, which, through improper distribution of current, can easily become anything but satisfactory. The whole matter is as yet in a formative stage. The electric furnace is bound to come steadily into greater and greater use, and the transformer problem therefore must receive the keenest attention.

Improvements in Substation Practice

AN EXAMPLE of the concrete embodiment of skillful substation planning is given in this issue in Walter H. Millan's description of the new 15,000-kva. equipment of the Union Electric Light & Power Company of St. Louis. In the development of this important system it became necessary to provide new substation equipment for the 60-cycle distribution in the southern half of the city. From the point of view of design the usual building procedure was reversed. The electrical equipment throughout was first planned and then the substation put around it. This new substation is about 5 miles (8 km.) from the main generating plant, whence the energy is transmitted at 13,200 volts. For a part of this the station acts merely as distributer, sending the current out at the same voltage on three-conductor feeders. The major part of the energy received is, however, transformed for local distribution. The three-phase, four-wire system at 2,600 volts between phase wire and neutral is used, there being about twenty outgoing feeders of this type. The transformers by which the distributing system is fed are of the three-phase construction, capable of an output of 3,000 kva. each when operated as water-cooled units, while as self-cooled units they are good for a continuous rating of 2,200 kva. At present the water cooling is used only at the peak of the load.

The switching arrangements for the feeders deserve special notice. The whole station capacity is arranged to be divided up and operated at present in two, and finally in five, independent sections. This exemplifies the comment we recently made on switchboard design in pointing out the advantage of loose or open relation between feeder groups to lessen the severity of short circuits and the complications of the switchboard. The distribution bus is connected to the feeders by a single set of solid and capacious oil switches, a flexible transfer bus taking the place of the duplicate switches commonly installed. The oil switches are provided with automatic reclosing relays with a time delay. Thus, pending attention to trouble, the main switch may be closed tentatively three times before the effort is finally given up.

Altogether this substation is a capital example of the tendency toward simplicity which has been of late observable. The straight run in definite sequence of each feeder from bus to cable and the conservative use of well-planned switching apparatus are features especially to be commended.

Local Dealer Can Build Good Will for the Central Station

CENTRAL stations need the good will of the public more than they need additions to their connected appliance load. Public good will or ill will toward utilities in no small measure grows out of the feelings of the local dealers toward the local utilities. If all of the electrical men in a city except those employed by the central stations are constantly telling the public that the utility is a grasping corporation, nothing but unfavorable public utility relations can possibly exist. Any central-station merchandising policy, therefore, which antagonizes the local trade and causes it to talk against the utility is an unprofitable policy and should be discontinued, even though the central station may feel that the policy is ethical and that the trade should not object to it. The strength of the electrical trade as a molder of public opinion is growing. The utilities need to add this strength to their own and can do so by making their merchandising policy such that it will not cause destructive competition with the contractor-dealer.

Depth Versus Breadth in Technical Education

EVERY one believes that higher technical education ought to be broad, but this breadth is hardly ever achieved by scattering the student's attention over a number of elementary, disconnected courses. On the other hand, the usual criticism regarding the narrowness of engineering curricula ought not to apply to colleges in which the student pursues only a few well-defined lines of thought throughout the four years. There is both depth and breadth in a course like electrical engineering, provided that the individual topics are laid out systematically and that the student sees the physical foundation of his specialty, its place in the industrial life of the country, the economics involved, the human element and the relationship to the neighboring industries.

When a student gets a smattering of many subjects without the fundamental knowledge of any of them, there is a definite neglect of the methods in which problems should be attacked, of the technique of investigation, and a rather disheartening inculcation of a spirit that is overcredulous and takes on faith what other investigators have done. There is no time for thorough-going, scientific analysis, and in its stead is developed the idea that one can be fit for managerial and administrative duties without first slowly and painfully ascending the ladder toward them through an essentially technical, painstaking and detailed study. Our social structure is such as to encourage this "hit or miss" attitude toward the professional life on the part of the young generation, because of a lack of a definite connection between the student and the industry. He gets an alluring picture of men in leading positions from well-known advertisements, and from his colleagues he gets a disheartening first-hand knowledge of the precarious economic status of purely technical men.

A solution of the problem of how to combine thoroughness and broadness in technical education does not lie in one radical measure that will change the whole educational system, but is to be found rather in a number of improvements and progressive steps. Summer work in a chosen specialty, or at least a year spent in a shop or in the field before entering the technical college, is of considerable importance and assistance, because it not only helps the student to see the chosen branch of engineering, but even helps often to make connections with the company which he may join upon graduation. Another suggestion is vocational guidance in the most general sense, embodying character analysis and psychological tests. In this way the student may be guided in the beginning to the field of endeavor where he may be most happy, whether it be as "trouble shooter" or as a promoter of large hydro-electric projects. There is also urgent need for a rearrangement of courses in such a way that a general bird's-eye view of the whole of the domain of engineering can be obtained in the freshman year, so that only one year is lost in orientation rather than four spent in nibbling at various things in the hope of finding the right one.

True depth in technical education is not opposed to breadth, but they go hand in hand. One who studies deeply one engineering subject in the right way cannot fail to see its manifold ramifications into other fields of human activity and to see, or rather to feel by implication, similar problems involved in other fields reaching into his own. The problem thus narrows down to the selection of broad-gage teachers who can present particular problems in their specialty in the right way.

Iron and Steel Wire for Transmission

COPPER is so well established as the leading metal for use in alternating-current conductors that, except in the case of aluminum, it hardly permits of a rival under normal trade conditions. However, during the war the scarcity of copper for the electric arts made the use of steel wires a temporary necessity. Owing to the relatively high permeability of such steel, the skin effect in these steel wires reduces their effective conducting powers to a very marked degree, even at 60 or at 25 cycles per second. The linear resistance of steel wires to alternating currents is not only considerably greater than to continuous currents at one and the same temperature of operation, but it varies with the strength of the alternating current, ordinarily reaching a maximum value within the range of the wire's carrying capacity. This uncertainty in the electric behavior of steel wires constitutes a serious objection to their use on alternating-current distribution circuits. If a steel wire could be produced which possessed a high conductivity associated with a low transverse permeability, this objection would be overcome to a corresponding degree. It seems possible that steady research might succeed in developing such a steel.

In steel rails, such as are used in electric railway work, it has been shown experimentally that the effective skin depth of penetration at 20 deg. C. to an alternating current of 60 cycles is approximately from 0.5 mm. to 1.2 mm., with an average of about 0.9 mm., the effective permeability reaching values as high as 2,500.

The article by Prof. R. W. Goddard on this subject, appearing in this number, draws attention to the uncertainty of the data ordinarily obtained for finding the linear resistance of steel wires. On the other hand, it is pointed out that from a mechanical point of view steel wires, strung on poles or towers, have decided advantages over copper wires, both from laboratory tests and from actual experience.

Frank Julian Sprague

Pioneer in electrical operation of street railways, originator of multiple-unit train control and an early advocate of steam railroad electrification

ALTHOUGH best known as the father and champion of direct-current railway operation, Frank Julian Sprague's service to the electrical industry has covered all its branches. After graduation from the United States Naval Academy in 1878 and spending five years in naval service, he resigned to enter the employ of Thomas A. Edison in 1883. With W. S. Andrews he worked on the installation of the early lighting plants and developed a mathematical study of the three-wire system of distribution. This led up to his developments in electric motors for stationary and electric railway use. His success in this direction caused him to resign and with the late E. H. Johnson to found the Sprague Electric Railway & Motor Company in 1884. Then followed tempestuous times, now become historical because of the courage and persistence with which he urged the use of electric power for transportation. After installing electric operation on a number of roads he finally demonstrated its possibilities on a larger scale than ever before at Richmond, Va., in 1888. In 1890 the Sprague Electric Railway & Motor Company was absorbed by the Edison General Electric Company. Soon thereafter followed the formation of the Sprague Electric Elevator Company and the Sprague Electric Company to produce Mr. Sprague's developments principally for the electrification of elevators. In 1895 he invented the multiple-unit system of electric train control and in spite of discouragement on all sides proved its practicability on the South Side Elevated Railway in Chicago. This system has since found universal appreciation in this country and abroad.

In a consulting capacity Mr. Sprague has been engaged on a wide variety of engineering problems in the United States and other countries, notably on railway electrification for the New York Central company as a member of its electric traction commission and on electrical manufacturing and design for the Sprague, Otis and General Electric companies. Many honors and medals for inventions and meritorious achievements in electrical engineering have been awarded to him. Mr. Sprague is a past-president of the A. I. E. E., the American Institute of Consulting Engineers and the New York Electrical Society, and during the war he served on the Naval Consulting Board. His name is indelibly written in electrical progress as a brilliant engineer and inventor, a stanch supporter of direct-current electrification and a fearless defender of his engineering convictions. Mr. Sprague was born at Milford, Conn., July 25, 1857.

New Features in Distribution Substations

Electrical Apparatus, First Arranged for Maximum Safety, Simplicity and Convenience, Then Buildings Constructed Around It — Experienced Operator Made Responsible for Construction Details

By WALTER H. MILLAN
Superintendent of Substations Union Electric Light & Power Company, St. Louis

THE growth of light and power business in St. Louis has made it necessary for the Union Electric Light & Power Company to build a 15,000-kva. distributing substation at about the center of its 60-cycle distribution for the southern half of the city. Among the electrical features worthy of attention is the 4,500-volt bus arrangement which obviates the use of duplicate oil switches on feeders. Special provision also is made to confine the oil ejected from any apparatus in case of fire. The building was constructed entirely of reinforced concrete and brick, because conditions of the market would not permit the use of structural steel. The structure, which is 122 ft. x 65 ft. (37 m. x 20 m.), was made to conform to the arrangement of the electrical apparatus instead of the reverse, as is often the case.

The station receives 60-cycle energy at 13,200 volts, three-phase, three-wire, from the busbars of the generating station, about 27,000 ft. (8,200 m.) distant. A portion of this energy is distributed over 4/0 (107.2-sq.mm.) three-conductor outgoing feeders (two are installed, but ultimately there will be five) at the same voltage at which it is received. The major portion is transformed to 2,600/4,500-volt, three-phase, four-wire, and distributed over eight 4/0 (107.2-sq.mm.) four-conductor automatically regulated cables (ultimately to be twenty).

All incoming 13,200-volt feeders are brought underground from the generating station. All outgoing feeders of both voltages leave the substation underground and are carried thus to the point where the first distribution load is taken off, at which point in most cases the feeders are continued overhead.

The main three-phase, 60-cycle transformer units have a self-cooled continuous rating of 2,200 kva. Copper water-cooling coils are provided which when used increase the continuous rating to 3,000 kva., based on 55 deg. C. rise. The water-cooling coils are used only

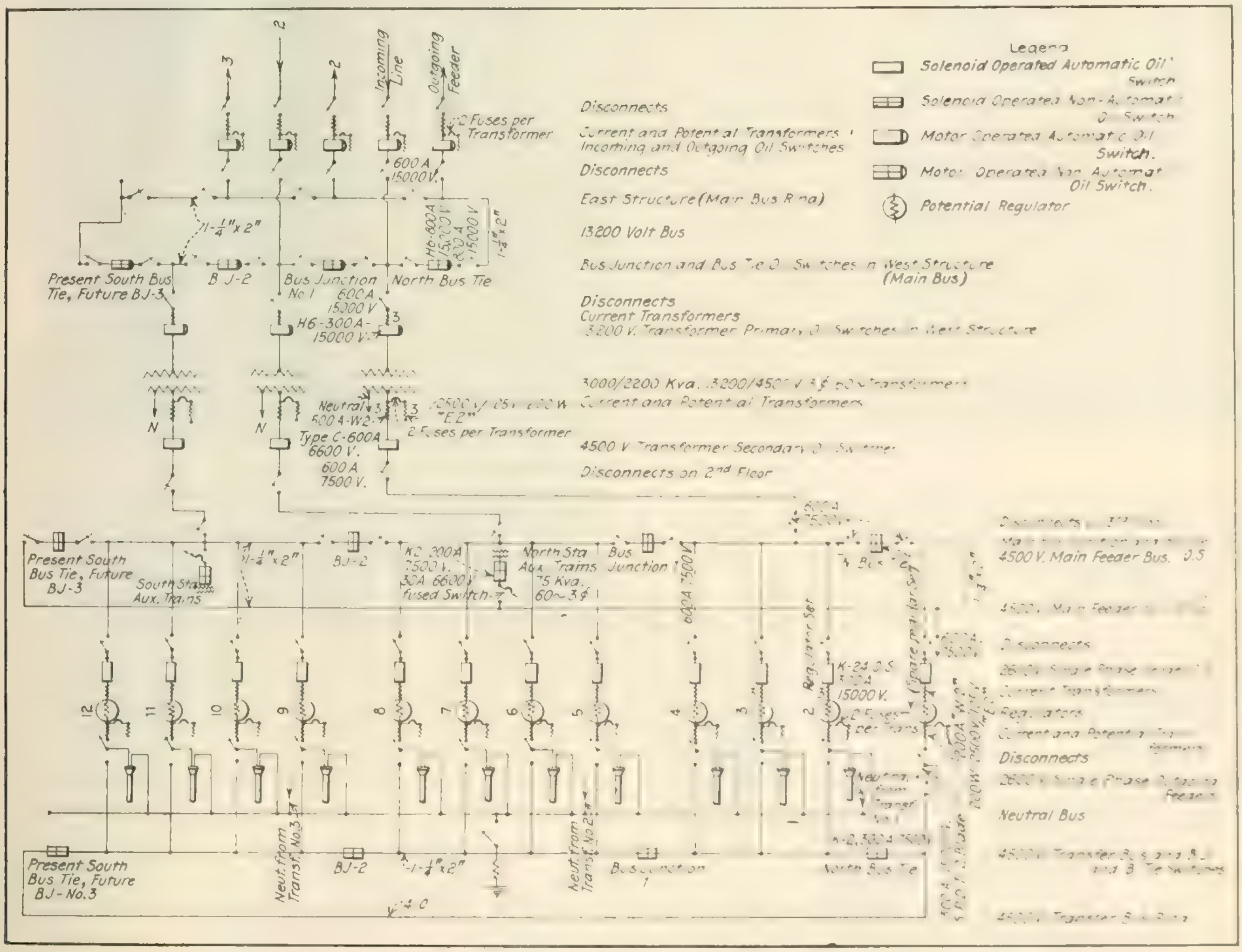

Legend
Solenoid Operated Automatic Oil Switch
Solenoid Operated Non-Automatic Oil Switch
Motor Operated Automatic Oil Switch
Motor Operated Non-Automatic Oil Switch
Potential Regulator
Incoming Line
Outgoing Feeder
2 Fuses per Transformer
600 A 15000 V.
Disconnects
Current and Potential Transformers Incoming and Outgoing Oil Switches
Disconnects
East Structure (Main Bus Ring)
13200 Volt Bus
Bus Junction and Bus Tie Oil Switches in West Structure (Main Bus)
Disconnects
Current Transformers
13200 V. Transformer Primary Oil Switches in West Structure
3000/2200 Kva. 13200/4500 V 3φ 60~ Transformers
Current and Potential Transformers
4500 V Transformer Secondary Oil Switches
Disconnects on 2nd Floor
Present South Bus Tie, Future BJ-3
BJ-2
Bus Junction No 1
North Bus Tie
600 A 15000 V
H6-300A-15000 V
Neutral
N
Type C-600A 6600 V.
600 A 7500 V.
"E2"
2 Fuses per Transformer
Present South Bus Tie, Future BJ-3
South Sta. Aux. Trans
BJ-2
KC 300A 7500 V.
30A 6600 V fused Switch
North Sta. Aux. Trans 75 Kva. 60~3φ
Bus Junction
North Bus Tie
4500 V. Main Feeder Bus
K-23 O.S. 15000 V.
2 Fuses per Trans
Disconnects
Regulators
Disconnects
Neutral Bus
Present South Bus Tie, Future BJ-No.3
Neut. from Transf. No.3
BJ-2
Neut. from Transf. No.2
Bus Junction 1
North Bus Tie
12
11
10
9
8
7
6
5
4
3
2

FIG. 1—ONE-LINE WIRING DIAGRAM OF NEW DISTRIBUTION SUBSTATION AT ST. LOUIS

The station may be operated "split" into two sections (ultimately into five sections). Each section includes one incoming 13,200-volt feeder, one main transformer, a group of four outgoing 4,500/2,600-volt regulated distribution feeders and a section of the transfer bus. The outgoing 13,200-volt feeders are fed from the backbone of the 13,200-volt ring bus.

during the peak load. These transformers are provided with head-block taps on the high-voltage winding for 27,600-25,200-13,800 and 13,200-12,900-12,600 volts, to give flexibility and to make them interchangeable with transformers in other substations. What is ordinarily an advantage in using three single-phase transformers —*i.e.*, open delta operation—does not apply in this case, because the 4,500-volt, three-phase, four-wire system must be connected in "Y." Furthermore, single-phase transformers would have cost more and have taken up approximately twice the space occupied by the three-phase units.

The oil switches used on the 13,200-volt circuits and buses are all of form "H-6," General Electric make. For incoming and outgoing 13.200-volt feeders and the high-voltage side of the transformers the switches are rated at 300 amp., 15,000 volts, arranged "pots in parallel," back and bottom connected. For the junctions in the 13,200-volt bus switches of 800 amp., 15,000-volt rating are used, with the pots arranged in "tandem" and "back-and-back" connected.

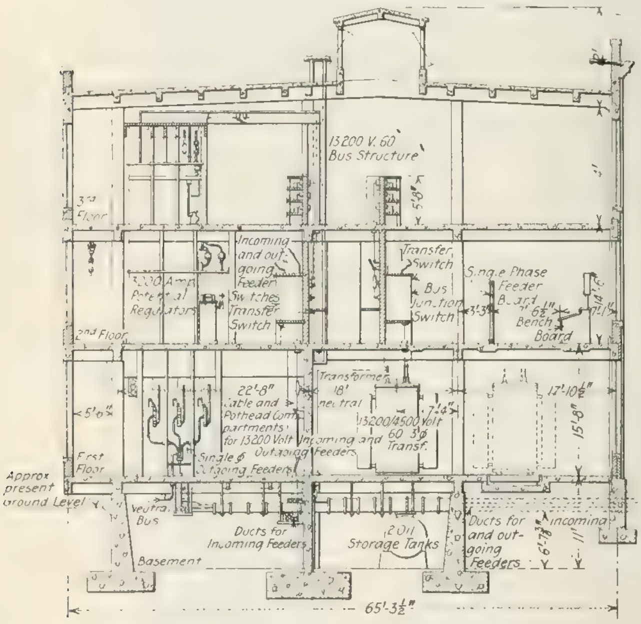

13200 V. 60
Bus Structure
5'8"
3rd Floor
Incoming and outgoing Feeder Switches Transfer Switch
3200 Amp Potential Regulators
Transfer Switch
Bus Junction Switch
3'3"
Single Phase Feeder Board
6½"
Bench Board
14'6"
7'1½"
2nd Floor
22'-8"
Cable and Pothead Compartments for 13200 Volt Incoming and Outgoing Feeders
Single ϕ Outgoing Feeders
5'0"
Transformer 18' neutral
13200/4500 Volt 60 3ϕ Transf.
7'4"
17'-10½"
15'-8"
First Floor
Approx present Ground Level
Neutral Bus
Ducts for Incoming Feeders
2 Oil Storage Tanks
Ducts for incoming and outgoing Feeders
6'-7"
11'
Basement
65'-3½"

FIG. 2—CROSS-SECTION THROUGH SUBSTATION

No electrical apparatus has been installed in the basement. The structure is arranged in units covering six phases (two feeders) each arranged back to back. The center walls of these units are of concrete into which are cast fiber conduits for the main wiring (No. 4/0 flame-proof wire) and iron conduits for the control wiring. The compartment barriers and end walls are of brick.

The back-and-back connected switch was chosen for the junction position because it permits executing three-phase junctions without crossing any conductors and at the same time provides very liberal clearances. The back-and-bottom-connected switches arranged in parallel were chosen for the 13,200-volt feeders and transformers mainly because they demanded the least possible number of bends and turns in wiring to and from them, with resultant simplicity and safety. The high rupturing capacity was also considered in all cases.

Unit Operation of Feeder Groups

A study of Fig. 1, which is a diagram of the main wiring, will disclose some unique and very interesting features in the arrangement of switchgear seldom found in a station of this character. For example, the station may be divided up and operated in two (ultimately in five) independent sections. The outgoing 13,200-volt feeders may be isolated and operated from either end section of the main bus. The advantage of "split" operation is that it keeps the available short-circuit current within the rupturing limits of the various switchgear and permits the rapid isolation of a section involved in trouble.

In laying out the 4,500-volt distribution bus and feeders a departure from general practice was made in that only a single set of busbars and oil switches are provided. Ordinarily these 4,500/2,600-volt distribution feeders must be kept in service continuously, and for that reason duplicate oil switches have been provided in the past to permit the switchgear being overhauled or repaired. In this case it was decided to use a single set of extra-rugged oil switches and a flexible transfer bus arrangement. The oil switches chosen for this duty are General Electric form K-24, of 300-amp., 15,000-volt rating. They are in single-pole units and are solenoid-operated. These oil switches are very much more rugged than any previously used by the company for the same purpose. The automatic reclosing feature of these switches is described below.

By consulting Fig. 1 it will be noted that one of the end positions for outgoing 4,500/2,600-volt feeders is used as a spare. This spare position is fed from the back section of the 4,500-volt ring bus and in turn feeds the back section of the transfer ring bus, thus permitting its being operated from either end of the station. Each outgoing 4,500/2,600-volt feeder is provided with double-throw double-blade disconnecting switches at the pothead which permit the feeder to be transferred from its own regulator and switchgear to the spare set. During periods of light load a whole section (four feeders) may be carried on the transfer bus, on the single set of regulators of the spare, thus permitting a section of main bus to be killed for repairs or cleaning. This operation may be carried out without interrupting service on any of the feeders involved.

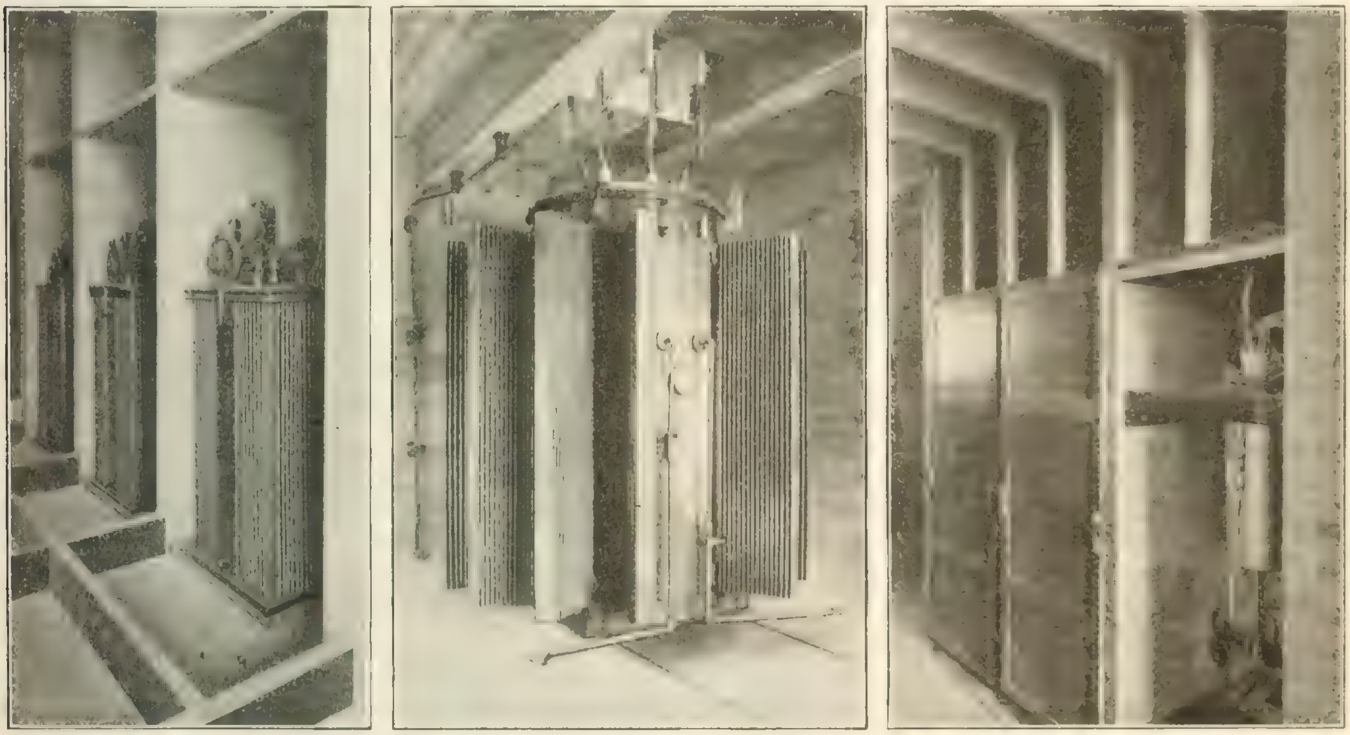
Neutral Wiring Is Insulated

The neutrals of all outgoing 4,500/2,600-volt feeders are carried from the potheads through floor bushings to the basement ceiling, where a neutral bus runs the full length of the building. All floor bushings and wall are calked with fireclay. It is easily removed and is a protection against fire spreading. The neutrals of all 4,500/2,600-volt feeders, also of the main transformers and the induction regulator, primary neutrals, etc., are connected to this bus through bolted link joints. It might be mentioned that all neutral wiring is treated the same as phase wiring in the matter of insulation in order to permit inserting a limiting resistance between the station neutral bus and the earth at some future date if required. For the present, however, the neutral bus is directly connected to a ground plate made up of a slab of cast iron having an area of about 100 sq.ft. (10 sq.m.) embedded in charcoal and salt. Provision is made for a second one of these grounds to permit overhauling the first.

The 4,500-volt structure, which contains all busbars, switch gear and induction regulators for all outgoing 4,500/2,600-volt feeders, is on three floors of the building (see Fig. 2). The 4,500-volt bus is carried in a horizontal plane at the top of the structure on the third floor. Directly below are compartments containing the disconnecting switches, and next to them are the oil switches. On the second floor and directly beneath this, phase for phase, are the compartments containing the current and potential transformers and induction regulators. Likewise on the first floor are the compartments containing the double-throw "disconnects" and transfer-bus connection; also the potheads of the cables. In short, the main wiring of each phase of each feeder travels directly downward from the point at which it leaves the bus on the third floor until it joins the other phases at the pothead on the first floor.

PROVISION AGAINST SPREAD OF OIL FIRES

The unit structures containing the induction regulators have concrete curbs on the floor between the structures and joining the barriers forming the regulator compartments (see Fig. 3). It is believed that this arrangement will confine an oil fire to one regulator, or at most to the one in trouble and the one immediately across the aisle. Consideration is being given to the adoption of a similar scheme in connection with the large compartments containing the main transformers.



FIGS. 3, 4 AND 5—TYPICAL FEATURES OF THE ELECTRICAL INSTALLATION

Fig. 3—Regulator in position. The concrete curbs together with the regulator compartments which they join form basins of sufficient capacity to hold all the oil in a regulator. The curbs are made of weak concrete (eight-to-one mixture) which can be easily demolished and renewed if it becomes necessary to remove the regulator. All high-voltage connections are placed so far back that it is impossible to come into contact with them even by reaching into the compartments. Fig. 4—Combined water and oil-cooled three-phase transformers. This 13,200 4,500/2,600-volt, 60-cycle transformer is shown from the high-tension side. It is rated at 3,000 kva. when the water-cooling coils are used and 2,200 kva. when operating as a self-cooled unit. Notice rails in floor to facilitate removing transformer for repairs. Fig. 5—4,500-volt outgoing switch compartment. This photograph shows the 4,500-volt outgoing structure on the third floor. The busbars are in compartments formed by the overhead barriers, which are deep enough to conceal the bus.

On the second-floor level near the regulator compartments a monorail crane of 2-ton capacity is so arranged that any regulator may be moved around to the other side of the building where a floor hatch permits its being lowered directly to the bed of a motor truck which may be backed into the station. This same crane may be used to handle oil-switch mechanisms and other more or less heavy gear. Some provision is made for removing for repairs all heavy pieces of apparatus used in the substation. A very complete system for handling the transformer oil has been installed in the basement directly below the transformers.

On two control boards on the second floor operating deck (see Fig. 2) are mounted all control switches, instruments and relays for the entire installation. All control gear for the outgoing 4,500/2,600-volt feeders is mounted on a vertical panelboard, and that for all 13,200-volt feeders and junctions, including both high-tension and low-tension sides of the transformers, is mounted on a benchboard.

On the floor of the aisle between the two rows of "H-6" switches on the second floor is a full-size diagram of bus connections at the actual locations. This permits of quickly and accurately locating any set of disconnecting switches or oil switch and tends to eliminate confusion in the mind of the operator when disconnects must be located and opened or closed quickly. This diagram was marked in the granitoid floor with a marking trowel while the cement was fresh.

The iron conduits which carry the control wiring from the vertical boards and the benchboards to the various pieces of equipment are entirely concealed, being buried in the concrete of the floors and walls. The conduits all terminate in condulet outlet fittings which are embedded flush in the structure walls, only the porcelain covers being visible. This reduces to a minimum the amount of exposed metal in the compartments. There is a total of approximately 35,000 ft. (10,000 m.) of this control conduit in the station. The sizes of conduit vary from 1 in. up to 1½ in. (25 mm. to 38 mm.). All of the control wiring is made up of multiple-conductor braided cable, No. 12 (3.3 sq.mm.) being used for all potential and oil-switch control circuits and No. 9 (6.6 sq.mm.) being used for all current transformer secondary circuits. All of this cable has colored tracers in the braid of each conductor. This feature eliminates testing and tagging, as a definite code is followed in connecting.

AMPLE PROVISION FOR STATION OPERATING SERVICE

Current for operating the oil switches is derived from a sixty-cell N409 Gould storage battery having a discharge capacity of 160 amp.-hr. at a 20-amp. rate and from two motor-generator sets. These motor-generator sets each consist of a 15-hp., 230-volt induction motor directly connected to a direct-current generator having a rating of 50 amp. at 115-175 volts. The special voltage range enables the battery to be charged directly from one of the sets while the other set furnishes power for the operating bus.

A 230-volt, three-phase, 60-cycle operating bus for supplying service to station auxiliary motors and station lighting is energized from two 75-kva., three-phase, 4,500/230-115-volt General Electric transformers installed on the third floor in the 4,500-volt structure and fed from two different sections of the bus. Either of these transformers is capable of taking care of the entire load. All switches and instruments for all of this auxiliary apparatus are on a vertical panelboard at one end of the operating deck. A reverse-current circuit breaker is so connected in the direct-current operating bus as to disconnect the generator from the battery system in case of failure of 60-cycle voltage and to leave the battery connected to the operating bus.

The vertical switchboards and benchboards provide complete and independent control for each phase of each outgoing and incoming feeder of both voltages. The single exception is that three-pole oil switches are used on the 13,200-volt feeders. The 4,500/2,600-volt system has a permanently grounded neutral. The 13,200-volt system neutral is not grounded, and the general practice is to use only two current transformers, one or two ammeters and a polyphase wattmeter.

DRILLING OF HOLES MADE UNNECESSARY BY USE OF INSERTS

A great deal of time was saved in the electrical construction of this station by providing inserts in the concrete and brick for everything that was to be bolted up; in fact, it was not necessary to drill a single hole or cut away any material to mount any of the equipment.

The 13,200-volt wiring is carried out entirely by the use of ¼-in. x 2-in. (6-mm. x 51-mm.) bare rolled copper bar mounted on busbar supports and run in either brick or soapstone barriers of sufficient depth to give at least 3 in. (75 mm.) clearance between the cell door and the blade of the disconnecting switch mounted in the compartment.

Wherever the bars go through floors or walls a corrugated porcelain bushing is provided which projects 6 in. (15.5 cm.) on each side of the floor or wall. The 4,500-volt circuits from the main transformers to the 4,500-volt bus and the 4,500-volt bus itself are also composed of ¼-in. x 2-in. (6-mm. x 51-mm.) copper mounted in the same manner but built up of two or more laminations.

It is worthy of notice that very liberal aisle space is provided throughout, also that personal danger is lessened by the fact that no matter where a man may be working there is always more than one avenue of escape from the spot.

The incoming and outgoing feeders of both voltages are each protected by three General Electric form IA single-pole wattmeter-type definite minimum time limit overload relays. Incoming cables, on the other hand, are operated in pairs which are protected by differential balanced quick-acting relays operating on 25 per cent current unbalance. The transformers are protected by quick-acting differential relays of plunger type which function only when trouble occurs within the transformer. These differential relays trip out the oil switches on both sides of the transformer and are set to operate as nearly instantaneously as possible.

In all except very severe weather it is expected that the radiation from the transformers and regulators will furnish sufficient heat for comfort within the building. With this in view dampers were installed in the brick chimneys which lead from each of the main transformer compartments to the roof.

Each of the outgoing 4,500/2,600-volt feeders is equipped with standard Westinghouse reclosing relays in connection with the oil switches. These devices consist of a contactor which acts immediately upon the opening of the oil switch on overload and recloses it. A wattmeter-type, time-delay relay whose functions it is to stop the action of the contactor goes into operation at the initial opening of the oil switch and allows the contactor to reclose the oil switch three times at 0.75-second intervals before it stops the operation. This duplicates the company's standard practice in its manually operated stations.

Revision of British Wiring Rules Demanded

ACCORDING to *Beama*, a journal devoted to the interests of British electrical and allied engineering, the wiring rules of the Institution of Electrical Engineers are in urgent need of revision, with the object of prescribing reasonable minimum requirements. It is an open secret, says *Beama*, that a vast number of installations are made in contravention of the rules as they stand. No power exists, except in the case of a few undertakings which have taken powers under special parliamentary acts, to enforce any regulations whatever on the wiring contractor, and if a consumer chooses to pay a low price he can have his work done entirely with foreign cables and accessories of a quality that no British manufacturer dreams of making. The result naturally is the loss of a large volume of trade. A complete revision of the wiring rules has been put in hand by the Institution of Electrical Engineers, and it is hoped that the new rules will form a working basis acceptable alike to authorities, contractors and manufacturers.

AT THE *close of the Civil War a man could plant his feet on the ground of the Constitution and, if he could hold himself there, he was safe. Today all old postulates are denied. There are a vast number of people who think that, after all, the best way is for men to do what seems to be right, and that it is all wrong that we should be limited by so many constitutional provisions, and that there is too much law. Their method is that of the Turkish cadi. The background is the assumption of perfection. The great and pressing need of our country is the preservation of our institutions.* —ELIHU ROOT.

Standardized Maintenance in Power Plants—II*

Maintenance Systems Show Wide Variation Due to Operating Condition—High Load Factor Increases Difficulties of Maintenance Work — Periodic Inspection and Record Keeping Are Important

By A. B. STITZER
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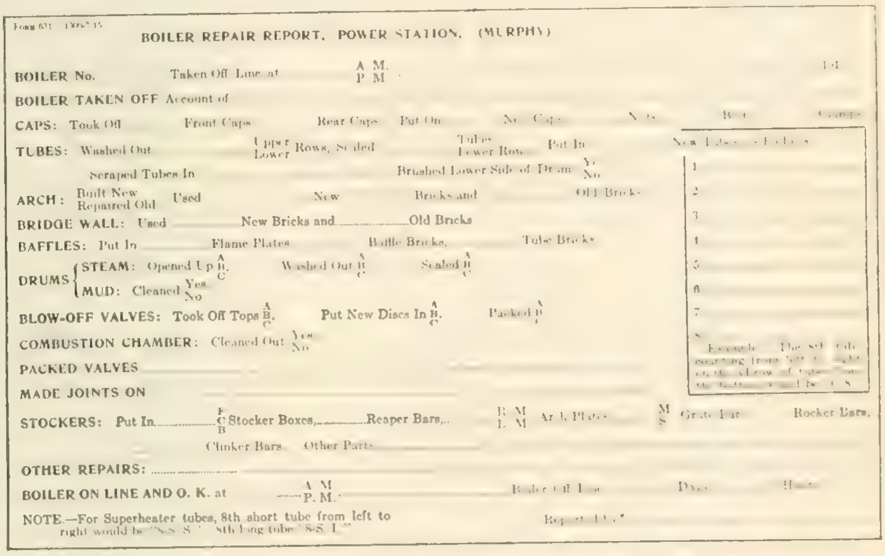
IN THE development of a system of maintenance for central stations it is not always possible to carry out a plan in elaborate detail owing to peculiar operating conditions involved. There is always a possibility, however, of improving conditions by a definite study of the subject and by evolving a plan which will be flexible enough to provide for unusual factors. The following data, collected from representative companies, will show the variation of plans used for maintenance work:

COMPANY No. 1.—This company has a maintenance system which, while not very much standardized, is carried out to the greatest extent possible under the operating conditions. At the present time the company's main plant is very heavily loaded, frequently maintaining daily load factors as high as 70 per cent to 75 per cent. In consequence of this it is practically impossible to take any of its generating units out of service for any length of time for the purpose of repair. It is equally impossible for the company to arrange any stated time for taking its boilers off the line for inspection or overhauling. This condition partakes of an emergency nature and will be relieved as soon as a new plant, now in process of construction, is in operation.

An attempt is made to take a boiler off the line for cleaning and overhauling after five weeks under steam. Frequently this is impossible and the boiler is allowed to remain in service until the first convenient repair period, at which time it is opened up and such repairs as are necessary are made and the heating surface is cleaned. In the meantime any urgent repairs, such as stoker breakdowns and furnace repairs, are made at periods when the load is lightest and the boiler can be spared from the line for a sufficient length of time to do the work.

VERY EFFECTIVE WORK ORDER SYSTEM

It is the intention of this company to make up a standard schedule and follow it out as soon as conditions will permit. The present system of handling maintenance work and keeping records of it is excellent. When a piece of apparatus is to be overhauled or inspected a work order is issued from the office of the chief engineer or plant superintendent stating just what is to be done to a particular piece of apparatus and the time at which it shall be done. Two days before the work is to be performed the work order is turned over to the foreman in charge of that part of the station in which the apparatus is located. Upon receipt of the order the foreman investigates the condition and makes certain that he has the proper material and spare parts on hand for the work and arranges with the operating force for the release of the specified piece of apparatus from service at the stated time. As soon as the work has been completed the apparatus is turned over to the operators, ready for use. A statement is made on the work order that the work has been satisfactorily performed and inspected and the work order is then returned to the chief engineer's office, where it is filed in a permanent record file.


BOILER REPAIR REPORT, POWER STATION, (MURPHY)

BOILER No. Taken Off Line at A.M. P.M.
BOILER TAKEN OFF Account of
CAPS: Took Off Front Caps Rear Caps Put On New Caps
TUBES: Washed Out Upper Lower Rows, Scaled Tubes Lower Row Put In
Scraped Tubes In Brushed Lower Side of Drum Yes No
ARCH: Built New Repaired Old Used New Bricks and Old Bricks
BRIDGE WALL: Used New Bricks and Old Bricks
BAFFLES: Put In Flame Plates Baffle Bricks, Tube Bricks
DRUMS { STEAM: Opened Up A B C. Washed Out A B C Scaled A B C
MUD: Cleaned Yes No
BLOW-OFF VALVES: Took Off Tops A B C. Put New Discs In A B C. Packed A B C
COMBUSTION CHAMBER: Cleaned Out Yes No
PACKED VALVES
MADE JOINTS ON
STOCKERS: Put In F C B Stocker Boxes, Reaper Bars, R.M. L.M. Arch Plates M S Grate Bars Rocker Bars.
Clinker Bars Other Parts
OTHER REPAIRS:
BOILER ON LINE AND O. K. at A.M. P.M. Boiler Off Line Days Hours
NOTE.—For Superheater tubes, 8th short tube from left to right would be "S-S. S." 8th long tube "S-S. L."
Reported By

1
2
3
4
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6
7
8

FIG. 1—FORM USED FOR BOILER INSPECTION AND CLEANING

In case of an emergency where there is not sufficient time to obtain a regular work order in advance any repairs on account of accidents to apparatus or other causes which require immediate attention may be made at once, but a work order covering the job must be obtained as soon as possible. The work order system is further simplified by dividing the machinery in the power station into a limited number of main groups so that all machinery comes under a certain group and the maintenance of any particular machine can be carried on in such order as is consistent with the arrangement of the machinery in its group.

In the boiler room the company has two or three types of boilers and as many types of stokers. There is a printed form, similar to that shown in Fig. 1, covering each particular type of boiler and stoker, which the boiler-room foreman must fill in each time a boiler is taken off for cleaning and inspection. The forms cover practically all parts of the boilers and when properly filled in show the condition of the entire boiler and its auxiliaries. The forms are filed in the maintenance file as a permanent record of work performed on the various boilers.

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*Presented before station operating committee, Ohio Electric Light Association. See ELECTRICAL WORLD, March 27, page 718, for Part I.

Elaborate Maintenance Schedule

Company No. 2.—Here an elaborate maintenance schedule is in operation, the plan of the system being as follows:

Card Index of All Apparatus.—Each piece of equipment has a separate card specifying the group to which it belongs and its number. This card shows for one year the periodic dates at which the apparatus should be taken out of service for overhauling.

Monthly Card Index.—A card for each month indicates what apparatus is to be overhauled during the month and on what date the overhauling should take place. This file is arranged for five consecutive years.

Maintenance Record Books.—There are four books, one for each department (boiler room, electrical, etc.), in which every machine is recorded. Numbered spaces are provided opposite the name of the apparatus and show the work to be performed. For example, on the page covering No. 1 fan engine there would appear: Item 1—thorough overhaul of all bearings; item 2—inspection of pistons, etc.

Foremen's Lists.—The foreman in charge of each maintenance gang is given a list of the machinery in his department which is to be overhauled on a given date, the numbers of the items which are to receive attention being included in each particular case. This list is given to each foreman a week in advance of the time at which the work is to be done. It is then his duty to check up the repairs ordered and see if they are correct and make such additions as appear advisable; also to see that all necessary material is on hand for the work.

Reports.—At the scheduled time each machine is taken out of service, inspected, overhauled and put in first-class condition. The foreman then makes a written report of the condition of the machine and of the repairs made, which report is turned into the office and put into the maintenance record book.

Follow-Up.—If for any reason it becomes impossible to overhaul a machine on its regular date, it is put into a follow-up schedule. The time of inspection is then postponed for one week or as much longer as necessity requires.

This system, even though quite involved, is undoubtedly a good one. Under the actual working conditions of this particular plant, however, it becomes extremely difficult to follow out. In the first place, there is not enough spare capacity installed to work out the schedule, and, furthermore, there are not enough men available to carry out the work as scheduled. However, neither fault is due to the schedule.

No Schedule Followed

Company No. 3.—This company does not have a schedule for the maintenance of its apparatus. The practice has been to handle emergency repairs by taking the faulty apparatus off the line, repairing it and putting it back in service as soon as possible. It has also been the policy to anticipate as much as possible the maintenance work on various pieces of machinery and to arrange for such work by a system of work orders originating in the master mechanic's office. These work orders provide for the work to be done and for men to do the work, but the only record of such work is the entry made in the station log. An endeavor is made to inspect one main generating unit and its auxiliaries each Sunday and to do as much overhauling as possible.

In the boiler room there is sufficient capacity to allow one boiler off for cleaning and overhaul at all times. There is no schedule specifying any particular time at which a certain boiler shall be taken off for maintenance, but the selection of the next boiler to be worked upon is left to the judgment of the boiler-room foreman. The work-order system applies in the boiler room only in so far as the nature of the work to be done requires the services of the master mechanic's crew, boiler-room maintenance being handled almost entirely by the men under the boiler-room foreman.

Records of the maintenance work are kept on printed forms which show the repairs made to all boilers and auxiliaries. The number of tubes turbined, replaced or rerolled and the first-row tubes on which bags and blisters have been driven back are recorded on a special diagrammatic form which shows the tube sheets of the various types of boilers.

Company No. 4.—The general policy here is alert watchfulness rather than completely standardized maintenance. The operating force is trained to detect the least irregularity by variations in sound while equipment is in operation. The trouble is investigated as soon as practicable and can usually be eliminated in time to prevent serious damage.

The inspection of boilers is based chiefly on a record of hours' use and the rate of driving. After every 2,000 hours at rated capacity the boilers are thoroughly cleaned and as many rows of tubes turbined as is found necessary, beginning, of course, at the lower rows and extending upward until comparatively little scale is found. An endeavor is made to give each boiler a complete overhauling once a year. Furnaces, baffles, bridge walls, headers, tubes, drums, etc., are all put in first-class condition.

Turbine casings are lifted once yearly and a thorough inspection made. There is no periodic inspection on auxiliaries or electrical rotative apparatus. They are watched closely from day to day, and any variations in sound or behavior are immediately reported.

Frequency of Inspecting Electrical Equipment

All oil switches and transformers are drained of oil and refilled once a year. The oil in switches is sampled about once every three months. All large oil switches are tested for operating condition by being thrown in and out during every week-end light-load period. The operation of each switch is carefully watched and any trouble which can thus be detected is immediately remedied. There is no other maintenance on these switches unless one happens to open under load, in which case the switch is immediately dismantled and overhauled. Outdoor switches are arranged so that the cans may be dropped from time to time for the inspection of mechanism and contacts. Small hand-operated oil switches are regularly inspected every three months.

When emergency repairs are made on any of the equipment coming under a standard schedule of maintenance, the next inspection is moved ahead one period from the date of the completed repairs.

One rather novel idea instituted by this company is the method of record keeping. Attached to every piece of apparatus is a tag which contains all data pertaining to the last inspection and the initials of the man responsible for the work. It is the duty of the operating force to report weekly on the observed tag record. These reports are a guide for the engineer in charge as to just what equipment is nearing the time when it will probably need inspection, and he can thus lay his plans for taking such apparatus out of service.

No file card record of inspection is kept except that covering the cost data. When repairs are to be made a rough pencil estimate is made out in duplicate in the office of the station superintendent. One copy is placed in the station file and the other transmitted to the auditing department with an application for a work order. The auditor then issues a numbered work order authorizing the specified repairs. A detailed daily record is kept of labor and material charged to this work order and this record is turned in to the auditing department. When the job is completed, the auditing department makes out a neatly typewritten card giving all details of the work done and its cost and then transmits the card to the station superintendent's office, where it replaces the original pencil estimate in the station file. In an emergency it is, of course, necessary to do the work first and obtain the work order afterward, but this constitutes the only exception to the rule.

COMPANY NO. 5.—After a number of years of experimentation, this company has developed an elaborate and yet remarkably efficient system of standardized maintenance. The cost last year was approximately 15 per cent of the total operating cost and included periodic inspections, file-card records, repairs and renewals. The "periodic schedule" follows:

Apparatus.	*Interval Between Inspections.*
Boilers	Six months
Stokers	Five weeks
Blowers	One week
Feed pumps	Three months
Turbines	One year
Circulating pumps	Two weeks
Other auxiliaries	Two months
Generators	Three months
Rotaries and motor-generator sets	Three months
Exciters, boosters and balancers	Four months
Switchboard instruments	One year
Relays	Six months
Oil switches, partial inspection	One week
Oil switches, complete inspection	One year
Batteries, pilot cells tested	One day
Batteries, all cells tested	One week
Batteries, complete inspection	One year

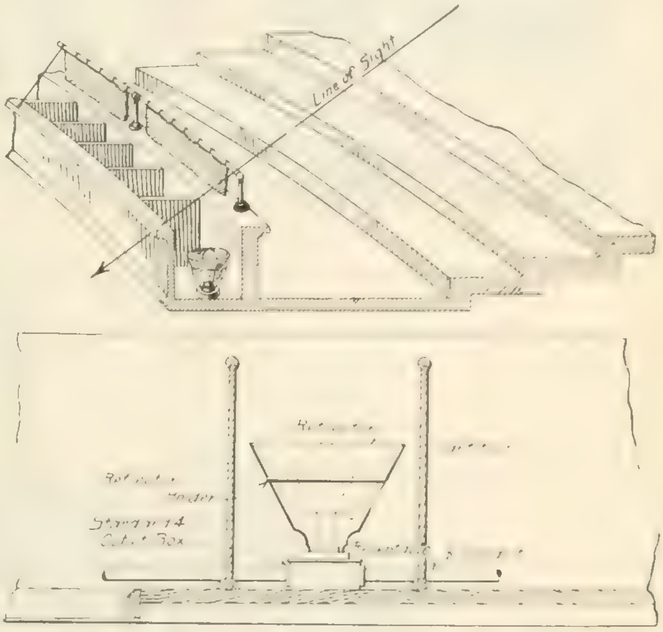
COMPANY NO. 6.—No definite system of maintenance is in force. The stations are carrying a load so near the limit of their capacity that a standardized schedule is out of the question. Equipment cannot be taken out of service long enough to permit a thorough inspection. Emergency repairs are made during periods of light load and on Sundays. As there is evidently very little prospect of increasing load this company would have difficulty in financing the additional equipment required for a standardized schedule of inspection.

IT HAS *never proved to be humanly possible to regulate prices through the instrumentality of the central government with such delicacy and accuracy of adjustment as to enable the ship of state to navigate successfully between Scylla and Charybdis. As a temporary expedient, government control of prices is sometimes imperative, but as a permanent method, as a substitute for the economic law of supply and demand, history and our own recent experience demonstrate clearly that government regulation of prices is foredoomed to failure.*—PHILIP CABOT.

Theater Lights Concealed on Balcony and in Cornices

THE elimination of pendent ceiling fixtures has been accomplished in the lighting installations of the American Theater, Chicago, without losing any of the desired lighting effects. A lighting trough was built on the front of the balcony below the rail and barriers were placed between each lighting unit, as shown in the illustration. In the stair walls leading into the balcony from the second-floor lobby an arrangement similar to this was used.

Viewing the balcony from near the stage, it is not at once apparent that the projecting compartment has been added. No lamps are visible to any one seated in the balcony, and only the extreme ends of the lighting compartment on the front of the balcony may be seen.



THEATER LIGHTING WITHOUT PENDENT FIXTURES

The upper sketch shows the projection which was built onto the front of the balcony and the arrangement of the lamps and reflector equipment in compartments. The lower sketch is a section of one of the compartments.

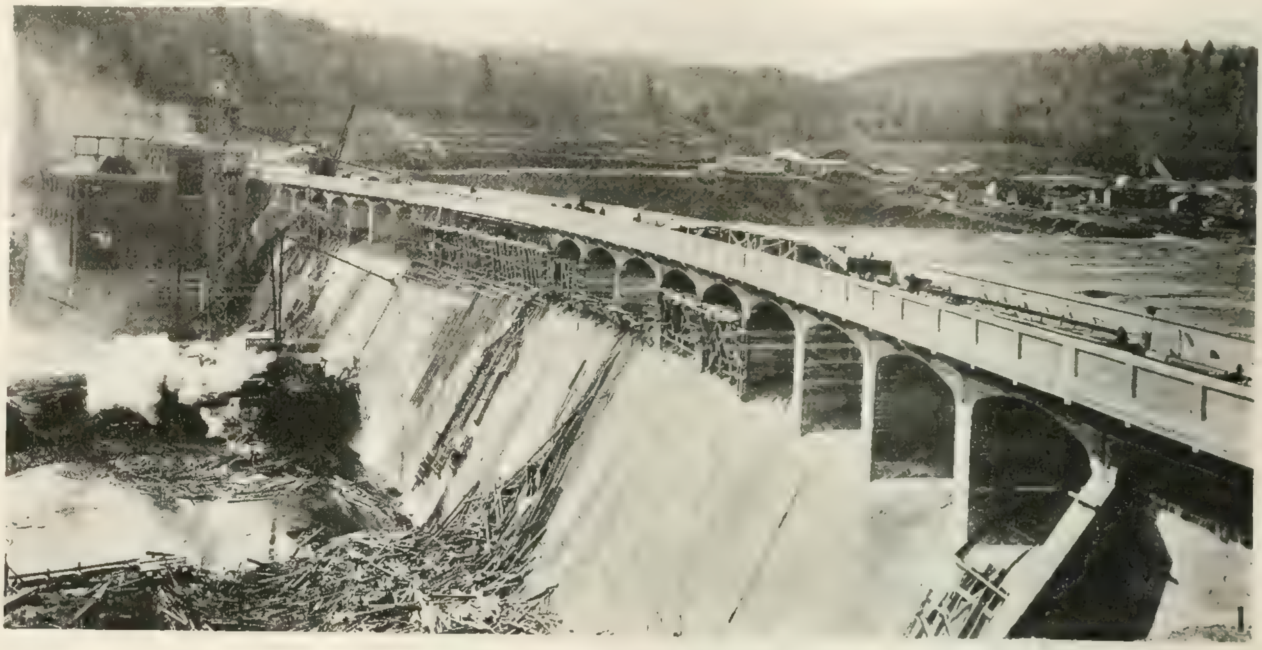
Another arrangement of concealed lamps and reflectors which is suitable for some theaters is the cornice type of lighting. This system was installed in the Pantheon Moving Picture Theater, Chicago, which is built in the form of a Pompeian temple. In order to get desired color combinations four series of lamps and reflectors are employed—one for white lighting and one for each of the primary colors, red, yellow and blue. Color screens of glass are mounted above the openings of the lighting units and a system of dimmers is provided. The accompanying table gives the data on this installation.

TABLE OF LIGHTING DATA FROM PANTHEON THEATER AUDITORIUM

Size of room	85 ft. x 140 ft.
Floor area	11,900 sq.ft.
Height of ceiling	45 ft.
Number of reflector units in coves	256
Kind of reflector used	X-ray No. [illegible]
One lamp in each unit	200-watt Mazda C
Wattage consumed (each color)	1.08 watts per sq.ft.

The data on these two installations was contained in a paper by Augustus D. Curtis and J. L. Stair of Chicago, read before the recent convention of the Illuminating Engineering Society.

New Water-Power Plants in New England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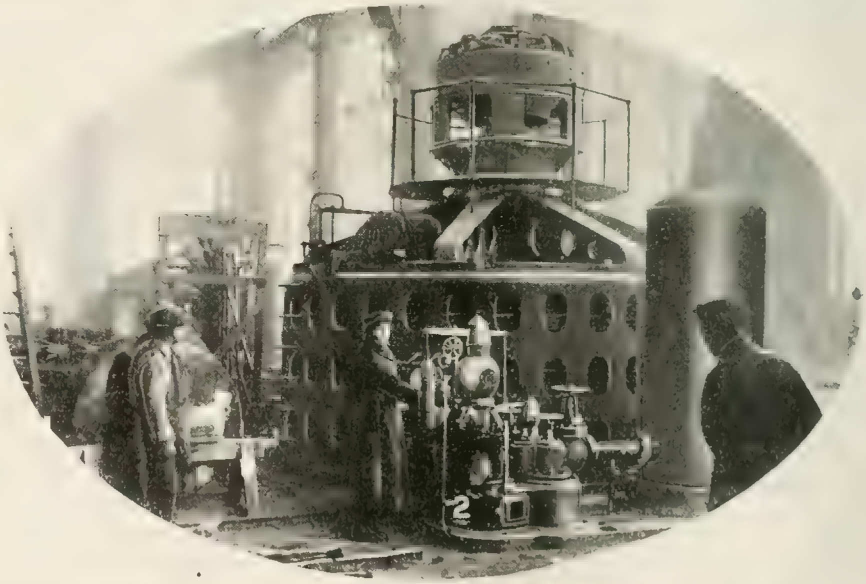
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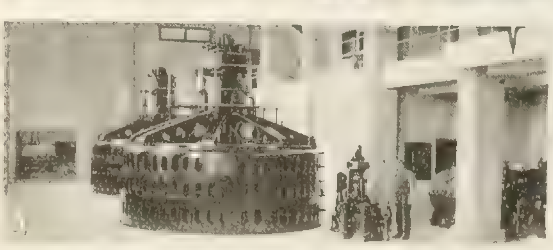

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(1) Dam of the Stevenson plant of the Connecticut Light & Power Company on which W. S. Murray was construction engineer, completed in 1919. (2) One of the alternators in the Stevenson plant. The small pictures (3) and (4) show the new plant of the Rumford Falls (Maine) Power Company. The combined capacities now aggregate 24,000 kw. The hydro-electric plant shown (5), with the high water in the tail race, is the 2,500-kva. "tunnel" plant of the Eastern Connecticut Power Company, built by the Harry M. Hope Engineering Company, Boston, Mass.

Iron and Steel Wire for Transmission

Analysis of Available Data Shows that Cheaper Grades of Iron and Steel Conductors Have the Advantage of Lower Permeability   Greatest Usefulness Is Found Where Load Is Light and Scattered

By R. W. GODDARD
Professor of Electrical Engineering New Mexico College of Agriculture and Mechanical Arts

IRON-WIRE lines prove most advantageous in cases where the power requirements are small and steady and where the load is somewhat scattered, requiring high-voltage transmission, and where the cost of construction and maintenance must be reduced to a minimum. Fortunately the effects due to the higher permeability of iron are minimized in the cheaper grades of iron and steel.

In making comparisons between two possible methods of constructing a transmission line, it is usual to consider net returns on the investments required, all other factors being made as nearly equal as possible. To make such a comparison, it is then necessary to be able to pre-determine the characteristics of each line in order to balance them.

For copper lines, all the necessary data as to the actual performance of any prospective line is readily obtainable. But for iron-wire lines little information is at hand. What is available seems inconsistent to such an extent as to make the average engineer skeptical as to the practicability of using it with any degree of success in pre-determining the operating characteristics of a proposed line. Such doubt tends to make the courageous ones that do try it use such high factors of safety that the full advantages of the iron over the copper are often lost. It is the purpose of this paper to review briefly the causes for differences between the operating characteristics of iron and copper lines that they may be better understood.

For copper, the resistance is a function of the length area, purity and temperature. Within commercial limits it is constant over a large current range. It is practically the same for alternating current as for direct for the ordinary frequencies, and always assumed constant.

SKIN EFFECT AND RELATED PROBLEM

For iron, the resistance is quite different for alternating and direct currents. This is due to the fact that the wire is of magnetic material, and an alternating current sets up in it an appreciable alternating field, thus causing potentials to be generated within the conductor. These increase from the outside toward the center of the cross section. Now this potential is opposed to the current flow and therefore, since the current takes the path of least resistance, it will distribute itself in reverse proportion to the potential, or the current density will be a minimum in the center and a maximum on the surface. This phenomenon is known as the skin effect. The practical result of skin effect is a reduction of the available conducting area of the wire.

In addition to the skin effect there is in iron wires carrying alternating currents a hysteresis loss and an eddy current loss in iron wire greatly in excess of that found in copper due to the increased magnetic field in the magnetic material. Since all these things depend in complicated degree upon the same factors, *i.e.*, current, frequency, wire diameter, permeability and conductivity, and produce the same practical effect, *i.e.*, absorb power to heat the wire, it is generally conceded there is no need to separate them and so they are grouped together into a single factor whose value is equal to the power lost in the line divided by the current squared. This is of the nature of a resistance and so it is termed the effective alternating current resistance and is measured in ohms. The problem is then to discover the law of variation of this effective resistance with the different factors affecting it.

This subject has been studied by some from the theoretical standpoint and by others from the tabulation of actual test data. In all cases the results are expressed as a ratio of the effective resistance to the direct current resistance, or in other words a factor is deduced which multiplied by the direct current resistance would give the effective alternating current resistance.

Steinmetz* gives this relation as follows:

$$\frac{R}{R_o} \qquad \frac{d}{2} \qquad \frac{\sqrt{\mu f}}{5030}$$

in which R = effective a.-c. resistance; R_o = d.-c. resistance; d = diameter of wire in cm; μ = permeability of material; ρ = resistivity of material in microhms per cu. cm; f = frequency.

Lord Rayleigh† gives the following formula, the symbols being the same as in the above except ρ which is in absolute electromagnetic units (microhms per cu. cm. × 1000).

$$\frac{R}{R_o} \qquad \frac{\pi d}{2}\sqrt{\quad f} \qquad \frac{1}{4}$$

Both of the above formulae are arrived at from a theoretical consideration of the problem and do not agree very well. This discrepancy is probably due to a difference of assumptions upon which the reasoning is based or a lack of proper consideration of some of the many factors which actually affect the results.

Actual test data are at the present time somewhat limited and also lack uniformity. This is probably due to the variations in quality of wire used and the different methods of testing and arriving at the conclusions.

Probably the most complete table published to date is one by Messrs. Oakes and Sahm of the Bureau of Standards, Washington, D. C., and published in the ELECTRICAL WORLD for July 27, 1918.

As an illustration of the difference between the effective and ohmic resistance of a line, the following data was collected for a No. 6 B. W. G. iron wire:

By Steinmetz's formula using $\mu = 500$, $\rho = 12{,}200$, gives a ratio $R|R_o$ at 60 cycles of 2.5,

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*Transient Electric Phenomena and Oscillations, p. 376-317.

†Radio Telegraphy & Telephony, Fleming, p. 15. Principles of Wireless Telegraphy, Pierce, p. 237-238.

Similarly by Rayleigh's formula, using $\mu = 500$, $\rho = 12{,}200$, gives a ratio $R|R_o$ at 60 cycles of 1.52.

Actual test on a No. 6 B. W. G., B. B. grade-wire line of the Pacific Gas & Electric Company at San Francisco, operating three-phase, 60 cycle, at 60,000 volts, gave the following results per mile of wire, considering wire to neutral:

Amps.	D. C. Res.	A. C. Res.	R/R°	React. to Neutral	Imped. to Neutral
7.2	10.45	18.7	1.8	9.50	20.95
12.2	10.45	20.8	2.0	9.65	22.9
22.3	10.45	20.1	1.9	10.05	22.4

A test by the General Electric Company, on a three-phase No. 6 B. B. grade line spaced at the points of an 84-in. (2.13-m.) triangle gave per mile of wire to neutral:

7.0	10.6	20.0	1.93	10.0	22.5
13.7	10.6	21.0	1.98	10.2	23.5
22.0	10.6	21.0	1.98	10.5	23.5

Based upon the table published by Messrs. Oakes and Sahm of the Bureau of Standards for a No. 6 B. W. G., E. B. B. grade iron wire the constants per mile of wire to neutral are:

5.0	10.5	17.4	1.66	....	.....
7.0	10.5	19.7	1.88		
13.0	10.5	20.0	1.90		

A scrutiny of these values shows that the calculated values are high and low respectively, but that their average is closely that obtained by actual tests, all of which seem to agree very well among themselves. The change of effective resistance with current is due to the change of permeability of the wire with the change of flux density. This is well illustrated by the fact that after the iron becomes saturated the effective resistance ceases to increase and may even decrease. This effect is more noticeable with wires of high permeability than for the poorer grades with low permeability. Because of this fact and the lessened amount of skin effect the poorer grades of iron or the steel wires make better lines than the purer and more expensive wires.

WHY CHEAPER GRADES OF STEEL SHOULD BE USED

The reactance of a line is made up of three components, the capacity reactance usually considered separately from the others and the internal and external inductive reactance.

The internal reactance is due to the self-induction of the wire, caused by the cutting of the wire by the flux created by its own current. For copper wire this factor is so small as to be negligible and is seldom considered. But in the iron wire the flux is so greatly augmented because of its magnetic properties as to make the internal reactance a sizable factor. A table giving internal reactance of several grades of steel wire for various currents by Oakes and Sahm was published in the ELECTRICAL WORLD, July 27, 1918. The values are arrived at by substracting from the effective reactance of the line the external reactance as calculated by the usual formula for copper transmission lines.

For purposes of comparison, the following specific values of internal reactance, based upon the data of Oakes and Sahm, have been worked out below for $\frac{5}{16}$-in. (7.9-mm.) 7-strand cable in ohms per mile of wire:

INTERNAL REACTANCE

Material	Current in Amperes			
	1	5	10	15
E. B. B.	0.40	1.75	2.50	2.25
B. B.	1.186	0.93	1.66	2.19
Ordinary steel	0.18	0.68	1.20	1.72
Siemens-Martin	0.04	0.20	0.40	0.60

A study of this table brings out some curious facts. The internal reactance is from 4 to 10 times greater for an E. B. B. $\frac{5}{16}$-in. (7.9-mm.) 7-strand cable than a Siemens-Martin one of corresponding size; from 2½ to 4⅝ times for a B. B. cable; and from 2 to 4½ times for ordinary steel. At low current densities the effect of the material is most noticeable and is less than half as marked for the high current densities. The variation of internal reactance with change of current is greater for iron wires and less for the steel wire.

For comparing the effect of wire diameters on internal reactance the following tabulations were made:

Size B. W. G.	Current Density Circ.mil. 1 Amp.					
	5,000	7,500	10,000	12,500	15,000	20,000
	Actual Current in Conductor					
6	8.24	5.5	4.12	3.3	2.75	2.06
4	11.32	7.5	5.66	4.5	3.78	2.83
	Internal Reactance for Above Current Densities					
6	12.94	10.75	10.32	9.84	9.31	8.76
4	8.31	7.40	6.96	6.68	6.50	6.28
	Per Cent. Reduction in Internal Reactance of Larger Wire					
36	32	30	32	30	.....	27.5

From this it is seen that the larger wire will carry more current in proportion to its area than a smaller one with the same internal reactance, or have a smaller reactance for the same current density.

The external reactance is caused by the self-inductance of the wires. Its value is a function of the spacing and diameter of the wires. For iron and steel lines it is calculated from the same formulae as are used for copper lines as stated above.

The capacity reactance of an iron line is the same as for one of copper, and is figured in the same way.

It is well to remember at this point that an iron or steel line having the same power losses and regulations as a corresponding copper line has conductors of considerably larger diameter and therefore has greater capacity. Usually this is an advantage, as the capacity current neutralizes a greater amount of inductive current of the ordinary load, thus improving the power factor of the line and consequently the regulation and power losses. With extremely long lines the preponderance of capacity current due to the great capacity might prove troublesome.

USEFULNESS OF IRON WIRE IN TRANSMISSION LINES

In conclusion it might be well to enumerate some of the vital points to be considered in comparing an iron substitution for copper in transmission-line construction.

The effective resistance of iron wire is approximately 1¼ to 3 times and the effective reactance from 5 to 12 times greater than for copper under the best conditions. Skin effect is the chief cause of increased resistance due to alternating currents. This effect varies nearly directly with the radius of wire used. On this account small diameter or stranded cables should be used. For sizes below No. 12 B. W. G., the skin effect is nearly negligible. The resistance also increases rapidly, with the frequency varying about as the square root.

The permeability of the iron is an important factor to be considered. It affects both the skin effect and the internal reactance. On this account cheaper and poorer grades of iron and steel wires make better lines than the more expensive purer grades.

The internal reactance is considerably affected by the current density. To maintain regulation with reasonable power losses it is necessary that the current density be not much in excess of 1 ampere per 10,000 circular mils of conductor area.

Iron and steel are much stronger than copper, making its use in smaller sizes practical for lines requiring only small currents. Also the allowable spacing of poles can be increased. Experience has proven that the steel line cannot be pulled up too tightly, linear elongation within the elastic limit being greater than the temperature contraction. This means sags may practically be forgotten, allowing shorter poles and quicker and cheaper construction. One line* built with poles 412 ft. (125 m.) apart and strung with No. 6 iron wire drawn as tightly as possible to pull it without breaking has withstood wind and sleet where surrounding copper lines have given way.

The life of iron and steel is shorter than that of copper, being from two to twenty-five years, depending upon the presence of moisture in the air, proximity of salt air, soft coal smoke, etc.

The power loss and consequent heating of iron wires are proportional to the effective resistance and not to the d.-c. resistance as compared with copper lines.

The possibility of using stranded guy wire for extension lines into new territory, later replacing it with copper when the service demands it, the iron then being turned to its original duty of guying on further lines, has attracted more than one public utility to the use of iron transmissions.

Optimistic View of Turbine Development

Past Turbine Troubles Were Due Chiefly to Maufacturing Conditions During War—Turbines Can Be Made Most Reliable Prime Mover Built

BY RICHARD H. RICE†

Manager Lynn Works, General Electric Company

IN THE old days of the reciprocating engine there were difficulties and troubles which at the time were thought to be very serious. Today those difficulties look very small in the light of the magnitude of the present power-station industry, the large number and large size of units involved and the greater necessity of absolutely continuous service. As in the old days, difficulties have been experienced with new types of prime movers. However, it must be remembered that there is no instance of a similar art developing with such rapidity. In such a rapid development it must be expected that the safety line will be passed occasionally and the danger zone penetrated a little too far in a desire to achieve the final form of apparatus quickly. Certainly no apologies are necessary for striving after high efficiency in the face of seven-dollar coal and the high cost of all materials which make up a plant.

The great change in manufacturing conditions during the war had a considerable effect on turbine development. On account of the unprecedented demand for steel the manufacturers gave more attention to tonnage output than to quality. Still, that was a period when new materials or materials of greater strength and different qualities were wanted for turbines and when research or careful analysis was most needed. Then, too, the character of labor changed for the worse and workmanship was uncertain.

Co-operation between turbine operators and designers is one of the best ways to avoid unsatisfactory development. A very good measure of this co-operation has existed in the last year. In those conferences all the cards have been laid on the table on both sides. This must always be done, because designers must know the troubles in order to cure them. It was one of my troubles as a turbine designer that I could not get close enough communication with the operators. As a matter of fact, operators do not "open up" unless they have serious trouble.

I have had occasion to study the question of heat treatment a great deal in the last ten or fifteen years. Many steel experts engaged in the manufacture of steel and in its study from a more theoretical viewpoint were consulted, but there were great differences of opinion. As a result the turbine manufacturers had to study those problems for themselves. In our plant at Lynn we tested out the methods advised by steel experts and developed treatments of our own. I can say for our works at Lynn, with the progress of which I am quite familiar, that we do not feel any uncertainty or any doubt in the use of heat treatments; but we must be sure that the heat treatment is followed in accordance with our specifications and that the treatment covers the entire piece. Sometimes we have had difficulty because the heat treatment has been localized. Sometimes we have had trouble because when we thought we were getting heat treatment we were not getting quite that. That trouble has been due to the fact that steel manufacturers have been under great pressure and were not able to supervise their work during war times and during reconstruction days with the thoroughness that they exercised before the war.

All the difficulties cited have to do with the reliability of operation of our machines, but I am certain that the difficulties are of a temporary nature and that they will be overcome in a reasonable period. Since periods of uncertainty and difficulty have existed during the development of other prime movers, but have always been followed by successful achievement, I believe that the turbine can be made to be the most reliable prime mover which has ever been built.

We have allowed turbine size to be pushed up quite rapidly, perhaps too rapidly; but that is a co-operative problem. The operators have wanted large machines and we have done our best to give them what they wanted. Certainly, it is not unreasonable to suppose that a turbine casing weighing several hundred thousand pounds with its complete equipment should take some little period to warm up. It ought to be put into operation rather gradually.

I look forward to a continued development of the turbine. Perhaps there will not be a development of its present form to much greater efficiency, but I believe that in combination with other methods we shall go forward along the lines of economy.

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*Sag calculation for iron wire lines, ELECTRICAL WORLD, August 3, 1918.

†Abstract from an address by Mr. Rice before the Boston Sections of the A. I. E. E. and A. S. M. E.

Correcting Synchronous-Motor V-Curves

Harmonics in the Line Voltage Frequently Produce Discrepancies in the Characteristic Curves of Synchronous Motors—Simple Analysis Is Offered for Correcting Erroneous Results

By JACOB R. COLLINS

MOST engineers who make use of V-curves of synchronous motors have encountered difficulties in the failure of measuring instruments to indicate reasonable power factors at the region of the curve where the armature current approaches its minimum value. Discrepancies of this character cast doubt upon the whole data. The analysis offered in this paper makes it possible to account for irregular data due to harmonics in the wave form of voltage at the synchronous motor. The method should also prove useful in other measurements when current or voltage are not sinusoidal.

The use of vectors in one plane to represent alternating electromotive forces and currents is based on the assumption that these qualities are simple sine functions of the time and of the same frequency. If the currents are not simple sine functions of the time, but are made up of components of different frequencies, vectors in one plane no longer truly represent these currents. It has been shown by Prof. F. Bedell* that the components of higher frequency may be represented by a vector at right angles to the plane containing the vectors of fundamental frequency.

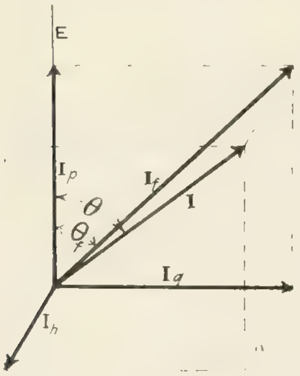

FIG. 1—COMPONENTS OF A CURRENT WITH A PRONOUNCED HARMONIC

The vector I (Fig. 1), representing the total current in a circuit, is then the resultant of the vector I_f, which represents the current of fundamental frequency, and the vector I_h, which represents the currents of all the higher frequencies combined. Since these components are at right angles to one another we have:

$$I^2 = I_f^2 + I_h^2 \tag{1}$$

The current I_f of fundamental frequency may, in the usual manner, be considered as made up of the two components, both in the plane of fundamental frequency, namely, the power component I_p, in phase with the impressed electromotive force, and the reactive component I_g, in quadrature thereto. Since I_p and I_g are mutually at right angles,

$$I_f^2 = I_q^2 + I_p^2$$

and

$$I^2 = I_h^2 + I_q^2 + I_p^2 \tag{2}$$

These relations are made clear by Fig. 1.

In ordinary practice the quantities measured are the impressed electromotive force E, the current I and the power W. These quantities are measured by voltmeter, ammeter and wattmeter respectively. Since only the component I_p represents power, we have directly

$$I_p = W/E.$$

Even when the current I_f of fundamental frequency is in phase with the impressed electromotive force, namely, when $I_q = 0$, the total current I contains a reactive component I_h which throws I out of phase with E (hence out of the plane of fundamental frequency), so that the power factor is not unity. In this case

$$I^2 = I_h^2 + I_p^2 = I_h^2 + (W/E)^2 \tag{3}$$

Since I, W and E can be measured, this expression enables us to calculate I_h for this special case. If for other phase relations between I_f and E, I_h should remain constant or practically so, the value of I_f could be determined from the readings of E, W and I, for, from equation (1),

$$I_f^2 = I^2 - I_h^2; \tag{4}$$

$$I_q^2 = I_f^2 - I_p^2 = I_f^2 - (W/E)^2, \tag{5}$$

so that a complete representation, as in Fig. 1, could be made.

The writer has made an application of this method in the case of the V-curves of a synchronous motor, which show the variation of armature current with field current. At constant load such a curve shows a minimum value of the armature current when the component current I_f of fundamental frequency is in phase with the impressed electromotive force. For field currents larger or smaller than this value the armature current increases and the phase angle between the current and impressed electromotive force increases.

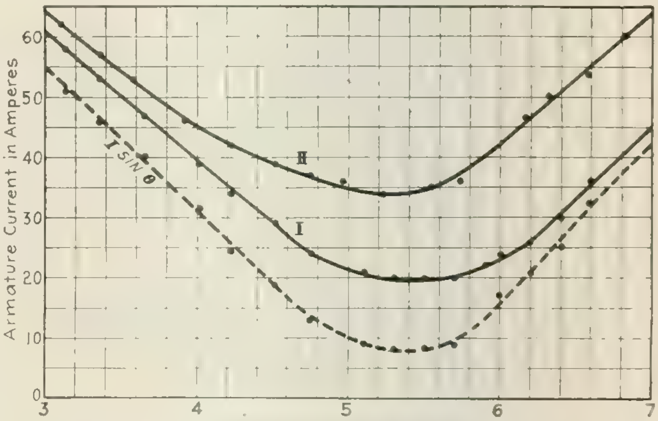

FIG. 2—V-CURVES OF A SYNCHRONOUS MOTOR (I) RUNNING LIGHT, (II) WITH LOAD

If the current flowing is not one of a single frequency, the product of the impressed electromotive force and minimum armature current will be greater than the reading of the wattmeter. In this case the ratio of the wattmeter reading to the impressed electromotive force gives the value of the component current of fundamental frequency. Hence by means of equation (3) the component current of higher frequency is readily computed for this particular value of the field current.

This component current of higher frequency may be due (a) to the deviation of the impressed electromotive force from a simple sine wave, (b) to the devia-

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*See *Trans. A. I. E. E.*, Vol. XXV, 1906, page 685.

tion of the counter electromotive force of the motor from a simple sine wave, or (c) to both effects together. In either of the last cases the current of the higher frequency would vary with the field excitation of the motor, but since the armature current increases rapidly with the change of field excitation, the effect of the higher frequency current is appreciable only when the field current has a value near that for minimum armature current.

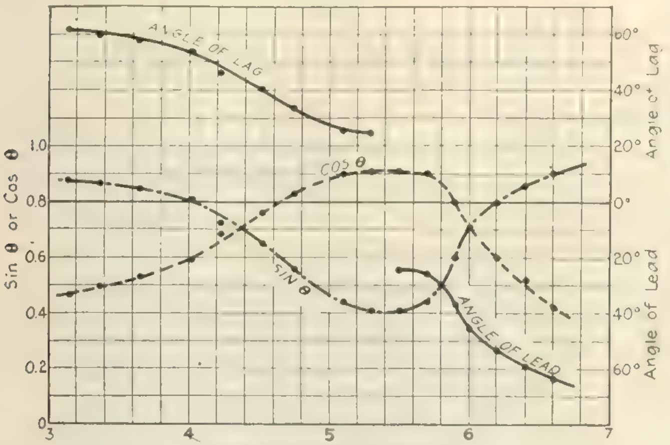


FIG. 3—DISCREPANCIES IN CHARACTERISTICS OF MOTOR DUE TO NEGLECTING PRONOUNCED HARMONIC

To illustrate, the V-curves for a synchronous motor are plotted first in the usual manner (without regard to the component current of higher frequency) and, second, in a manner suggested by Professor Bedell, which takes account of the component of higher frequency in the way just described. The curves *I* and *II* are plotted from observed values of armatures and field current at two different loads. Curve *I* is taken at practically no load, the motor being belted to a generator which is running idle. Since the total armature current is small at high power factors, the current of higher frequency will be a considerable fraction of the total current when the power factor is near unity. From the values of *I* taken from curve *I* the curves in Fig. 3 are obtained.

The phase angle θ between impressed electromotive force E and total current I is obtained by the relation

$$\theta = \cos (W/EI).$$

θ, $\sin \theta$ and $\cos \theta$ (power factor) are plotted in Fig. 3 against the field current. For a sine current the minimum value of $\sin \theta$ should be zero, the maximum value of $\cos \theta$ should be unity and the minimum value of the phase angle should be zero. From Fig. 3 it may be seen that the minimum value of $\sin \theta$ is 0.41, the maximum value of $\cos \theta$ is 0.91, while the curve for the phase angle θ is discontinuous in changing from angle of lag to angle of lead, the minimum value being 24.5 deg.

The minimum armature current is 19.5 amp.hr. The load in this case *I* is 3.95 kw., and the impressed electromotive force 220 volts. Consequently from equation (3) we have as the value of the current of higher frequency at this field current:

$$I_h = \sqrt{I^2 \ (W/E)^2} = \sqrt{\ldots (19.5)^2 - (3950)2/220} = 7.5 \text{ amp.}$$

Using the value of I_h as constant for all values of field excitation, I_f was calculated by means of equation (4), and the phase angle between I_f and E calculated by means of the expression

$$\Theta_f = \cos (W/E)/I_f$$

These values of θ_f, $\cos \theta_f$ and $\sin \theta_f$ are plotted in Fig. 4 against the field current. It is seen that the phase angle between I_f and E now changes continuously from the angle of lag to an angle of lead as the field current is increased, and not discontinuously as before in Fig. 3. Also $\cos \theta_f$ has the maximum value unity and $\sin \theta$ has the minimum value zero. These curves therefore are seen to represent the phase relations between the impressed electromotive force and current I_f of fundamental frequency more accurately than do the curves of Fig. 3.

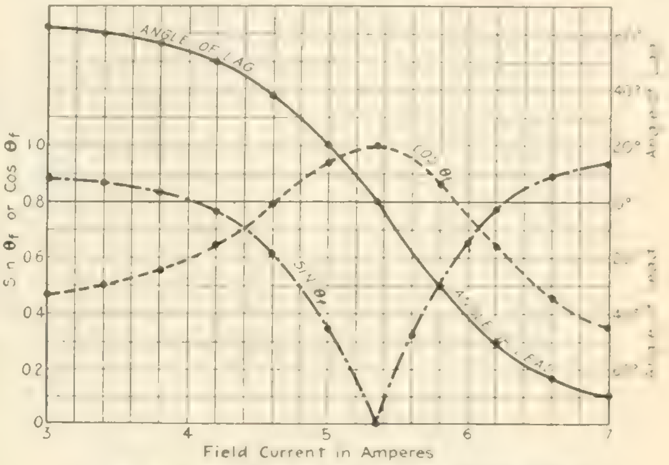


FIG. 4—ANALYSIS MADE BY THE AUTHOR GIVES REASONABLE CURVES

Transformer Connectors Which Eliminate Mistakes

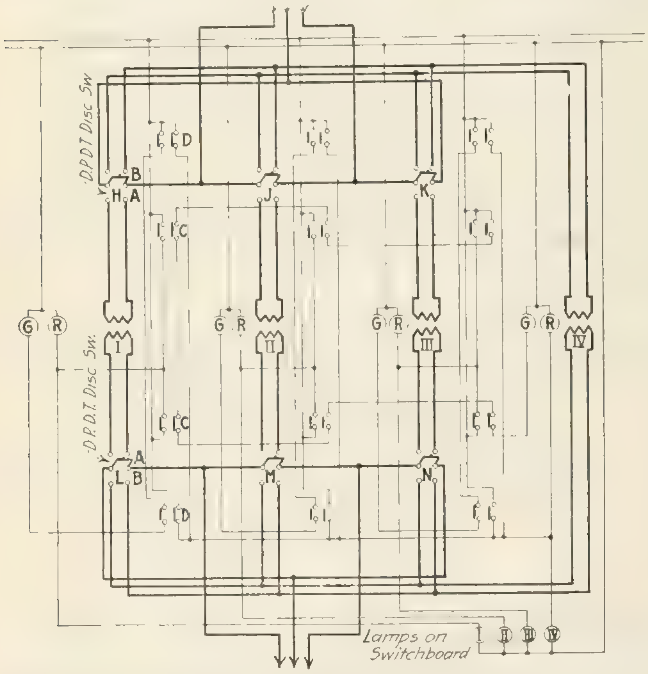
Connecting Bars Between Buses and Transformers Are Removable and Cannot Be Placed in Wrong Position

By M. M. Samuels
New York, N. Y.

Where there is only a single bank of transformers, made up of three single-phase units, it is generally customary to provide a fourth single-phase unit to serve as a spare and take the place of any one of the other three in case of accident. In order to be able to throw in the spare unit quickly, a system of double-throw disconnecting switches is often used, one side of each switch (*A* in Fig. 1) being connected to any one of three transformers, and the other sides of all switches (*B* in Fig. 1) being connected to a bus which is permanently tied into the spare transformers. Instead of using single-pole-hook disconnecting switches, double-pole, double-throw mechanically operated disconnecting switches are now generally preferred, in order to expedite the operation. The diagram of Fig. 1 shows a system of connections where I, II, and III are the three single-phase transformers making up the bank and IV is the spare unit. If, for instance, unit II is out of commission, it is only necessary to throw switch *J* over to its upper position *B* and to throw switch *M* over to its lower position *B* in order to throw unit IV on the phase occupied by unit II. This can be done without any "phasing-out" tests. Of course, the switching must be accomplished with the load off, or, in other words, with the oil circuit breaker open.

With the use of mechanically operated disconnecting switches it is possible to install auxiliary switches (*C* and *D*) on the mechanisms for operating red or green indicating lamps at various points. The auxiliary switches shown in Fig. 1 are so interlocked that the red lamps at each transformer will light when either side of the transformer is energized through the operation of any of the disconnecting switches, whereas the green lamp will light only when the respective transformer is absolutely de-energized and both sides of it are disconnected. This, as may readily be seen in Fig. 1, is not only the case on the transformers I, II and III, making up the bank, but also on the spare transformer IV, even though no switches are provided for this spare transformer. In addition, Fig. 1 shows a set of four lamps on the switchboard to indicate which of the four transformers is operating at any time.

In spite of all these precautions, this system is not to be recommended, for the reason that mistakes and accidents may occur where it is used. If, for instance, after unit IV has been thrown in to replace unit II, an accident should happen to unit I, the operator, being trained in the idea that he can replace a defective transformer by a spare one by simply throwing the switches of the defective transformer to their opposite positions, might throw switch *H* to its upper position (*B*), which would mean a short circuit, since switch *J* would also be closed in its upper position (*B*).



C-D P Aux. Switch closed when disconnecting Switch is closed at A
D- " " " " " " " " " " B
Red Lamp at Transformer Lights when Transformer is alive on Either Side
Green " " " " only when Transformer is dead on Both Sides

FIG. 1—CONNECTIONS OF INDICATING LAMPS FOR SPARE TRANSFORMER

The transformers are not always within sight from the switches, nor are the low-tension switches always within sight from the high-tension switches. Thus an additional mistake can easily be made by throwing the low-tension switch of one phase and the high-tension switch of another phase, as for instance, switches *J* and *L*, in which case a mixing of phases would be the result.

In addition to these objectionable features of the system shown in Fig. 1, it is expensive and requires complicated wiring, as double-throw high-tension switches usually do. It is therefore preferable to use the much simpler, less costly and not at all dangerous scheme shown in Figs. 2 and 3. With this system a set of solid "jitney" buses are used for each of the high-tension and low-tension delta or Y connections.

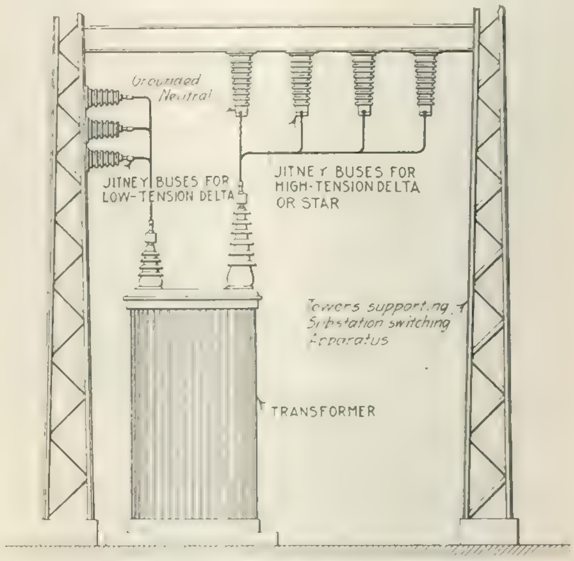

Grounded Neutral
JITNEY BUSES FOR LOW-TENSION DELTA
JITNEY BUSES FOR HIGH-TENSION DELTA OR STAR
Towers supporting Substation switching Apparatus
TRANSFORMER

FIG. 2—"JITNEY" BUS METHOD OF CONNECTING SPARE TRANSFORMERS

These buses extend over the full length of the space occupied by the four units. The connections from the three units making up the bank to the jitney buses are solid copper bar for the low-tension and copper pipe for the high-tension. Each of these connection bars or pipes will fit only between a transformer terminal and one particular phase of the jitney bus, and it could not possibly be used on another phase since it would be either too long or too short. In order to replace transformer unit II in Fig. 2 by spare unit IV bars 13 and 14 and pipes 7 and 8 are removed from No. II, and these bars and pipes are used for connecting the spare transformer to the jitney bus. It will not be necessary to phase out, since each of

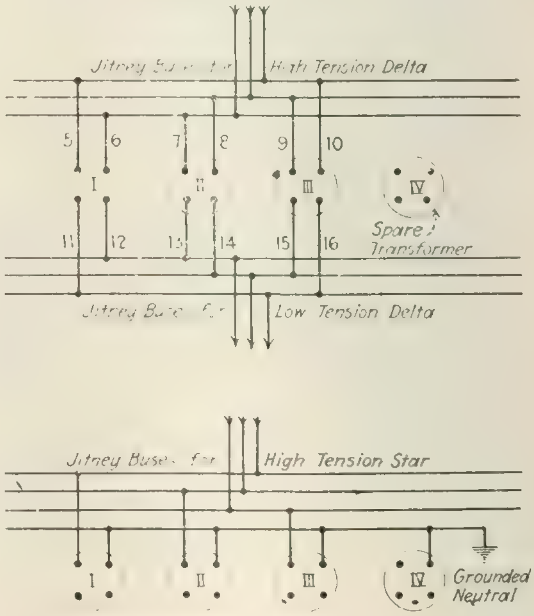


FIG. 3—SUPPORTS FOR "JITNEY" BUS CONNECTIONS

the connections transferred from II to IV will fit only its proper phase and cannot be connected to any other phase. Offsetting the buses will prevent reversed connections. The operation of transferring the four connections from one transformer to another does not take more than a very few minutes, since it requires no testing and no fitting whatever.

Cost of Fuses for Service Entrances

Formulas for Finding Annual Costs of Standard and Renewable Type Fuses Used at Customers' Entrances on Central-Station Service Lines

BY WILLIAM BAUM

A REPORT by a research engineer of a large Middle West public utility covering an investigation of fuse costs says: "The field for renewable fuses is in the protection of induction motors and other installations where frequent overloads occur. Unless an average of more than one fuse in four is blown every year, no saving will be effected over the cost of standard fuses by the installation of the renewable type." With renewals of less than 25 per cent per annum, it was found that the fixed charges on the investment in renewable fuses for use at customers' service entrances were much more than the saving due to the refillable feature.

This investigation covered fuses from 30 amp. to 200 amp. inclusive, and the great majority were for 250-volt service. The report was compiled during the latter part of 1918, and the following cost figures were used as a basis for comparison:

COST COMPARISONS OF STANDARD AND RENEWABLE FUSES USED AT SERVICE ENTRANCES WHERE BLOWOUTS WERE 8.7 PER CENT PER ANNUM

Standard Fuse Data				Annual Cost of Standard Fuses			Comparative Annual Cost Renewable Fuses				
Amp.	Volts	Number in Use	Number Blown in One Year	12 per Cent Fixed Charges	Renewals	Total	12 per Cent Fixed Charges	Renewals	Total	Annual Saving with Standard Fuses	Blowouts per Annum to Give Equal Cost per Cent
30	250	14,950	1,300	$179.40	$130.00	$309.40	$398.40	$45.50	$443.90	$134.50	22.5
35-60	250	14,050	1,221	219.60	158.73	378.33	525.00	64.71	589.71	211.38	28.2
30	600	96	6	1.72	.90	2.62	4.02	.31	4.33	1.71	24.7
35-60	600	391	34	10.79	7.82	18.61	24.82	2.41	27.23	8.62	22.5
65-100	250	2,700	235	110.16	79.90	190.06	259.84	31.25	291.09	101.03	26.7
110-200	250	2,220	193	202.46	146.68	349.14	474.18	40.53	514.71	165.57	22.2
		34,407	2,989	$724.13	$524.03	$1,248.16	$1,686.26	$184.71	$1,870.97	$622.81	24.3

A figure of 12 per cent was taken for fixed charges, which included 6 per cent interest, 5 per cent depreciation and 1 per cent taxes. The number of fuse blowouts necessary to produce an equal renewal expense with either type was then obtained by subtracting the fixed charges for standard fuses from the fixed charges for renewable fuses and dividing the result by the difference between the two unit renewal costs. The formula is as follows:

$$x = (b - a) / (c - d)$$

x = number of fuse blowouts to give equal renewal costs.

a = fixed charges on capital invested in standard fuses.

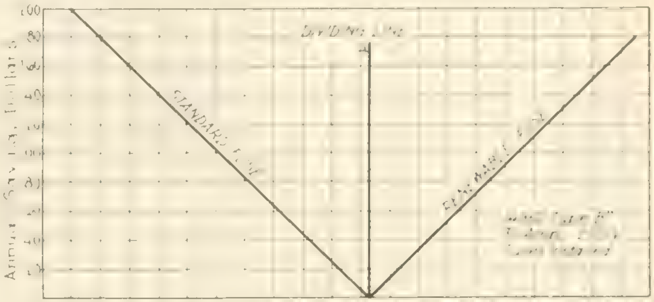
b = fixed charges on capital invested in renewable fuses.

c = unit renewal cost (also first cost) of standard fuse.

d = unit renewal cost of renewable fuse.

Before any conclusions could be arrived at it was necessary to determine the number of fuse renewals required on the company's system. A careful study of the records and an analysis of conditions showed that out of 34,407 fuses in service 2,989 were blown during one year. The blowouts, therefore, amounted to 8.7 per cent.

These fuses were installed at the customers' service entrance. This figure was compared with that arrived at by engineers not connected with the company who had had experience in this line. Under similar conditions they had found the annual blowouts to range from 7 per cent to 10 per cent. This does not hold true in induction-motor installations, where the extreme variations of load cause a much higher percentage of blowouts a year.



EFFECT OF BLOWOUTS ON CHOICE OF MOST ECONOMICAL TYPE OF FUSE

The summary of the results shown in the table indicates that, under the prevailing conditions on that company's system, the standard fuses were more than $600 a year cheaper than renewable fuses. Results also showed that the percentage of blowouts would have to be increased from the present figure of 8.7 per cent to an average of about 25 per cent or more before conditions would change in favor of the renewable type of fuse.

The relationship between annual saving with either type of fuse and the percentage of fuse blowouts per year can be plotted on a curve for any size of fuse and set of conditions. A sample curve of this description is shown in the illustration. The curve is based on the prices and fixed charges given in this article and on an installation using 14,950 type B 30-amp., 250-volt standard fuses.

While this is a characteristic curve, it may not apply under other conditions. A special curve should be worked out for each individual case, taking into consideration any unusual factors.

Readers' Views and Comments

The 50-Deg. Motor a Remedy for Overmotoring

To the Editor of the ELECTRICAL WORLD:

SIR: While there are probably some industries where the 50-deg. motor may prove a detriment, in pulp and paper mills it will be a decided advantage. In these mills it is safe to say that 95 per cent of the machines are overmotored. This may seem like a reflection on the ability of the electrician in charge, but it is really the fault of the superintendent or the designing engineer. He is more familiar with steam engines and waterwheels than with electric motors, and it is hard for him to believe that so much power can be delivered by such a small mass of material. When he is buying a pump and the manufacturer specifies a 40-hp. motor he plays safe and orders one rated at 50 hp. If he gets a 40-deg. rise motor he has one capable of carrying 60 hp. continuously, and in place of being 10 hp. overmotored he has 20 hp. more capacity than is actually needed.

Thus he has an increased first cost and a lower efficiency and power factor than if he had bought a 50-deg.-rise motor. While the 50-deg.-rise motor will not entirely cure the overmotoring, it will be a decided check to the disease.

RALPH MCKINNEY.

Brown Company, Berlin, N. H.

Fallacies in Fixture Ventilation

To the Editor of the ELECTRICAL WORLD:

SIR: When the gas-filled tungsten lamp first came on the market designers of fixtures and sockets to take these lamps were suddenly confronted with the necessity of providing for greater heat around the lamp base than had before been common. Consequently much attention began to be given by designers to ventilation, as the chief means of getting rid of the undesirable heat. It now begins to appear that many of the attempts at ventilation might better have been omitted, and that it would be better to conduct the heat away from the lamp socket to a point where effective cooling could be obtained by radiation and by convection into surrounding circulating air currents than to circulate air through a lamp globe.

Ward Harrison of Cleveland, before the Illuminating Engineering Society, Chicago Section, in February gave some interesting figures of tests which showed that a common type of ventilation in which air is taken in through a hole in the bottom of an inclosing globe and allowed to circulate up around the socket gave very little lower lamp base temperature than if a closed globe were used, while the practice had the very serious disadvantage of drawing so much outside air through the globe that much dirt was deposited on lamp and globe.

A careful study of thermal conductivities, including both the transfer of heat from metal and glass to air and the reverse process, should usually make it possible to design inclosed fixtures for large lamps which will stay cleaner much longer than the inclosed ventilated type. The requirements are, primarily, plenty of external radiating surface and ample paths of high thermal conductivity from the lamp base to these external radiating surfaces.

One reason for the result quoted by Mr. Harrison is that the circulation of air inside an inclosed globe fixture serves as a fairly good medium of heat exchange between the lamp base and neck and the outside of the fixture. To be sure, the thermal conductivity of air is not particularly good—in fact, air is one of the best known insulators when it is not permitted to circulate—but experience with heat-insulating materials shows that circulation of air is very effective in bringing about heat exchange and that the air must be very closely confined if its heat-insulating qualities are to be made use of. The lesson to be learned from this is that air circulation within a fixture of the inclosed globe type may be made quite effective in transferring heat. At any rate, the ventilation of the inclosing globe for gas-filled lamps has undoubtedly been overdone in some cases, and the design of the future should be along more scientific lines.

J. R. CRAVATH,
Chicago, Ill. Fowle & Cravath.

Formulas for Calculating Antenna Constants

To the Editor of the ELECTRICAL WORLD:

SIR: You may be interested in some work I have been doing in the field of radio-engineering, *i.e.*, in the derivation of new formulas for the accurate calculation of the true and equivalent antenna constants of long and horizontal aërials. I have checked the formulas by many experiments and found that they hold with a very good degree of approximation also for many power aërials used.

The formulas for the correct antenna constants are:

$$C_{e_1}^F = A_1 C_A^F,$$
$$L_{e_1}^H = B_1 L_A^H,$$
$$r_e^\Omega = B_1 r_A^\Omega,$$

while for the apparent effective constants they are:

$$C_{e_2}^F = A_2 C_A^F,$$
$$L_{e_2}^H = B_2 L_A^H,$$
$$r_e^\Omega = B_1 r_A^\Omega,$$

if C_e, L_e and r_e refer to the value of the effective capacity, of self-induction, of resistance, and C_A, L_A and r_A to the corresponding true constants. The constants A_1, B_1, A_2 and B_2 are given by:

$$A_1 = \frac{8\lambda^1}{\pi\lambda}\,\frac{\sin^2 \lambda/\lambda^1\, 90}{\pi\lambda/\lambda^1 + \sin 180^\circ\,[1 - \lambda/\lambda^1]}$$

$$B_1 = \frac{\lambda^1}{2\pi\lambda}\,\frac{\pi\lambda/\lambda^1 - \sin 180^\circ\,[1 - \lambda/\lambda^1]}{\sin^2 \lambda/\lambda^1\, 90}$$

$$A_2 = \frac{2\lambda^1}{\pi\lambda} \sin \lambda/\lambda^1\, 90^\circ$$

$$B_2 = \frac{2\lambda^1}{\pi\lambda}\,\frac{1 - \cos \lambda/\lambda^1\, 90^\circ}{\sin \lambda/\lambda^1\, 90}$$

λ^m = wave length for unloaded antenna; λ^{1m} = wave length for coil-loaded antenna.

The true antenna constants for a loading self-induction L_o are therefore found from the expressions

$$L_A^H = \frac{A_1 - A_2}{A_2 B_2 - A_1 B_1} L_O^H$$

$$C_A^F = \frac{\lambda^2}{144 \times 10^{10} L_A^H}$$

Berkeley, Cal. AUGUST HUND.

Station and Operating Practice

A Department Devoted to Problems of Installation,
Operation and Maintenance of Equipment for Economical Generation and
Distribution of Electrical Energy

Transformers Quickly Cleaned by Gasoline Circulated Through Oil Filter

CLEANING transformers with gasoline circulated through an oil filter press has been found by the Northwestern Power & Manufacturing Company to save time and labor. After all oil has been pumped from the transformer sufficient gasoline is poured into it to cover the end of the hose or pipe leading to the suction side of the filter. To the discharge end of the filter a hose is attached with a nozzle through which the gasoline is sprayed on the transformer. The washing is started at the top of the transformer and carried down. With large transformers the core is raised as the washing proceeds to make the cleansing easier and more thorough. If the transformer is very dirty, it may be necessary to change the filter papers, of which two are used, or to scrape the caked dirt off them. After the transformer is cleaned the gasoline is stored for further use and the transformer is dried by the short-circuit method for twenty-four hours and then filled with oil. Before the transformer is put back into service the oil is tested.

Besides using this method to wash transformers it has been also used to clean high-tension switches without disassembling them, thus saving much time and labor.

A. L. LOFTSTRAND.

Port Angeles, Wash.

Transmission Line Troubles Quickly Located

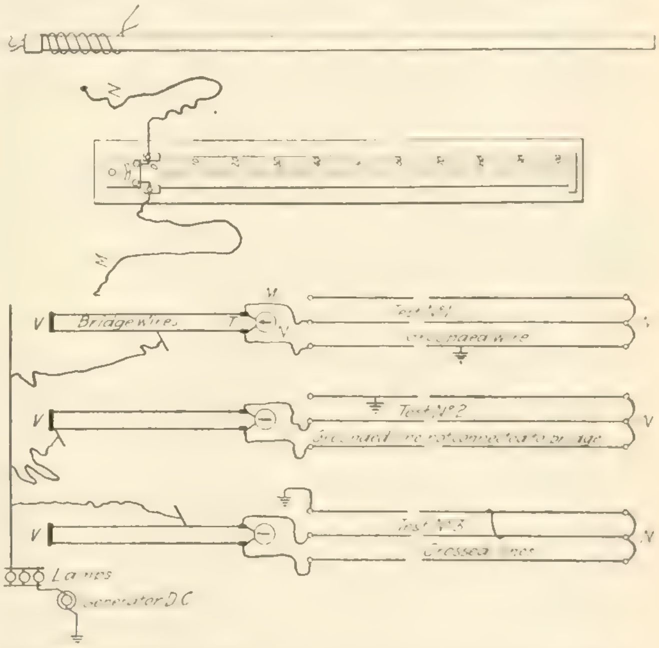
Application of Murray Loop Test with Slide-Wire Bridge Permits Position of Ground or Short-Circuit to Be Accurately Determined from Station

A SATISFACTORY device for locating distant transmission-line troubles was rigged up by the Cleveland Cliffs Iron Company at a total cost of $250. The equipment consists of a small motor-generator set, a galvanometer, a slide-wire bridge and an insulated platform. By means of this equipment and the Murray-loop test faults have been located on the company's 85 miles (175 km.) of transmission line to within one or two spans of the exact spot. The apparatus is inexpensive, accurate and the maintenance expense during the five years in which it has been in service has not exceeded $10.

A schematic diagram of the arrangement is shown herewith. When one line is grounded it is connected to one of the other wires at the distant end of the line. A spring connector on the end of a pole as shown is used for this purpose. The bridge arms are then connected to the other ends of the same lines as shown. Direct-current energy is required for testing and is supplied in this case from a 0.2-kw. motor-generator set, upon which the direct-current potential may be varied from 0 volt to 500 volts. When no other direct-current service is available an accurate test can usually be obtained with a battery of from ten to twenty primary or secondary cells, and almost any wire can be used for a bridge in an emergency.

One side of the direct-current of the motor-generator set should be grounded, and in this particular case three 50-watt, 240-volt lamps are connected in the circuit in multiple series. The other side of the direct-current system is connected to the sliding contact on the bridge. The slide is then moved along one or both sides of the bridge until a balance is established as shown by the galvanometer being at zero. The fault will then be on the phase connected to the bridge wire upon which the balance was obtained and will be proportionately in the same position on the outside lines from *T* to *Z* that the sliding contact is on the bridge wire between *T* and *V*. A table which was worked out for each circuit gives the location of each tower and its percentage corresponding to the percentage on the bridge.

As a matter of convenience, all phases are often short-circuited instead of simply connecting the defective line



CONNECTIONS FOR FINDING TRANSMISSION-LINE FAULTS, AND SLIDE-WIRE BRIDGE AND CONNECTING POLE

The bridge wires are divided into 100 divisions of 1 mm. each. The pole is used to connect a bridge wire with a defective line. The bottom hook of the spring is placed under a bridge-connecting wire and the pole is pushed up until the top hook connects with the desired line wire. The pole is light and hangs in position until the line is disconnected. The bridge-connecting wires run under all outgoing lines to facilitate connection. One pole is required for each line to be connected. The two bridge wires each consist of 100 mm. of No. 16 tinned steel wire. The leads *M* and *N* are of about the same conductivity as that of the line to be tested, and they should both be of equal lengths. A telephone receiver or low-reading voltmeter may be used when no galvanometer is available. When a balanced condition has been obtained there will be no reading on the voltmeter and no sound in the telephone receiver.

with one of the others. When this is done two clear lines are sometimes connected to the bridge by mistake. Under such conditions the sliding contact on the bridge will be at *V* when the galvanometer is at zero (see test No. 2). This indicates either that the faulty line has not been connected to the bridge or that the fault is near the point where the phases have been short-circuited. If two wires have become crossed or short-circuited, as shown in test No. 3, one of the short-circuited lines should be grounded at any convenient point before the test is made. This will be equivalent to a ground at the short circuit, which may then be located by the same procedure as in test No. 1.

F. C. Stanford,
Cleveland Cliffs Iron Company. Electrical Engineer.
Ishpeming, Mich.

Megger Successful for Testing Insulation and Locating Cable Grounds

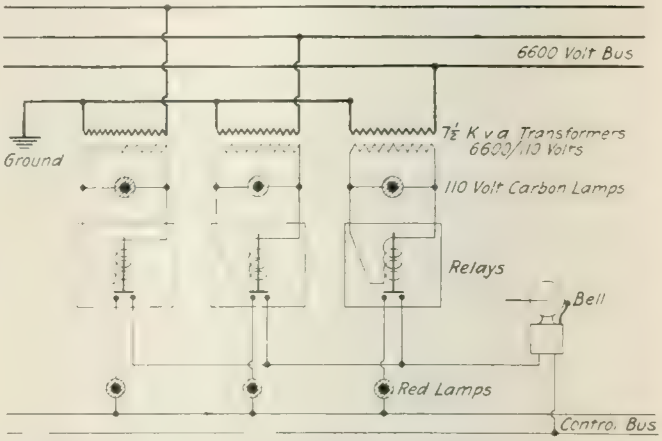
FOR determining insulation resistance megger tests are sufficient, but for tests of dielectric strength these must usually be supplemented by high-voltage or high-frequency tests. The main uses of the megger, as indicated in a recent meeting of the Empire State Gas and Electric Association, were as follows: (1) For routine tests of insulation resistance of equipment and cables, so that deterioration of insulation may be revealed before failure occurs; (2) for measuring the insulation resistance of apparatus which is being dried out; (3) for hunting trouble in underground cables. For the last purpose, however, it is the consensus of opinion that overvoltage tests should be put on doubtful cables before service is resumed over them.

Static Discharger and Ground Detector Made with Small Stock Transformers

PERSISTENT insulator trouble was stopped on a 6,600-volt line in Michigan by draining off the static through three small stock transformers each connected to a phase of the line and to the ground. Later these transformers in connection with lamps and relays were used as a very satisfactory ground detector. The 7.5-kva., 6,600/110-volt transformers used for the purpose were connected with their "high" sides in star, the neutral of which was grounded and the three points attached to the three phases of the station bus, while the 110-volt sides were left open. The trouble, which had been present for two years, causing interruptions and loss of insulators, was eliminated when the discharger was installed.

During further experimenting with this apparatus it was discovered that with certain modifications it would serve as a dependable ground detector. The first of these modifications was to connect a 110-volt carbon lamp across the secondary leads of each transformer. Under normal conditions these lamps show red as about 58 per cent of normal voltage is impressed on them, but when a leg of the line becomes grounded the corresponding lamp filament becomes black, since the primary voltage on the transformer drops. At the same time the other lamps will receive full voltage as the primaries of the transformers are subjected to 6,600 volts. In this way the grounded leg is always indicated by the dark lamp.

As an additional refinement, Westinghouse type C. V. relays were connected to the small transformer secondaries in order to close a control circuit when the secondary voltage falls to 50 volts. The closing of the control circuit rings an alarm bell and lights a red lamp. The lighted red lamp indicates the line which is in trouble, and the transformer lamps indicate the extent of the trouble. If the carbon lamp on the transformer is dark, the operator knows a dead ground has occurred, whereas if the lamp glows, but not so brightly as the other two, he knows that there is an arcing ground on the line. More accurate information could be obtained if desired by the use of voltmeters instead of or in conjunction with the carbon lamps.



HOME-MADE STATIC DISCHARGER AND GROUND DETECTOR

This ground detector proved so successful on the 6,600-volt system that it has been installed on the company's 13,200-volt line, where it has proved equally reliable. The transformers which were available for the 13,200-volt line were of 5-kva. capacity, and these were used. The load on the transformer consists of the signal apparatus, and only a small-sized unit is required. Both the 6,600-volt and the 13,200-volt lines are carried upon steel structures or upon wood poles with steel cross-arms grounded at each pole. The plan outlined would not work so accurately on lines not metallically grounded.

Charles E. Harger,
Peninsula Power Company. General Superintendent.
Iron River, Mich.

Transformer Practice on Rural Transmission Lines

TWENTY-FIVE-CYCLE transformers are used on both the 25-cycle and 60-cycle, 13,200-volt rural lines radiating from one of the cities on the Great Lakes and there have been no complaints about the service. The regulation is known to be poorer on the 60-cycle than on the 25-cycle service, but as the customers were satisfied the transformers were not tested to find out the exact results.

The company has 13,200-volt and 26-400-volt, 60-cycle lines for which 60-cycle transformers as small as 10 kva. are purchased with windings for both voltages. Smaller transfomers were required for some customers, but 5-kva. or 7.5-kva. units wound for 13,200 volts to 26,000 volts (primary) cost but little less than the 10-

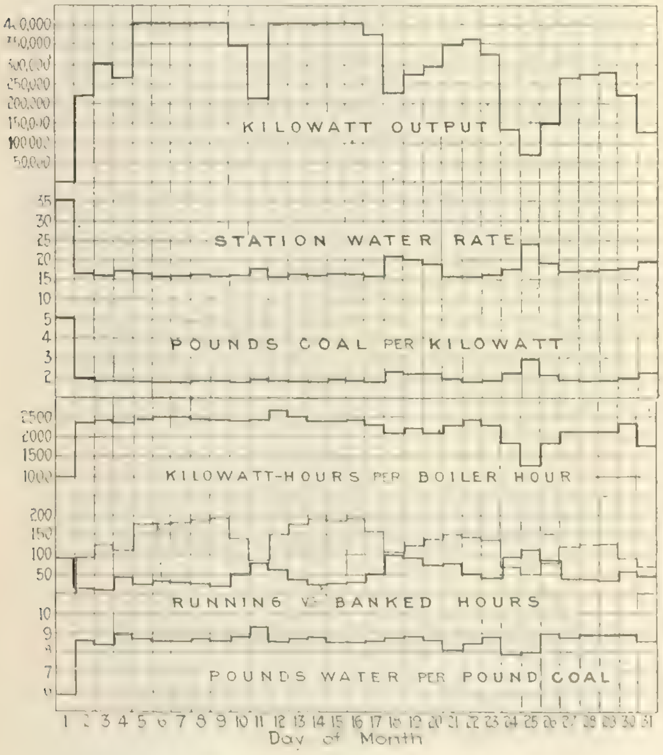
kva. size. This is why the 5-kva., 13,200-volt transformers purchased for the 25-cycle lines were used on the 60-cycle lines.

This particular company uses only 5-kva., 10-kva. and 15-kva. units in supplying service to its rural customers. A 5-kva. transformer is used for a connected load up to about 9 kva., about three times as much is connected to a 10-kva. unit, and from 35 kva. to 45 kva. is connected to transformers rated at 15 kva.

Milwaukee, Wis. Roy L. Dodd.

Graphic Operating Record Shows Daily Plant Performance

The major operating records of the United Electric Light Company, Springfield, Mass., are plotted day by day on large sheets to show at a glance the more important items bearing upon plant efficiency. The two sheets (combined in the reproduction shown here) give the daily kilowatt-hour output, the water rate, the fuel consumption per kilowatt-hour, the energy output per boiler-hour, the amount of banking and operating hours, and the evaporation. A summary of the month's performance is tabulated at the right of one chart. These charts, which are 10.5 in. x 19.5 in. (38 cm. x 50 cm.), offer a quick means for visualizing plant conditions. It will be seen from the accompanying curves that the plant efficiency improved, as a rule, as the relative amount of boiler banking was reduced, and also as the total output increased. The lighter Sunday loads and a period when one of the larger turbo-units in the plant was shut down for repairs imposed a decided handicap on efficiency. The monthly over-all figure, however, of 1.97 lb. (0.9 kg.) of coal per kilowatt-hour show excellent economy. The charts were designed and prepared by McClintock & Craig, Springfield, consulting and supervising engineers, for the United Electric Light Company.



DAILY OPERATION OF PLANT EASILY SEEN

Underground Records of Central Station Prove Valuable

The maintaining of complete maps and card records of its distribution system by the United Electric Light Company of Springfield, Mass., has proved of great value in connection with reconstruction work, additions to transformer, manhole and line equipment. Moreover, in case of operating trouble the records facilitate the restoration of service. A typical section of an underground system map is reproduced in Fig. 1. The key provides for showing manhole locations, transformer installations, overhead and underground primary mains and secondary services, pole locations and abutting real estate. Red, yellow and blue lines are used in the drawing for identifying the various equipment, and a card record (Fig. 2) is kept for each transformer, giving the connected load thereon, size, make, date of installation and other information convenient in case field men telephone in to the headquarters of the department.

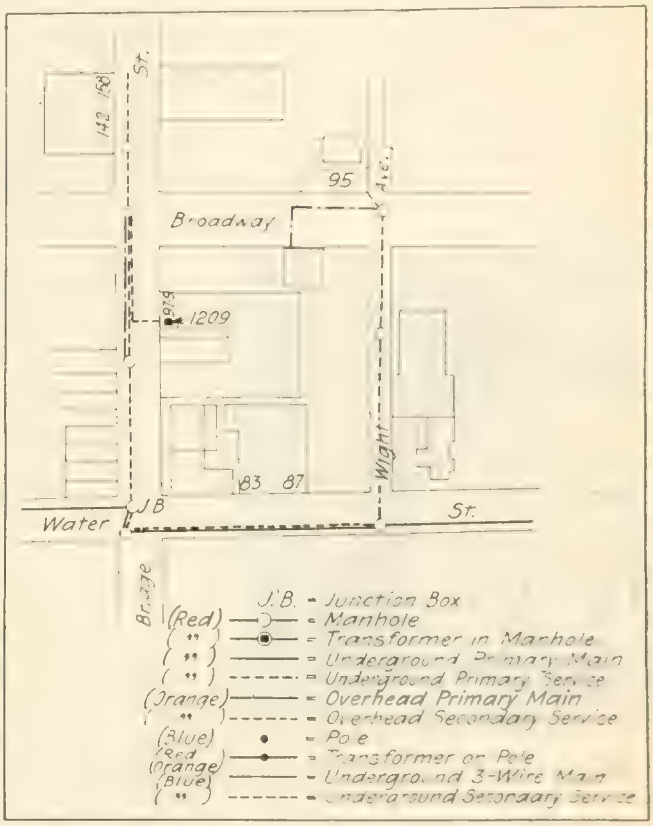

St.
142
95
Ave.
Broadway
1209
Wight
83
87
J B
Water
St.
Bridge
J.B. = Junction Box
(Red) = Manhole
(") = Transformer in Manhole
(") = Underground Primary Main
(") = Underground Primary Service
(Orange) = Overhead Primary Main
(") = Overhead Secondary Service
(Blue) = Pole
(Red) = Transformer on Pole
(Orange) (Blue) = Underground 3-Wire Main
(") = Underground Secondary Service

FIG. 1—SECTION OF MAP SHOWING UNDERGROUND DISTRIBUTION SYSTEM

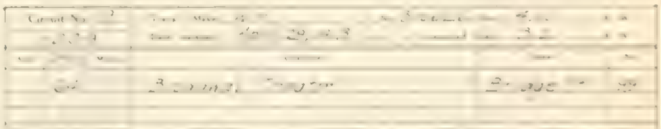


FIG. 2—EACH TRANSFORMER HAS A CARD

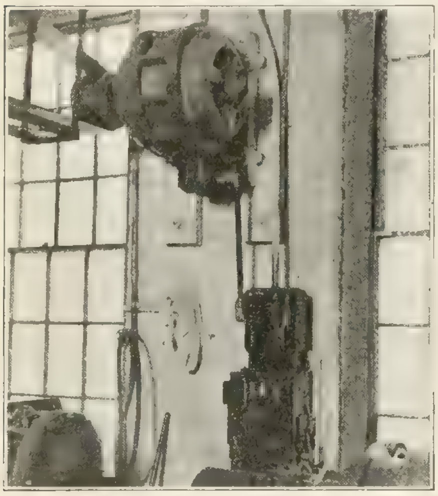
The manhole card record system employed by this company was described in the Aug. 16, 1919, issue of the Electrical World on page 360. W. H. Bolewine is superintendent of distribution for the United Electric Light Company.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

Side Wall Mounting for Motor and Starting Compensator

IN THE ELECTRICAL WORLD for Feb. 28, 1920, page 499, a method was shown for mounting motors on combined wood and iron beams. In this connection the method shown in the accompanying illustration will be of interest. The 15-hp. motor is supported by bolts passing through a 16-in. (42-cm.) brick wall. This allows a very compact grouping of motor and starting apparatus. The $\frac{5}{8}$-in. (16-mm.) through bolts used to support two 2.5-in. x 7-in. (6.4-cm. x 18-cm.) plank strips are provided with 6-in. (15-cm.) cast-iron washers to distribute the strain on the bricks, which is considerable on account of the pull of the belt. The motor is bolted to these plank strips. Directly under the motor the control apparatus is mounted. It consists of a starting compensator and overload-relay trip coils, requiring a conduit run of only 20 in. (51 cm.).


COMPACT MOTOR AND STARTER MOUNTING ON BRICK WALL

WALTER B. ATCHISON,
Electrical Engineer.
Chapman Valve Manufacturing Company,
Indian Orchard, Mass.

Electric Ovens Save Dies in Steam Wire Mills

COMPARED with ovens heated by coal, coke or steam for making steel wire, the electric oven saves dies, takes a smaller number of annealing and pickling processes in drawing down the bars, and consequently turns out a larger output in a given period. Owing to the dusty condition of combustion in coal-fired or coke-fired ovens, considerable dust is deposited upon the outside surface of the wire when such fuel is used for heating. This dirt and grit has a very destructive effect upon the dies through which the wire is drawn.

It is an easy matter to maintain any desired temperature in the electrically heated oven, and as it contains no combustible material, very little scale is formed on the wire by this method of annealing. On the other hand, it is seldom possible to maintain a temperature in excess of 600 deg. F. (315 deg. C.) in ordinary coal-fired or coke-fired ovens, and in steam-heated ovens expensive superheaters must be installed to maintain even this temperature.

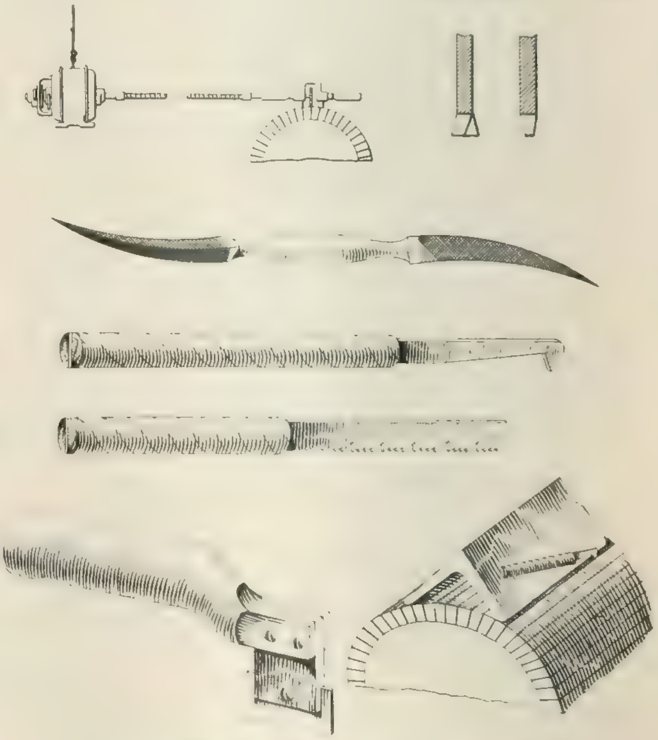
Furthermore, in pickling, certain classes of wire very frequently receive a light pickle immediately after being drawn to remove grease and dirt. If this wire is then placed in an electric oven, the pickling acid can be dried off and the wire annealed in one operation. The time and trouble of the pickling process are thereby reduced, and the wire can be returned directly from the electric oven to the next drawing operation.

Halcomb Steel Company,
Syracuse, N. Y.

EDWARD T. MOORE,
Electrical Engineer.

Undercutting Tools Made from File and Hacksaw Blades

FOR undercutting commutator mica industrial plants with a large number of motors can make some very handy tools for use on armatures taken out of the frame and on armatures which are to be worked on in place.

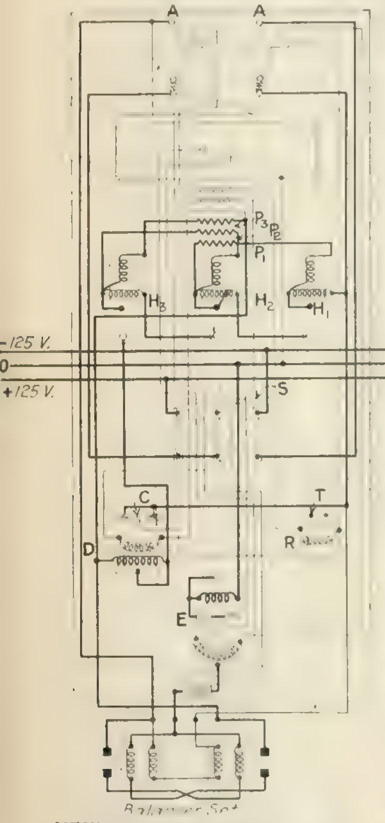

UNDERCUTTING TOOLS MADE IN THE SHOP

For small armatures which can be taken from the frame a circular saw about 1 in. (2.5 cm.) in diameter driven through a flexible shaft facilitates work. The "set" of the saw should be ground off and a guard provided to limit depth of cut to about $\frac{1}{32}$ in.

For working on an armature in its frame a hand tool is better. A thin three-cornered file may be used to start a groove in the mica, after which the file or a hack-saw tool shown in the drawing may be used to deepen it. A silversmith's "riffler," which is a curved double-ended file, may be employed. Some experienced men consider that a straight edge and a hook are the most efficient tools. The edge of a piece of angle-iron longer than the commutator will be parallel to the slot and is a very handy straight edge. For a hook a hacksaw may be ground into any of several different shapes and a handle formed of tape or wood taped on the blade. About four good strokes with a sharp hook will remove $\frac{1}{32}$ in. (0.9 mm.) of ordinary mica, which is the proper depth.

Automatically Closing Neutral on Balancer Set

BY CAREFULLY selecting machines that are as nearly alike as possible a direct-current balancer set may be arranged to have its neutral thrown on the system automatically without an operator first checking and regulating the voltage. Such a condition is found in two 12.5-kw., 125-volt machines connected to the system of the American Can Company at Maywood, Ill. The connections are arranged so that the neutral connection is made by means of an additional relay and magnetic contactor mounted on an ordinary motor-starting panel. In selecting the machines care was taken that the saturation curves should be as nearly alike as possible. The shunt fields are connected in series on 250 volts and the series fields are cross-connected. The accompanying diagram shows the connections on the board. The neutral magnetic contactor is at *E*. It is closed by the relay *R*, which is energized through the auxiliary contact *C* on the main line switch *D*. The sequence of operation is as follows: The circuit breakers *AA* are closed. Then the switch *S* is shoved in. The current passes directly to the positive side of the balancer set, and the negative side is connected through the resistance P_1, P_2, P_3 and the coils H_1, H_2, H_3, which automatically cut out in succession as the motors come to speed. When full speed is reached the circuit breaker *D* closes the line directly on the set. Then the auxiliary contact *C* is connected to the negative side of the line. Current passing through the relay *R* closes the contact *T*, which energizes the magnetic contactor *E*. This connects the neutral of the set on the line. Should the line circuit breaker *D* open, the coil *M* will release and the contactor *E* will open.



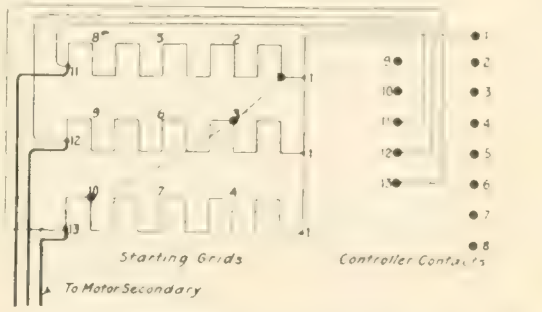
NEUTRAL CONNECTED AUTOMATICALLY BY CONTACTOR AT *E*

E — Magnetic contactor for closing neutral. *R*—Relay energizing neutral contactor. *D*—Circuit breaker in negative line to balancer set. *C*—Auxiliary contact to energize relay *R*. H_1, H_2, H_3—Starting coils. P_1, P_2, P_3—Starting resistances. *A*—Main circuit breakers.

J. A. TOLEIK,
Electrical Engineer.
American Can Company,
Chicago, Ill.

Motor-Starting Trouble Illustrates Necessity for Checking Connections

THE importance of checking connections after installing electrical equipment was demonstrated in the improper starting of a 550-volt, 200-hp. slip-ring motor recently installed in a western Massachusetts stone quarry. When the controller handle of this motor was thrown to the starting position the motor quickly jumped to full speed before the handle was thrown to the running position. An investigation of the controller connections explained this by showing that part of the starting grids were shunted out during starting, as indicated by the dotted lines in the diagram. After the connectors for the common lead were changed to studs 1-1-1 the motor started in the proper manner, by not coming up to speed until the handle was thrown to the second position.



WRONG CONNECTION THAT STARTED MOTOR TOO FAST

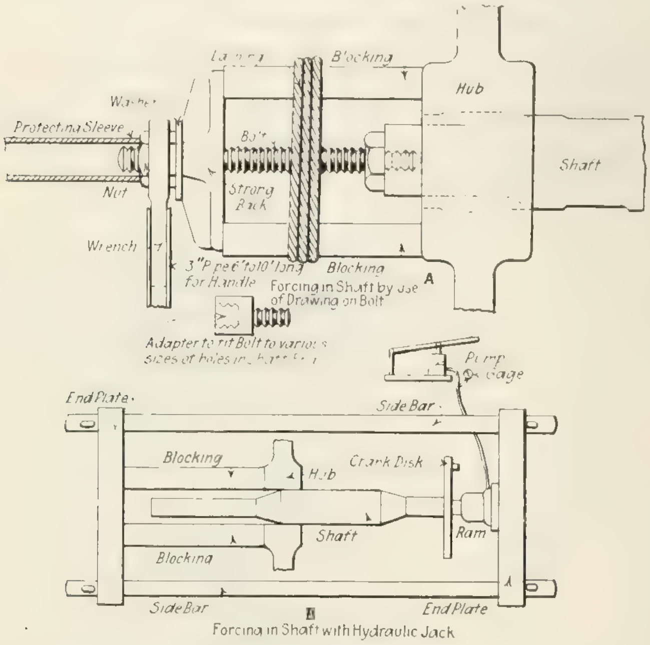
ARTHUR R. McDONALD.
McCleary, Wallin & Crouse,
Amsterdam, N. Y.

Screw Device for Forcing Armature on Shaft

FOR forcing an armature on a shaft the screw device shown in the accompanying illustration has been successfully used in an Eastern repair shop. This device consists essentially of a 3-in. (75-cm.) screw or bolt, one end of which is fastened into the shaft, the other end having a nut, which is screwed against a push plate and blocking that in turn bears on the armature, pushing it on the shaft. In using the device the bolt is first screwed into the threaded hole in the end of the shaft. If it does not fit, it is necessary to use an adapter having a screw on one end which fits the shaft and a threaded socket on the other end which fits the bolt. When this bolt is mounted in the shaft an iron push plate, or "strong back," is fitted over the bolt and the nut is screwed up against this plate with a heavy washer between them. Then hard-wood blocking is placed between this plate and the hub and the bolt is tightened. It is well to lash the blocking in place with rope to prevent buckling. By means of a wrench and a piece of pipe used as an extension handle the nut can be screwed up on the bolt, forcing the hub onto the shaft. A 3-in.

(75-cm.) bolt will easily give 90 tons pressure with a 10-ft. (3-m.) handle. For medium-sized shafts the pressure required is 40 tons to 50 tons. Larger shafts take as high as 125 tons, and for shafts with a bore larger than 14 in. (35 cm.) the use of a hydraulic press is recommended.

Before forcing a hub on a shaft the diameter of each is measured. The shaft is always slightly larger than the hole in the hub, usually 0.00025 in. for each inch of shaft plus 0.001 in. (0.0025 mm. for each cm. + 0.25 mm.). If the difference is greater, the bore must be increased by scraping or the shaft must be reduced to prevent jamming. Micrometers are used to measure this allowance, or a pin gage may be made for the hub and the shaft measured with stiff calipers and the difference measured with a feeler gage. If the difference is correct, before the forcing is started the tapped hole in the shaft, the bolt and the shaft and bore must be cleaned and oiled. A thin mixture of oil and white lead is applied to the shaft and the washer should be lubricated with a graphite grease before starting. In order to prevent injury to the bolt when shifting the wrench, a protecting pipe sleeve is placed on the bolt behind the nut.



Forcing in Shaft by use of Drawing on Bolt

Forcing in Shaft with Hydraulic Jack

METHODS FOR FORCING AN ARMATURE ON A SHAFT ABOVE, WITH SCREW; BELOW, WITH RAM

For shafts over 14 in. (36 cm.) in diameter a hydraulic pump and ram, arranged as shown, may be employed. The end plates of the frame are I-beams bolted together or heavy wooden beams, and the side bars are steel bars, rails, cables or chains.

Cleveland, Ohio. JAMES DIXON.

Desirable Properties in Insulation

In selecting insulation for electrical rotating machinery the following properties must be investigated: (1) High insulating quality; (2) ability to withstand mechanical strain; (3) ability to withstand vibration; (4) flexibility; (5) longevity; (6) ability to exclude moisture; (7) ability to withstand heat; (8) ability to withstand acids; (9) adaptability to use in small space, and (10) good heat conductivity.

Iron Plates Used to Provide Support for Conduit on Brick Walls

IRON plates for holding conduit to walls other than wood have been found more satisfactory by the writer than the wood plugs that are commonly used. These plates are drilled and countersunk for a wood screw, which is held in the wall by expansion shields, and the conduit straps in turn are fastened by machine screws to the plates.

For a single $\frac{1}{2}$-in. (1.2-cm.) conduit the plate is of black iron, $\frac{3}{8}$ in. x 1 in. x $2\frac{1}{2}$ in. (1 cm. x 2.5 cm. x 6 cm.), drilled and countersunk in the center for one No. 16 $1\frac{3}{4}$-in. (4-cm.) flat-headed wood screw which fits into a $\frac{1}{4}$-in. x 2-in. (0.6-cm. x 5-cm) expansion shield set in a $\frac{1}{4}$-in. (0.6-cm.) hole in the wall. To hold the pipe straps the plate is drilled and tapped for $\frac{3}{16}$-in. (5-mm.) machine screws. For carrying three runs of conduit, as shown in the illustration, a larger plate supported by two wood screws is drilled for four machine screws for the three pipe straps. For conduit over 2 in. (5 cm.) in diameter $\frac{5}{16}$-in. (8-mm.) expansion shields are used with No. 18 wood screws and the plates are $\frac{1}{2}$ in. thick by $1\frac{1}{4}$ in. wide (1.2 cm. x 3 cm.). These plates are about 6 ft. (2 m.) apart along the run. These plates for single risers may be kept in stock and other plates may be made to suit the job. When a number are required they are cut by a power saw six at a time and drilled and tapped in a four-spindle drill press.

Their use insures strong and neat construction and reduces the number and size of holes to be drilled in the wall. Another advantage is that irregularities in the wall may be compensated for by placing shims or blocks under the plates. Moreover, unlike the wooden plug which usually shrinks and becomes loose in the hole, the expansion screws maintain their hold permanently. L. E. WOOD.

Glasgow, Scotland.

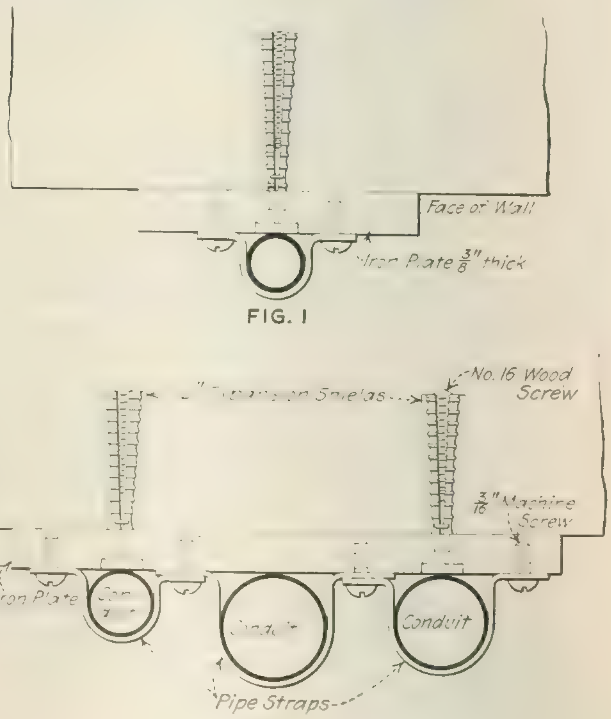

Face of Wall
Iron Plate $\frac{3}{8}$" thick
Expansion Shields
No. 16 Wood Screw
$\frac{3}{16}$" Machine Screw
$\frac{3}{8}$" Iron Plate
Conduit
Conduit
Pipe Straps

FIG. 1

FIG. 2

METHOD OF USING IRON PLATES FOR FASTENING CONDUIT TO BRICK WALLS

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

Merchandising Results in Scattered Texas Towns

ELECTRIC appliances sold during the year 1919 and during the month of January 1920, in twenty-one towns served by the Texas Power & Light Company, exclusive of the large cities, are listed in the accompanying table taken from a sales report in the *Texas Utility News*.

Since the average population of the towns is less than 12,000, it has been deemed unprofitable to maintain a separate sales force in each district. A commercial department, however, is maintained which devotes its efforts to each territory in turn, thus enabling each company to benefit from the work of the department at a very low individual selling expense. The gross revenue shown for the year 1919 of $220,857 is exclusive of lamp sales.

Appliance	No. Sold Year 1919	No. Sold January, 1920
Electric ranges	469	35
Vacuum cleaners	663	51
Washing machines	301	50
Irons	2,285	242
Heaters	519	73
Miscellaneous appliances	3,641	655
Total	7,878	1,106
Gross revenue from merchandise sales	$220,857	$19,837

Central-Station Assistance in Financing Range Sales

WITH the feeling that central stations should take the initiative in the pushing of range sales but that the co-operation of the retail dealer should nevertheless be obtained in furthering the interests of the range business with the public, several of the power companies of the San Francisco Bay region have adopted a policy of assisting in the financing of range sales as handled by retail dealers.

The Great Western Power Company has offered to handle any range sales made by contractor-dealers to consumers on its lines on a time-paying plan, agreeing to take over the obligation of making collections on the sale and to pay the dealer the full price of the range immediately. This arrangement provided that the dealer shall supply the range from his own stock and obtain a signed contract on the regular form supplied by the company. A cash payment of at least 10 per cent must be made by the customer at the time of sale, the remainder within nine months. Each contract must be approved by the district manager of the company in whose district the sale is made, who of course before approval investigates carefully the credit standing of the purchaser and secures also a written statement from the customer that the range has been satisfactorily installed by the dealer. When such a sale has been approved a requisition is forwarded to the purchasing department giving necessary information as to type of range sold, cost, consumer's name and address, dealer's name and address and so on. The purchasing department then places an order on the contractor-dealer in question, who renders his bill in triplicate just as though he had sold the range to the power company in the first place.

The Pacific Gas & Electric Company has made a similar arrangement with dealers in its territory by which the company allows the dealer 10 per cent on all range "prospects" turned over to it when the sale is actually consummated. The company also assumes the wiring charge in districts other than San Francisco and Oakland. If the name has been turned in by a contractor in the first place, the electric company agrees to give the wiring job to the contractor who submits the estimate 10 per cent lower than the bid of any other competitor. Ranges in both of the cases mentioned are sold at list prices.

Studying Power Costs for Steam Laundries

This Class of Business Offers Possibilities to Central Stations and Can Usually Be Served by Lines Already Constructed

By P. P. Pine
Commercial Department San Diego (Cal.) Consolidated Gas & Electric Company

ONE of the most common of the industries which obtain their power from isolated plants is the steam laundry. Since relatively few of these have installed central-station service, this is a source of new business which offers great possibilities to the commercial department of practically every central station. This business is very desirable as the load factor is high and constant throughout the year. Furthermore, as most laundries are located along existing lines very little additional investment is required to handle the load.

The first obstacle which the central-station power salesman must overcome when he endeavors to secure the business is, "How is the wash water to be economically heated?" The laundry owner will probably assert that his power costs him nothing because he has to have steam to heat water anyhow and can just as well take it from the engine exhaust. The securing of the laundry business then hinges on the proposition: Can sufficient fuel be saved to pay the cost of electric energy? If this can be done, the many advantages incident to the use of electric drive will quickly cause most laundry owners to substitute electric power. One method of figuring the theoretical cost of power where all of the engine exhaust is utilized in heating water is as follows:

Assumptions:

A 30-hp. engine of the Atlas type operating at an average load of 15 hp.

Steam consumption, 65 lb. per brake-horsepower-hour.

Evaporation of boiler, 10 lb. water per pound of oil.

Absorption of heat by engine (as found by barrel calorimeter method), 20 per cent of total heat received.

Cost of oil, $1.75 per barrel (at 315 lb. per barrel) = $0.0055 per lb. (This is equivalent to coal of 10,000 B.t.u. costing $4 per short ton, or coal of 14,000 B.t.u. costing $7 per short ton.)

Calculation:

Steam consumption of engine = 65 lb.×15 = 975 lb. per hour.

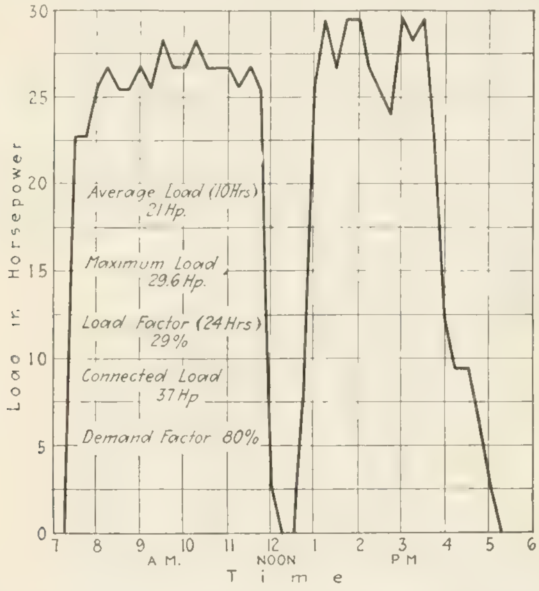
Steam equivalent of heat absorbed by engine = 20 per cent×975 lb. = 195 lb. per hour.

Fuel cost of evaporating 1,000 lb. of steam at 10 lb. evaporation = 100×$0.0055 = $0.55.

Equivalent cost of fuel for heat absorbed by engine = 195÷1,000×$0.55 = $0.107.

Cost of fuel per brake-horsepower-hour = $0.107÷15 = 7.15 mills, or 9.6 mills per kw.-hr.

About two years ago one of the prominent laundry men of San Diego requested that a test be made of his plant and an estimate submitted on cost of operation with electric drive. His boiler capacity was not sufficient to carry the load. As he was contemplating the building of a new plant, he did not wish to install another boiler at the old location. It was found that a 20-hp. motor would handle the load. As the prospective customer was paying only $1.20 per barrel for fuel oil at that time, his fuel cost for power was calculated to be about 6.6 mills per kilowatt-hour. He was already using central-station service for heating flatirons. By changing to motor drive he would be able to guarantee $75 a month and earn a net rate of 2 cents per kilowatt-hour.



LOAD CURVE FOR A LAUNDRY HAVING A CONNECTING LOAD OF 37 HP.

As he would not be able to save anything on labor costs, it seemed that electric drive would cost considerably more than steam. However, without making an estimate of the cost, the power company offered to install a motor on two months' trial and if it was not satisfactory to remove it and charge him only a nominal sum for the installation and use of the electrical equipment. This proposition was accepted and the motor installed. In order to make as good a showing in oil saving as possible, the steam-piping system was overhauled. It was found that some of the collar and other small steam-heated machines exhausted directly into the atmosphere. This steam was piped to the wash-water tank. Other changes were made, with the result that practically no live steam was needed to heat the wash water. For this reason, practically all the steam was saved that had formerly been sent to the engine.

After three months' operation, the comparative cost of power was found to be as follows:

215	barrels of oil used per month when operating steam engine.
131	barrels of oil used per month after motor was installed.
84	barrels of oil saved per month.
$100.80	saving in fuel cost (oil at $1.20 per barrel).
57.17	Electric power cost per month at 2 cents per kw.-hr.
43.63	net saving per month.

This installation has been in operation for about two years, and although another boiler has been installed, the engine has not been turned over since the day the motor was put in.

After finding that electric drive had made such a showing in this laundry, a drive was started to obtain more of this business. Six small-sized and three large laundries have now shut down their steam engines and installed motors. Electricity has proved satisfactory and economical in every case. In two instances it was found that the fuel saving was sufficient to pay double the electric power bill.

Saving of $60 a Month in Fuel Oil

In one of the large laundries which have discontinued engines and installed motors the first month's operation showed no saving in fuel oil. The reason was that the piping had not been changed so as to utilize properly the exhaust steam from the mangles and other steam-consuming appliances. After these changes were made, the second month's operation of the motors not only showed enough oil saved to pay the power bill but netted about $60 over and above this cost.

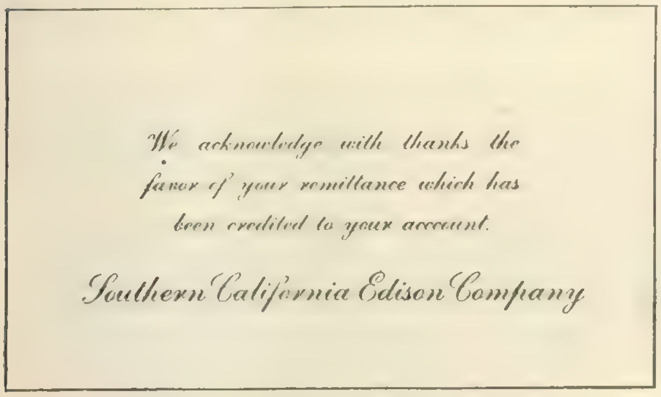
It will generally be found that the large laundries are being operated more efficiently than the smaller ones. The steam wasted owing to the exhaust escaping directly into the air, uncovered pipes and poor engineering in general is a smaller proportion of the total steam generated in the large laundries than in the small ones.

At the prevailing high costs of fuel it will be found that central-station service is able to compete with the fuel cost of power in many industries utilizing the exhaust steam for heating. This will be found to be particularly true where hydro-electric power is used. It is not necessary to make a sufficient saving in fuel to cover the power bill. With electric drive throughout much less time is required of the fireman or engineer, especially where coal is used as a fuel. The time thus saved can be very profitably devoted to other useful purposes.

It will be found that in many cases the engines or boilers are overloaded, causing very poor speed regulation. In such instances motor drive will increase the capacity of the entire plant. This advantage will more than compensate for a higher power cost, so that whether or not a saving can be effected by changing to central-station service is not always the determining factor. Another important feature to be considered where it is economical to discontinue the steam engine and adopt motor drive is the conservation of fuel.

Marks of Courtesy That Build Good Will

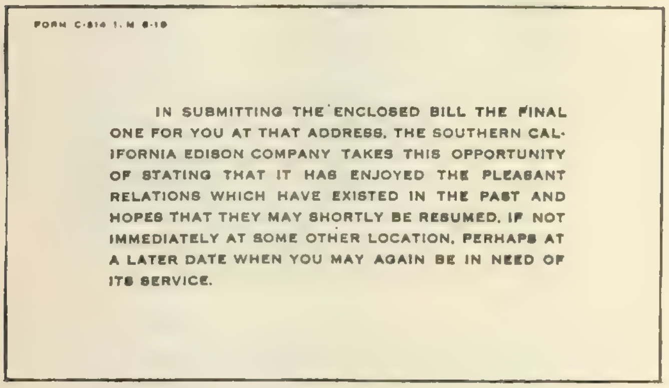
THE forms shown are two of those used by the Southern California Edison Company for inclosing with copies of bills sent to consumers. They illustrate the courteous manner in which the Southern California Edison Company deals with all of its customers. The sentiment expressed is not merely superficial but is backed up by the attitude of the employees of the company who come in contact with the public.



We acknowledge with thanks the favor of your remittance which has been credited to your account.

Southern California Edison Company

DIGNIFIED ACKNOWLEDGMENT OF PAYMENT



FORM C-814 1.M 8-19

IN SUBMITTING THE ENCLOSED BILL THE FINAL ONE FOR YOU AT THAT ADDRESS, THE SOUTHERN CALIFORNIA EDISON COMPANY TAKES THIS OPPORTUNITY OF STATING THAT IT HAS ENJOYED THE PLEASANT RELATIONS WHICH HAVE EXISTED IN THE PAST AND HOPES THAT THEY MAY SHORTLY BE RESUMED, IF NOT IMMEDIATELY AT SOME OTHER LOCATION, PERHAPS AT A LATER DATE WHEN YOU MAY AGAIN BE IN NEED OF ITS SERVICE.

THIS MESSAGE GOES OUT WITH THE FINAL BILL

Domestic Refrigerator Earns Most Per Kilowatt Demand

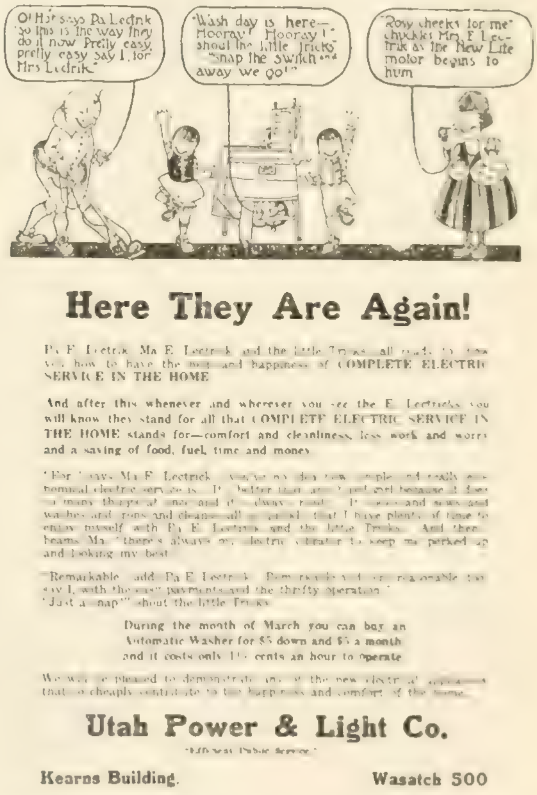
"CENTRAL stations generally consider the most desirable power customer to be the one paying the largest bill per kilowatt demand, and if household electric appliances were compared on the same basis, their relative desirability could be more intelligently determined," said Robert Montgomery, commercial manager of the Louisville (Ky.) Gas & Electric Company, in a paper read before the Commercial Section of the Indiana Electric Light Association at Fort Wayne, Ind. "However, the time of day and season of the year that the appliance is used should also be considered. A central station must as a rule spend more than $100 for increasing the capacity of the meter, service wires and transformers before service can be furnished to a range; but a domestic refrigerating machine, which yields almost ten times the revenue per kilowatt of demand, requires no investment of this nature on the part of the company."

ANNUAL REVENUE PER KILOWATT OF DEMAND FOR VARIOUS ELECTRIC APPLIANCES

Appliance	Maximum Demand, in Watts	Annual Kw.-Hr. Consumption	Equivalent Hours Use of Demand	Rate Per Kw.-Hr.	Annual Revenue	Annual Revenue per Kw. of Demand
Refrigerator	300	864	2,880	$0.0325	$28.08	$93.60
Fan	40	31	775	.084	2.60	65.00
Radiator	600	96	160	.084	8.06	13.43
Cleaner	170	25	147	.084	2.10	12.35
Percolator	400	42	105	.084	4.03	10.07
Iron	575	67	116	.084	5.62	9.79
Range	5,000	1,500	300	.0325	48.75	9.[illegible]
Toaster	500	37.5	75	.084	3.15	6.30
Grill	500	34	68	.084	2.85	5.70
Washer	300	20	66	.084	1.68	5.60

In the appended tabulation, showing the average annual revenue per kilowatt of demand for various electric appliances, 8.4 cents is assumed to be the average lighting rate throughout the United States and 3.25 cents the average cooking rate. The refrigerating machine, owing to its high load factor, is assumed to earn the same rate as the electric range.

Advertising a Washing-Machine Campaign


Oh! Ho! says Pa Lectrik "So this is the way they do it now. Pretty easy, pretty easy" say I, for Mrs Lectrik"
"Wash day is here— Hooray! Hooray!" shout the Little Tricks. "Snap the switch and away we go!"
"Rosy cheeks for me" chuckles Mrs. E Lectrik as the New Lite motor begins to hum

Here They Are Again!

Pa E. Lectrik, Ma E. Lectrick and the little Tricks are all ready to show you how to have the [illegible] and happiness of COMPLETE ELECTRIC SERVICE IN THE HOME.

And after this whenever and wherever you see the E. Lectricks you will know they stand for all that COMPLETE ELECTRIC SERVICE IN THE HOME stands for—comfort and cleanliness, less work and worry and a saving of food, fuel, time and money.

"For," says Ma E. Lectrick, "you've no idea how simple and really economical electric service is. It's better than [illegible] because it does so many things at once and it's always ready. It [illegible] and sews and washes and irons and cleans all so quickly that I have plenty of time to enjoy myself with Pa E. Lectrick and the little Tricks. And then," beams Ma, "there's always my electric vibrator to keep me perked up and looking my best."

"Remarkable," adds Pa E. Lectrick. "Remarkable and very reasonable too, say I, with the easy payments and the thrifty operation."
"Just a snap!" shout the little Tricks.

During the month of March you can buy an Automatic Washer for $5 down and $5 a month and it costs only 1½ cents an hour to operate.

We will be pleased to demonstrate any of the new electrical appliances that so cheaply contribute to the happiness and comfort of the home.

Utah Power & Light Co.

"Efficient Public Service"

Kearns Building. Wasatch 500

THIS is a type of advertising used by the Utah Power & Light Company, Salt Lake City, Utah, during a recent washing-machine campaign. As a result of this campaign more washing machines were sold in one month than had been sold in two months of the year previous. The company now boasts one washing machine for every five resident customers on its lines. The campaign is being continued and it is the expectation of the company that this record will be exceeded during the coming season.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

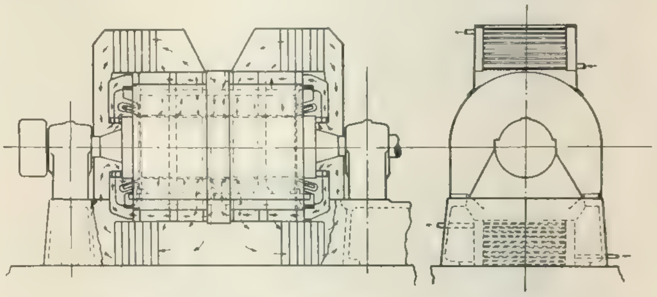
Generation, Transmission and Distribution

Hydraulic Shocks in Power-Station Conduits.—The problem of calculating the pressure rises caused by hydraulic surges, or water hammer, in the conduits of hydro-electric power stations has of late received much attention among French scientists and engineers. When the inlet to a water turbine, fed through a long tubular conduit, is suddenly closed, a pressure wave arises, which travels along the conduit and undergoes reflection at discontinuities and at the point where the conduit terminates in the upper reservoir. By superposition of pressure waves overpressures sometimes occur which may endanger the turbines and the walls of the conduit. An important paper by Camichel, Eydoux and Cariel (*Revue Générale d'Electricité*, Feb. 15, 1919) deals with the theoretical aspects of this problem, and contains also a report on some interesting experimental researches on pressure shocks in actual conduits. In a series of notes to the French Academy Count de Sparre gives a detailed mathematical analysis of a number of special cases which may occur in practice. (These notes are reproduced from the *Comptes Rendus*, 1917-18, in *La Houille Blanche*, January to August, 1919, and have recently been collected in more complete form in the *Bulletin Spéciale No. 2 de la Société Hydrotechnique de France.*) For construction reasons conduits are often built in two or more parts of different diameters and wall thicknesses. De Sparre's theory indicates that in a two-part conduit the maximum pressure rise may be 40 per cent higher, and in a three-part conduit as much as 65 per cent higher, than in a similar homogeneous conduit. In a recent article (*Revue Générale d'Electricité*, Nov. 29, 1919) de Sparre finally investigates the case of a conduit of a great number of parts, corresponding to the case where diameter and thickness vary linearly along the tube. E. Carey (*Revue Générale d'Electricité*, Oct. 25 and Dec. 6, 1919) takes up similar problems in connection with discontinuous conduits and offers a great number of curves from which the overpressure may be determined for different cases. If the conduits contain airpockets, oscillations *en masse* may arise, which, through resonance, sometimes give rise to dangerous overpressures of another sort. The latter have been studied by Camichel (*Houille Blanche*, September-October, 1919) and also by Foch (*Comptes Rendus*, Sept. 19, 1919).

Installations, Systems and Appliances

The Evolution of the Electric Brass Furnace.—H. M. St. John.—The evolution is considered from the standpoint of the survival of the fittest. The furnaces are classified as (1) induction or direct-resistance furnaces, in which heat is generated by the direct resistance of the metal itself; (2) indirect-resistance furnaces, in which heat is generated in a resistor and transferred by radiation or conduction to the metal to be heated, and (3) arc furnaces, in which heat is transferred to the metal directly or indirectly by conduction or radiation. The various types of brass-melting furnaces are discussed under these three heads.—Paper presented at meeting of American Electro-Chemical Society, Boston, April 8, 1920.

Investigation of Water-Air Radiators for Cooling Generators and Motors.—H. G. Reist and E. H. Freiburghouse.—It is pointed out that in the case of electrically driven ships the usual method of washing the ventilating air for turbo-generator units cannot be applied on account of the space limitations on shipboard. The plan of circulating salt water through a radiator much on the order of the automobile radiator and cooling the hot ventilating air by this means has been investigated by the authors. Considerable data and curves are given to show the advantages of this method where space is limited.—*General Electric Review*, February, 1920.



VENTILATION OF A TURBO-ALTERNATOR BY COOLING AIR THROUGH A WATER RADIATOR

The Working of Mercury Rectifiers.—E. Carlevaro.—Opinions do not agree as to the dependence of the efficiency of mercury rectifiers upon the form of the curve, some experimenters concluding that the two quantities are independent while others conclude the opposite. The author has therefore made a methodical and long series of experiments in order to throw light upon the working of the apparatus. The different forms of alternating curves were obtained from two alternators mounted on the same shaft, the frequency of one being three times that of the other. The windings were connected in series, and the phase of the third harmonic was varied by shifting the stator of the triple-frequency alternator. The changing of the excitation of the latter alternator produced the change of amplitude of the third harmonic. The efficiency of the mercury rectifier fed by sinusoidal current was found to be practically constant for loads varying from one-third to full load; for very small loads it is higher; for loads larger than the normal one it diminishes. The mean voltage drop in the arc was found to be 13 volts. The efficiency varies according to a linear law with the potential difference. Consequently the efficiency of mercury rectifiers increases when the primary potential difference increases. The frequency, within the ordinary practical limits, has no influence upon the efficiency. The form of the alternating-current curve was, found to have only a slight influence upon the efficiency; in particular, with a rectangular curve the efficiency is slightly greater. Stroboscopic observations of the arc showed that its lighting and extinction take place extremely rapidly, and that the arc lasts a little more than half a period.—*Science Abstracts, Section B,* Aug. 30, 1919. (Abstracted from *Elettrotecnica,* June 25. 1919.)

The Specification of Alternating-Current Switchgear. —A. E. VAN DAVIES.—Specifications for the electrical equipment of a generating plant with the present capacity of 5,000 kw., but which is expected to reach a capacity of 25,000 kw. in the next ten years, are given for the alternating-current switchgear. The writer gives reasons for the specifications as drawn up.—*Transactions of the South African Institute of Electrical Engineers,* December, 1919.

A Study of the Deterioration of Nickel Spark-Plug Electrodes in Service.—HENRY S. RAWDON and A. I. KRYNITZKY.—Some unusual as well as some more common types of deterioration which occur in nickel spark-plug electrodes are described. An intercrystalline brittleness is produced in service in the surface metal exposed to the hot gases and to the action of the spark. Sometimes definite "knife-cut" breaks occur in the wire. The brittleness is due to the action of hot reducing gases and to local heating of small areas. The greatly reduced strength of nickel wire when hot permits breaks to occur in electrodes by the relatively slight tensional stresses set up in service. This is particularly true of electrodes which are firmly anchored at both ends.—*Technologic Paper No. 143, United States Bureau of Standards,* Jan. 22, 1920.

Electrophysics and Magnetism

Solid Versus Stranded Wire for High Frequency Coils.—W. ROGOWSKI.—At ordinary frequencies stranded wire will give less resistance than solid wire of the same copper area. At a certain frequency, however, the stranded wire will give just as high resistance as corresponding solid wire, and at still higher frequencies the solid wire will have the lower resistance. For example, a coil of high-frequency cable made of forty-eight strands of No. 38 copper wire will at about 400 m. wave length have the same resistance as a similar coil of corresponding-size solid wire. Such a stranding should therefore not be used for shorter wave length than 400 m. This follows from a formula presented by the author in an earlier paper. Considering instead a constant frequency and constant number of strands, the author shows that a sharply defined minimum of resistance occurs at a given diameter of strands. At 1,000 m. wave length for instance and eighty-one strands, No. 36 or No. 37 wire will give minimum resistance, a heavier or finer strand giving higher resistance. At this minimum point the skin effect resistance ratio is just 1.5, corresponding to a 50 per cent increase over direct-current resistance.—*Archiv für Elektrotechnik,* Nov. 10, 1919.

Constants of Radiation of a Uniformly Heated Inclosure.—W. W. COBLENTZ.—A recalculation is given of data previously published (Scientific Papers Nos. 261 and 262). The new value of the coefficient of total radiation is $\delta = 5{,}722 \times 10^{-12}$ watt cm.$^{-2}$ deg.$^{-4}$, which is in agreement with the value previously published. Experimental data are given on the absorption of dry and humid air. The effect of atmospheric absorption is discussed and it is concluded that, if corrections are made for absorption by water vapor, the value of δ obtained recently at Naples is close to the average value, $\delta = 5.7$.—*Scientific Paper No. 357, United States Bureau of Standards,* Jan. 16, 1920.

Telegraphy, Telephony and Signals

Portable Radio Apparatus Used by the German Army. —A. SALOMON.—In a profusely illustrated article a great number of different types of portable radio outfits are described such as were used in the German army during the war. Although the paper is too rich in detail to permit abstracting, there are certain outstanding features of design which should be noted. The transmitters were mostly of the multi-gap, quenched-spark type, fed either from an audio-frequency generator, with resonance transformer, or from storage batteries, by means of a spark coil with a special type of oscillating interrupter. This device appears in a good many German transmitter designs for radio and ground telegraphy, and consists of a polarized bipolar interrupter so arranged that the moving contact, in oscillating between two fixed contacts, not only breaks but actually reverses the primary current of the spark coil, thus enabling a utilization of the steepest parts of the hysteresis curves of the core. Most of the receiving sets employ ordinary detectors, but in recent types vacuum tubes are used for detection and amplification. Common to almost all German tube-sets is the iron filament resistance, consisting of a small coil of fine iron wire inclosed in a vacuum tube. The resistance of such a unit is rather low up to a certain strength of current, when it rapidly attains very high values. An iron-wire tube therefore will hold the filament current constant within certain limits, even though the battery voltage may change over a relatively wide range. It will also prevent accidental filament burnouts, since it constitutes an extremely effective fuse.— *Revue Générale d'Electricité,* Dec. 13, 1919.

Miscellaneous

Energy Storage and Utilization of Idle Electric Power for Heating Purposes.—W. DAHLGREN.—Usually consumption of electric power is paid for according to some such formula as $A + B +$ kw. $+ C +$ kw.-hr. The first two terms are determined only by maximum demand, which is usually reached during at most two or three thousand hours a year. It is therefore clear that any consumption of electric power below the maximum paid for during the remainder of the 8,760 hours of the year will be paid for at a very low rate. This is particularly, and justly, the case when the energy is supplied from hydraulic stations. The author develops a method of storing the surplus energy by heating during idle hours the water in a big hot-water tank. The accumulated energy then may be utilized to heat the buildings during daytime. It is shown that if the constant C is 0.01 kr. (¼ cent) per kilowatt-hour, this electric heating system will be more economical than steam heating with coke if the price of coke is more than 52.4 kr. (about $12) per ton, and even where conditions seem rather adverse to electric heating the results secured from the heat-storage system show surprisingly good figures.—*Teknisk Tidskrift Elektroteknik,* Feb. 4, 1919.

Scientific and Industrial Research

(Printed in the Third Issue of Each Month)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by Prof. Vladimir Karapetoff
Cornell University, Ithaca, N. Y.

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

MACHINERY, ELECTRICAL, VENTILATION OF.

While the output of electrical machinery has been increased considerably during the past decade by the use of more efficient ventilation, considerable further improvement is possible in this direction. Very little is known regarding the fundamental laws governing the design of various types of blowers, especially of those types which are adapted for machines operated in either direction of rotation. Systematic studies along this line would be of great benefit to the art.—***R. E. Hellmund, Pittsburgh, Pa.***

MAGNETOS, CIRCUIT BREAKERS FOR.

Oscillographic tests indicate that there is a certain amount of mechanical chance in the best constructed and adjusted circuit breakers used in ignition magnetos. Considerable research and real invention are needed to improve them.—***F. W. Springer, University of Minnesota, Minneapolis, Minn.***

MOTORS, DIRECT-CURRENT, SERIES WOUND, CONNECTED IN PARALLEL.

In some industries, especially in steel mills, two series motors are sometimes used—mechanically interconnected and electrically connected in parallel. When a common starting resistance is used for the two motors, large circulating currents are sometimes observed, due to a slight difference in the saturation curves of the machines. A practical remedy is desired for this difficulty.—***Editorial Suggestion.***

SWITCHES, EXTRA-HIGH TENSION.

In a paper on "Problems of 220-Kv. Power Transmission," presented before the last A. I. E. E. convention (***Proceedings***, 1919, p. 802), A. E. Silver recommends that all line switching, both automatic and manual, should be done on the high-tension side of the transformers. He believes that with enormous currents involved on the low-tension side high-tension switching will be both simpler and safer. Experiments are desired that will lead to the development of 220-kv. disconnecting switches and circuit breakers, in anticipation of a project involving such voltages.—***Editorial Suggestion.***

TELEPHONE, AUTOMATIC, RATCHET ACTIONS.

Automatic ratchet actions might be further studied, their structure, power required, safeguards for accuracy and prevention of wear, together with the relative merits of magnetic drive and spring drive. The driving of the moving part is accomplished either by the forward stroke of the magnet or by the return stroke.—***A. B. Smith, Chicago, Ill.***

TELEPHONE TRANSMITTER, DIAPHRAGM ACTION.

There is no complete theory available of the microphone diaphragm that would take into account the mode of its fastening, the damping springs and the variable pressure of the carbon capsule. Such a theory substantiated by accurate experiments would tend to place the transmitter design upon a more rational and quantitative basis such as has been attained in some other branches of electrical engineering. — ***Editorial Suggestion.***

RELAY, FOR AUTOMATIC SUBSTATION.

In connection with our automatic railway substation we need an accurate timing device for dropping the substation off the line when there is no further demand for it. The present relay, which is an oil-dashed box, is unsatisfactory on account of the variable time element due to temperature. We have in mind to develop an induction-type relay, because I do not believe that either of the present forms of relays—that is, the one driven by a little direct-current motor, or the oil-dashed box—will be satisfactory. I am certain that control must be from the alternating-current side, as the small direct-current motor will be subjected to too many electrical disturbances, like lightning.—***J. M. Drabelle, Iowa Railway & Light Company, Cedar Rapids, Iowa.***

TELEPHONE NETWORKS OF MAXIMUM OUTPUT.

Four resistances may be so connected by ideal transformers that each resistance will have the maximum possible output into the remaining three resistances. It has been found that in such circuits the resistances must be conjugate in pairs; that the minimum number of elements required for the general case is six windings, three on each of two transformers; that the number of distinct networks is 57,340, all of which are equally unrestricted; that the number of special cases in which restrictions as to the distribution of the input, the magnitudes of the resistances and the directions of current flow are permitted is 577,722. The properties of these circuits have been investigated, together with those of related circuits having either a larger or a smaller number of elements. The application of these networks to telephone substations and repeater circuits has been specially considered.—*George A. Campbell, American Telephone & Telegraph Company, New York City.*

WELDING, METALLIC ARC.

In this kind of electric welding a metal electrode is used of approximately similar material to that being welded. Extensive tests have been made at different places in this country and in England regarding the best conditions for producing a first-class uniform weld under the actual working conditions in a shipyard. The following factors were investigated in particular: (1) The type of electrode, *i.e.*, bare metal or covered; (2) chemical composition of the electrode; (3) chemical composition of the metal being welded; (4) size of electrode; (5) kind of current, *i.e.*, alternating or direct; (6) amperage and voltage; (7) skill of the operator; (8) method of preparing and building up the joint. Much of the work had to be carried on under the trying war conditions, and a great deal of important fundamental research remains to be done.—***Welding Committee of Emergency Fleet Corporation.***

AERIALS, COIL-TYPE, USE OF.

Coil aerials are coming to replace the large antennas in radio work. The advantages of the coil aërial as a direction finder, interference preventer, reducer of strays and submarine aërial make it important to know how effective such an aërial is as a transmitting and receiving device in comparison with the ordinary antenna. A mathematical theory has been developed and experiments have been performed which have verified the conclusions reached so that the formulas obtained are a valuable aid in the design of an aërial to fit any kind of radio station. It is found that the coil aërial is particularly desirable for communication on short wave lengths. A coil aërial is as powerful as an antenna only when its dimensions approach those of the antenna. For other reasons, however, a small coil aërial is in many cases as effective as a large antenna.—***J. H. Dellinger, Bureau of Standards, Washington, D. C.***

GLASSES, COLORED, ULTRA-VIOLET, AND VISIBLE TRANSMISSION OF.

During the last three years the spectral transmissions of a great number and variety of glasses have been measured throughout the ultra-violet, visible and infra-red parts of the spectrum. Such data have been collected for a large number of American and imported samples of glass, so that it is possible to compare their relative merits.—***K. S. Gibson, E. P. T. Tyndall, H. J. McNichols, Bureau of Standards, Washington, D. C.***

INDUCTION, ELECTROMAGNETIC, AND RELATIVE MOTION.

In the *Physical Review* for **August 1918, S. J. Barnett** describes an experiment which at first sight appears to show that the uniform rectilinear motion of a magnet is not accompanied by an electric field such as would be given by the "moving-line theory." The experiment consists in an attempt to charge a condenser by causing an electromagnet to swing past it. The condenser and the remainder of the insulated system were, however, shielded by a brass case to protect them from electrostatic effects. An investigation has been made by the present writer to show that the electric field which the moving-line theory would predict as operative under the conditions prevailing in Barnett's experiment is of a type derivable from a potential of origin external to the brass case. Thus, under the influence of this potential, the case assumes a charge distribution whose field at all internal points just annuls that due to the moving lines. In other words, the case wards off the effect.—***W. F. G. Swann, University of Minnesota, Minneapolis.***

INSULATING MATERIALS, THERMAL EXPANSION OF.

Experimental data have been obtained on a few materials possessing irregular or unusual expansive properties. In most cases the expansions are too irregular to justify the use of the general quadratic equations. A knowledge of the thermal behavior of these materials is essential before assembling them in certain types of apparatus subjected to wide temperature variations. The most striking peculiarities are: (a) The wide range in the values of the co-efficient of porcelain (from 1.6 to 19.6 millionths per unit length per degree Centigrade); (b) the three varities of expansions for porcelain, namely, straight line, concave and convex expansion curves; (c) the shrinkage and the loss in weight of the phenol and similar compounds when subjected to excessive heat treatment; (d) the permanent growth and variations of different marbles when subjected to heat treatment; (e) the negative co-efficient of expansion of marble at low temperatures.—***W. H. Souder and P. Hidnert, Bureau of Standards, Washington, D. C.***

SPARK PLUG ELECTRODES, DETERIORATION OF.

The electrodes of spark plugs are usually made of commercial nickel wire, 97 per cent grade being a common material. After considerable service the electrodes show crystalization and cracks of various types. The following factors have been found to have a tendency to make the electrodes brittle: Continuous heating for several days at a high temperature (approximately 850 deg. C.), heating in reducing gases similar to those encountered in service, and intense local heating by means of the electric spark. The central electrode is found to deteriorate much less than the side ones. The latter, when anchored at both ends across the shell of the plug, are subject to tensional stress due to the differential expansion of the shell, and hence the cracks develop quite readily. Evidently this deterioration of nickel wire is a characteristic behavior of this material at high temperatures.—***H. S. Rawdon and A. J. Krynitzky, Bureau of Standards, Washington, D. C.***

PAINT, WHITE LEAD, SPECIFICATION STANDARDIZATION OF.

A specification has been prepared of the chemical and physical requirements for dry basic carbonate white lead and basic carbonate white lead ground to a paste in linseed oil. Methods of sampling and of testing both dry pigment and paste are included. This specification is recommended by the United States interdepartmental committee on paint specification and has the approval of the Paint Manufacturers' Association.—***Bureau of Standards, Washington, D. C.***

INSTRUMENTS, MEASURING, ACCURACY SPECIFICATION FOR.

There should be an American specification for instrument accuracy like the one by the British engineering standards committee.—*H. B. Brooks, Bureau of Standards, Washington.*

Books of Technical and Industrial Interest

OIL ENGINES. By L. H. Morrison. New York: McGraw-Hill Book Company. 459 pages, 21 tables, 357 illustrations.

Owing to the extensive application of oil engines to various purposes and the necessity of intelligent operation of these engines if the fast-decreasing oil supply of this country is to be conserved, any work that gives more than the mere construction details of oil engines is welcome at this time. In addition to the details of construction of the more important types of oil engines on the market, this volume explains how to make adjustments so that the most satisfactory operation will be obtained. The author's relation with the government should afford him an impartial viewpoint. After giving a brief historical outline of the development of oil engines he considers various modifications of Diesel, semi-Diesel and low-compression oil engines, first giving the details of installing an oil machine. Then the features of the different parts of each machine are described, means of avoiding trouble are outlined, methods of adjusting parts are explained and procedures in making some major repairs are suggested. Methods of determining the performance of engines are explained, comparative operating costs are given, and data on air pressures, cooling-water temperatures, amount of lubrication and characteristics of fuel oils are presented. Particular attention is given to valves and auxiliary equipment such as fuel pumps, air compressors, cooling and lubricating systems. The chapters on fuel consumption and operating costs are particularly interesting.

CONTROLLERS FOR ELECTRIC MOTORS. By H. D. James. New York: D. Van Nostrand Company. 351 pages, 259 illustrations.

This volume consists of a series of articles originally published in the *Electric Journal* to which have been added some new text and illustrations. It is particularly adapted to give a general idea of industrial controllers and to explain their principles of operation. The first half of the book deals chiefly with elementary phases of the subject, such as fundamentals, historical development, operation of three general types of controller (face-plate, drum, magnetic), methods of securing automatic acceleration, starting characteristics of motors, methods of speed control, principles of direct-current and alternating-current magnetic controllers, application of resistors, nature of different protecting devices and series-parallel control. Instead of considering specific makes of apparatus the author refers to fundamental principles. This is one feature of this book particularly to be commended. The last half of the book is devoted to practical applications of control apparatus, mine hoists, pumps, machine tools, machines requiring low initial speed, steel-mill auxiliaries, cranes, car dumpers, ore and coal bridges, elevators, oil-well operations, mine locomotives, etc. While some specific data would add to this section of the volume, it serves a very useful purpose in giving a good general knowledge of what types of apparatus are available and suitable for different purposes and what their relative advantages and disadvantages are. Every one who is interested in industrial applications of control will benefit by reading this book by one of the foremost authorities on electrical control.

ELEMENTS OF ELECTROMAGNETIC THEORY OF LIGHT. By Ludwik Silberstein, New York: Longmans, Green & Company. 48 pages.

This little volume is more than merely a neat exposition of the electromagnetic theory of light based on vectorial notation; it is a brief review of the essentials and difficulties of optical theory as developed in the last three-quarters of a century. The earlier treatments of the subject were based on hypotheses regarding the dynamics of the ether, and their intricacies reflect the uncertainties of our knowledge. Maxwell's theory, later amplified by others, evades rather than explains these almost insoluble problems by referring the solution to the electric and magnetic forces which act through matter in ways which are at least definite and analyzable, irrespective of molecular dynamics. We are now perhaps approaching a stage of investigation in which the two may be tied together by clearing up the dynamical relations of the dielectric constant, which seems to be the point of contact between the old theories and the new. Until that is done the electromagnetic theory must hold the field as such, a beautiful example of the proximate solution of a transcendently difficult problem by a brilliant attack along the line of least resistance. Professor Silberstein's book is not one for the tyro, but will be found stimulating and helpful to those who need an efficient introduction to optical theories in their broadest aspect and are willing to follow up the advantage thus gained.

Books Received

ANALYSIS OF BABBITT. By James Brakes. Troy, N. Y.: Allen Book & Printing Company. 170 pages.

MECHANICAL WORLD YEAR BOOK, 1920. Manchester, England: Emmott & Company, Ltd. 665 pages, illustrated.

ELECTRIC LIGHTING. By Olin Jerome Ferguson. New York: McGraw-Hill Book Company, Inc. 244 pages, 104 illustrations.

SCHOOL OF PRACTICAL ELECTRICITY. By O. Werwath. Milwaukee, Wis.: Electroforce Publishing Company. 60 pages, 110 illustrations.

GOVERNORS AND THE GOVERNING OF PRIME MOVERS. By W. Trinks. New York: D. Van Nostrand Company. 236 pages, 139 illustrations.

PRINCIPLES AND PRACTICE OF ELLCTRICAL TESTING. By R. G. Allen. New York: Longmans, Green & Company. 364 pages, 286 illustrations.

IONS, ELECTRONS AND IONIZING RADIATIONS. By James Arnold Crowther. New York: Longmans, Green & Company, 276 pages, 95 illustrations.

ARMATURE WINDING AND MOTOR REPAIR. By Daniel H. Braymer. New York: McGraw-Hill Book Company, Inc. 500 pages, 300 illustrations.

THE PRINCIPLES OF ELECTRICAL ENGINEERING AND THEIR APPLICATION. By Gisbert Kapp. New York: Longmans, Green & Company. 388 pages, 175 illustrations.

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

NEW building construction, which has started at a good rate in nearly all sections of the country, will suffer seriously if the present railroad tie-up continues for another week. Improvement in traffic conditions, however, is reported from Chicago and other points in the Middle West.

JOBBERS as a whole in the affected regions are going to be hard put to it in a short time to fill any sizable orders on the general run of wiring supplies, except wire. Stocks are low as a consequence of the condition of transportation during the winter and the inability of manufacturers to fill orders, and the halt in rail and water transit has made matters extremely serious. Both manufacturers and jobbers are moving material, raw and finished, by motor truck, and some little relief is afforded in this way. Manufacturers are short of raw materials, coal and coke, and many steel mills are being forced to close.

FEW PRICE changes have come through this week, but more rigid-conduit mills are reported on card 45 and at least one manufacturer of flexible armored conductor has increased his price $5 per 1,000 ft.

A PROMINENT New England manufacturer has cut out the production of some lines to concentrate on a few, expecting thereby to render better service at a lower cost.

DURING February an improvement was shown in the value of electrical exports. The total amount was $6,583,228, or almost $250,000 above the figures for January. The total for 1920 is averaging only $10,000,000 below the record year of 1919.

WORK on the Tugaloo hydro-electric development of the Georgia Railway & Power Company, which has been suspended for eighteen months because of post-war developments, is being resumed.

OWING to the difficulty of financing development, the Consolidated Light, Heat & Power Company of Huntington, W. Va., has entered into a contract with the Virginian Power Company of Charleston, W. Va., for a ten years' supply of commercial power.

A WIRELESS dispatch to the ELECTRICAL WORLD from Brussels, Belgium, records progress made by the advisory committees of the International Electrotechnical Commission. A special committee is to begin at once a comprehensive vocabulary of essential electrical terms. The American delegates' plan for fixing temperature limits was indorsed.

FIFTY papers were presented at the annual convention of the American Electrochemical Society, held jointly at Boston with the A. I. E. E. and the Electric Furnace Association. The development of electric furnace applications was the chief topic of discussion. W. S. Landis was elected president of the American Electrochemical Society and Acheson Smith of the Electric Furnace Association.

NEW JERSEY has defeated and Massachusetts has adopted a daylight-saving bill.

IN COMPANY with all industry, the electrical companies have been affected by the "outlaw" railroad strike, but they are coming through the disturbance well. Central stations in the East for the most part have good coal reserves, but fuel scarcity is acute in Detroit, Toledo and Columbus. Raw material is running out in New England, and manufactured stocks everywhere are accumulating.

THE STRIKE of 326 employees of the Pacific Gas & Electric Company in California still continues. One hundred electrical workers are out in Salt Lake City, Utah.

ILLINOIS public utilities may be forced by the high cost of money to abandon a program of improvements which would involve a total expenditure of $100,000,000.

A REFERENDUM on the establishment of a federal Department of Public Works, to combine the engineering and construction activities of the government, has been ordered by the Chamber of Commerce of the United States.

ON MONDAY next the joint engineering societies of Chicago will be addressed by the presidents of the four large national engineering bodies at a dinner to be held in the interests of professional upbuilding.

CHICAGO voters defeated four proposed bond issues this week, including one of $15,000,000 for extending the electric street-lighting system. The public affairs committee of the Western Society of Engineers had recommended the defeat of the measures.

THE FIRST units for the new Calumet power station of the Commonwealth Edison Company, Chicago—two 30,000-kw. turbines—have been ordered. It is the expectation that the station will be ready for opening in the fall of 1921. Its capacity is to be greatly augmented later.

WITH only one exception the power companies of California have signed an agreement whereby the State Railroad Commission is to frame rules for the distribution of electrical energy. H. G. Butler has been appointed state power administrator by the commission.

COMPLETION of the state-wide plan of interconnection in California is expected by May 1, when ninety-two steam and hydro-electric plants will be tied into one system with a daily load of 10,000,000 kw.-hr.

ELECTRIC drive and the Diesel engine will be developed by the United States Shipping Board in the merchant marine as conducing to motive power of the best efficiency.

BALLOTING for officers of the A. I. E. E. is now proceeding. Results will be announced at the annual business meeting in May.

PRESENTATION of the Edison medal to W. L. R. Emmet of Schenectady, to whom it was awarded last December, will be made on May 21.

OFFICIAL reports show that 72.7 per cent of the developed water power of Canada is utilized by electric central stations.

EXISTING high prices for bituminous coal are, in the opinion of Herbert N. Stenton, secretary of the United States Bituminous Coal Commission, absolutely unwarranted by the condition of the industry.

THE "self-interest" plan used by the San Joaquin Light & Power Corporation of Fresno, Cal., to promote sales of stock to customers is being explained in detail to eastern electrical bodies by A. Emory Wishon.

WATER power saved more than 22,000,000 tons of coal in 1919, according to the returns received from about 2,800 power plants by the Geological Survey.

SEARCHLIGHT developments during the war were described at the meeting of the New York Section of the Illuminating Engineering Society.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

High Cost of Money Forces Illinois Utilities to Abandon Plans

PUBLIC utilities in Illinois, it was announced this week by James H. Wilkerson, a member of the Illinois Public Utilities Commission, will be forced this year to abandon plans for improvements involving expenditures amounting to more than $100,000,000 unless loans can be obtained at more reasonable interest rates. The Chicago Telephone Company, it is reported, has announced that it will not proceed with a request for authorization of a $10,000,000 loan at 7 per cent. It was explained that 9 per cent is asked and that this is considered prohibitive.

State-Wide Interconnection in California by May 1

A TOTAL of ninety-two steam and hydro-electric plants in California, virtually all of the power companies in the state, are to be connected for the first time in one system by May 1, according to a statement recently made by L. S. Ready, assistant chief engineer of the State Railroad Commission.

The daily load of this interconnected system, it is estimated, will be around 10,000,000 kw.-hr. The output of the interconnected plants in 1919 was 3,200,000,000 kw.-hr.

There is only a short job now waiting to be spanned. This is from Newman to the vicinity of Modesto, and when this link is built it will connect the San Joaquin Light & Power Corporation and the Pacific Gas & Electric Company.

Referendum to Business Men on Proposed Public Works Department

AS A result of a petition from Engineering Council, the Chamber of Commerce of the United States has ordered a referendum on the question of creating a national department of public works. This action followed the submission of a special report of a committee appointed by the chamber to study the whole question of public work. Of this committee Charles Nagle of St. Louis, formerly Secretary of Commerce and Labor, was chairman.

The proposal submitted by the Chamber of Commerce to the commercial organizations of the country is "that a Federal Department of Public Works should be created (1) in which can be assembled certain or all of the government agencies with primary functions in the construction or operation of works of an engineering or construction character; (2) which, if found desirable, can take over engineering and construction work now being performed by services with primary functions other than the performance of such work, and (3) which, if found desirable, may act as a contracting agency for the performance of engineering or construction work when called upon by an agency of the government not included in the Department of Public Works."

Approval of the principle underlying the creation of a Federal Department of Public Works consolidating the now widly scattered federal engineering and construction activities has been given by the Merchants' Association of New York. The special committee of which J. G. White, president of J. G. White & Company, Inc., was chairman, while recommending the association's approval, stated that it was of the opinion that an actual plan for consolidation of the engineering and Construction activities of the government should be drafted only after a committee of Congress has made a very careful study of the functions of the bureaus which it is proposed to transfer and assured itself that such a transfer is desirable and will result in increased administrative efficiency.

Electrical Industry Weathering "Outlaw" Strike Excellently

INDUSTRY generally has been upset by the "rump" railroad strike which has swept over the country in the past two weeks, and in a measure the electrical industry has shared in the attending troubles. Where utilities have depended on rail for coal shipments shortages have appeared. In some cases power supply was sharply curtailed to insure a continuance of the lighting supply.

Manufacturers, for the most part, have been plentifully supplied with raw materials. Stocks of finished apparatus, however, are piling up rapidly at the factories, and unless some out-going transportation can be secured shutdowns will occur for want of space to store finished material.

Jobbers' stocks, already in so many instances at vanishing point, naturally are getting poorer and poorer, and even should the strike end this week no large measure of relief can reasonably be expected.

Central stations in the eastern states were for the most part well prepared with coal reserves to meet the conditions brought about by the strike. Embargoes upon all freight excepting necessary foodstuffs have stopped coal shipments. However, the coal reserves of the power companies have thus far been sufficient to enable them to continue operation at full capacity, and they do not expect to find it necessary to restrict the amount of power used by customers. Companies in and about New York City are purchasers of tidewater coal, the supply of which is dependent on rail shipments. On April 15 these companies had on hand coal reserves sufficient for their full requirements for a period of from ten days to two weeks. Should the condition continue beyond this time it will be necessary for these companies to establish a priority list of power users and apportion the amount of power available for each.

At the office of the Public Service Company of New Jersey it was stated that the load on its system had increased materially on account of the use of the trolleys by commuters whose customary trains had been annulled because of the strike.

Manufacturing plants which use central-station energy have shown no falling off in the amount of power required. Among the central-station managers, however, it is the consensus of opinion that should the strike continue for an extended period the inability of manufacturing plants to replenish their supplies of raw materials or ship their finished products away from factories would necessitate shortening the hours of operation and automatically lessen their power requirements.

The Westinghouse Electric & Manufacturing Company has plenty of raw materials for some weeks to come, it was stated in New York on Thursday. Finished material is piling up at East Pittsburgh, but it will be several weeks before warehouse space will be filled up to capacity. The company is working on its heavy bookings.

At the offices of the General Electric Company it was stated that certain raw material stocks are already low and will give out in spots in ten days to two weeks. In general, however, it was stated, the factory can run along for several weeks. Good storage space is still available.

The Westinghouse Lamp Company is shipping from Milwaukee to Chicago by boat and by motor truck from Newark, N. J., to Philadelphia. There are no factory stocks to speak of, and raw materials, except perhaps packing materials, are in good shape.

The Independent Lamp & Wire Company had only sufficient stocks to last a few more days.

Continued operation of New England industry will be seriously threatened by the railroad strike unless it is ended within a fortnight. Many electrical manufacturing plants have but two or three weeks' supply of raw material, and interruption of particular lines of production is liable at any time. Inability to ship products is causing great embarrassment. Connecticut jobbers are hard hit by freight embargoes. Boston jobbers are getting sockets from Connecticut, but steel shipments are throttled and the inflow of washing machines made outside New England has ceased. Sockets are being shipped in carload lots from Connecticut to Chicago stock. Schedule material factories are suffering from the holdup of porcelain shipments from New Jersey. These factories can probably run a month on restricted production. Lamp shipments into Boston are restricted. Brass mills are working full time, but labor trouble threatens the Waterbury district this week. The Lynn Works of the General Electric Company are choked with unshipped motors and other products, but radical curtailment is unlikely, at least for three weeks. Industrial plants in Rhode Island and central Massachusetts can run two to three weeks more, according to the best estimates. The Holtzer-Cabot plant in Boston is inconvenienced by the embargo on outgoing shipments, and the same is true with the Sturtevant plant. Motor truck service has begun from New York to Boston jobbing interests. Central stations are not yet curtailing the output. The Boston Edison company has about one month's coal supply. The Worcester Electric Light Company has had forty-five cars of coal commandeered by railroads during the week and has but two weeks' supply. The situation therefore causes anxiety. Hartford has three to four weeks' supply of coal, Providence four weeks, Springfield two weeks, but the Hydro-Electric supply of 12,000 kw. at Springfield through the Turners Falls interconnection and 20,000 kw. from the Stevenson plant are a great help at Springfield and Waterbury respectively. The Boston elevated railway has ten days' coal supply and ten more on water route. Maine and New Hampshire utilities are functioning well on water power.

Country dealers and buyers of electrical supplies and apparatus in the Middle West have been hit the hardest by the railroad strike. Jobbers and dealers in their vicinity have been somewhat inconvenienced, but so far the electrical manufacturers have not suffered so much from lack of raw material as their customers have from their inability to get the finished products. The combination of the railroad strike and the effective tie-up of express by the express company employees has put a premium on every means of transportation. The rush to the parcel post has so clogged the mails that even first-class mail is being seriously delayed in consequence. Jobbers and manufacturers are delivering around their cities in trucks which would be used for greater distances were it not for the fact that the great demand for trucks has made it impossible to get the necessary equipment.

The Detroit Edison Company shut off power on Monday to all except "essential" industries. It was also reported that Detroit went back to war-time lightless nights. The Mayor of Toledo, Ohio, on Monday ordered the confiscation of coal on the Pennsylvania Railroad tracks and its diversion to the Toledo Railways & Light Company. The Columbus (Ohio) Railway Power & Light Company reported on Tuesday only enough coal to last until this Saturday.

State Power Administrator Now Controls California Output

WITH only one exception the power companies of California, about ninety in all, have signed an agreement whereby the State Railroad Commission is to frame rules for the distribution of electrical energy. Among other things the commission will regulate rates for interchange of energy. H. G. Butler has been appointed state power administrator by the commission to direct all electric power distribution in California.

Mr. Butler, at a meeting of the power companies before the commission, said that as compared with the 1919 demand, the power shortage amounts to 114,000,000 kw.-hr., or 10 per cent. It represents 14 to 18 per cent of the demands this year. This was true of companies in the northern and central parts of the State. San Diego and vicinity would have their normal output of power, owing partly to steam generation, partly to power which could be obtained from other concerns. Los Angeles had an agreement with the Southern California Edison Company whereby the latter agreed to give the city any surplus power it might have, for the privilege of being permitted to distribute as it saw fit any surplus generated by the city.

The estimated demand is from 5 to 9 per cent greater than for the corresponding months of last year. Steam plants, Mr. Butler said, must generate 77,000,000 kw.-hr. per month this year.

The best previous record for the same plants was 64,000,000 kw.-hr. made in August last year.

Actual work being done on California power plants to be finished by the spring of 1921 will add 198,000 kw. generating capacity.

Edison Medal Presentation to W. L. R. Emmet in May

ANNOUNCEMENT of the election of officers of the American Institute of Electrical Engineers will be made at the annual business meeting to be held at the Engineering Societies Building, New York, May 21. Balloting is now going on by mail. At the same time the board of directors will present its report covering the activities of the year.

At this meeting the presentation of the Edison medal to W. L. R. Emmet of Schenectady will take place. The medal was awarded to Mr. Emmet last December.

Presidents of the Four Big Engineering Bodies Will Speak at Chicago

THE presidents of the four great national engineering societies—civil, electrical, mechanical and mining—are announced to address the joint engineering societies of Chicago at a dinner in the La Salle Hotel to be held on Monday evening next, April 19. This meeting has been arranged by the Chicago engineers with the avowed idea of "establishing jointly with the national bodies simple and comprehensive relations for the upbuilding of the profession and for the good of the country." In addition to the speakers mentioned Dr. Lynn H. Hough, president of Northwestern University, Chicago, will deliver an address entitled "Efficient Democracy." A. Stewart Baldwin, past-president of the Western Society of Engineers, will preside.

New York Defeats Proposition for State to Develop Water Power

THE New York State Senate's action on Tuesday in defeating the hydro-electric bill is taken in some quarters as indicating the feeling of the public with respect to government on municipal ownership.

The bill, among other things, provided for the development of water powers by the State of New York and for their later sale to municipalities. The provisions, generally speaking, were similar to those of the laws governing the Hydro-Electric Commission of Ontario, Canada.

Chicago Voters Defeat $15,000,000 Lighting Bond Issue

A BOND issue for $15,000,000 to extend the electric street-lighting system of Chicago was one of four proposed bond issues which the voters of that city refused to approve at the election this week. The public affairs committee of the Western Society of Engineers had recommended their rejection. In making this recommendation to the public the engineers pointed out that the Chicago municipal bond situation was such that it would be impossible to dispose of the proposed issues, totaling $34,500,000, until the retirement of some of the outstanding bonds. There was also said to be no urgent necessity for the work upon which the money was to be spent.

Shipping Board to Develop Electric Drive

BECAUSE of their demonstrated efficiency, electric drive and the Diesel engine will be developed by the Shipping Board, Admiral William S. Benson, chairman of the board, announced at the ninth annual dinner of the National Marine League in New York on Tuesday night.

In order to meet foreign merchant marine competition, Admiral Benson declared, we must make our own motive power the most efficient. He pointed out that electric drive had been demonstrated in the navy to be more economical than the old turbine engine. It was also stated that under no circumstances should American shipowners be persuaded to give up oil for fuel.

"I propose," the Admiral stated almost in conclusion, "to see that the electric drive and the Diesel engine are developed by the Shipping Board."

A Proposed Canadian Institute of Research

A CONSIDERABLE amount of committee work has been done lately in some industrial centers in Canada in favor of a national research institute. A parliamentary committee is strongly in favor of such an institute, and the response from various societies has been quite encouraging. In a forceful circular the committee for national research says:

"As a result of Canada's participation in the great war we are in a serious financial condition. Before the expenses of the war are ended we shall have a national debt of two billions of dollars, the interest alone on which will be $100,000,000. We shall have to meet an annual bill of $30,000,000 to $40,000,000 for pensions. Altogether the annual budget of Canada for many years to come will reach a total of about $450,000,000 which is more than double what it was in the years before the war.

"To carry this burden—a tremendous one for a nation of 9,000,000 people—there will first have to be practiced everywhere and by everybody the greatest thrift and conservation possible, for we are to-day one of the most wasteful of nations; second, there will have to be greater development of all our natural, industrial, commercial, agricultural and, above all, human resources, so that we shall be able to cope successfully with the fierce competition for a share of the world's markets of all kinds that we are sure to meet from all other commercial nations.

"In order to secure this development and be able to meet other nations on anything like an equal footing, it will be absolutely necessary for us to devise new ways and means, through the work of men specially qualified to do research work in all the lines mentioned above. We must never forget that it is largely on the amount of research work done that our strongest competitors are depending for success.

"There is now before the Parliament of Canada the question of establishing a national research institute, which will no doubt develop greatly in a very few years, if only a start can be made now. It is very desirable that all organizations that have the welfare of the country at heart should support this measure in every way possible."

Water Power in 1919 Saved More Than 22,000,000 Tons of Coal

An average daily production of energy of 124,300,000 kw.-hr., of which 33 per cent was produced by water power, is the figure for January as compiled by the Geological Survey from returns received from about 2,800 power plants of 100-kw. capacity or more engaged in public service, including central stations, electric railways and certain others. The capacity of the reporting plants is about 90 per cent of the total.

The Geological Survey's output figures for 1919 were 40,300,000,000 kw.-hr., of which 36.6 per cent was by water power and 63.4 per cent by fuel.

The fuel consumption for 1919 was as follows, the Survey states: 35,000,000 short tons of coal, 11,050,000 barrels of oil and 21,700,000,000 cu.ft. of gas. Converting the oil and gas to coal, an average of 3 lb. of coal was required per kilowatt-hour. On this basis the water powers permitted the saving of 22,140,000 tons of coal in 1919.

It was estimated by the Survey that electric public utility plants consumed about 7.6 per cent of the 1919 production of bituminous coal.

Self-Interest Plan of California Being Told in the East

During the past ten days A. Emory Wishon, president of the Pacific Coast Section, N. E. L. A., and assistant general manager of the San Joaquin Light & Power Corporation, Fresno, Cal., has been in the East telling his "self-interest" story. Mr. Wishon has a program which includes talks in New York before the Rotary Club, bankers and manufacturers both in and without the electrical industry, in Pittsburgh, Schenectady, Victor, N. Y.; Pittsfield, Mass., and St. Louis, where arrangements have been made for him to address the St. Louis Electrical Board of Trade and also the St. Louis Chamber of Commerce.

The California electric light and power industry, Mr. Wishon states, is growing so rapidly and the demand is so insistent that $500,000,000 new capital will be needed and spent in the next decade.

To finance this growing demand in a measure the San Joaquin company is selling 7 per cent preferred stock to customers. Instead of selling the stock solely on its financial strength, the "self-interest" appeal is used.

About 25 per cent of the capital required is in this preferred stock and is being marketed in the San Joaquin Valley. The remaining 75 per cent is in the form of bonds and marketed through the usual financial channels. In the first month $500,000 of this preferred stock was sold locally on this basis.

These customers, almost all of whom need additional power, are shown that power cannot be forthcoming until additional capital is in hand. Thus the customers, Mr. Wishon points out, are back of the company.

In addition, the "self-interest" idea reaches out to all of those who are interested in supplying equipment for this development. Mr. Wishon has had charts prepared showing what proportion of every dollar spent in new work is for, each kind of equipment and material and for the labor charge thereon. He is thus able to show what the total expenditure of $500,000,000 means in dollars and cents to each of a number of separate interests. Mr. Wishon is also interesting Eastern capital in the San Joaquin project in the same manner.

Secretary of Bituminous Coal Commission Attacks High Prices

Holding that the existing high prices of bituminous coal are inexcusable on any theory of supply and demand or on any other economic theory, Herbert N. Shenton, secretary of the United States Bituminous Coal Commission, which adjudicated the dispute between the soft-coal operators and miners, declared the other day that the advice of the commission to buy and store coal early, the requirements of the export trade, the status of car service, the daily output of the mines, the weather conditions and the supposed shortage of supply all alike fail to explain in any manner the rise in prices, which, he says, is out of all relation to the increase in the cost of production caused by the higher wages granted by the commission.

Mr. Shenton attributed the increase in price largely to the alarm caused by a widespread feeling that there is going to be a scarcity of coal for domestic consumption owing to the foreign demand, but he estimated that exports overseas in 1920 cannot exceed 10,000,000 tons, which is only 2 per cent of total production. There seems also, he says, to be a misapprehension in regard to production. The weekly reports of the Geological Survey, however, show that in the first quarter of the present year production was decidedly in excess of the production last year and slightly in excess of the production under high pressure in 1918. Nor is the fear of immediate suffering from car shortage based on facts. There will be no shortage save as a part of the general transportation difficulties of the present time.

"Frenzied bidding up of prices on the part of coal buyers seems, therefore," Mr. Shenton concludes, "at this time to be entirely unjustified. Efforts are being made to stabilize prices through regulations of the Interstate Commerce Commission and by special legislation. The educational campaign for early buying and storage will also tend to stabilize the market."

New York Illuminating Engineers Hear War History of Searchlights

Revolution in design of army field searchlights during the war was the outstanding feature of a paper read by Doraf W. Blakeslee, former first lieutenant 56th Engineers, in a meeting on April 8 of the New York Section of the Illuminating Engineering Society. Mr. Blakeslee described the experiences in the field which led to the change from the old horse-drawn outfit of 1916 to the light truck-mounted equipment of 1918. Among those discussing the paper were P. R. Bassett and A. F. Dickerson, Schenectady, the latter stating that within ten days after Major Lewis had returned from France with ideas on proper searchlight design derived from battle experience the lamps were being made.

In a historical sketch of street lighting P. S. Millar reviewed the means of illumination from the firebrand through the present electrical systems. In addition to Mr. Millar's slides illustrating the talk, other slides showing the development in New York City were shown by William T. Dempsey.

M. O. Layton, chairman of the Public Works Department Association, made a short plea for the support of engineers in the movement by his association to consolidate all bodies doing public work in order to increase efficiency of management and production.

Further Daylight-Saving Clarification in the East

Daylight saving in New Jersey was defeated on Monday by the State Senate. The measure had previously passed in the House.

Massachusetts has enacted a daylight-saving law, effective April 25. Rhode Island is in the throes of a conflict over the issue, and various Maine cities are proceeding along the line of "local option."

Denver & Rio Grande Electrification Plans Revived

WITH the return of the lines of the Denver & Rio Grande Railroad to private ownership the plans for the electrification of certain parts of the line are being revived. Tennessee Pass, the highest point on the system, and Soldier Summit are the two sections first to be electrified. On the western slope of the Tennessee Pass the grade has an average of 3 per cent up to an elevation of 10,239 ft. (3,070 m.), extending from Minturn to the summit, a distance of 22 miles (35 km.). On the eastern slope the average grade is 1.42 per cent. It is proposed to electrify the western approach and the first few miles of the eastern slope nearest the summit. On Soldier Summit, which is at an altitude of 7,454 ft. (2,236 m.), the grade has been reduced by reconstruction from 4 to 2 per cent with the same grade on the eastern slope. About 12 miles (19 km.) of electrification is proposed there. Plans for the construction of three electrified tunnels under the continental divide are being made. These plans are being made largely on account of the success of the recent electrification work by the Chicago, Milwaukee & St. Paul Railway.

International Electrotechnicians Indorse U. S. Temperature-Limit Scheme

(*Special to* ELECTRICAL WORLD)

EXCELLENT progress was made by the International Electrotechnical Commission's advisory committees on rating, nomenclature, symbols and standard pressures at their meetings which took place at Brussels, Belgium, on March 27 to 31, inclusive. A wireless dispatch to the ELECTRICAL WORLD from Brussels states that a revision of the commission's publication No. 27 was completed and will be issued at once. A large number of graphical symbols were agreed upon. The work of nomenclature, which had been suspended for the past six years, was again started. A special committee of eight nations, including the United States, was formed to draw up without delay a comprehensive vocabulary of essential electrical terms in French and English. It will hold meetings in Zurich in June. Standard pressures for lines and insulator tests were discussed and recommendations prepared.

On ratings a number of important points were agreed upon. The American delegates presented their logical scheme for fixing temperature limits, which was received with great interest and adopted unanimously.

The delegates were welcomed by Prof. Omer de Bast of the Institute Montefiore on behalf of the Belgian committee. He referred in feeling terms to the late Prof. Eric Gerard, who had presided at a similar meeting in 1910 in the same building.

There were about thirty-eight delegates from ten countries present, including a number who attended the first meeting of the commission in 1906. The American delegation included Dr. C. O. Mailloux, president of the commission, and A. H. Moore, H. M. Hobart, C. E. Skinner, L. W. Chubb and Dr. P. S. Agnew. On Saturday, the twenty-seventh, the delegates were entertained at lunch by the Belgian committee, and on Sunday the delegates were taken over the Flanders battlefields by Capt. Leon Gerard, who pointed out the most interesting features of these historic fields. Practically the whole of the devastated area, including Ypres and Dixmude, was visited.

Admirable arrangements were made by Secretary Uytborck. The working sessions were held from early morning until late at night. The delegates gave a luncheon to the Belgian committee and endeavored to express for themselves and their national committees appreciation of the cordial welcome offered by the Belgians and recognition of the great progress made in the face of enormous difficulties in the process of reconstructing their industries.

Electric Furnace Practice Is Topic at Boston Convention

ELECTRICAL progress in metallurgy was exhaustively discussed at Boston last week at the annual convention of the American Electrochemical Society, held jointly with the American Institute of Electrical Engineers and the Electric Furnace Association. About 350 members and guests attended. Chemical technique and electrical engineering practice were allied in joint session on the ninth, when twenty-three papers devoted to problems of mutual interest were discussed. In all fifty papers were presented at the meetings, which were held at the Copley-Plaza Hotel, Boston, and at the Massachusetts Institute of Technology and Harvard University in Cambridge. Trips through the Lynn Works of the General Electric Company, the laboratory of Arthur D. Little, Inc., at Cambridge, the plant of the Huff Electrostatic Separator Company at Arlington and other local establishments were much enjoyed, together with an informal dinner on Friday evening and a social program for ladies accompanying the delegates.

EXPANSION IN ELECTRIC FURNACE USE EXPECTED

The development of electric furnace application was the chief topic of engineering interest. At the sessions on Friday it was generally acknowledged that the electric furnace, when properly designed and handled, through its superior control characteristics has attained an impregnable position in modern industry, and it was brought out that enormous expansion in its use is to be expected. The training of furnace operators, however, is at present very inadequate, and in order also that electric furnace practice may realize the best results closer co-ordination with the central station is of great importance.

An entire session was devoted to thirteen papers on electrically produced alloys, emphasis being laid upon the manufacture of ferro-vanadium, nickel-chromium, ferro-manganese, high-speed steel and other products. B. D. Saklatwalla, general superintendent Vanadium Corporation of America, Bridgeville, Pa., in an exhaustive paper on "The Development of Ferro-Vanadium Metallurgy," predicted that the bulk of the future commercial output will be produced electrically with carbon as the reducing agent.

In the manufacture of ferro-alloys, according to C. B. Gibson, Westinghouse company, 7,500 kw. is now the limiting size of a 60-cycle furnace and about 16,000 kw. on 25 cycles. Automatic regulation is increasing on account of labor and time saving, the more efficient use of power and better control of process. This permits higher speeds of electrode travel, eliminates over-travel, avoids arcing at contacts and prevents feeding of electrodes into the molten bath. Transformers feeding furnaces of 3,750 kw. upward require braced windings to withstand surges and short-circuit currents. Ventilation also needs special attention. The possibility of the blast furnace again competing with the electric furnace in the treatment of ferro-silicon was mentioned.

Data on Energy Consumption

Data upon energy consumption were presented. R. M. Major, Driver-Harris Wire Company, Harrison, N. J., read a paper giving a range of 700 kw.-hr. to 750 kw.-hr. per ton of manufactured product for alloys of the nickel-chromium variety, the furnaces being of moderate size and operated intermittently. Only twenty-five heats are obtained from the roof. Other speakers quoted as low as 200 kw.-hr. to 400 kw.-hr. per ton in brass melting. Various authorities give figures expressed in kilowatt-days for certain ferro-alloys—for example ferro-silicon (10-95 per cent), 109 to 1,000 kw.-days; ferro-manganese (18-75 per cent), 67 to 167 kw.-days; ferro-tungsten, 286 to 400 kw.-days; silicon-manganese, 133 to 333 kw.-days, and ferro-chromium, 286 to 555 kw.-days. Furnace manufacturers maintain that in many cases energy consumption is of far less importance than product quality, but furnace users strongly urged keeping down both demand and energy input in view of their great influence upon central-station rates. The manufacture of cobalt-chromium alloys in the electric furnace was described in a paper by Elwood Haynes, Kokomo, Ind., who pointed out that from 2,000 to 3,000 melts are obtained by using a magnesite lining. R. C. McKenna, Latrobe, Pa., pointed out that the average power consumption of a 3-ton heat of high-speed steel melt is 1,000 kw.-hr., the average life of lining and roof in the Heroult type furnace used being eighty heats. The bottom of specially prepared dolomite lasts for about 500 heats. Various speakers agreed that by the use of the electric furnace a more uniform product in tool steel is procured than is possible by any other method. M. A. Hunter and J. W. Bacon, Rensselaer Polytechnic Institute, submitted a comprehensive paper upon the electrical properties of titanium alloys, which showed that the addition of titanium to iron improves the magnetic qualities of the latter.

Viewpoints on the Power Problem

Eleven papers bearing upon the power problems of the electric furnace were presented in a symposium representing furnace manufacturers, operators and central stations. The Electric Furnace Association held a conference during the conventions at which the vital importance of better training of furnace operators was discussed, and the opinion was generally expressed that manufacturers and users should co-operate toward this end. Such training is essential in cutting down peaks as well as in insuring higher grade production. In the symposium above mentioned the importance of continuous, reliable service on the part of the central station was emphasized, while the necessity of reducing peak loads was firmly set forth by the electric utility representatives.

H. L. Hess, Baltimore, Md., and W. G. Berlin, High Bridge, N. J., each presented a paper upon power problems from the furnace operator's viewpoint. Both authors criticised central-station rate schedules as unduly complex, but in the discussion there appeared to be general recognition of the fairness of a demand charge and an energy charge. The point was made that the protection of small central stations by public utility commissions has sometimes worked injustice to furnace users who might better be supplied from nearby utilities with greater power resources. Had this been possible, in a typical case the power cost per ton of metal could have been cut down 50 per cent. Parallel operation, it appeared, worked out better for the furnace operator than for the central station. Various speakers showed that much might be done in future to improve operating conditions by the joint efforts of furnace users and central-station representatives through conference regarding the hours of service, off-peak rates, selection of reactors, design of appropriate feeder systems, scheduling of runs for night periods and clear explanations of methods of billing for energy. E. A. Wilcox, Pittsburgh Electric Furnace Company, presented a comprehensive paper upon furnace power requirements from the central-station viewpoint, and A. C. Smith, Buffalo General Electric Company, read a trenchant paper in which the importance of cutting down surges was discussed specifically. Feeding by separate lines from substations carefully laid out with respect to industrial load development, as on the Detroit Edison system, was favored in the discussion.

Discussion of Furnace Operating Data

The need of more data upon the behavior and life of electrodes in the rocking type of furnace was emphasized. F. W. Brooke, Philadelphia, and E. L. Crosby, Detroit, defended the furnace manufacturers from charges of overenthusiasm in regard to operating data, in response to a general criticism of Lewis B. Lindemuth, New York City, who submitted a searching paper on the position of the electric furnace in iron and steel metallurgy. The last-named contributor declared that steel made in the electric furnace by the basic process is superior to that produced by the acid process in the electric furnace. A marked tendency toward the use of larger furnaces and toward forced heating is apparent. Divergent views were evident regarding the extent to which power factor is involved in furnace service. In general, power factors from 65 to 90 per cent were held to be satisfactory, varying with local conditions. Prof. J. W. Richards presented a paper describing the Söderberg self-baking continuous electrode, with data upon its successful use at Fiskaa, Norway. Other papers of electrical engineering interst were: "The Evolution of the Electric Brass Furnace," by H. M. St. John, Detroit Electric Furnace Company; "Step Induction Regulator for Electric Furnaces," by P. B. Short, Westinghouse company; "Fundamental Problems in Alloys Research," by H. E. Howe; "Nitrogen Fixation by the Silent Discharge Process," by Prof. C. F. Harding; "Magnetic and Electric Properties of Iron-Nickel Alloys" (see Electrical World, April 3, 1920, p. 774), by T. D. Yensen; "Reactors for Electric Furnace Circuits," by

H. A. Winne, General Electric Company; "Economics of the Power Situation," by C. A. Winder, General Electric Company; "Power for Electrochemical Purposes," by John L. Harper, Niagara Falls Power Company; "Water Powers of the Pacific Coast," by F. F. Fowler; "Location for New England Electrochemical Plant," by C. T. Maynard, Rumford Falls (Me.) Power Company, and "Power Development in Scandinavia," by J. W. Beckman.

ELECTION OF OFFICERS

Officers were elected as follows for the American Electrochemical Association: President, W. S. Landis, New York; vice-presidents, John A. Mathews of Syracuse, N. Y., L. E. Saunders of Worcester, Mass., and A. T. Hinckley of Niagara Falls, N. Y. Managers elected were C. G. Fink of New York, Acheson Smith of Niagara Falls, N. Y., and H. B. Coho of New York. P. G. Salmon, Philadelphia, was elected treasurer, and Dr. J. W. Richards of Bethlehem, Pa., secretary.

For the Electric Furnace Association these officers were elected: President, Acheson Smith; vice-presidents, H. L. Hess of Baltimore, Md. and C. H. Booth of Chicago; secretary, C. G. Schluederberg of Pittsburgh; treasurer, F. J. Ryan of Philadelphia; directors, H. G. Weidenthal of Cleveland and F. J. Tone of Niagara Falls, N. Y.

Extracts from various papers presented at the above conventions will be presented topically in later issues.

Easier to Contract for Power Than to Finance Development

BECAUSE of a situation in relation to earnings that would make it difficult to finance necessary extensions, the Consolidated Light, Heat & Power Company of Huntington, W. Va., has entered into a contract with the Virginia Power Company of Charleston, W. Va., whereby commercial power sufficient for existing and prospective industries in Huntington is assured for a period of ten years. This contract, as explained by General Manager W. R. Power of the Consolidated company, provides for delivery of power to the city limits of Huntington by the Virginian Power Company, which will run high-tension wires from its plant at Cabin Creek to some point immediately east or south of Huntington. A minimum of 3,000 kw. and a maximum of 5,000 kw. is called for, but the contract further provides for the extension of the maximum to 15,000 kw. when the need shall arise. The contract is to become effective Dec. 1.

To fulfill this contract the Virginian Power Company must expend approximately $350,000 and the Consolidated Light, Heat & Power Company in the neighborhood of $100,000.

Work on Tugaloo Hydro-Electric Development Resumed

AFTER eighteen months' suspension caused by conditions following the war, work on the Tugaloo hydroelectric development of the Georgia Railway & Power Company, which was begun two years ago, is being resumed. This development is on the Tugaloo River, Georgia, immediately below the junction of the Tallulah and Chattooga Rivers. A power house, 60 ft. x 190 ft. (18 m. x 57 m.) in size, with an installed capacity of about 75,000 hp. in waterwheels, will be built below a masonry dam 150 ft. (45 m.) in height. Four waterwheels rated at 18,750 hp. each will be directly connected to 6,600-volt, three-phase, 60-cycle, 12,500-kw. vertical-type alternators. Two banks of 25,000-kw. transformers, each consisting of three single-phase units, will raise the voltage to 110,000 for transmission over a new line about 3 miles (4.8 km.) in length to the double-circuit 110,000-volt steel-tower line extending from the existing plant at Tallulah Falls to Atlanta, the company's central point of distribution.

The S. Morgan Smith Company of York, Pa., holds the contract for the waterwheels and the General Electric Company that for the generators. The construction work will be done by the Georgia company's own organization. Charles G. Adsit is chief engineer.

Accrued Depreciation Not Allowed Where Rates Were Inadequate

ACCORDING to a decision of the New York Public Service Commission, Second District, in proceedings brought by the Elmira Water, Light & Railroad Company for increased rates, a public utility which in the past has failed to maintain a sufficient depreciation charge to cover renewals and replacements, but has not received an excessive return on the value of its property, should not be compelled to deduct from its rate base an amount equal to the accumulated theoretical accrued depreciation. Extracts from this decision, which was rendered on Jan. 22, have just been printed in pamphlet form by the United Gas & Electric Engineering Corporation of New York, which owns and operates the Elmira property.

If the returns that should have gone into the depreciation reserve have been disbursed in increased dividends, the commission holds that the company should be required to keep the plant up to full efficiency by proper renewals and replacements which will have to be paid for out of moneys which otherwise might go to stockholders. On the other hand, the commission in its decision declares:

"If the company has not made a fair return and the consumers have not been charged in current rates, from year to year, any appreciable amount to meet such accruing depreciation, the present public should not require such a company to make good at once the full amount of such theoretical accrued depreciation by deducting the whole of the theoretical accrued depreciation from the rate base. The public has had the benefit of rates which were lower by the amount of the allowable depreciation ratio which was not included. The public has not paid nor the company received the 'annual depreciation ratio.' The company has not availed itself of the opportunity to build up a reserve. That was a gain to the consumers and was of course reflected in rates.

"The amount of the loss to the company will some day be fixed when renewals and replacements must be made. When that day comes the company will have to meet the loss. However, in the meantime, if the company delivers and the public receives full service, it seems hardly fair to use the ratios of annual depreciation which were meant to estimate the annual sum to be set aside and apply them as a definite measure of actual present loss in value to that amount and deduct the same from the rate base."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Feeding the C., M. & St. P.—Since August of last year the Washington Water Power Company has furnished 8,000,000 kw.-hr. and the Puget Sound Traction, Light & Power Company has furnished 150,000 kw.-hr. to the Chicago, Milwaukee & St. Paul Railway for its mountain lines.

British Wireless Research Board.—The Department of Scientific and Industrial Research of the British government has established a wireless research board, the object of which is to co-ordinate and develop the research into wireless telegraphy and telephony now being undertaken officially. Admiral Sir Henry B. Jackson is chairman of the board.

Japan's High Poles.—What are said to be the highest concrete poles in the world (660 ft.) are being erected at Tomioka-cho, in Fukushima Prefecture, Japan, for the new wireless stations which will be opened early in April especially for communication between Japan and the United States. The capacity each way is about 8,000 words a day.

Music by Wireless.—A demonstration of an invention by Thomas Brass, a sergeant in the United States army, by means of which music can be sent over the wireless telephone, was recently given before the Atlanta (Ga.) Radio Club and is reported to have been entirely successful. A very sensitive diaphragm for a two-step amplifier receiving set was used. Individual head sets were worn by the auditors, but the inventor expects to enable music to be heard clearly without the use of these.

Baltimore Company's Success in Selling Stock to Customers and Employees.—More than 2,000 customers of the Baltimore Gas, Electric Light & Power Company have thus far completed instalment payments under the company's stock purchase plan and have received stock certificates representing a par value exceeding $1,125,000. More than 1,200 employees—40 per cent of the total—are now participating in the company's savings and investment plans. One hundred and ninety-five employees own 6,065 full-paid shares.

Klamath Falls Dam Controversy Near End.—It is authoritatively asserted that the California-Oregon Power Company is ready to relinquish its contract with the United States government for the building of the Link River dam, which includes provisions for the storage and distribution of power and irrigation water supply in the Upper Klamath Lake, on assurance that the government will build the dam at once. The agreement provides a solution for a controversy that has stirred up much factional dispute and resulted in retarding irrigation development.

One Telephone to Ten Persons.—From the Bureau of the Census, Washington, D. C., the report on telephones which forms part of the census of electrical industries for 1917 can now be had. According to this report, there were in that year 11,716,520 telephones in the United States, exclusive of certain railway, government and private lines. The estimated number of messages or talks was nearly 22,000,000,000, the miles of wire reached 28,827,188, the employees numbered 262,629, and the value of plant and equipment was almost $1,500,000,000. Seventy per cent approximately of the telephone business was done by the Bell system.

Using the Airship to Boom the Electric Range.—In a campaign to interest the housewives of Rome, Ga., in electric appliances for home use the Western Electric Company's Atlanta office sent an electric range by aeroplane to the Walker Electric & Plumbing Company of Rome, covering the 70 miles in one hour and twenty-five minutes at a cost for transportation of $100. The shipment was accompanied by a message extolling electric service written by Mrs. Newton C. Ring of the Atlanta Woman's Club and addressed to the Woman's Club of Rome.

Water Power Development in Oregon.—A permit has been filed with the State Engineer of Oregon to appropriate 100 second-feet from the middle fork of the Malheur River to develop 26,000 kw. This power will be used to pump water for the irrigation of Harney Valley and for municipal purposes in the town of Vale. The project will cost $350,000 and work will start on it before the end of the year.

Giving Publicity to Copper Conditions.—A systematic research into the sources, forms and uses of copper is to be carried out by leading producers and manufacturers of that metal for the enlightenment of the public. An organization with a cash fund of $50,000 has been formed for this purpose, and Ivy Lee of New York will have charge of the publicity work. It is the intention to carry on the investigation in Europe and Asia as well as America, and special inquiry will be made into the extent to which Germany denuded herself of the metal during the war.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Electric Power Club.—The annual convention of the Electric Power Club will be held May 5 to 8, inclusive, at Signal Mountain, Tenn.

Arkansas Utilities Association.—The convention of the Arkansas Utilities Association will be held at the Arlington Hotel, Hot Springs, Ark., on April 26, 27 and 28.

Society of Automotive Engineers.—A meeting of this society to be held in Witherspoon Hall, Philadelphia, on Thursday, April 22, will be addressed by C. F. Kettering.

A. S. M. E., Philadelphia Section.—"Modern Practice in the Manufacture of Steel" will be discussed by Colonel W. P. Barba before this section of the American Society of Mechanical Engineers on Tuesday, April 27.

Tri-State Water and Light Association.—Reports from various sections of North Carolina, South Carolina and Georgia point to a record-breaking convention of this association at the Piedmont Hotel, Atlanta, on May 19 to May 21.

I. E. S., Chicago Section.—This section of the Illuminating Engineering Society will meet at the rooms of the Western Society of Engineers on Wednesday, April 21, to hear M. Luckiesh of the National Lamp Works research laboratory, Cleveland, speak upon "Lighting and the Householder."

Association of Iron and Steel Electrical Engineers.—The next meeting of the Cleveland Section of this association will be held on Saturday, April 24. On May 22 members of the section will join with the Pittsburgh Section in its inspection trip to the works of the Trumbull Steel Company, Warren, Ohio. A similar trip of inspection was made by the Philadelphia Section, A. I. and S. E. E., on Saturday, April 10, when the Lukens steel plant at Coatesville, Pa., was visited.

Electric Club of Louisville.—Since the Electric Club of Louisville, Ky., was organized last November to take the place of the former Louisville Jovian League the entertainment committee has been very successful in introducing new features to maintain interest in the regular meetings on the first and third Mondays of each month. The regular meeting of April 5 was in charge of A. R. Magee, superintendent of foreign advertising for the Louisville *Courier-Journal and Times.* In honor of the event a special four-page miniature edition of that paper was published and christened the *Louisville Electric Club Extra.*

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Working Capital Allowable.—A cash allowance for working capital of an electric utility equivalent to two months' average operating expenses plus stores and supplies on hand was approved by the Public Service Commission of Missouri in a rate-making proceeding, sums due from but retained by an interested company and amounts to cover unbilled energy being eliminated from consideration.

Extension of Service to Rural Lines Without Certificate.—Under a general order of the Illinois Public Utilities Commission covering the construction, ownership and maintenance of electric distribution circuits in rural districts, an electric company is not required to obtain a certificate of convenience and necessity for the extension of service to rural lines owned and maintained by a mutual association for operation without profit.

Intercorporate Relations as Affecting Public Benefit.—The Public Service Commission of Missouri has held that the purchase, subsequent to the filing of a complaint, by a distributing company, defendant in rate proceedings, of the property and assets of its supplying company—thus removing cross-charges for hydro-electric energy—renders ineffectual an allegation that the distributing company serves as a pretext for the diversion of the saving and benefit of hydro-electric energy from the public.

Service and Minimum Charges.—In sustaining increased power rates put into effect by the Pine Grove Electric Light, Heat & Power Company, the Pennsylvania Public Service Commission insists, however, on the elimination of coal and war clauses from the tariff and on the cancellation of a ready-to-serve charge of 50 cents on motors of 1 hp. and less and of 15 per cent of the gross monthly bill on all motors over 1 hp. The commission holds that a charge for service is already substantially included in the minimum charge of $1 a month.

Exploitation of Franchise and Duplication of Service Alike Against Public Interest.—The Glen Mills Electric Company having applied for permission to do business in territory covered by the franchise of the Thornbury Township Electric Company, it was shown that the latter had allowed four years to elapse without making any substantial effort to furnish service until the rival company sought to enter its field. The Public Service Commission of Pennsylvania held that in normal circumstances such inactivity could not be tolerated, certificates not being granted "in order that legal rights may be acquired by corporate interests and then held for the purpose of exploitation or development at a later period." However, in view of war conditions another opportunity was given to the Thornbury Township company and the plea of the Glen Mills company was denied on the ground that "competition in public service, with its attendant evils of duplication of plant investment, the burden of which ultimately falls upon the ratepayers, is of course to be avoided."

Protection from Competition.—The Libbe Power Company, a small concern at Washington, Mo., generates electricity for use in the factory of its proprietor and in addition supplies it to two customers, one of them on the other side of the street. In view of this fact the Union Electric Light & Power Company of St. Louis made complaint to the Public Service Commission of that state to the effect that the company complained against was engaging in the business of generating and selling electricity without having obtained a certificate of convenience and necessity. The commission found that, under a ruling of the Supreme Court of Missouri, such a plant as that of the defendant is not devoted to public use and is not an electrical corporation within the meaning of the law.

"Dumping" Power Is Condemned.—Summer Customers.—An electric company which has developed its plant greatly beyond the needs of its own territory and beyond any reasonably anticipated growth cannot, the Maine Public Utilities Commission declared in adjudicating complaints against the Bar Harbor & Union River Power Company, regard this surplus energy as "dump power" to be disposed of at a low price to a large customer which it controls, so as to cast the burden of carrying such surplus investment upon its regular customers. In the cases under notice the commission applied a principle recognized by it previously and involving the seasonal rate to summer customers of a public uility: That if the summer business creates an increased demand, then the principle of readiness to serve applies, which is that the summer customers must pay their proportional part of the overhead and all-the-year-round charge and expense occasioned by the increased capital invested, depreciation, maintenance, insurance and those charges which go on regardless of the extent of consumption. The commission found, however, that there is lawful justification for a difference in the rates which the company might charge its "seasonal customers" and those it might charge its "year-round" customers and ordered it to amend its schedules and in such amendments so to classify its customers as to show clearly to each customer the class within which it is claimed he comes and the rate at which service is offered.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Power of Judge to Direct Verdict in Case of Contributory Negligence.—In a case where an employee of a mining company was killed by grasping, without looking to see what he was doing, a live blade instead of a switch handle, and where $5,500 in damages was awarded by the trial jury to the father of the victim, the Supreme Court of Arizona has overruled the verdict and ordered the suit dismissed, on the ground that where the facts are undisputed and a clear case of contributory negligence is established it is the duty of the judge to direct the jury to find accordingly. (187 P. 563.)

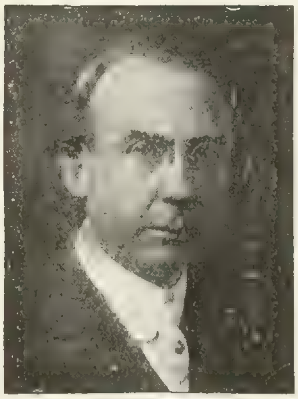
Contributory Negligence Not Shown in Case Where Electrical Supply Company's Neglect Injured Workman.—An electrician employed in a private residence to repair secondary wires carrying 110 volts was severely injured through the contact of these wires with bare primary wires improperly installed and carrying 2,300 volts. The electric supply company, in appealing to the Supreme Court of North Dakota against a verdict for $15,000 damages, alleged contributory negligence inasmuch as the workman only took the precaution of standing on a dry board when he might have cut off the circuit. The court found that had it not been for the negligence of the company the workman's precaution would have been ample. (176 N.W. 352.)

Discrimination Cannot Be Allowed.—Finding that the Southern Power Company, having a monopoly of hydro-electric power supply and the markets therefor in the territory through which its lines extend, was seeking to charge the Salisbury & Spencer Railway Company 1.8 cents per kilowatt-hour for energy while charging, under similar conditions, only 1.1 cents to other corporations, with which in some cases the supply company had close relations, the Supreme Court of North Carolina sustained the lower court in overruling a demurrer filed against a writ of mandamus to compel the Southern Power Company to cease such discrimination. The Supreme Court denied the right of the defendant company to select its customers or to fix its rates according to the peculiar circumstances of each case without regard to the authority of the Corporation Commission. It also held that if a purchaser of energy from such a company as the defendant retailed the power itself at an excessive profit, this fact would not justify discrimination against the purchasing by the selling company. (101 S. E. 593.)

Men of the Industry

Changes in Personnel and Position—Biographical Notes

S. M. Kennedy, formerly general agent of the Southern California Edison Company, Los Angeles, Cal., has been elected vice-president and general agent and will have charge of business development and public relations. Mr. Kennedy became identified with public utility work in the West in 1901, when he accepted the position of assistant to the president of the United Electric Gas & Power Company of Los Angeles. When that company was absorbed by the Southern California Edison Company in 1903 he was made general agent and has since held that position and been largely responsible for the commercial end of the company's business. Mr. Kennedy has always been an active worker in the National Electric Light Association and the Pacific Coast Sections of the N. E. L. A. and A. I. E. E. He is the sole member of the present committee of the N. E. L. A. on public relations and will make a comprehensive report at the national convention at Pasadena in May.



S. M. KENNEDY

A. M. Evans of Chicago, who has been with the local traction companies for the last fourteen years, has resigned his position as assistant to the chief engineer of the Chicago Surface Lines to accept a post under Col. Peter Junkersfeld in the organization of the Geyser Electric Company of Chicago. During the war Mr. Evans served in the construction division of the army in various capacities. He was made executive assistant to officers in charge of the building staff and later gained the rank of major and received a citation from the Secretary of War.

Ake Alin, assistant engineer of the Royal Swedish Waterfalls Board, who has been sent by the Swedish government to examine large dams in the United States, is in San Francisco. Mr. Alin is to examine the Hetch-Hetchy works and other large construction projects on the Pacific Coast. The Swedish government is contemplating the building of large power dams in northern Sweden.

Paul L. Bean, formerly chief engineer Maine Public Utilities Commission, has become associated with Walter L. Sawyer, consulting engineer, Lewiston, Me., specializing in water-power practice.

Lewis G. Webber, formerly assistant electrical engineer with Fay, Spofford & Thorndike, Boston, on the Boston army base installation and previously with Monks & Johnson on the development of electrical equipment at the Squantum (Mass.) destroyer plant, has joined the staff of Roy R. Burnham, consulting engineer, Boston, as principal assistant.

H. W. Young, president of the Delta-Star Electric Company, Chicago, is receiving the sympathy of his friends on the death of his wife, Dorothy S. Young, on March 30. Mrs. Young was not only widely known among members of the industry as a hostess but had also accompanied her husband for years on his extended business trips and added to a charming personality a business ability that had been of no small assistance to him.

Robert M. Searle, vice-president of the Rochester (N. Y.) Railway & Light Company, has been elected president of that company to succeed James T. Hutchings, who has resigned to become assistant general manager of the United Gas Impovement Company of Philadelphia. Mr. Searle went to Rochester fourteen years ago from the organization of the Westchester Lighting Company. He entered the electrical field in 1884 as office boy with Thomas A. Edison. In the course of his promotions from that position to his present duties he has passed through the various branches of the central-station business and has served in a number of capacities involving duties of state and national scope.

R. M. SEARLE

Eugene A. Roberts, manager of the Public Utilities Company of Carlsbad, N. M., has recently been elected president of the New Mexico Electrical Association. This association at its annual meeting, as reported in the Electrical World for Feb. 21, page 451, voted to separate from the Pacific Section, N. E. L. A., and with similar associations of Colorado and Wyoming form the Rocky Mountain geographic section. Mr. Roberts is a graduate of the New Mexico Military Academy, class of 1912, and since that time has been employed by the Public Utilities Company.

E. A. ROBERTS

Herbert C. Stephens, who recently resigned as power engineer for the Northern Ohio Traction & Light Company of Akron, Ohio, has accepted the position of sales engineer for the Electric Motor & Repair Company of that city. Mr. Stephens was graduated from the University of Illinois in 1908.

Dr. Willis Rodney Whitney, director of the research laboratory of the General Electric Company at Schenectady, N. Y., to whom the Chandler medal has been awarded, will receive that recognition of scientific achievement on April 27 at Havemeyer Hall, Columbia University, New York City, when he will make an address on "The Littlest Things of Chemistry."

Samuel Ferguson, vice-president of the Hartford (Conn.) Electric Light Company, has been elected president of the Connecticut Power Company, which was recently acquired by the Hartford company. Mr. Ferguson's work in the field of interconnection is putting central-station service in Connecticut on an advanced plane of economic usefulness, through the co-operation of the Hartford company and other companies supplying energy to the central portion of the state.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler
and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities
and Business Methods

Insulation Materials Higher Under Longer Shipments

INSULATING materials are characterized by longer shipments, higher prices and in some cases withdrawn prices. Spot cotton in New York is 43 cents. Prices on cotton webbing, tape, tubing, varnished cambric and friction tape are higher by about 5 per cent since the last of March, and reports from insulation jobbers show they are likely to change overnight. The demand for cotton insulations is heavy, and shipments from the factory are about three months. Finishing mills are hard put to it to get yarns for electrical uses because of the heavy demands on this material from other sources, especially from the automobile trade. In this connection the shortage of long-fiber cotton for cord tires has just caused the curtailing of output of at least two tire mills and is requiring the use of other kinds of cotton in the electrical trade where the long fiber was formerly used. Higher prices at the semi-finishing cloth mills are the result of material shortage and the high labor turnover, which is rather too rapid for economical operation. Prices are so uncertain in the case of one manufacturer that there are no general quotations. Specific prices can be obtained only when there are determined the size of the order, amount of material needed and time of shipment. This is deemed necessary because of uncertainties in production in the semi-finished mills.

Varnished silk cloth and tape is reported 20 per cent higher than it was three weeks ago. Shipments are in general longer than for cotton goods because of a reported greater shortage of the semi-finished product. One producer of silk insulation is still shipping on orders of last June. Insulation varnishes, too, are higher by about 5 per cent.

Canada's Relation to the Electrical Industry

CANADA during the fiscal year 1919 imported electric apparatus to the value of $11,005,753, of which no less than $10,887,657 came from the United States. Imports of American goods of this kind have more than doubled during the last five years. In 1915 they were $5,137,383 and in 1919 they were $10,887,657. Imports of electric supplies from other countries during that year were: Great Britain, $88,778; France, $2,803; Spain, $19,629; Sweden, $6,480. In January of the present year Canada imported $953,361 worth of electric and gas fixtures, of which $930,773 came from the United States. Canada is also becoming quite an exporter of electrical apparatus. In 1915 these exports were valued at $97,870; in 1919 they were valued at $2,167,545.

Though the manufacturing of electrical apparatus is one of the newer of the Canadian industries, it is making satisfactory progress. The report of the Bureau of Statistics for 1918 shows that there were sixty-eight plants in operation throughout the Dominion, forty-two being in Ontario, thirteen in Quebec, seven in Manitoba, three in British Columbia, two in Alberta and one in Saskatchewan. The total capital investment for the Dominion was put at $43,285,405, divided as follows: Land, buildings and fixtures, $10,636,572; machinery and tools, $6,518,138; materials, stock in process, finished products, etc., $17,071,528; working capital, $9,059,173. The total investment is divided among the provinces as follows: Ontario, $26,426,129; Quebec, $16,525,454; Manitoba, $253,026; British Columbia, $42,881; Alberta, $19,736; Saskatchewan, $18,179. The number of employees is given as 8,862, while the salaries and wages paid during the year totaled $8,456,705.

The total selling value of all articles produced at the works in 1918 was $30,045,399, the value of the principal products being: Dynamos, generators and converters, $1,503,433; transformers $2,291,874; switchboards, panels, etc., $990,898; motors, $2,727,673; storage batteries, $213,624; primary batteries, $1,397,635; incandescent lamps, $1,525,198; insulated wires and cables, $5,154,984; other electrical machinery, $1,738,085; carbons, $1,362,666; other miscellaneous products, $8,492,643.

Low Stocks Expected to Melt Away in Transit Tie-Up

HAD this transportation tie-up come in normal times most jobbers undoubtedly would have had sufficient stocks of the essential wiring materials to last for some time. Manufacturers, too, would have been able to keep up production beyond the life of any probable tie-up. But, coming as it has on the heels of a transportation-crippling winter, with manufacturers unable to obtain sufficient raw material to meet the demands of the electrical market and jobbers unable to supply the orders on their books, it has found raw-material stocks and jobbers' stocks at an extremely low level.

There is some flexible armored conductor in the market, but in most cases it is in lots of a couple of thousand feet and is being held for emergencies. Several manufacturers in the East will undoubtedly have to close down production if steel-strip stocks are not replenished by the end of the present week. It is some time since they have had anything close to a stock of strip on hand. One producer says he has been running only intermittently for the last six months. The mills supplying the strip are also having trouble in obtaining their supply of raw material from which to make the strip. It is the policy in at least one quarter not to accept orders for flexible armored conductor under present production conditions as shipments are so uncertain as to be too unsatisfactory.

Rigid conduit production is nearly as bad. Some jobbers have a little of all sizes, maybe a few thousand feet, and some are out of ½ in., ¾ in. and 1 in. The mills have shipped carloads of the pipe, but it is held up in transit. For New York City jobbers in particular there are a number of cars of pipe on the Jersey meadows and in terminals. Where pipe and other materials are in the terminals the jobbers are getting some of it by trucks, where they can find transit across the river. The few ferries running permit of a light flow of materials into the city by way of private trucks. Material arriving at and departing from coast points by boat is, of course, held up.

There has been a great deal of trucking between manufacturers and jobbers in the New England, New York and Philadelphia districts, especially in the movement of schedule material, pipe, steel strip, lamps, wire, flexible armored conductor and boxes. In this way jobbers are keeping some semblance of stocks, but even this small amount will not last very long unless the strike breaks quickly. A canvass of several prominent Eastern jobbers brings to light some cases of virtually no stocks of the general run of wiring materials, with the exception of rubber-covered wire. Of course, at the same time sales can be made only within trucking distance of the source of supplies, so it is expected that the demand will fall off to some extent.

Improvement Shown in Electrical Exports for February

A SLIGHT improvement was made in electrical exports during the month of February, 1920, when the total value of these exports amounted to $6,583,228. This is $235,791 higher than the value of January's exports but nearly a million dollars less than the amount received for electrical goods in February of 1919.

The greatest improvement over January is shown in batteries, fan motors, metal-filament lamps, motors, rheostats and switches, while smaller gains were shown in heating devices, interior wiring supplies, carbon-filament lamps, meters and telephone instruments. Telegraph instruments fell off heavily.

These figures for total exports for the month compare well with those of the three previous months in showing clearly the rather lower level of exports during the period of depressed European exchange. With this in mind the present year is starting out at a rate only about ten million dollars behind the total of the previous year, which was the highest ever recorded.

Following are the figures for February, based on the returns of the Bureau of Foreign and Domestic Commerce:

	February		Two Months Ended February	
	1919	1920	1919	1920
Batteries	$420,437	$526,972	$766,248	$901,702
Carbons	161,117	76,586	350,468	216,226
Dynamos or generators	387,445	363,340	637,298	776,633
Fans	121,003	79,780	297,529	109,367
Heating and cooking apparatus	71,136	140,020	169,651	253,839
Insulated wire and cable	710,830	567,036	1,515,311	1,228,878
Interior wiring supplies	211,402	195,514	405,967	364,403
Arc lamps	2,702	172	2,908	262
Carbon-filament lamps	16,658	9,746	36,699	16,879
Metal-filament lamps	403,379	363,391	981,554	575,088
Magnetos, spark plugs, etc	256,280	251,876	535,454	513,418
Meters and measuring instruments	255,495	219,454	579,899	407,587
Motors	1,107,268	825,727	1,788,150	1,559,549
Rheostats and controllers	16,442	86,482	64,878	105,040
Switches and accessories	189,669	381,203	366,828	675,239
Telegraph apparatus	129,596	16,750	186,137	200,154
Telephones	333,180	253,457	547,352	483,643
Transformers	401,594	295,185	710,622	645,549
All others	2,370,456	1,930,537	4,345,660	3,897,209
Total	$7,566,089	$6,583,228	$14,288,613	$12,930,665

Concentrated Production Expected to Improve Service

THE Simplex Electric Heating Company, Cambridge, Mass., has recently inaugurated the policy, which will undoubtedly be watched with much interest by other manufacturers, of concentrating manufacturing effort upon a much less diversified line of products than has formerly been listed in the output of this house. The management felt that better service could be given to the trade by confining factory work to certain main lines of output which might be called staple goods, and that greater opportunities for profitable manufacture accompanied this policy than were possible under the old plan, which was characterized by great variety of designs, types, sizes and styles. During the past winter the total number of product variations has been reduced from 617 to 44.

The output of the factory is now grouped around the following so-called "leaders": Flatirons, ranges, heating pads, toasters, radiators and soldering irons, under which headings there are various types. The items dropped from future production include glue pots, pitch kettles, immersion coils, corset soldering irons and a long line of specialized heating apparatus which the company does not care to undertake to build under present conditions, unless in some particular case arrangements should be made for extremely large orders running up into totals that would pay the manufacturer for inaugurating virtually a new line for the time being.

The foregoing simplification of output has already put the company in an unusually good position to handle orders for spare parts, and maintenance work can be done much more quickly than formerly. The freight embargoes in New England resulting from severe winter weather have held back the arrival of much material, but with the opening of spring delivery conditions begin to show decided improvement. The reduction in the company's line, it is felt, will give better control of overhead costs, permit the maintenance of better factory stocks in extra parts, facilitate catching up on orders, reduce unit production expense in due course (barring unforeseen changes) and enable the company's business to be developed symmetrically and intensively for the joint benefit of its customers and itself. Factory space formerly assigned to diversified output is being co-ordinated for larger production within the stated range, and as conditions require and the market and resources of the company justify it new lines can be brought out to yield to the consumer the benefits of advances in the art of electric heating.

European Market for American Electrical Goods

AS THE result of a visit last summer to Europe in connection with an investigation into the market there for electric meters and similar devices Robert C. Lanphier, general manager of the Sangamo Electric Company, has made some observations on the conditions found in France, Spain, Italy, Switzerland, Belgium, Holland, the Scandinavian countries, and especially in England and Scotland.

"Throughout the war Denmark, Holland and especially Sweden were in communication with Germany," said Mr. Lanphier, "and it was amazing to learn of the large quantity of electrical apparatus supplied to these countries by Germany even when the war was at its height. For example, I was told in Holland that one or two of the largest German electrical manufacturers supplied the Electricity Works at The Hague with about 15,000 meters in 1917, and even during the great German drive in the spring of 1918 meters and other apparatus were being shipped in quantities to Holland. I saw some of the product thus made in Germany under war conditions, and while substitutions had to be made in many cases, such as pewter and zinc castings where brass would ordinarily be employed, paper insulation in place of mica or composition, etc., yet the product was really creditable considering the conditions under which it had to be made. I state this, not from the standpoint of any particular credit due the German manufacturers, but to emphasize that we should not underestimate the difficulties we must face in competition with the German electrical manufacturers, now that they no longer have to contend with war conditions.

"In Great Britain, France, Italy and Belgium there was still a strong feeling against the purchase of German goods, although by the middle of 1919 this was beginning to be tempered by the realization that these countries could not continue to buy from America as they did during the war with exchange against them continually growing worse. So far as Spain, Holland and the Scandinavian countries are concerned, or at least Sweden, there is rather a leaning toward the purchase of German goods if these can be obtained in anything like the quantity and at the prices of American goods. I was surprised at the comparatively small effort that had been made by many American electrical manufacturers, either before or during the war, to get real business in Holland and the Scandinavian countries, and as one prominent Dutch engineer at The Hague, himself a Fellow of the American Institute of Electrical Engineers, remarked to me: 'It is surprising that American manufacturers have not made any effort to cultivate our requirements and our friendship over here when we are so ready to purchase from the United States, quality and price reasonably considered.' I have never seen in any country engineers more alert, up to date and willing to consider new developments than these same Dutch and Danish engineers that I talked to.

"Naturally, there have been no marked changes or improvements in the meter art in European countries during the war, and so far as quality is concerned, I feel that American manufacturers of meters and similar electrical products have little to fear from European competition. But we must not deceive ourselves by thinking that we can rest on our oars and assume that European customers will take our goods simply because they are of high grade and well made. Many other factors enter into the situation first of all the present exchange; next, cost, even at normal exchange; third, service rendered in the way of prompt and correct shipments, good packing, attention from engineering and sales representatives; fourth, attention to the many special details which in themselves seem trivial but which mean so much to the average foreign buyer.

"The market for American electrical product in the countries visited, especially with the dearth of electrical production in these countries during the war, is enormous, and if our manufacturers generally will attack the problem in the light of conditions already mentioned, as some really have done, there is no question that a large and satisfactory sale will await them provided the great and fundamental question of exchange as it now stands with some of the above-mentioned countries can be solved.

"As to Great Britain, there was considerable question last year as to what the attitude of the British government would be on importation of many articles which before the war were absolutely free under Great Britain's well-known policy of free trade. Under the restrictions announced later in the year by the British Board of Trade, it is impossible even now for certain electrical articles to enter at all; that is, it is not a question of any duty but of an absolute embargo to protect some of the British manufacturers who were sadly stricken by the war. On some lines restricted importation is permitted, but only with the provision that at least assembling, and later manufacturing in a considerable degree, shall be carried on in Great Britain.

"It therefore seems especially important that the American electrical manufacturer, contemplating and hoping for an extensive trade in Great Britain and her colonies, should consider at an early date the advisability of a plant in Great Britain or at least at some point in the British Empire."

Metal Market Situation

THERE is little activity in the copper market, but it is strong. Producers are holding at 19.25 cents a pound for second-quarter delivery, but only here and there is there any buying. Consumers are pretty well sold up on second quarter, and producers are not at all anxious to deal beyond that time. It is felt that there will be little buying for a time, until consumers have to come into the market for third quarter, and that will not occur probably until well into the middle of the present period. It seems to be rather common to buy in three months' periods rather than in six.

In the outside market prompt and April copper is quoted at 18⅝ cents to 18½ cents, with second quarter about 18¾ cents. Little copper is changing hands.

The transportation tie-up has, of course, stopped the movement of metals, and the output of copper at Eastern refineries has been reduced considerably. They are attempting to keep going in a small way on the small stocks of raw materials on hand until transportation conditions become better again.

NEW YORK METAL MARKET PRICES

	April 7	April 14
Copper	£ s d	£ s d
London, standard spot	105 0 0	104 10 0
	Cents per Pound	Cents per Pound
Prime Lake	19.25	19.00
Electrolytic	19.00	19.25
Casting	18.62½	18.37½
Wire base	23.00	23.00
Lead, trust price	9.25	9.25
Antimony	10.50	10.75
Nickel, ingot	43.00	43.00
Sheet zinc, f. o. b. smelter	12.50	12.50
Zinc, spot	8.85 to 8.95	8.75 to 8.85
Tin	62.00	63.00
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.50 to 17.25	16.50 to 17.25
Brass, heavy	10.25 to 10.50	10.25 to 10.50
Brass, light	9.00 to 9.25	9.00 to 9.50
Lead, heavy	7.50 to 7.75	7.50 to 7.62½
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

FROM all sections of the country, demand for roughing and finishing materials is increasing rapidly as the spring building season progresses. Jobbers who heretofore have been unable to do more than 70 per cent of the normal amount of business, either on account of materials being delayed in shipment or because of poor factory conditions and resultant long deliveries, are now seriously affected by the present railroad tie-up. In New York, Boston and Chicago conditions are growing worse than in the South and West. Many truckloads of schedule material, lamps and wire, are being brought into New York, but the total volume is small as compared with normal shipments. No electrical work has been stopped in the metropolitan district, although but little has been started, and a canvass of jobbers indicates that present work can continue ten days without being held up for material.

In Atlanta building construction is going ahead rapidly. A strike there of plumbers, tinners and painters has not held up work as yet. Jobbers are badly in need of conduit and other roughing materials. Strike conditions in Chicago have had little effect on orders received, which continue to pour in. Here the railroad situation is reported as improving.

In the West housebuilding has commenced but may be delayed if materials are held up. Heavy demand has been made for electrical apparatus in fruit and berry canneries.

NEW YORK

In spite of a harbor strike, a rail strike and embargoes on both freight and express, jobbers in the metropolitan district, although badly handicapped by the lack of some much-needed materials, are continuing to do considerable business. Demand continues heavy for roughing materials, such as conduit, flexible armored cable, outlet boxes and wire. This is mostly for new houses in the outlying districts, for remodeling work and for new construction jobs in the city. No freight has been received this week by rail, but between Tuesday and Friday of last week several carloads of conduit arrived, with the result that there is more conduit on hand in the city today than during the past two weeks. The amount, however, is so small that it will not go far, but it will help to tide over many small jobs until more conduit arrives.

In addition, much schedule material, insulated wire, lamps and other products have been brought into the district by truck from Connecticut and from other nearby sources.

Taking all lines into account, the demand has lessened and will probably continue to drop off for another week or so until building schedules are further advanced and until the rail strike is adjusted. Additional manufacturers have issued card 45 on conduit.

Prices have been advanced on conduit by virtually all manufacturers and on flexible armored conductor by at least two manufacturers. Increases are also noted on wireless and radio equipment.

Conduits.—Several cars were received in the latter part of last week, increasing the total amount held in the metropolitan district. This stock is being used to fill back orders. The majority of the jobbers are completely out of pipe. Additional manufacturers have sent out card 45.

Flexible Armored Conductor.—Jobbers generally are completely out. Small quantities are held on a few instances. At least one manufacturer has advanced prices $5 per 1,000 ft. Prices for No. 14 double-strip are quoted at from $104 to $110 per 1,000 ft. and three-wire from $135 to $138.

Lamps.—Stocks are spotty, with here and there breaks in 25, 50 and 100-watt sizes.

Bare Wire.—No change in base from the 22.25 cent level has been reported. Demand is rather slow.

Weatherproof Wire.—Shipments on large sizes are around six weeks, while the smaller sizes are requiring eight weeks or so. Demand is pretty good.

Heating Appliances.—There are a few irons available, but tableware is very short. Jobbers have no large stocks of heaters for the spring season, and those with no stocks report no intention to take in any.

Line Hardware.—Mill shipments are two to four months, but certain warehouses can supply almost any item from stock. Prices are firm, but from at least one quarter an upward tendency is expected. Demand is very good.

Lamp Fixtures.—Industrial types sold better than house fixtures in outlying districts, although the demand in the city for the latter has been good. Sales are on a par with those of April, 1919.

Radio and Wireless Equipment.—One manufacturer has advanced prices on all radio and wireless equipment 10 to 15 per cent. Demand is heavy.

Boxes.—Flexible armored conductor boxes are particularly hard to get. Outlet boxes are generally low in stock. The 4-in. size is more plentiful than the 3-in. size, stocks of which are spotty.

BOSTON

The volume of trade continues to tax manufacturing and jobbing facilities, deliveries being in poor shape in most lines and stocks spotty. Collections are somewhat better than in March, though still below normal. Building contracts and engineering operations signed in New England exceed $88,000,000 to date for 1920, or very nearly double the best previous record. Electrical labor is well employed, and up to this writing there has been no stampede to follow the "outlaw" strikes in New York and elsewhere in the transportation industry. Prices hold firm, with occasional stiffening to obtain preferential service. Transportation conditions have not recovered from adverse winter weather, and present tie-ups in freight movement and curtailments in passenger train service are beginning to burden even distant distributers. Here and there a note of caution is being heard in jobbing circles relative to the wisdom of avoiding heavy purchases in supplies at current prices.

Rigid Conduit.—Stocks are low. The ½-in. black pipe is quoted at $98 per 1,000 ft. and 1-in. at $190. Shipments are very unsatisfactory.

Flexible Armored Conductor.—Little of this material is in the market, but jobbers are handling occasional orders from old customers. A price readjustment is in process amounting to about $10 per 1,000 ft. on No. 14 single-strip. The new level is about $105 to $110, but this does not represent an advance all along the line as some jobbers have been quoting on this basis for two or three weeks.

Non-Metallic Flexible Conduit.—Stocks are spotty, and some jobbers are in fair shape to meet immediate demands, others being virtually out of loom. The 7-32-in. size brings $37 and the ¼-in. size $40 per 1,000 ft. in coil to 1,000-ft. lots.

Wire.—Rubber-covered No. 14 wire is in good supply, with prices firm at $11.50 to $12 per 1,000 ft. in moderate lots. Weatherproof is quoted on a 32-cent base and bare is running around 26 cents to 27 cents.

Lamps.—Labor troubles in New York have begun to hold up shipments to New England. Gas-filled lamps of the 75, 100 and 200-watt size are hardest to obtain.

Sockets.—A good supply is on hand. Pulls were quoted Monday at 47.5 cents to 50 cents net in case lots, with keys at 28 cents and keyless at 26 cents.

Porcelain Fittings.—A few barrels of "Nail-it" knobs have been received within a few days, but the supply is far below the market requirements. Jobbers are getting $32 per 1,000 in barrel lots. Tubes are scarce.

Motors.—Business is very brisk in sizes up to 50 hp. One jobber sold six motors aggregating 95 hp. out of stock Monday and ordered over 100 more, but shipments are uncertain. Stocks are low, on the whole.

Radiators.—Local stocks are in readiness to meet a fair demand when the fires are allowed to go out. It is understood that a well-known type listing at $11 will go to $12 this fall.

Appliances.—Trade continues active in washers and cleaners. Irons are moving well and factory stocks are conspicuous by their absence.

CHICAGO

Transportation troubles complained of a week ago now seem mild in contrast with the effectual railroad tie-up resulting from the so-called "outlaw" strike of switchmen. Shipments of any kind to any destination are today impossible. Every available motor truck in the district is being pressed into service to secure distribution to nearby cities, but, necessarily, perishable goods are the ones receiving the most attention. It is not conceivable that existing conditions will continue for any great length of time. So much derangement of affairs has already occurred that much time will be required to get things back to normal shipping schedule.

All of which seems to have no effect on the volume of orders which is coming in to jobbers and manufacturers. Railroads, which are expected to be in the market for a great deal of equipment in the near future, are already making numerous inquiries. Unusual demand is felt from paper mills, which are buying anything they can get in the way of motor equipment. The Pullman company has also been noted as a recent good customer.

Local interest is keen in the fate of a fifteen-million-dollar bond issue to cover street-lighting rehabilitation and extensions. The measure is facing strong opposition on the ground of economy. Building continues rather heavy, with excellent weather. The week's building permits exceeded $2,000,000, being confined almost exclusively to non-industrial construction.

Power Cable.—Demand exceeds supply. The upper trend of copper has been given as reason for slight increase in price.

Bare Copper Wire.—Reflecting the advance in copper, a new base has been established on bare copper, an increase of 50 cents per 100 lb. over prices recently in effect. No. 8 is quoted at $25.75 in lots up to 200 lb. and at $24.50 for larger quantities. No. 12 brings $26 in small lots and $25 in large. The supply of this size is ample.

Weatherproof Wire.—Deliveries are getting somewhat better, certain manufacturers quoting from thirty to sixty days. An advance of 50 cents is noted.

Tape.—Heavy demand keeps jobbers' shelves bare, deliveries ranging from three weeks to two months. An advanced list went into effect this week. A high grade of tape is quoted at 90 cents in less than 5 lb. lots, 78 cents for 25-lb. lots, 75 cents for 100 lb. Medium grade brings 78 cents for 5 lb., 70 cents for 25 lb. and 60 cents for 100 lb.

Farm Substations.—Manufacturers report a strong demand for single-pole high tension switching substation equipment for farm lighting. This demand is widespread over Canada and the United States and particularly noticeable in the Mid-West and Northwest sections of this country.

Outdoor Industrial Substations.—Unusually heavy demand for high-tension substation equipment is reported from both public utility companies and industrial concerns. Builders are booked up to such an extent that prompt deliveries are impossible.

Sleeving-Solder.—All lead products are following the recent market advance of that metal, current quotation on half-and-half solder being 38 cents per pound. Sleeving is being billed at 10 cents per pound.

Glass Insulators.—New list prices on the Hemingray Glass Company's insulators are as follows: In less than standard package, pony No. 9, $82.50 per 1,000; No. 19, double-groove, double-petticoat, $126.25; No. 62, large groove cable, $194.10. In standard packages these styles are quoted at $49.50, $75.75 and $116.45 respectively, and in lots of from one to ten thousand at $38.75, $59.35 and $91.25. Deliveries are fairly prompt.

ATLANTA

All indications point to a well-sustained volume of business throughout the section. The spring season has stimulated the demand for electrical specialties of the seasonal type, while weather conditions are becoming such as to permit of the pushing of all types of building construction. Jobbers continue to complain of the poor shipments of material requiring steel or porcelain in its manufacture and all local stocks of this class of material have become badly depleted.

Builders report that the recent strike of the tinners, plumbers and painters in Atlanta has had no appreciable effect on building activities in the city, nor do they anticipate that the carpenters' strike scheduled for May 1 will be successful in tying up local building activities. April building permits for the first week in the month reached a new high level, and builders hope for a sufficient supply of labor even in the face of the threatened strike.

Reports from jobbers indicate that collections are slightly improved over this time last month. A number of jobbers are commencing to use trade acceptances. Bank clearings are approximately 40 per cent in excess of the same period last year.

Conduit.—Pipe continues as scare as heretofore, with no slackening in demand. A price advance of from 5 to 10 per cent has been registered.

Exhaust Fans.—In response to a seasonal demand, exhaust fans have commenced to move briskly and jobbers are reporting the receipt of large orders. Fair stocks have accumulated in the territory during the winter, so shipments are good. Price, 32-in. size, $159.

Flexible Armored Conductor.—One jobber reports the receipt of a large shipment on order since last December. This shipment will be sufficient to take care of all apartment house requirements in this city, permitting construction which had been held up because of the lack of this class of material. Price, two-conductor, No. 14, 1,000 ft. to 2,500 ft., $11.60 per 100 ft.

Outlet Boxes.—A fair supply of obsolete-type boxes is available, but the popular sizes are reported scarce, with shipments unsatisfactory.

Storage Batteries.—Stocks of the more standard types are reported fair, although difficulty is being experienced in obtaining batteries in anything but the standard type. Slow shipments, however, are serving to deplete local stocks badly. A price advance of 14 per cent has been applied to electric vehicle batteries.

Lamp Cord.—Jobbers report that stocks are low, with shipments at three months. Brisk demand will prevent an accumulation of sufficient supplies of this article for fall trade. Prices, 1,000 ft. to 5,000 ft., $3.50 per 100 ft.

SEATTLE—PORTLAND

Both jobbers and retailers in the Seattle territory report trade volumes during the past week holding to levels set during March, the only deterring factor being lack of stock. This is the chief difficulty, and the shortage includes not only household appliances but wiring devices and power apparatus as well. The proposed campaigns on labor-saving devices have been postponed indefinitely; in fact, stocks are not nearly adequate to meet the constantly increasing demand. Building activity continues at a rapid pace in spite of restrictions due to shortage of schedule materials. Apparently prospective home builders have come to realize that to wait for lower prices of lumber and other building materials is futile and they have determined to proceed with construction.

Weather conditions in the Puget Sound territory are ideal. Agriculture, both in number of persons employed and acres cultivated, is steadily increasing in the Pacific Northwest, and almost every locality is engaged in an enterprise that will enhance the acreage under cultivation either for fruit and berries or irrigated farming. Spring wheat has not had all the moisture that is desirable, but accurate crop predictions are impossible at this time. The outlook, however, is generally favorable. Inquiries and orders are being received by jobbers for power apparatus and electrical equipment used in berry and fruit-canning plants.

Lumber mills in the Northwest are operating at practically full capacity to keep up with persistent demand coming from all parts of the country. Reports from various Northwest cities indicate that labor is well employed. Building and electrical contractors in Spokane recently declared an open-shop policy following a demand of workmen for higher wages.

Mangles.—Both Seattle and Tacoma dealers report increasing inquiries and some sales, following unprecedented movement of electric washers. One large Seattle dealer states that while housewives of means are showing considerable interest in the mangle there is some hesitancy in placing orders. Sales are not being pushed because of short stocks.

Sewing Machines.—Retail price of one vibrating style advanced approximately 10 per cent recently, although jobbers state that this apparently has not slowed up sales. Stocks are low and replacements hard to obtain.

Sockets.—In face of increasing demands stocks are practically exhausted and shipments are poor. Shipments reported en route may arrive in Seattle in time to save the day. Rural demand is the heaviest in years.

SAN FRANCISCO

A serious tie-up is threatened by the strike of yardmen and switchmen on all the California steam railroads. San Francisco and Oakland are still concerned, but it is reported that interior junctions have complied with the demands and are operating as usual. This tie-up comes at a very serious time, affecting the movement of citrus fruits and other perishables. A linemen's strike on the lines of the Pacific Gas & Electric Company is under way, although business, to outward seeming at least, is proceeding as usual.

Schedule Material.—The most popular socket device is the two-way or double-duty socket in various makes, because of the enormous increase in the marketing of socket devices. This demand parallels for the smaller devices the demand created by the co-operative campaign for baseboard receptacles for the larger household appliances which was recently carried on.

Electric Drills.—Recently efforts have been made to promote the regular use of electric drills and hammers in various industrial shops and in the shipyards and this effort is making headway. Electrical rivet-heating machines will also be marketed in this district.

Motors.—There never was a greater demand for motors of all sizes than there is now, ranking from big motors in reconstructed plants to fractional horsepower motors for manufactured products of which they are a part. Deliveries, which were formerly poor for single-phase styles but fair for other types, are now universally poor. Some dealers in second-hand and repaired motors are refusing absolutely to sell, finding the renting business during the present scarcity more profitable.

Heating Material.—A new schedule of American Beauty heating devices is being introduced into the territory. Based strictly upon the quantity in each individual order, this practice is very different from the Hotpoint yearly contract. Deliveries are better, the surprise of the past week being a large shipment of percolators, all of which were applied against long-standing orders.

Wire.—Prices on office and annunciator wire have increased 10 per cent, No. 18 now selling at about 56 cents per lb. in 50 lb. assorted quantities. Deliveries are good. Rubber-covered wire, size No. 14, in 5,000-ft. assorted lots sells for $12.30 per 1,000 ft. f. o. b. Coast houses. Deliveries are good. Lamp cord has jumped about 10 per cent in standard sizes and now sells in 2,500-ft. assorted lots at about $28 per 1,000 ft. for No. 18 cotton-covered twisted and $37 per 1,000 ft. for the light reinforced style. It is probable that light cord will be permitted for fixture work during the rest of the year.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

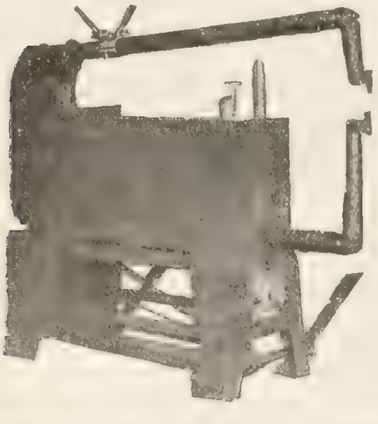
Lead-Covered Battery-Connecting Clip

A battery-connecting clip adjustable to any diameter up to 1¾ in. is being put out by the Reliable Manufacturing Company, 2814 Prospect Avenue, Cleveland, Ohio. This clip, known as the "Bulldog," is heavily lead-coated and made in two pieces with spring jaws and a clamp which may be adjusted on the jaw to grip different-sized terminals. The wire lead is soldered in the clamp. Contact is made on the battery terminal by sawtooth jaws. The grip is rated at 50 amp.

SLEEVE ADJUSTED FOR DIFFERENT SIZED TERMINALS

Spot Welder

A spot welder with its transformer built into its throat has been developed by the Automatic Controller Manufacturing Company, Ogden, Utah. The size of throat in one model is 52 in. and in two other models 42 in. The transformer is built into the throat of the welder, enveloping a portion of the lower arm and thus permitting a throat almost the full length of the machine. The electrodes are made with a tapered shaft for quick changing. Four foot treads are provided. The cooling system is confined within the throat member. The regular equipment is made for connection to running water, but a special syphon pump may be had. The largest machine occupies a floor space of 67 in. x 24 in. and is 48 in. high. The shipping weight is about 900 lb. These welders are built for 110/220 and 440 volts, at 25, 40 and 60 cycles.



TRANSFORMER FORMS PART OF THROAT

Portable Tilting Lamp

H. G. McFaddin & Company, 38 Warren St., New York City, have recently put on the market the Dresalite, a portable lamp equipped with an adjustable shade which can be tilted or turned to deflect the light in any direction. The fixture can be attached by two small screws to the back of the mirror frame or support of the dresser or to the head of the bed.

Portable Switchboard for Studio Work

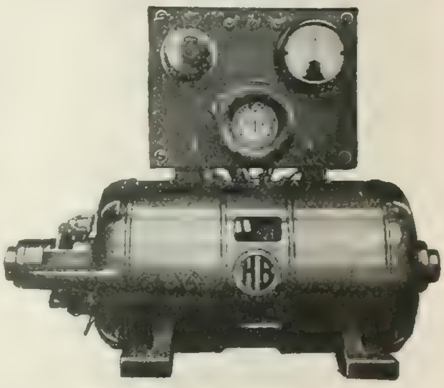
A portable switchboard has been specially designed for motion-picture studios by the Krantz Works of the Westinghouse Electric & Manufacturing Company, Brooklyn, N. Y. It consists of a slate panel on which are mounted six three-pole, single-throw, 125-amp. knife switches. Each knife feeds to a three-point Kliegle receptacle and is capable of taking care of one six-way Kliegle spider box. The switches, receptacles and plugs are contained in a No. 12 gage steel box, and two swinging doors permit access to the switches. The doors may be secured and contact with live parts thus made impossible. Connection is made to the main line at the top of the switchboard, and six circuits may be operated simultaneously if required. The outstanding feature of this switchboard is its portability. It is mounted on four wheels and can be quickly and easily moved from one part of the studio to another.

Large-Size Nitrogen Lamp

Believing that the success of the small 50-watt milk-white nitrogen lamp has created a demand for a lamp embodying the attractive features of this type but with longer life and greater illumination, the Liberty Appliance Corporation, New York City, has developed a new line of nitrogen lamps, called "Liberty Nitrogen Opalites." The new lamps are similar to the C-4 lamps, except that they are not tipless and come only in larger sizes, 100-watt and 200-watt. In these larger sizes, the maker says, the lamps give the same soft, radiant diffused light as do those of the smaller size; but, made in these sizes, they make it possible for each socket to contribute greater illumination where it is frequently needed without the necessity of additional wiring or other attachments. Hospital operating rooms, opticians' offices, stores and homes requiring unusually good diffusion of light will find these lamps especially applicable, the maker declares.

Battery-Charging Outfit

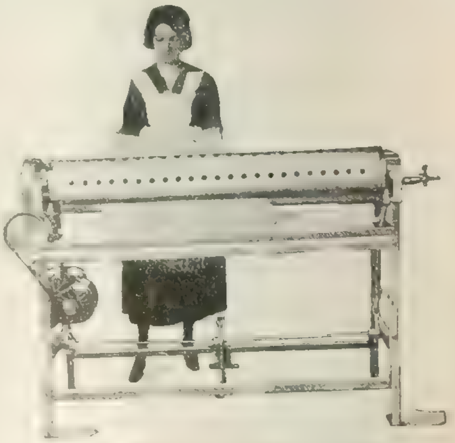
A new 250-watt battery-charging outfit made by the Hobart Brothers Company, Troy, Ohio, is designed for recharging from one to four automobile starting and lighting batteries at one time. This outfit has ball-bearing motor and generator, automatic voltage control, allowing different voltage batteries to be charged at the same time, and a complete panelboard with meters mounted on top of the motor-generator.



CHARGES FROM ONE TO FOUR BATTERIES

Ironing Machine with Gas-Heated Shoe

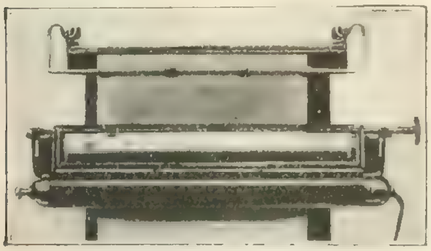
An ironing machine with gas-heated shoe and motor-driven roller has recently been brought out by the Barnett Foundry & Machine Company, Irvington, N. J., under the trade name "Capitol." A feature of the machine is the method of control of the motor and roller by a foot lever, which is arranged so that the hands are left free for handling and guiding the materials to be ironed. All gears are covered by guards.



CONTROLLED BY FOOT LEVER

Lighting Device for Stenographers

A device for lighting and magnifying the copy which is being read by the operator of a typewriter has been developed by the Lineatime Manufacturing Company, Inc., Rochester, N. Y. This device, which is to be mounted at the back of the typewriter, illuminates one line of the copy at a time, which is seen magnified through a longitudinal lens designed, the manufacturers say, to filter out some of the injurious light rays.



LIGHTS AND MAGNIFIES ONE LINE

Combined Ceiling and Reading Light

An ornamental lighting fixture with a center lamp that may be pulled down close to a table for use as a reading lamp has been developed by the Majestic Heater Company, San Francisco, Cal. Ordinarily the fixture has the appearance of the common four-light fixture, but the center lamp has a flexible cord wound on a reel in the fixture which unwinds when the lamp is pulled down.

MIDDLE LAMP PULLED DOWN FOR READING

One-Twentieth-Horsepower Motor

A split-phase induction-type motor of 1-20 hp. at 1,725 r.p.m. has been developed by the Bodine Electric Company, 2256 West Ohio Street, Chicago. The manufacturers claim liberal proportioning of all parts subject to wear, regardless of the small size of the motor. Substantially the same cut-out mechanism is used as in the larger-size motors of the same manufacture. It is considered by the makers essential that this cut-out mechanism shall be such as to insure uninterrupted service, no matter how small the motor. Two larger sizes of the same general construction are being developed and will be offered as soon as production is under way.

Collapsible Canvas Tool Bag for Linemen

The Industrial Products Company, Philadelphia, has put on the market a canvas tool bag for use in hoisting tools, paint and other implements or supplies. The bag is made with no metal parts which can come into contact with the current, as the sides are of canvas, the bottom is of wood and the handle is of rope. The manufacturers have designed it to hold tools and materials which, if not properly taken care of, may be a menace to those below.

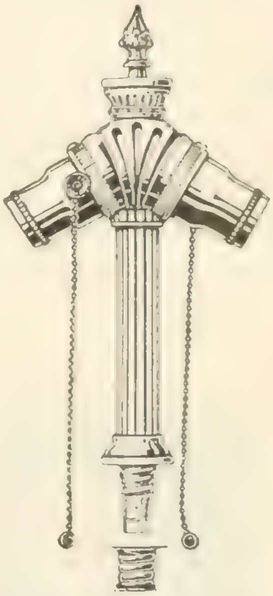
Small Lighting Plant

A small generating plant for operation on kerosene or gasoline has been developed by the Matthews Company, Port Clinton, Ohio. This plant, known as the "Ker-o-el," is rated at 800 watts to 1,000 watts at 32 volts and is equipped with either an 80-amp.-hr. or a 160-amp.-hr. battery. Air cooling is used for farm operation and water cooling for marine work. It is self-cranking and has an automatic stop to operate when the battery is fully charged. The control board is mounted over the generator and is fitted with a fused line switch, an ampere-hour meter and a starting-box circuit breaker. The set weighs 270 lb. exclusive of the battery, which weighs 420 lb. for the 80-amp.-hr. size and 525 lb. for the 160-amp.-hr. size. It measures 26 in. x 24 in. x 15 in. with a 12-in. x 18-in. bed plate.

Double-Duty Cluster with Individual Lamp Control

The double-duty cluster recently brought out by the Peerless Light Company, Washington Boulevard and Union Street, Chicago, is so named, the maker says, because it combines simplicity of construction, artistic appearance and service.

The cluster is a one-piece casting, and its construction, it is said, is designed to counteract the jarring effects of switching the lights on or off. It is equipped with two pull-chain sockets, giving individual control of the lamps.



DOUBLE-DUTY CLUSTER MADE OF A ONE-PIECE CASTING

In another form the cluster is completed with one keyless socket and one pull-chain socket, so wired that both lights are controlled by one motion.

Notes on Recent Appliances

Automatic Unit Battery-Charging Section

For charging electric trucks by the constant-potential method, the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has put out an automatic unit battery-charging section.

Separatorless Storage Battery

Storage batteries without separators are being offered by the Electrolyte Storage Battery Company, 1309 Race Street, Philadelphia.

Built-up Commutator Resurfaced

The Ideal Commutator Dresser Company, 6 South Dearborn Street, Chicago, Ill., has designed a new commutator resurfacer which is to be used with a portable or side-attachment resurfacing machine.

Small Oscillating Fan with Adjustable Base

A 9-in. oscillating fan with a base which may be adjusted for mounting on a wall has been perfected by the Emerson Electric Manufacturing Company, St. Louis, Mo.

Indicating Ohmmeter

An indicating meter for measuring resistance of an electric circuit or portion thereof in the same manner that voltmeters measure pressure has been perfected by the Thompson-Levering Company, 325 Arch St., Philadelphia.

Conduit Bender

The Rattan Manufacturing Company, New Haven, Conn., is putting out a conduit bender with curved jaws.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

MAJOR CARL H. REEVES has been appointed superintendent of public utilities by Mayor Hugh M. Caldwell, of Seattle, Wash., as successor to Thomas F. Murphine, resigned. Major Reeves has had many years' experience in railway engineering and in the construction of public utilities, having served in the city engineer's office for several years. From 1906 to 1915 he was assistant engineer with the Seattle Electric Company, resigning in 1915 to perform special work for the State Public Service Commission. Since 1916 he has been in private practice in Seattle, except for about three months' service with the United States Army, when he had charge of construction work at Camp Fremont and at Puget Sound forts.

T. J. PACE, formerly industrial assistant to manager of supply department, has recently been appointed assistant manager of the supply department of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Mr Pace has been actively identified with the electrical industry along supply lines with Westinghouse and allied interests for about twenty years. A portion of this time was devoted to commercial and engineering work in lighting applications. In this work he has been prominently connected with a number of the larger of the present-day street lighting installations and has presented a number of papers before the various engineering organizations on this and other subjects. He has been a leading advocate of standardization within the industry. More recently Mr. Pace has devoted a large part of his time to industrial applications of electricity and to popularizing the use of electrical devices, including safety electrical appliances, in industrial plants.

T. J. PACE

THE ROLLER-SMITH COMPANY, 233 Broadway, New York City, announces the appointment of Hammond D. Baker as manager of its Detroit (Mich.), office at 1202 Majestic Building. Mr. Baker, a graduate electrical engineer of Alabama Polytechnic Institute, after his discharge from the aviation service of the army, became connected with the United Motors Corporation as technical traveling representative. Later he joined the sales department of the Hoskins Manufacturing Company, Detroit, Mich., from which he resigned to accept the appointment with the Roller-Smith Company.

THE YARNALL-WARING COMPANY, Chestnut Hill, Philadelphia, announces that D. T. Newman, formerly connected with the Philadelphia sales office, has been placed in charge of the Atlanta (Ga.) office which was recently opened in the Candler Annex, Atlanta, Ga.

THE VALLEY ELECTRICAL COMPANY, St. Louis, Mo., has awarded contract for the construction of a new industrial plant on King's Highway Boulevard, between Kemper Park and Connecticut Street, to cost about $300,000. The company has recently taken over the business and property of the St. Louis Electrical Works, now at 4060 Forest Park Boulevard, St. Louis, Mo.

THE STAROBIN ELECTRICAL SUPPLY COMPANY, 101 Fourth Avenue, New York, manufacturer of electrical supplies, has increased capital stock from $30,000 to $100,000.

THE SIMMS MAGNETO COMPANY, North Arlington Avenue, Orange, N. J., manufacturer of magnetos and ingnition systems, has awarded contract for an addition to its plant, to cost with equipment about $385,000.

THE CLOX-LIGHT MANUFACTURING COMPANY, 24 Scott Street, Newark, N. J., recently organized to manufacture controller devices for automobile lighting systems, is arranging for an increase in capital stock to $500,000, the proceeds to be used to increase the capacity of its plant. Werner O. Olsen is president.

THE WICO ELECTRIC COMPANY, Springfield, Mass., has filed articles of incorporation under the laws of Massachusetts with a capital stock of $400,000 to manufacture magnetos, storage batteries, ignition equipment, etc., in its West Springfield plant. Phelps Brown, 44 Avon Place, is president.

THE PHILADELPHIA STORAGE BATTERY COMPANY, Ontario and C Streets, Philadelphia, is planning to make alterations and improvements in its plant to cost about $35,000.

ELECTRICAL SHOW IN COLUMBUS.—The first annual electrical show held under the auspices of the Columbus (Ohio) electrical dealers was open for the week of April 5. The show was designed to teach the public the wonderful improvements in electrical fixtures and appliances and to educate the people in the proper use of electricity. All of the local dealers and many of the manufacturers had large exhibits at the show.

RUSSELL P. ASKUE has severed his connection with the publicity department of the National Lamp Works, Cleveland, Ohio, to go into agency work with headquarters at Cleveland. Mr. Askue had been with the National Lamp Works for several years, prior to which he was advertising manager for the Ivanhoe Regent Works of the General Electric Company.

THE WEBER ELECTRIC COMPANY, Schenectady, N. Y., manufacturer of electrical supplies, contemplates the erection of an addition to its plant, 65 x 100 ft., to cost about $25,000.

THE A. A. WIRE COMPANY, 50 East Forty-second Street, New York, has filed notice with the Secretary of State of an increase in its capital stock from $100,000 to $800,000.

THE FRANK ADAM ELECTRIC COMPANY, St. Louis, Mo., manufacturer of switchboards, panels, cabinets, electrical equipment, etc., is breaking ground for a new factory addition. This is the second time within a year and a half that the company has been forced to build. The new building will follow the general line of the present plant, and when completed it will cover practically an entire city block on Windsor Place and St. Alphonsus St., nearly doubling the capacity and floor space of the present plant.

E. C. RUTZ and P. E. WIDSTEEN, formerly with the Woodmansee-Davidson Engineering Company, consulting engineers, announce the incorporation of the R. & W. Construction Company, to specialize in power plant and transmission line construction for public utility and industrial development. The company has established offices at 35 South Des Plaines Street, Chicago.

THE UTILITIES ENGINEERING & ACCOUNTING COMPANY announces that it has opened an office at 10 South Second Street, Harrisburg, Pa., in charge of William C. Rommel, formerly rate expert for the Public Service Commission of Pennsylvania.

THE O. K. WELDING COMPANY, Henryetta, Okla., recently incorporated with a capital stock of $75,000, plans to erect a machine shop and foundry.

GOVERNMENT SURPLUS MOTORS FOR SALE.—At the United States government warehouse No. 193, Remington Arms (U. M. C. plant), Bridgeport, Conn., there are 150 three-phase, 60-cycle, 440-volt General Electric and Westinghouse motors for sale, most of them 870 r.p.m. and 1,160 r.p.m. G. E., from 97 to 100 per cent condition. There are also nineteen Crocker-Wheeler and Wagner 220-volt motors, from 1 hp. to 15 hp., 1,140 r.p.m., and in good condition.

THE VOLTA MANUFACTURING COMPANY, LTD., Welland, Ontario, Canada, recently incorporated with a capital stock of $200,000, will acquire and take over the property and business of the Volta Manufacturing Company, manufacturer of electrical machinery, tools, equipment, etc.

JOSEPH H. LECOUR has been elected treasurer of the Mitchell-Rand Manufacturing Company, New York, manufacturer of electrical insulating materials, succeeding in this capacity W. E. G. Mitchell, whose duties as vice-president require all of his attention. Mr. Lecour, who is well known in the electrical and affiliated industries, was born in New York and was graduated from Trinity College in 1898 and from the New York Law School in 1900. He was admitted to the bar of this state in the latter year and to the New Jersey bar in 1905. During the war period Mr. Lecour served with the Essex Troop of New Jersey on the Mexican border and later with the 112th and 124th Field Artillery. He was also on the staff of the First American Army.

J. H. LECOUR

JOHN W. HOOLEY, contracting electrical engineer, 95 Liberty Street, New York City, announces that after May 1 he will be located at 45 Barclay Street, where he will occupy the entire second loft. This change is being made in order to combine office, shop and stockroom on the same premises.

THE EDISON ELECTRIC APPLIANCE COMPANY, Chicago, is planning to erect a two-story office and storage building to cost about $125,000.

E. E. HEDLER has recently been appointed Eastern representative of the Buckeye Electric Division of the National Lamp Works of Cleveland, Ohio, succeeding W. O Conley, who has had his headquarters in Philadelphia. Mr. Hedler is well known in electrical circles in the East, having been associated with the Western Electric Company and the Electric Service Supplies Company.

THE INTERNATIONAL ENGINEERING & MANUFACTURING COMPANY, South La Salle Street, Chicago, contemplates establishing a plant in Kokomo, Ind., to cost about $100,000, for the manufacture of low voltage farm electric lighting and power plants.

W. H. SMAW, purchasing agent for the Georgia Railway & Power Company, Atlanta, resigned March 1 to become Southern sales representative of the Electric Service Supplies Company, Philadelphia, manufacturer and jobber of electrical supplies and street railway specialties. Mr. Smaw joined the Georgia company in 1903 as assistant purchasing agent and in 1910 became purchasing agent.

A. E. VIENNEAU has been placed in charge of sales of wiring devices in the Philadelphia office of the Cutler-Hammer Manufacturing Company.

Supply Jobbers' Notes

THE STUART-HOWLAND COMPANY, electrical supply jobber, Boston, is receiving the congratulations and best wishes of the electrical trade on the occasion of the twentieth anniversary of the house, which was reached on April 2.

GEORGE T. FISHER, formerly general superintendent of the Cumberland County Power & Light Company, Portland, Me., has joined the sales staff of the Pettingell-Andrews Company, Boston. Mr. Fisher is well known in the New England central-station field, having served in both the commercial and operating branches of the industry.

THE ERNER & HOPKINS COMPANY, electrical jobbers, Columbus, Ohio, whose place of business was almost totally destroyed by fire on April 1, has opened temporary quarters at 267½ North High Street. Some of the stock in the establishment was salvaged, and with other stock coming in the company is able to continue business in many lines. Its construction work will hardly be interrupted and much of the retail business can also be looked after. The officers of the company will soon start the erection of a modern business block to replace the structure destroyed by fire.

Foreign Trade Notes

ELECTRIC HEATING APPARATUS NEEDED IN FOREIGN COUNTRIES.—In the countries of South and Central America, in India, in Shanghai and the Far East there is an increasing demand for electric heating and cooking apparatus. According to reports there is great difficulty in getting electrical supplies, particularly irons, in these countries.

DEMAND FOR ELECTRICAL APPARATUS IN NETHERLAND INDIES.—According to reports there is an increasing demand in the Netherland East Indies for electrical supplies of all kinds, including electric lighting sets, electrical fittings and accessories, incandescent lamps, etc. Before the war a good deal of electric plant equipment, etc., was supplied by German manufacturers.

THE ROLLER-SMITH COMPANY, 233 Broadway, New York City, announces the appointment of the American Manufacturers' Export & Import Corporation, Seattle, Wash., as its agent for China. The latter company has branch offices in Shanghai, Hong Kong and Hankow, the Shanghai office being in charge of R. L. Stevens, vice-president, formerly with Byllesby & Company. The other two offices are in the hands of H. C. Best and Samuel Wong, respectively. In addition to the Roller-Smith Company, the American Manufacturers' Export & Import Corporations represents the Wagner Electric Company and several other American manufacturers of electrical apparatus.

ROTARY SNAP SWITCHES.—Rotary snap switches are coming rapidly to the fore in England as they enable many switching operations hitherto impracticable or effected with difficulty by tumbler-type switches to be performed with ease. In no sphere perhaps is this superiority felt to be so apparent as in the control of heating and cooking apparatus. These switches are available in a multiplicity of types performing widely varying operations. The General Electric Company, Ltd., has accepted the sole agency in England for the "H & H" rotary snap switches and other specialties manufactured by the Hart & Hegeman Manufacturing Company. Arrangements have been made whereby representative stock will be held by the General Electric Company at its various branches throughout the country.

AMALGAMATON OF LAMP WORKS IN JAPAN.—The Tokyo Electric Company and the Dai-Nippon Electric Lamp Company, the two largest lamp works in Japan, have recently been consolidated into one organization. The former has been manufacturing incandescent lamps for many years, using General Electric patents, while the latter is a comparatively new concern. A patent litigation which has been under way for a few years has finally been settled.

GERMAN TRADE WITH GREAT BRITAIN.—The American Chamber of Commerce calls attention to the fact that direct imports from Germany to England, although small in quantity, are gradually extending and cover a much wider range than a few weeks ago. Cargoes recently discharged at Grimsby, Liverpool and London included among other goods flashlight batteries and magnetos.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An electrical engineer in Argentina (No. 32,442) desires to secure an agency for the sale of electrical appliances in general, especially for lighting and heating, electrical machines, motors, cables, electrical measuring instruments and laboratory instruments.

L. G. Hawkins of L. G. Hawkins & Company, 116 Charing Cross Road, London, W. C. 2, England, European representative of Landers, Frary & Clark, announces that he will arrive in America on April 17. He writes that he is particularly interested in labor saving appliances.

Joseph Clarke & Company, National Mutual Buildings, 143 Hereford Street, Christchurch, New Zealand, would like to secure agencies for electrical goods and copper cables.

A firm of engineers and contractors in Siberia (No. 32,473) desires to get in touch with manufacturers and exporters in order to secure agencies in Russia and Siberia for electrical machinery, etc.

Trade Publications

SCREW-CUTTING AND GAGING SYSTEMS.—The new S. T. D. gage catalog, recently issued by the Greenfield Tap & Die Corporation, Greenfield, Mass., in addition to being a catalog includes graphic tolerance charts, and complete gaging systems are shown. The latest methods in "precision" measuring and inspection are given prominence.

LIGHTING FIXTURES.—The Central Electric Company, 316-326 South Wells Street, Chicago, has issued bulletin No. 75, describing its Maxolite diffuser and fixtures for industrial lighting. Illustrations are given of the Maxolite diffuser, RLM standard dome reflectors, fixtures, cut-out hangers, etc.

INSULATING MATERIALS.—The Mitchell-Rand Manufacturing Company, New York, N. Y., has issued catalog No. 262, entitled "Everything in Insulation." It contains seventy-two pages and gives data and prices of insulating material, including tapes and webbings, varnished materials, varnishes and paints, mica, soldering paste, armature twines, friction tape and splice, vulcanized fiber, carbon and brushes, asbestos, adhesives, insulating waxes and compounds, etc.

PORCELAIN INSULATORS.—In bulletin No. 62, distributed by the Lapp Insulator Company, Inc., Le Roy, N. Y., a comparison of American and European high-voltage pin-type porcelain insulator designs is given. Curves are included.

SPRAY COOLING SYSTEM.—E. B. Badger & Sons Company, 63-75 Pitts Street, Boston, has issued bulletins Nos. 100 and 102, describing methods of cooling water and air by the spray system.

New Incorporations

THE WICO ELECTRIC COMPANY of Springfield, Mass., has been incorporated under the laws of Massachusetts with a capital stock of $400,000 to manufacture magnetos, storage batteries, ignition equipment and specialties. The officers are: Phelps Brown, 44 Avon Place, president; Arthur W. Lamson, Vice-president, and Edward L. Stoughton, treasurer.

THE ATLAS MANUFACTURING COMPANY, Port Arthur, Ont., Canada, has been incorporated by Alexander C. Lotoski, Amos C. Allen, Walter L. MacGregor and others. The company is capitalized at $40,000 and proposes to manufacture electrical supplies, machinery, etc.

THE SOUTHERN ELECTRICAL & EQUIPMENT COMPANY of Charlotte, N. C., has been incorporated with a capital stock of $100,000 to manufacture electrical appliances, etc. L. H. Hardin is general manager.

THE CONNERSVILLE (Pa.) ELECTRIC STEEL COMPANY has been incorporated with a capital stock of $195,000. The officers are: G. M. Gadsey of Pittsburgh; F. E. Markell, treasurer.

THE MASTER ELECTRIC COMPANY, 460 Bacon Street, Dayton, Ohio, has been incorporated by R. G. Corwin, John H. Larsh, S. A. Brown and A. C. Jackson. The company is capitalized at $50,000 and proposes to manufacture pumps and other electrically driven machinery.

THE KENTUCKY SWITCH & SIGNAL COMPANY of Louisville, Ky., has been incorporated by R. V. and L. Cheatham of St. Matthews; W. S. Scoggan of Sanford, Fla., and R. R. Scoggan of Jeffersonville. The company is capitalized at $16,000 and proposes to manufacture appliances for electric and steam railroads.

THE TEXAS BATTERY COMPANY of Dallas, Tex., has been incorporated with a capital stock of $20,000 to manufacture electric batteries, by E. R., H. B. and R. L. Tennant.

THE VOLTA MANUFACTURING COMPANY, LTD., of Welland, Ont., Canada, has been incorporated by Robert T. Turnbull, John Young, John W. Simpson all of Welland; Charles W. Sims of St. Catherines. The company is capitalized at $200,000 and proposes to take over the property and business of the Volta Manufacturing Company, manufacturer of electrical machinery, tools, equipment, iron, steel and other metals.

THE MORGAN CRUCIBLE COMPANY OF AMERICA has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $3,000,000 to manufacture electrical machinery, etc. The incorporators are: Ira L. Anderson of East Orange, N. J.; George Edwards of Bellrose, N. Y., and Harry E. C. Mills, New York City.

THE COLONIAL CHANDELIER WORKS of New York, N. Y., has been incorporated by G. S. Fulton and J. and H. W. Gross, 1017 Intervale Avenue, New York, N. Y. The company is capitalized at $100,000 and proposes to manufacture lighting fixtures.

THE WILLYS LIGHT & POWER COMPANY, of Syracuse, N. Y., has been incorporated with a capital stock of $10,000 by C. B. and V. L. Wheeler and C. A. Schneider. The company proposes to operate local electric light and power plant.

THE HUDSON ELECTRIC APPLIANCE COMPANY of West New York, N. J., has been incorporated by Davis, M. A. Rosenberg and D. J. Delaney. The company is capitalized at $25,000 and proposes to manufacture electrical appliances.

THE STAFFORD ELECTRICAL COMPANY of Buffalo, N. Y., has been incorporated with a capital stock of $10,000 to manufacture electrical goods. The incorporators are: H. C. and E. J. Stafford and L. Jaworski of Buffalo.

THE CEDAR KEYS (Fla.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $10,000 to install electric light and power plant, water works, and ice plant. L. A. Stoler is secretary and treasurer.

THE BINGHAMTON (N. Y.) ELECTRIC TRUCK COMPANY has been incorporated with a capital stock of $200,000 to do a general auto business. The incorporators are: H. C. Warner, F. S. Matthews and W. H. Riley of Binghamton.

Construction News

Projects, Plans, Bids and Contracts,
Contemplated or Under Way

New England States

BROCKTON, MASS.—The question of requiring the Edison Electric Illuminating Company of Brockton to place its wires underground on High Street is under consideration by the Board of Aldermen.

HOLYOKE, MASS.—Contracts amounting to more than $63,000 have been awarded for machinery for the municipal electric light plant. The equipment, which will increase the output of the plant from 10,000 kw. to 13,000 kw., includes two boilers, superheaters and automatic stokers. John J. Kirkpatrick is manager.

EAST HAMPTON, CONN.- The Central Connecticut Power and Light Company is erecting a new electric transmission line from Hartford to Glastonbury. Owing to the high cost of construction the company has abandoned any further development of water power and, it is understood, will purchase energy from the Hartford (Conn.) Electric Light Company.

NEW HAVEN, CONN.—A permit has been granted to the United Illuminating Company for the erection of a power house on Grand Avenue, to cost about $48,000.

NEW HAVEN, CONN.—Contract has been awarded by the National Folding Box Company for alterations and improvements to its power plant at Alton and James Streets to C. W. Blakeslee & Son, Waverly Street, New Haven.

NEW HAVEN, CONN.—The Sperry Engineering Company of New Haven has been awarded the contract for the construction of the new silk mill for Charles Wimpfheimer. Several buildings and also a power plant will be erected in connection with the proposed works

Middle Atlantic States

BUFFALO, N. Y.—A special meeting of the stockholders of the Buffalo General Electric Company will be held April 20 for the purpose of authorizing an issue of $5,000,000 in debenture bonds, and increasing its capital stock from $10,000,000 to $25,000,000.

BUFFALO, N. Y.—Bids will be received by Edward F. Jaeckel, clerk of Board of Supervisors of Erie County, until April 20, for furnishing and installing complete electric light and power equipment in the new county hospital at Wende.

CHURCHVILLE, N. Y. — The Public Service Commission has granted the village of Churchville permission to construct and operate municipal electric light and power plant.

ELMIRA, N. Y.—A bill has been introduced in the State Legislature authorizing the city of Elmira to establish a municipal electric light plant.

GOWANDA, N. Y.—Plans have been prepared by Charles E. Eaton, Sherman Building, Watertown, for construction of a power plant for the Iroquois Utilities Corporation on Cattaragus Creek at Gowanda to cost about $150,000. The equipment will include three 500-hp. generating units.

NEW YORK, N. Y.—Preliminary plans are being prepared for the erection of a telephone exchange at Vesey, Barclay, West and Washington Streets, to cost about $750,000, for the New York Telephone Company. McKenzie, Voorhees & Gmelin, 1123 Broadway, are engineers.

QUEENS, N. Y. — Contract has been awarded by the Borough Council for the construction of a new electrically operated pumping station at Sutter and North Conduit Avenues, including the installation of machinery, to the Fox Reynolds Company, 81 East 125th Street, New York City. The cost is estimated at about $125,000.

SALAMANCA, N. Y. — The Salamanca Panel Company is planning to install a 200-hp. electrically driven plant. Equipment will include two 50-hp. motors, one 15-hp. motor, five 10-hp. motors and several 5-hp. motors.

SARDINIA, N. Y.—The Holland-Sardinia Light & Power Corporation, recently organized with a capital stock of $150,000, has petitioned the Public Service Commission for permission to construct a hydroelectric plant on Sardinia Creek.

CAMDEN, N. J. — A large electrically operating crane, complete loading and unloading machinery, as well as other electrical and mechanical equipment will be required in connection with the construction of the proposed new pier, wharf and warehouse by the Harbor Commission at the foot of Spruce Street, Delaware River.

TRENTON, N. J.—Plans have been completed by the City Commission for improvements and extensions to the street-lighting system in the center district of the city as well as the outlying sections. It is proposed to install a large number of 600-cp. Mazda lamps to replace the present arc lamps and also 400-cp. and 100-cp. lamps in the outlying districts. Plans are also being prepared for the installation of a new lighting system in Upper Stacy Park.

CARLISLE, PA.—Work has been started on the construction of the proposed new power house at the carpet manufacturing works of E. C. Beetem & Sons on East Luther Street. The cost, including machinery, is estimated at about $50,000

MUNHALL, PA.—Plans have been completed by the Duquesne Light Company of Pittsburgh for the construction of a new substation in Munhall.

PHILADELPHIA, PA.—Bids will be received by William S. Twining, director Department of City Transit, 1211 Chestnut Street, Philadelphia, until April 20, for work on restoring conduits and cables in south side of city hall.

MILFORD, DEL.—Improvements to the municipal electric light plant, to cost about $20,000, are under consideration by the Town Council.

CHARLESTON, W. VA.—The Virginia Power Company is contemplating an addition to its Cabin Creek plant, including the installation of a 250-hp. turbine. The cost of the work is estimated at $350,000. The company has contracted to supply electricity to the Consolidated Light, Heat & Power Company. Under the terms of the contract the company is to supply a minimum of 3,000 kw. and a maximum of 5,000 kw., with provision for a further extension of the maximum to 15,000 kw. To supply the service the Virginia company will erect a high-tension transmission line from its plant at Cabin Creek to Huntington.

HUNTINGTON, W. VA.—Arrangements have been made with the Consolidated Light, Heat & Power Company to secure electricity from the Cabin Creek plant of the Virginia Power Company. An expenditure of about $100,000 will be required by the local company to utilize the energy to be supplied by the Virginia company. The Konova plant of the Consolidated company will continue to operate to its full capacity.

WASHINGTON, D. C.—Plans have been prepared by the Potomac Electric Company for improvements to its substation at 438 Washington Street, to cost about $17,000

WASHINGTON, D. C.—Bids will be received by the Machinery and Engineering Materials Branch, Munitions Building, Washington, D. C., until April 29 (Circular M. E. 195), for furnishing 52,000 feet of cable and 24,000 feet messenger strand wire. Bids will also be received until April 20 (circular M. E. 194) for furnishing one storage battery, one slate panel, one switchboard, one combination generator and feeder panel, one battery charging panel, one 7½-hp. motor, one direct current generator and one flexible coupling.

North Central States

DETROIT, MICH.—The Board of Fire Commissioners, it is understood, is asking for bids for the construction of a central fire alarm station, 55 ft. x 109 ft., to be located at Macomb and Antoine Streets. Donaldson & Meier, Penobscot Building, Detroit, are architects.

DETROIT, MICH.—At an election held April 6 the proposal to issue $15,000,000 in bonds, the proceeds to be used to build a municipally owned street railway system, was carried. Work will begin at once on the proposed car line.

DETROIT, MICH.—Extensions and improvements contemplated to the municipal lighting system, to cost about $108,000, are under consideration by the Public Lighting Commission. The work will consist of laying conduits, installing cables and fitting up eighty-two lamp posts and arc lamps on Kercheval Avenue between Junction Avenue and Fourteenth Avenue, and also fitting circuit regulators in substation. The construction of underground conduits in a number of streets of the city, to cost about $151,000, is also under consideration.

LANSING, MICH.—Plans are being prepared for the construction of a new municipal electric light plant, to cost about $1,000,000. Alvord & Burdick, Hartford Building, Chicago, Ill., are engineers.

NORTHVILLE, MICH.—Plans for the proposed hospital group to be erected in Northville by the Detroit Board of Health provide for a separate power and heating plant. Stratton & Snyder, Union Trust Building, Detroit, are architects.

DOVER, OHIO—Contract for extensions to the municipal electric light plant has been awarded to the Joseph L. Skelton Engineering Company of Toledo, at $99,950 Under the terms of the contract the contractor is to take the old gas engine equipment.

HAMILTON, OHIO—Plans are being prepared by Bodenstein & Surman, architects, Cincinnati, for equipping the plant of the Herring-Hall-Marvin Safe Company with motor-driven machinery. The plans call for a new power plant and a new boiler room. The cost is estimated at about $80,000.

LOVELAND, OHIO—Bids will be received by Frank Chase, Loveland, until April 27, for construction of a municipal light plant The cost is estimated at $125,000.

INDIANAPOLIS, IND.—Plans are being prepared by the Marietta Safe Cabinet Company for a new plant, to cost about $2,000,000. The building will include a main metal working plant, assembly building, power plant, chemical works and research laboratory. R. H. Dick is vice-president and general manager.

LOGANSPORT, IND. — The Indiana Public Service Commission has authorized a $50,000 bond issue for improvements in the municipal light plant.

CHICAGO, ILL.—Plans have been prepared by Marshall & Fox for a power station for the Commonwealth Edison Company to be erected on the Calumet River between 98th and 100th streets, to cost about $5,000,000.

DIXON, ILL.—The Public Utilities Commission has granted the Illinois Northern Utilities Company permission to construct and operate a transmission line connecting its Milan-Viola line with the plants of the Hydraulic Pressed Brick Company and other industrial concerns.

ELGIN, ILL.—The local electric plant of the Aurora, Elgin & Chicago Railroad Company was destroyed by the tornado on March 29.

ORION, ILL.—The Illinois Public Utilities Commission has granted the Sherrard Power System of Orion permission to extend its transmission lines from Orion to Osco and Lynn. The company was also authorized to erect a transmission line to Matherville and to extend its line from Preemption to Reynolds and furnish service to the Reynolds Light & Power Company

RICHMOND, ILL.—Plans are under consideration for extensions to the municipal electric light plant, to cost about $200,000

SPRINGFIELD, ILL.—Arc lamps will be installed by the City Council in South Fifth Street, pending an appeal to the Supreme Court of the state of the ornamental lighting system assessment case, which was decided against the city.

TAYLORVILLE, ILL.—At an election to be held April 29 the proposal to issue $80,000 in bonds for the installation of a municipal electric light plant will be submitted to the voters.

MILWAUKEE, WIS. — The Duplex Storage Battery Company, 637 Edison Avenue, is planning to build a plant in West Allis, to cost with equipment about $50,000.

SUPERIOR, WIS.—The installation of a lighting system on Tower Avenue this spring is under consideration by the City Commissioners.

ST. PAUL, MINN.—Bids, it is understood, will soon be asked for the installation of an ornamental street-lighting system on Summit Avenue, between Rice Street and the Mississippi River, to cost $104,000.

SAVAGE, MINN.—The village Council has granted the Lake Electric Company permission to erect an electric distributing system in certain streets of the village.

MAQUOKETA, IOWA.—The Iowa Electric Company has petitioned the Supervisors of Scott County for a franchise to erect a transmission line along the county road from Big Rock to Allen's Grove, and also to operate in the town of Big Rock. The company has applied to the Commissioners of Clinton County for permission to run continuous lines through Welton Township.

FULTON, MO.—The installation of a 250-kw. generating unit and engine in the plant of the municipal electric light and water works is under consideration. W. J. McCarroll is superintendent.

ST. LOUIS, MO. — Contract has been awarded by the Valley Electrical Company for the erection of a new plant on King's Highway Boulevard, between Kemper Park and Connecticut Street, to Henry Dilschneider, to cost about $300,000. The company has recently taken over the business and property of the St. Louis Electrical Works, now located at 4060 Forest Park Boulevard.

HETTINGER, N. D. — The electric plant of the Hettinger Electric Light & Power Company was recently destroyed by fire, causing a loss of about $20,000.

BEAVER CITY, NEB.—The installation of a 150-hp. engine and a 100-kva. generator in the municipal light and water works is under consideration. C. Roberts is manager.

HOWELL, NEB.—Plans are under consideration to change the system of the municipal electric light plant from direct to alternating current. G. Lodes is secretary.

HUTCHINSON, KAN. — Plans are being prepared by the United Water, Gas & Electric Company for improvements to its plant, including an addition to power house to provide space for two additional boilers. New pumps will also be installed.

Southern States

GASTONIA, N. C.—An election will soon be called to submit to the voters the proposal to issue $285,000 in bonds for extensions and improvements to the municipal electric light plant and waterworks system.

TIMMONSVILLE, N. C.—The plant of the local gas and electric company was recently destroyed by fire.

UNION, S. C.—The Council is considering calling an election to submit to the voters the proposal to issue $30,000 in bonds for extensions to the municipal electric lighting system.

ADEL, GA.—Improvements are contemplated to the municipal electric light plant, to cost about $14,000.

FERNANDINA, FLA.—Work has begun on the construction of a large phosphate plant for the Florida Phosphate Terminal Company, to cost about $500,000. The equipment will include power plant apparatus, crushing machinery, drying equipment, electrically-driven cars, etc. The plans provide for a separate power plant. Charles E. Waddell of Asheville, N. C., is engineer in charge.

CLARKSVILLE, TENN. — Preparations are being made by the Clarksville Electric Company to build a new electric plant.

BIRMINGHAM, ALA.—Work will begin at once by the Alabama Power Company for the construction of the 44,000-volt transmission line from Vida to Selma, a distance of about 30 miles.

BIRMINGHAM, ALA.—The Sloss-Sheffield Steel and Iron Company has applied to the city commission for a franchise to construct, maintain and operate a high-tension electric transmission line from its North Birmingham plant, through the city of Birmingham, to the southwestern limits of the municipality. The Sloss company proposes to operate its mines by electricity generated at its North Birmingham plant.

MONTGOMERY, ALA.—The Alabama Power Company of Birmingham has been granted permission by the War Department to erect a high-tension transmission line across the Alabama River in connection with its high-tension line from its hydro-electric plant at Lock 12 to Montgomery.

MONROE, LA.—Work will soon begin on the construction of the new municipal electric light and power plant. The Foundation Company, 233 Broadway, New York, N. Y., is contractor.

CLAREMORE, OKLA. — Bonds to the amount of $75,000 have been voted for improvements for the municipal electric light plant and waterworks system.

ABILENE, TEX.—The American Public Service Company of Chicago, Ill., has submitted a proposition to the city of Abilene to take over, rehabilitate and operate the local street-car system. The cost of such improvements is estimated at $50,000.

ALVIN, TEX.—The Alvin Ice, Light & Power Company contemplates the installation of complete machinery and equipment for an ice plant.

COLUMBUS, TEX.—Arrangements are being made by the Columbus Electric Light Company to enlarge its plant and to build an electric transmission line to Giddings, a distance of 3 miles.

DALLAS, TEX.—The Dallas Power & Light Company is contemplating the construction of a spray pond and cooling system at its local plant, to cost about $107,000.

DALLAS, TEX.—Plans are being prepared for an ornamental street-lighting system on North Harwood Street, to cost $25,000. George D. Fairtrace is engineer.

DENISON, TEX.—Plans are under consideration for new ornamental lamps to replace those now in use on Main, Elm and Commerce Streets. About 200 new lamp standards will be required, to cost about $70 each.

GONZALES, TEX.—Preparations are being made by the Houston-Guadalupe Water Power Company for the construction of a 1,000-hp. hydro-electric power plant on the Guadalupe River, to cost about $140,000. The plans include a transmission system, 60 miles long, to connect Guadalupe, Gonzales, San Antonio and other cities and towns, to cost from $250,000 to $300,000. Bids for construction, it is understood, will be asked within sixty days. E. Kennedy, Binz Building, Houston, is general manager.

Pacific and Mountain States

OLYMPIA, WASH.—Bids will be received at the office of Secretary of State Capitol Commission, until April 30, for the erection of the power house, chimney and tunnels, for the Capitol group for the State of Washington. Separate bids will be received at the same time for heating plant and other mechanical equipment. Plans and specifications are on file in the office of Wilder & White, architects, 50 Church Street, New York, N. Y., and of Bebb & Gould, architects, Temple of Justice Building, Oylmpia, where copies may be obtained.

ROSEBURG, ORE.—At an election to be held in May the proposal to issue bonds to the amount of $500,000 for construction of a municipal power plant and water system will be submitted to the voters. All previous bond issues on this project will be repealed.

VALE, ORE.—J. E. Johnson of Vale has filed application with the State Engineer for permission to divert the waters of the middle fork of the Malheur River in Harney County for a hydro-electric development. The construction of a canal and a municipal power plant is contemplated, to cost about $350,000.

ALAMEDA, CAL.—Plans for extending the municipal electric distributing system to Bay Farm Island are under consideration. The cost is estimated at $25,000.

ALAMEDA, CAL.—Contract has been awarded by the Electric Light Commissioners for the construction of a new substation on Webster Street and Atlantic Avenue, to cost about $60,000.

BUTTE CITY, CAL.—Application has been filed by N. A. Baker for the proposed Afton irrigation district, Butte City, for permission to take 60 cu.ft. per second from Sacramento River, Glenn County, for agricultural purposes on 2,000 acres. Diversion works, including a pumping plant, will cost about $20,000.

CHICO, CAL.—Application for permission to divert 12 cu.ft. per second of water from Hamlin slough, in Butte County, tributary to Butte Creek, for agricultural purposes on 2,768 acres, has been made to the State Water Commission by J. H. Jones of Chico. The project includes the construction of a dam and pumps.

LOCKPORT, CAL.—The Railroad Commission has granted the Snow Mountain Water & Power Company permission to issue $1,500,000 in capital stock for extensions to its electric power plant and system.

OAKLAND, CAL. — Extensive improvements are being made by the Pacific Gas & Electric Company to its local system involving an expenditure of about $7[illegible]. New equipment including a 16,000-hp. steam-turbine generator with condensing apparatus and six new boilers of 822 hp. each will be installed in the First and Grove Streets power station.

REDDING, CAL.—Surveys are being made by the Pacific Gas & Electric Company for a 200-mile steel tower line from Pitt River power house site down the valley in Shasta County. Surveys are also being made for a dam across Pitt River in the Big Bend, near Henderson.

SACRAMENTO, CAL.—Martin & Carter of Sacramento have applied to the State Water Commission for permission to divert water from the Sacramento River in Sacramento County for a 430-acre irrigation project to cost about $425,000.

SALINAS, CAL.—Surveys are being made by the Coast Valleys Gas & Electric Company, 52 Sutter Street, San Francisco, for the erection of an auxiliary transmission line between Lagunitas and Soledad. The cost of the proposed line is estimated at about $100,000.

SAN FRANCISCO, CAL.—The South Yuba Mining & Development Company of San Francisco has filed application with the State Water Commission to take 125 cu.ft. per second from the south fork of the Yuba River, Nevada County, for power purposes. The cost is estimated at about $400,000.

WEED, CAL.—The Weed Lumber Company contemplates the installation of a 1,500-kw. turbo-generator. J. M. White is general manager.

WILMINGTON, CAL.—A second petition has been presented to the Board of Public Works asking for extension of the ornamental lighting system from B Street to Water Street and along the entire length of the Catalina Terminal property.

TONOPAH, NEV. — The Montezuma Mines Corporation contemplates equipping the machinery in its mines for electrical operation.

CLAYTON, N. M.—The installation of one 100-kva. generator in the municipal plant is contemplated. J. H. Bender is superintendent.

Canada

MACLEOD, ATLA. — Reconstruction of the entire distribution system of the municipal electric light plant is under consideration. V. Pearson is superintendent.

SOURIS, MAN.—Work, it is understood, will soon start on the erection of the proposed transmission line from Portage la Prairie to Morden via Roland.

HALIFAX, N. S.—Tenders, it is reported, will soon be asked by the Nova Scotia Power Commission, Halifax, for an 8,000-hp. hydro-electric development in St. Margarets Bay, about 20 miles from Halifax. H. K. Smith is chief engineer of the commission.

HAMILTON, ONT.—The installation of a fire-alarm system, to cost about $110,000, is under consideration. A. B. Ten Eyck is fire chief.

HAMILTON, ONT.—The Grand Trunk Railway Company is planning to erect a telephone line (for dispatching service) between Hamilton and Sarnia, a distance of 150 miles. The cost is estimated at about $200,000. C. Forrester of London is superintendent.

PETERBORO, ONT.—The Canadian General Electric Company of Toronto is considering further extensions to its local plant. J. J. Ashworth is assistant general manager.

ST. CATHARINES, ONT.—The Niagara, St. Catharines & Toronto Railway Company contemplates increasing the capacity of its local substation. E. W. Oliver is general superintendent.

TORONTO, ONT.—Work, it is understood, will begin at an early date on the French River project by the Ontario Hydro-Electric Power Commission. The proposed developments will supply electricity in the towns and districts of Sudbury, Sturgeon Falls, Callander and North Bay.

PORTNEUF, QUE.—The J. Ford Company contemplates a 3,000-hp. development on the St. Annes River, in connection with an extension to its pulp and paper plant.

Miscellaneous

PANAMA.—Bids will be received at the office of A. F. Flint, general purchasing officer, the Panama Canal, Washington, D. C., until April 22, for copper cable, storage batteries, cable end bells, receptacle boxes, condulets, circular loom or conduit, cutouts, conduit elbows, hard horn fiber, electrical fixtures, renewable fuses, lamp guards, electrical water heaters, pipe-forcing jacks, [illegible] switches, etc. Blanks and information relating to this circular [illegible] may be obtained at the above office.

Record of Electrical Patents

Notes on United States Patents

(Issued March 30, 1920)

1,334,492. System of Field Excitation for Dynamo-Electric Machines. Chester T. Allcutt, Wilkinsburg, Pa. App filed March 13, 1918. Flux under interpole regulated in accordance with load current.

1,334,943. Trolley; Christian Aalborg, Wilkinsburg, Pa. App. filed Feb. 19, 1914. Number of pivotally and resiliently mounted contact shoes independently and separately supported upon a pantograph frame.

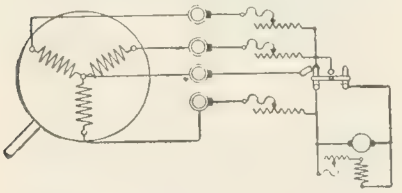
1,334,946. Primary or Voltaic Battery or Cell; John P. Constable and Clarence G. Michalis, West Orange, N. J. App. filed Oct. 6, 1917. Frame clamped to negative electrode, assuring good contact.

1,334,962. Apparatus for Subjecting Substances or Molecular Matter to the Electrostatic Stress of a High-Tension Electric Discharge. Fred G. Niece, Cleveland, Ohio, and Ross M. Leggett, Akron, Ohio. App. filed March 25, 1919. Produces polymerization or alterations in chemical or physical structure.

1,335,009. Process and Apparatus for Manufacturing Steel Alloys; William E. Moore, Pittsburgh, Pa. App. filed Nov. 19, 1918. Steel for forging and rolling preheated and treated in successive electric furnaces.

1,335,014. Electric-Current-Regulating Wall Switch; Antonio Papini, Philadelphia, Pa. App. filed Aug. 11, 1919. Fibrous resistance material inclosed in switch.

1,335,015. Current-Regulating Plug and Socket; Antonio Papini, Philadelphia, Pa. App. filed Aug. 11, 1919. Combination socket and plug with inclosed resistance material for regulation.



No. 1,335,050. Alternating Current Motor

1,335,016. Current-Regulating Treadle Switch; Antonio Papini, Philadelphia, Pa. App. filed Aug. 11, 1919. Compressible resistance material in switch container.

1,335,017 Current-Regulating Plug and Pull Socket; Antonio Papini, Philadelphia, Pa. App. filed Aug. 15, 1919. For medical batteries, lighting circuits and small motors.

1,335,018. Current-Regulating Plug and Socket; Antonio Papini, Philadelphia, Pa. App. filed Aug. 15, 1919. Contains insulating cylinder in shape of cup containing resistance material to be compressed by a piston.

1,335,019. Current-Regulating Foot Switch; Antonio Papini, Philadelphia, Pa. App. filed Aug. 15, 1919. Metallic spring-pressed, foot-actuated button.

1,335,020. Electric Heater for Water and Other Liquids; Antonio Papini, Philadelphia, Pa. App. filed Aug. 28, 1919. Resistance units in series within porcelain-lined container.

1,335,021. Carbon Comb Electrode; Antonio Papini, Philadelphia, Pa. App. filed Aug. 28, 1919. Carbon comb provided with projecting elements arranged in staggered order.

1,335,022. Rheostat; Antonio Papini, Philadelphia, Pa. App. filed Oct. 13, 1919. Cylindrical container with layers of mica mixed with graphite in suitable proportions and disks of metal to be compressed.

1,335,023. Current-Regulating Plug and Socket; Antonio Papini, Philadelphia, Pa. App. filed Nov. 19, 1918. Graphite mixed with pulverized mica forms regulating material for pull socket.

1,335,050. Alternating-Current Motor; Valere A. Fynn, St. Louis, Mo. App. filed March 15, 1918. Single or polyphase alternating-current motors with phase-wound induced members.

1,335,075. Article of Manufacture; Richard D. Paxson, Cleveland, Ohio. App. filed Sept. 19, 1919. Electric floor lamps to harmonize with surroundings.

1,335,079. Electric Furnace; Charles W. Speris, Battersea, London, Eng. App. filed June 10, 1919. Container composed of a material which constitutes conductor designed to be heated by a three-phase current.

1,335,107. System of Control; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Jan. 27, 1915. For alternating-current series commutator-type motors.

1,335,108. Phase-Converter System; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed April 4, 1916. Phase converter operates at synchronous speed to insure power-factor adjustment and stable operation.

1,335,109. Phase-Converter System; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 7, 1916. T-connected rotary type, provided with direct-current excitation for synchronous operation.

1,335,110. Commutating Means for Dynamo-Electric Machines; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 13, 1916. Commutating field winding excited under varying conditions of speed and load to compensate for sparking voltage under brushes.

1,335,111. System of Control; Rudolf E. Hellmund, Swissvale, Pa. App. filed Feb. 3, 1917. Automatic control of induction-motor circuits.

1,335,111. System of Control; Rudolf E. Hellmund, Swissvale, Pa. App. filed Feb. 13, 1917. Regenerative control with main dynamo-electric machine provided with an exciting field winding having a number of unequal parts.

1,335,119. Holding Means for Magnets; Terrence G. Louis, Springfield, Mass. App. filed March 26, 1919. Fork-like clip sprung over end of the magnet.

1,335,120. Electrical System for Automobiles; Walter O. Lum, Wilkinsburg, Pa. App. filed Nov. 29, 1915. Protects lamps of lighting systems.

1,335,125. Marking Device; John H. Miller, Wilkinsburg, Pa. App. filed Aug. 7, 1917. Recording stylus periodically supplied from an external source.

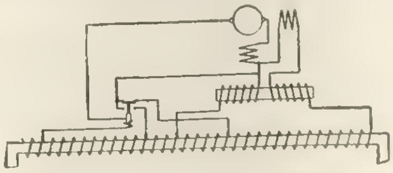
1,335,127. Control System; Laurence M. Perkins, Wilkinsburg, Pa. App. filed May 15, 1917. For alternating-current commutator-type motors.

1,335,129. Ventilation of Dynamo-Electric Machines; Giulio Schroeder, Hale, Eng. App. filed Nov. 22, 1916. Ventilation of inclosed railway and mill motors.

1,335,139. Thermostat System; Frank Thornton, Jr., Pittsburgh, Pa. App. filed Oct. 2, 1914. Thermostat operates to close control circuit, but never interrupts it.

1,335,141. System of Electrical Regulation; William A. Turbayne, Niagara Falls, N. Y. App. filed April 7, 1913. Variable-speed generator whereby generator voltage may be maintained substantially constant.

1,335,144. Dynamo-Electric Machines; Miles Walker, Manchester, Eng. App. filed Sept. 30, 1916. For machines having commutating poles or compensating windings for securing better commutation over wide variations in load.



No. 1,335,127. Control System

1,335,147. Electric Clock; Poul P. Andersen, Taastrup, Denmark. App. filed Jan. 23, 1918. Pendulum rotates toothed wheel, causing a periodical circuit closing by electromagnet which attracts its armature.

1,335,148. Electric Secondary Clock; Poul P. Andersen, Taastrup, Denmark. App. filed Jan. 23, 1918. Electromagetic circuit closed and broken periodically by a mechanical or electrical master clock.

1,335,152. Electrical Measuring Instrument; Charles B. Berst, Pittsburgh, Pa. App. filed July 3, 1916. Flat armature for ampere-hour meter with small air gap.

1,335,153. Automatic Starter for Automobiles; William L. Bliss, Niagara Falls, N. Y. App. filed Nov. 25, 1912. Small motor employed which will drive starting motor as generator.

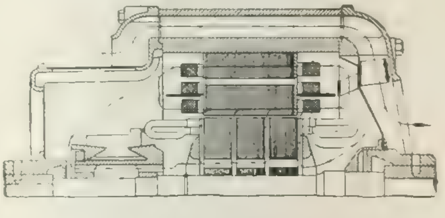
1,335,159. Means for Supporting Electrodes in Ionic Tubes; Frederick P. Driver, London, Eng. App. filed May 22, 1918. Tubes used as transmitting or receiving valves in wireless telegraphy.

1,335,174. Electrolytic Apparatus and Method; Matthew M. Merritt, South Middleton, Mass. App. filed Aug. 2, 1918. Use in connection with electrolytic deposits on cathodes.

1,335,175. Electrolytic Apparatus and Method; Matthew M. Merritt, South Middleton, Mass. App. filed Aug. 2, 1918 Provision for rapid and recurrent alternate immersion and emersion of cathode in electrolyte.

1,335,176 Electrolytic Apparatus and Method; Matthew M. Merritt, South Middleton, Mass. App. filed Aug. 2, 1918. Depositing copper to protect tips of aëroplane propellers.

1,335,177. Electrolytic Method and Apparatus; Matthew M. Merritt, South Middleton, Mass. App. filed Sept. 18, 1918. Manufacture of tubes for containers such as aëroplane radiators.



No. 1,335,129. Ventilation of Dynamo-Electric Machines

1,335,181. Rheostat; John Parkin, Jr., San Rafael, Cal. App. filed Aug. 12, 1919. For radio signaling.

1,335,199. Electric Furnace; Marcus Ruthenburg, Buffalo, N. Y. App. filed May 4, 1918. Resistance type adapted for reduction of elements from their compounds.

1,335,209. Process for the Prevention of Selective Corrosion of Tubes and Machinery Parts of Copper or Copper Containing Alloys; Franz Von Wurstemberger, Zurich, Switzerland. App. filed June 7, 1919. Prevents pitting by introducing into water an easily soluble hydrolytically decomposable acid reacting salt.

1,335,210. Method and Device for the Prevention of Selective Corrosion and Tubes and Machinery of Copper or Copper Containing Alloys; Franz von Wurstemberger, Zurich, Switzerland. App. filed June 11, 1919. Supplies from a chamber separted from but connected to water inlet of such machinery a salt having, when hydrolyzed, an acid reaction.

1,335,215. Annunciator; Henry J. Appleton, Detroit, Mich. App. filed Sept. 15, 1919. Provided with operating apparatus to give a differential peripheral speed to indicating rolls.

1,335,219. Coil-Unit and Spark-Plug Tester; Richard T. Carlson, Rosedale, Kan. App. filed Aug. 5, 1918. Spark-gap contactor in primary circuit for observing intensity of spark and for making adjustments.

1,335,256. System for Protecting Electrical Transmission Lines; Waldemar Petersen, Darmstadt, Germany. App. filed Nov. 12, 1914. Switches for disconnecting a section of line are provided with retarding means controlled by device inserted into line and responsive to rapid electrical disturbing waves.

1,335,272. Finger-Actuated Signal Light; Douglas J. Broughton, Springfield, Mass. App. filed March 20, 1918. For theater usher, to designate number of seats available.

1,335,295. Bell Rheostat; Antonio Papini, Philadelphia, Pa. App. filed Oct. 13, 1919. Adjusts voltage by compressible resistance in porcelain case.

Electrical World

The consolidation of Electrical World, Electrical Engineer *and* American Electrician

Volume 75 New York, Saturday, April 24, 1920 *Number* 17

Rising Publishing Costs

NEWSPAPER readers are generally conversant with the increasing burdens which all publishers now have to carry. Prices have gone up; but prices are not the only handicaps—freight embargoes and inability at times to get paper at any price are among the other troubles that must be encountered. An appreciation of what this means can be had from the following figures: At the present time the cost of publishing the Electrical World is 330 per cent greater than it was in 1915. Paper has increased in price 418 per cent; printing, 216 per cent; postage, 275 per cent; salaries and traveling expenses, approximately 100 per cent. True, subscription and advertising rates have been advanced, but not in proportion to the increased costs; and were it not for the enlarged volume of business the publishing company would be seriously handicapped. Inability to get paper has rendered it necessary to print this issue of the Electrical World with four less reading pages than normally. The service to readers remains the same, the articles being just as numerous but more concentrated.

Theodore N. Vail

THEODORE N. VAIL, unlike Alexander Graham Bell, with whose name the telephone will always be inseparably linked, was not an inventor. He was a business man with a genius for organization. To him more than to any one else the wide popularity of the telephone is due. His was the master mind that conceived and built the American Telephone & Telegraph Company and unified the telephone system from one end of the country to the other. Service was to him not sounding brass or a tinkling cymbal but an obsession. It found expression in the vast telephone system of which he was the head, and it manifested itself in the renewed vigor of the Western Union Telegraph Company when he obtained control. His perception of what was meritorious in invention was no keener than his ability to read men. In the handling of human beings he was a master. Large in stature and big in ideas, he exemplified what was best in American business and will be numbered among the great men of the industry.

A Sensible Solution

KEPT from striking for higher wages from a sense of loyalty to their company and yet believing that a 25 per cent increase was necessary to insure proper living conditions, a committee from the employees of the Colorado Springs Light, Heat & Power Company has put the matter before the Colorado State Industrial Commission. The committee has also petitioned the State Utilities Commission to grant an increase in rates to allow the company to meet the wage increase. Claiming that a precedent was set by the commission in the matter of rates and wages when it granted one of the traction companies permission to increase its fares to 6 cents to meet a demand by its employees for increased wages, the committee feels sure that an understanding will be reached by the two commissions. In these days of unrest in all industries such an example, based on the loyalty of a group of employees, is inspiring. It shows confidence in the institutions the people have created and a willingness to submit questions to the arbitrament of those institutions and abide by their decisions.

Central-Station Purchasing

THE question of purchasing the supplies of material and apparatus required in 1920 should have prompt consideration from central stations which have not already placed their orders. Prices may go up or they may go down, but that is beside the question. The public has a right to expect the utilities to exercise reasonable foresight in their purchasing policies, but high prices should not deter companies from maintaining adequate stocks. Electrical manufacturers are far behind with their orders, and deliveries are getting worse. Even if production could be increased and sufficient raw material could be obtained, it would be of doubtful benefit, because railroads can handle little, if any, more freight over existing tracks. The time has come when the central stations should follow the example of other large buyers and place orders for their requirements at least a year ahead. The supplies can then be shipped according to a predetermined schedule based on estimated needs. The adoption of this or some other method of assuring delivery is essential to the central stations if they intend to maintain their reputation and fulfill their obligation to be ready to serve.

The Needs of the Patent Office

THE National Research Council and the Engineering Council have joined hands in supporting legislation to meet the needs of the United States Patent Office. Not only is the personnel of the Patent Office insufficient in number, thus leaving much work undone or poorly done, but the salaries paid are inadequate for maintaining a competent force. The United States Patent Office employees appear to have had to join the ranks of the many who have not been helped in meeting the continuing increase in the cost of living. It is therefore time that something be done to provide for an adequate and better paid force in that branch of the government work. It is hardly necessary to point out that the present condition with its delays, its probable mistakes, and undoubtedly its low morale, is an obstacle in the path of progress. That our national engineering bodies are taking action in behalf of the Patent Office is therefore gratifying, and many engineers will doubtless join as individuals in supporting the bill that is at present before the Senate.

Danger of Specialization in Colleges

IT IS genuinely sound thinking that is prompting the faculties of some of our large engineering colleges to oppose the introduction of specialization into their courses. The amazing success of specialized, short-cut methods of teaching used to train men for carrying on specific work during the war has led leaders in the industrial and manufacturing field to call insistently for the application of the same methods in the training of the students they purpose to employ. The argument of these employers is that such men will be valuable from the day they start to work. What they fail to see is that the value of a student thus trained will be limited entirely to specialized subjects and that any change in occupation, due either to business conditions or to the personal inclination of the man, will leave him with no equipment that will help him to adapt himself readily and efficiently to new work. It should be evident that industry does not need such men. What it does need are men able to apply scientific methods to any work because they have a thorough grounding in fundamentals.

The university must teach fundamentals first. After that is it not better to let the graduate feel his way out in industry and find by experience the place where his usefulness is greatest? It is in itself a justification of higher education that those in charge of it see most clearly the way to progress in the training of men. It will be fortunate indeed, in these days when sound engineering is more than ever necessary for the general welfare, if the advantages to be derived by thorough courses can be made more attractive than the somewhat quicker routes to positions with good wages at the start which may be had through superficial instruction in special work.

Burning Low-Grade Southwestern Coals

IN THE aggregate the amount of our heritage from the carboniferous era is enormous, so great that it is difficult to compute, but until recent years the prodigious drafts of industry upon fuel have in the main been made upon the better grades found in the more convenient locations and relatively easy to work. The inroads on fuel of good quality from such sources have been very grave. If commercial exhaustion of good coal, both anthracite and bituminous, is to be postponed over a period of many years, it must be by utilizing the less promising kinds of fuel. It is with these that W M. Park has to deal in an article elsewhere in this issue. The coals he brings especially to view are those of the Southwest—a little anthracite, some rather poor semi-anthracite, much bituminous, and considerable lignite running as low as 6,000 B.t.u. As a whole, these Southwestern coals are quite rich in volatile matter, clinker rather readily and carry a high proportion of ash, reaching in some cases nearly 40 per cent. Semi-anthracite is of low volatility and hard to burn.

The interesting feature of Mr. Park's investigations is that even some of the worst of these coals can be burned at fairly high efficiency, passing 70 per cent, if proper conditions for combustion are obtained. In general these conditions, varying somewhat from fuel to fuel, are similar to those for other low-grade fuels—large grate capacity, big furnace space, and in many cases, particularly, long high-set arches. Chain grates seem in general to work well if properly installed and provided with a somewhat heavy draft. But under suitable conditions, and the secret here is chiefly furnace space and draft, almost any of these low-grade fuels can be worked with fair success and considerable economy. The result is extremely encouraging from the standpoint of fuel supply, and it is altogether evident that the time has arrived when the program for coal conservation must include the utilization of such coal.

Mechanical Standardization of Motors

AT THE present time, when the production cost of motors has been considerably increased and their use is rapidly extending, it becomes pertinent to inquire whether it may not be possible to keep down costs and thereby increase use through a cautious but thoroughgoing course of standardization. The variety of motors of closely similar electrical design is something prodigious. No very great differences are now to be found in general properties of motors produced by a considerable number of makers. Standard voltages, frequencies, specifications for temperature rise and the like, together with a somewhat general effort at standardized normal speeds, mark a certain uniformity of practice that has been of help. Nevertheless, there is a vast variety in the product of any single manufacturer. In output the machines run from about one cat-power to several thousand horsepower. Through this great range there is still considerable necessary diversity in speeds, especially in some sizes, to say nothing of differences in voltages and in form of winding. To these characteristic differences of design may be added not a few due to the utilization of motors for the directly connected tools and other conditions where special mechanical arrangements have to be adopted. All this means increased cost and inferentially some decrease of use.

C. W. Starker in this issue makes a strong and justified plea for an effort at mechanical standardization, which can certainly be carried out to a very considerable extent without meeting serious difficulties. He points out, for example, that a single concern, manufacturing by no means a wide range of motors, produces sixty-five different types of brush holders, twenty-seven sizes of oil rings and a similar number of bearings of odd bore and length, to say nothing of a preposterous variety in the smaller parts. All this complication, which had its origin in the growth of the art, cannot now be considered as in the least necessary or desirable. The mechanical details of a motor in such features as these have virtually no effect for better or worse on the electrical design. If the varieties could be considerably reduced in number by formal or informal standardization, the processes of manufacture would be much facilitated and costs by quantity production could probably be materially reduced. Labor is the serious item at present in all manufacturing processes, and to dispense with a certain amount of this even at slightly greater cost of raw material would mean no inconsiderable gain. A great many special sizes of motors are in reality rather unnecessary, having been the product of fancy rather than genuine need. Mr. Starker gives some striking data regarding the distribution of sales between the various sizes of smaller motors, from which it appears that the demand tends to fall into well-defined groups so that really a few mechanical forms would suffice to meet the whole genuine requirement. The same sort of thing would hold for a much wider variety of motors adapted to various uses. Now and then some very special form may be required in such large numbers as to justify a highly specialized design, but this is the exceptional and not the usual case.

Effectively Lighting a Large Interior

DESPITE all well-meant efforts to reduce practical lighting to a conventional level expressed in watts per square foot, the illuminating engineer finds himself not infrequently confronted with problems not to be solved by charts or the slide rule—problems in which harmony with architectural effects and the beauty and appropriateness of the results are the controlling factors. An excellent example of such a case is that described in this issue by James R. Cravath, one occurring in the ordinary course of his illuminating practice. The problem which confronted him was an unusual one, that of lighting the so-called atrium of a great hotel at West Baden Springs, Ind., a circular room some 200 feet (60 m.) in diameter with a dome 110 feet (33 m.) high. This great inclosed space is used chiefly as a "lounge," although at times as a ballroom and for other gatherings of a festive nature. Lighted from skylights by day, the normal condition was brilliancy in the upper part of the dome, shading off toward the widespread ground level. This same idea was carried out by the architect in his scheme of decoration, in which the color was toned from a tawny hue at the floor line to a hue substantially white at the center of the dome far above.

To deal with this situation and produce illumination which would harmonize in shading with the decorations, Mr. Cravath adopted a bold expedient, lighting the whole great space from a single colossal indirect fixture, a highly decorative structure framed in steel and 27 feet (8.1 m.) in diameter at a general level of about 100 feet above the floor. It is a mirrored fixture with eighteen 1,000-watt lamps in two tiers throwing their light, deftly shaded, from the mirrored structure upward and outward upon the dome. The bottom of the fixture is in ornamental plaster grillwork. A ring of lamps provides indirect light for illuminating this grill by reflection from the under side of the fixture floor and the backs of the main mirrors, all painted in tones to match the general color scheme of the interior. Finally a pendant to tone the light upon the grillwork, hung 12 feet (3.6 m.) below the center of the fixture, furnishes light from three mirrored reflectors. For floodlighting the atrium when *en fête* the pendant is lowered away, exposing four circular openings in the middle of the fixture, each carrying a powerful floodlamp the color of which can be modified by a revolving disk containing suitably tinted gelatine screens. The whole installation furnishes roughly a foot-candle of illumination on the floor, with a utilization factor of about 10 per cent—quite high enough where decoration is the fundamental purpose of the lighting scheme. Brackets on the columns, equipped with lamps having iridescent shades, furnish a decorative element below the main body of the dome, and table lamps give additional light for readers. The entire scheme strikes one as an extremely clever piece of decorative work, with illumination as the means rather than the end.

Engineers' Building in San Francisco

THE movement for the construction of an Engineers' Building in San Francisco, in which will be centered the activities of the engineering professions and trades of that community, is in line with the policy advocated by the ELECTRICAL WORLD. With the principle in mind that strong local organization is the first requisite to success in the broader fields of engineering enterprise and joint engineering activities, public-spirited engineers in the California city are endeavoring to enlist the support of organizations and individuals interested in carrying the building project through to completion. Their aim is to make it a true "civic center" of engineering interests. While the proposal is as yet tentative, the real need for such an institution and the determined manner in which the originators of the plan are setting to work seem to assure its complete success. This will be as it should be, for the idea merits wide consideration, and if San Francisco carries it through with characteristic enterprise, it will undoubtedly be adopted in other great industrial centers of the country.

Alleviating Short Circuits

ONE of the gravest features of modern central-station practice is the danger of short circuits involving all or a substantial part of the generating capacity. Especially does this bear on switchboard design and the capacity of the various circuit-breaking devices. In its crudest form the problem presents itself thus: Given n generators each of m kva. capacity, how shall one avert the necessity of providing a rather general equipment of circuit breakers, each capable of handling not only mn kva. but the corresponding short-circuit output? Around this problem centers the whole art of switchboard design and equipment. Elsewhere in this issue R. F. Gooding presents another of his very useful studies of the ways and means available for keeping short-circuit currents within reasonable reach of available circuit-breaker capacity. In particular he considers the technique of working with reactances to the best advantage, both on the primary and the secondary side. The best arrangement is not necessarily the most obvious, and the actual working out of the complex problem is given in some detail. Reactances have their limitations in the effect on the regulation; their cost, too, is far from negligible. They are, however, useful palliatives which can be put to good use. In fact, in a complex system one is always confronted by the cost and trouble of anything like full protection, and a point is finally reached where there is very strong temptation to take certain chances rather than go to the elaborate precautions necessary to guard against them. The method of group feeding outlined by Mr. Gooding has much to recommend it. In fact, we are inclined to the opinion that the concentration of the whole capacity of a big plant on a general busbar system, even sectionalized, is of dubious advantage. The gain in instantaneous flexibility hardly seems to compensate for some of the difficulties introduced, and there is much to be said for what may be called loose coupling with groups normally limited in interchange capacity.

Herbert A. Wagner

A pioneer in installation of alternating-current lighting systems, founder of the large electrical manufacturing company that bears his name and an able central-station executive

UNDER the supervision of Herbert A. Wagner, the first incandescent lighting plant in St. Louis, Mo., was installed in 1889. It was operated by the Missouri Electric Light & Power Company, later the Missouri Edison Company, now a part of the North American company's system in that city. As general superintendent Mr. Wagner worked out and placed in successful operation many of the features of present-day alternating-current distribution and transmission systems. Among these was the first series alternating-current arc-lighting circuit fed from the same station bus as power and incandescent lighting. About 4,000 direct-current series arc lamps were rebuilt for this purpose. Large single-phase direct-connected generators operated in parallel were installed for this system in 1895. In 1890 Mr. Wagner founded the Wagner Electric Manufacturing Company and began the manufacture of alternating-current fan motors in a small way. In this enterprise he was associated with the late S. M. Dodd, the organizer of the Missouri Electric Company and a prominent figure in St. Louis' industrial life for more than half a century. It was the urgent need of the Missouri Edison Company for better distributing transformers that led Mr. Wagner to extend the manufacturing business into the field of transformer work. The name of the Wagner company will, of course, always be associated with the introduction of the first successful alternating-current single-phase motor. These motors were first developed by Mr. Wagner for use in furnishing power from incandescent lighting mains.

It has fallen to the lot of very few electrical engineers both to build up a great manufacturing company and to develop a large central station. This Mr. Wagner has done, and in two widely separated states. In 1908 he relinquished a consulting engineering practice in St. Louis and New York to undertake the direction of the electrical division of the Consolidated Gas, Electric Light & Power Company of Baltimore, Md. He became vice-president of this company in 1911 and president in 1915. In its service Mr. Wagner has initiated many progressive methods and built up a business which measured in kilowatt-hours stands twenty-sixth among central-station outputs of the country. Since the early days of the National Electric Light Association he has taken an active interest in its affairs, serving on its public policy and executive committees, as vice-president in 1914 and 1915 and as president in 1916. Mr. Wagner was born Feb. 24, 1867, at Philadelphia, Pa.

Artistic Lighting of a Large Interior

Lighting of West Baden Atrium Was Designed to Harmonize with Decorative Scheme of Architects—Results Accomplished Largely by the Indirect Method, Giving a Utilization Factor of About 10 per Cent

By J. R. CRAVATH
Consulting Engineer, Chicago

ONE of the largest inclosed courts in the world, one well known to visitors at the West Baden and French Lick Springs in Indiana, is that of the West Baden Springs Hotel, commonly known as the "atrium." This hotel has its rooms arranged in a circle around this great court. The atrium has been for years a famous lounging place, offering indoor warmth with much of the sense of outdoor freedom during weather when outdoor lounging would not be comfortable. Incidentally it is a concert hall of remarkably good acoustic properties, of which the hotel management takes advantage several times each day for the pleasure of its guests. The artificial lighting of this court, which it is the purpose of this article to describe, was designed by the writer with the desire that it should harmonize with and form an important part of a beautiful scheme of interior decoration.

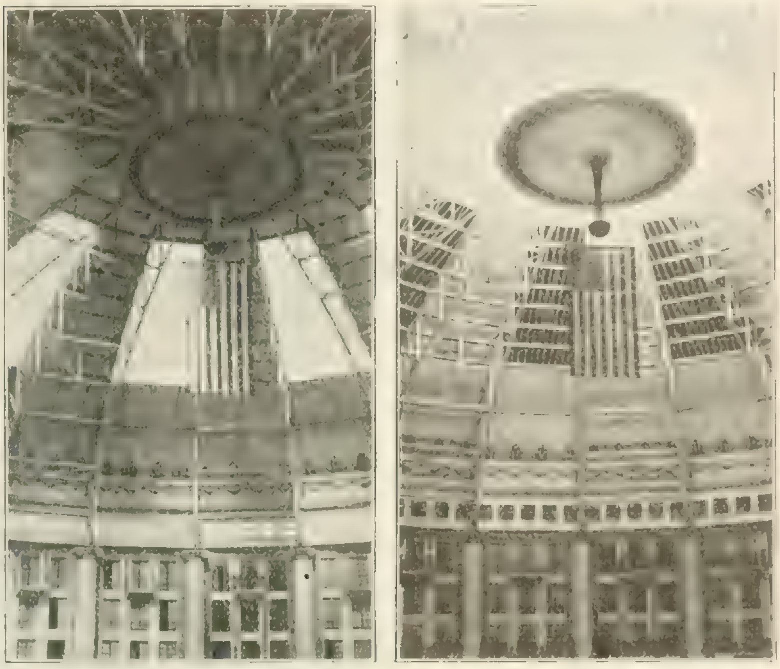


FIG. 1—LIGHTING OF DOME FROM ABOVE AND BELOW

Eighteen 1,000-watt lamps are used in the large indirect fixture above.

No photographs have ever been obtained which give an adequate idea of the atrium, owing to its great dimensions, both horizontally and vertically and its circular form. It is 200 ft. (61 m.) in diameter by 110 ft. (33 m.) high. The steel roof trusses converge to a hub at the center. Fig. 2 is a vertical cross-section through the center of the atrium, showing the approximate contour of the roof. Fig. 3 shows photographs taken by day and by night.

To understand the plan of the lighting, the decorative scheme must first be described. The background is all light in color, starting at the floor line with a color of light tan and gradually toning to nearly white at the center of the roof. The trim is verde antique. Along with a redecoration program the management wished to provide a plan of general lighting which would harmonize with the decorations. It seemed evident that the general lighting scheme provided must insure a gradual toning off of the brightness from the center of the roof down to the floor in much the same way as the toning off of the decorator's color background. To do otherwise would be to work at cross purposes. This, together with the shape of the interior, pointed to the necessity of having the central hub of the roof structure the brightness center of the upper interior. It was already the architectural center. As already intimated, the principal use of the atrium is as a lounging place, and therefore glare would be entirely out of place. At the same time, when fully lighted, it must be bright enough for dancing and social functions. The plan, as worked out, provides for a number of different lighting effects, ranging all the way from subdued localized lighting from table lamps and brackets alone to general lighting of the whole interior.

Design of Dome Lighting Fixture

The general lighting is mainly by the indirect method, using a fixture of very unusual design and size, shown in the photographs and in detail in Fig. 4. This fixture is directly under the steel hub of the roof structure and acts as an ornamental bottom for it. The hub is a steel cylinder 16 ft. (4.9 m.) in diameter and about 10 ft. (3 m.) high. The fixture is a steel-framed structure about 27 ft. (8.2 m.) in diameter. It is doubtless safe to say it is the only one of its kind in existence. For the general lighting of the atrium eighteen gas-filled tungsten lamps of 1,000 watts each are arranged in two circular tiers around the outside of this fixture. Each tier has nine lamps. Around the outside of the fixture, as shown, there are glass-plate mirrors which form a continuous covering or sheath for the steel structure, so that all light from the lamps incident upon the fixture is reflected outwardly or upwardly. Openings are provided which enable men to get out on the lower flange of the hub of the roof structure to clean these mirrors and renew lamps. The position of mirrors and lamps is designed to produce a gradation of brightness from the center of the roof to the lower walls. Direct light from the lamps ends about the second floor. Sharp demarkation between the zone of direct light and that of totally indirect light was to be avoided, and the arrangements shown accomplish this purpose well. Although no accurate tests of average illumination have been made, the installation when new showed illumination of one foot-candle and upward on the floor with all of the general indirect lighting turned on. This corresponds quite closely to the utilization factor of 10 per cent assumed in the preliminary calculations. The average illumination on the floor in this case, however, is only of importance as it indicates the general conditions of brightness of the interior, as the object of the lighting is to produce a beautiful general effect, with light enough to be cheerful. Light for reading is provided by the table lamps.

The brightness given to the surfaces by artificial light is one of the most important points. When the installation was new, with the general lighting units all in use, this was as follows, as viewed from a seat at one of the tables on the main floor:

Position (See Fig. 2)	Brightness in Millilamberts
(a) Near center of floor	0.77
(b) Half way up on wall	0.48
(c) Near edge of roof	0.94
(d) Near center of roof	4.33

In addition to concealing powerful lamps for general lighting, the fixture is also one of the notable decorative features of the atrium. The bottom of the fixture is an ornamental plaster grill-work designed to be in harmony with the other decorations of the atrium. In lighting a grill-work of this kind from above two things are important, diffusion and proper control of color. If there is not proper diffusion, there will be unpleasant glaring spots of light in the grill-work and other portions will be dark.

DOME FIXTURE IS ARTISTIC

To bring out the whole design of the grill the lighting must be fairly even and well diffused as it comes through the grill. Reasonably good diffusion can be obtained by various opal skylight glasses, but proper control of both color and diffusion by means of these glasses is difficult to obtain and likely to involve very annoying delays in securing just what is wanted. Therefore the plan used in this case was to provide indirect light for the interior of the fixture behind the grill-work, thus putting both color and diffusion well under control. For this a ring of 75-watt lamps, twenty-four in number, with flat reflectors pointed upward, is used in the space above the grill-work. These lamps throw light up against the backs of the mirrors and the under side of the floor of the switchroom, which is in the steel hub of the roof structure. The light which comes through the grill-work, as seen from below in the atrium, is the light reflected from the under side of this floor and mirror backs. By painting these diffuse reflecting surfaces the proper color, very beautiful and harmonious color effects are obtained.

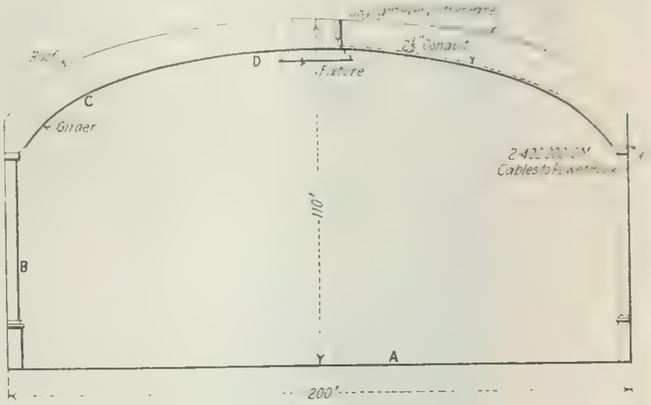


FIG. 2—PRINCIPAL DIMENSIONS OF WEST BADEN ATRIUM

In the ordinary program of daily operation during the early evening only the table and bracket lamps and the grill-work lamps of the main fixture are turned on.

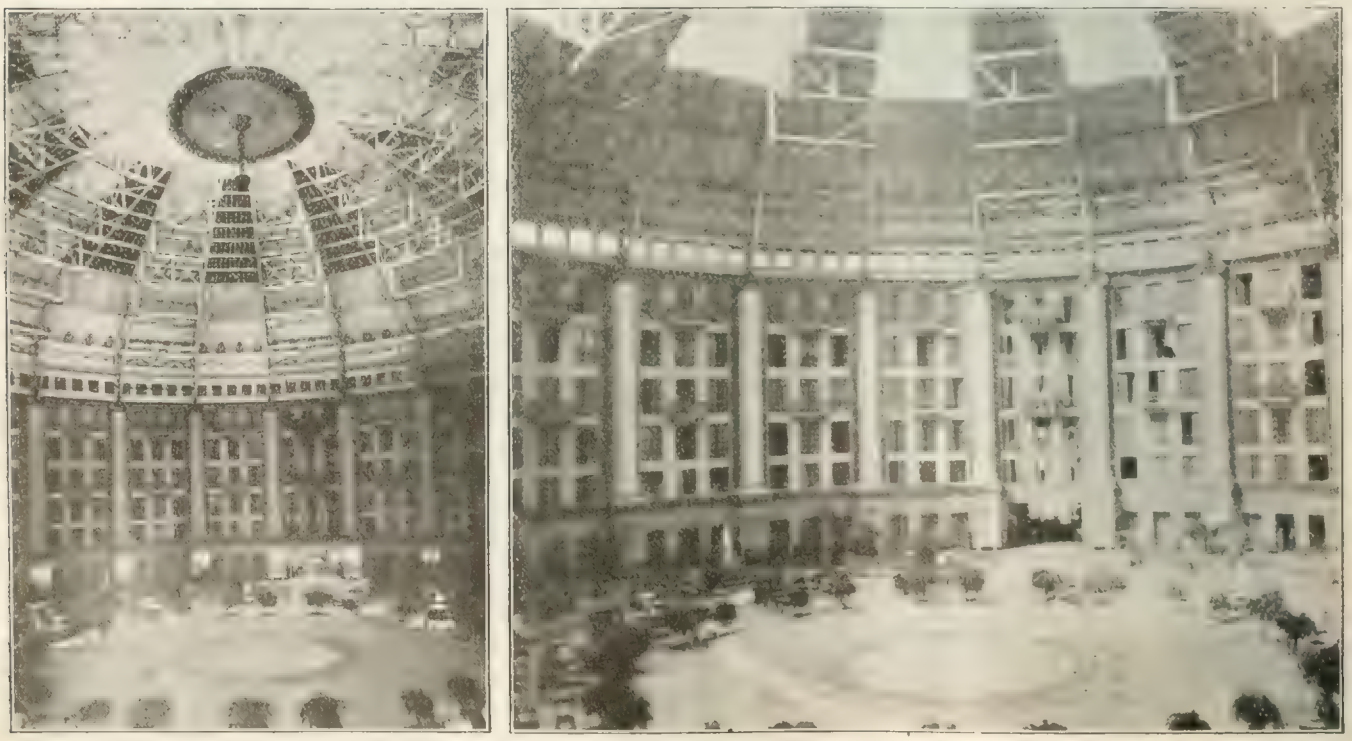


FIG. 3—NIGHT VIEW, FULLY LIGHTED; DAY VIEW WITH SUNLIGHT EFFECTS

This gives a subdued decorative effect. Later the general indirect light is turned on.

To light the grill-work of the fixture from below so that it will not appear altogether in silhouette, three mirrored reflectors were put in a pendant hanging about 12 ft. (3.6 m.) below the grill-work. In the decorative lighting of this fixture (independent of the general lighting it gives) three different effects can be obtained. With the grill lighted from above and below, which is the most pleasing combination and the one generally used, colored light comes from above through the grill-work and enough light is thrown up against the grill-work from the lamps in the pendant to bring out the design of the grill-work itself. With light coming through the grill and very little light from below the grill appears in silhouette. When the light above the grill is turned off and the indirect light from the pendant turned on, the grill-work is lighted from below only, giving a third effect on the grill.

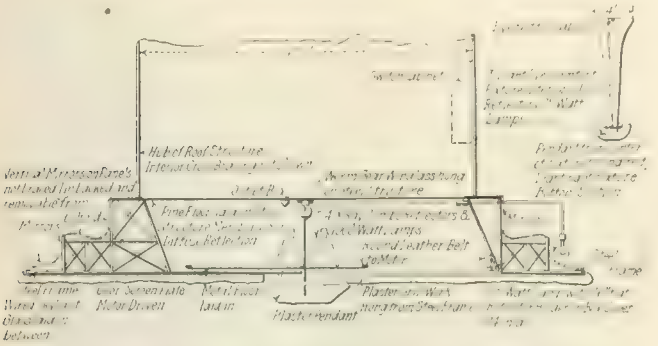


FIG. 4—SOME DETAILS OF CENTRAL FIXTURE MOUNTED IN THE DOME

Four gradations of intensity of the general illumination can be obtained by switching. Four switches control the general indirect lighting, and the 1,000-watt lamps on the big fixture are grouped upon these switches as follows: Three lamps equally spaced on the upper tier; six lamps equally spaced on the upper tier; three lamps equally spaced on the lower tier; six lamps equally spaced on the lower tier.

The switching is all done by remote-control switches housed in a switch cabinet in the hub of the steel structure above the fixture. These switches are controlled from the main floor of the atrium by the usual remote-control push-button switches.

FLOOD-LIGHTING WITH DIFFERENT COLORS

In addition to the regular lighting equipment of the central fixture, which is intended for ordinary service, a colored flood-lighting equipment has been provided for use on special occasions. When this is to be used the pendant is lowered to the floor by means of a windlass and is taken away. The removal of the pendant exposes four circular openings in the middle of the fixture, above which there are four "Jumbo" mirror reflectors each containing a 1,000-watt lamp. These are for flood-lighting the center of the atrium. To change the color of this flood-lighting, a color disk of steel with sixteen openings for colored gelatine screens is placed in such a position that it can be rotated under the four "Jumbo" reflectors so as to bring four different colors successively underneath the reflector opening. The rotation of the color disk is by means of a small electric motor, the movement of which is controlled by a push-button in the main control cabinet. It is not the idea that this motor be operated continuously, but at frequent intervals, thus preventing any color from getting ineffective.

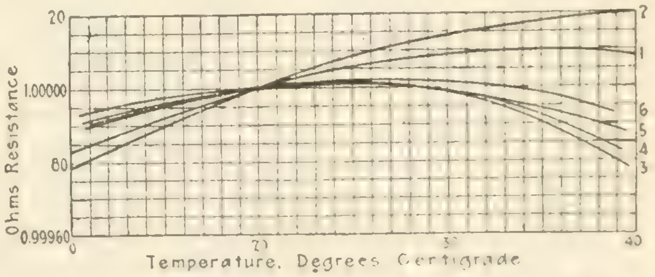
A scheme of this kind is not effective unless color changes can be made frequently, as the eye soon adapts itself so completely to any prevailing color that it is of no particular significance. The localized decorative lighting of the main floor, as before explained, is by brackets and table lamps. There are twenty-four brackets, one on each of the column bases. These are largely for decorative purposes and are provided with iridescent shades. Besides the brackets, there are twelve table lamps arranged symmetrically about an open central area. These can be removed to clear the floor when desired.

Controlling Temperature Coefficient of Manganin

INVESTIGATORS have observed large variation in the temperature coefficient of commercial manganin wire. Dr. Rosa has reported that samples of manganin tested in the Bureau of Standards between 15 deg. and 30 deg. C. have shown a temperature coefficient varying between four and twenty parts in a million per degree, but this sometimes exceeded twenty parts per million. The variation of resistance with temperature of six samples is given in the accompanying curves and the analysis of each of these samples is shown in the table.

DATA ON THE TEMPERATURE COEFFICIENT OF MANGANIN

	Analysis of Material				Temp. Coeff.	Resistivity in
Sample	Cu	Mn	Ni	Fe	18°–24° C.	Michrom-cms
1	88.02	9.93	1.74	0.24	1.2×10-5	34.2×10-6
2	87.24	10.26	1.77	0.52	1.5×10-5	37.4×10-6
3	88.20	8.84	1.78	0.93	0.33×10-5	55.6×10-6
4	83.60	12.03	3.41	1.04	0.22×10-5	47.8×10-6
5	84.72	12.83	2.08	0.73	0.38×10-5	50.8×10-6
6	84.07	12.98	2.60	0.82	0.57×10-5	51.1×10-6



VARIATION OF RESISTANCE WITH TEMPERATURE OF MANGANIN

It should be observed that the percentage of manganese, between the limits used, affects the resistivity of the wire, but has no effect on the temperature coefficient of resistance. The presence of iron, on the other hand, affects the temperature coefficient to a considerable degree. Those wires in which the iron content was low did not show the temperature coefficient reversal which is characteristic of a manganin wire. The results show that the presence of iron up to 1 per cent improves the temperature coefficient of the resulting alloy. It is also stated that during the annealing of the wire scrupulous care must be observed to avoid its oxidation and that, further, to stabilize the wire it is sufficient to anneal this at 150 deg. C. in an oil bath for a period of five hours.

Mechanical Design of Electric Motors

Standardization of Mechanical Features Necessary for Economical Manufacture—Standards Between Manufacturers Are Not a Bar to Progress—Cost Analysis and Sales Conditions as Basis of Design

By C. W. STARKER
Roth Brothers & Company, Chicago, Ill.

MANUFACTURING costs of electric motors may be reduced, production and sales increased by establishing standards for all motor manufacturers of such mechanical features as shaft and bearing sizes, base dimensions and heights, brush sizes, etc., so that parts may be used in common for a considerable range of ratings and motors of same characteristics, but different make, may be interchangeable. Considerable progress has been made in standardization of electrical features. Standard voltages, standard frequencies, standard temperature rises and so on have been adopted and are uniformly adhered to by motor manufacturers. But on the mechanical side practically no progress has been made. The mechanical design of a standard line of apparatus must have as its foundation the proper appreciation of the conditions peculiar to the industry, of market requirements and of manufacturing conditions.

The electric motor industry differs from other lines of manufacture in several respects. Where a machine tool or pump builder manufactures, at the worst, a few dozen different sizes and types, or the automobile manufacturer a single unit, the electric motor manufacturer has to deal with literally thousands of different ratings, sizes and types. The class of industrial motors alone comprises a range from say a graphophone or sewing-machine motor, rated at perhaps 0.02 hp., to the large motors for steel-mill drives of capacities in the thousands of horsepower. Each one of the different horsepower ratings is again built for different voltages and different speeds, alternating or direct-current, two-phase or three-phase, some of them single-phase, for different frequencies, squirrel-cage or wound rotor, and for direct-current, shunt, compound or series wound. There are further mechanical modifications of a great variety, vertical, back-geared, etc. The very flexibility of the electric motor drive has led to an almost endless variety of special designs to meet individual requirements in different industries, such as the textile or printing industry, steel mills, cranes, elevators, machine tools and so on.

Generators, differing to a varying extent from the corresponding motor type, and their special modifications, as for instance, for high-speed (turbo) work or for low-voltage (electroplating) service, must be considered.

Opportunities for Standards in Mechanical Design

These few examples have been enumerated because a full appreciation of the diversity of product in the electric motor industry is essential to the proper attitude on design questions. That, under these conditions, manufacturing, quantity production, equipment, stock-keeping all become quite different from the same operations in other industries and much more difficult is apparent. The mechanical designer can do a great deal—perhaps more than any one else in the organization—toward improving this condition. The best skill of the designers should be devoted to an effort toward taking care of a maximum number of required ratings and modifications with a minimum number of different parts and tools.

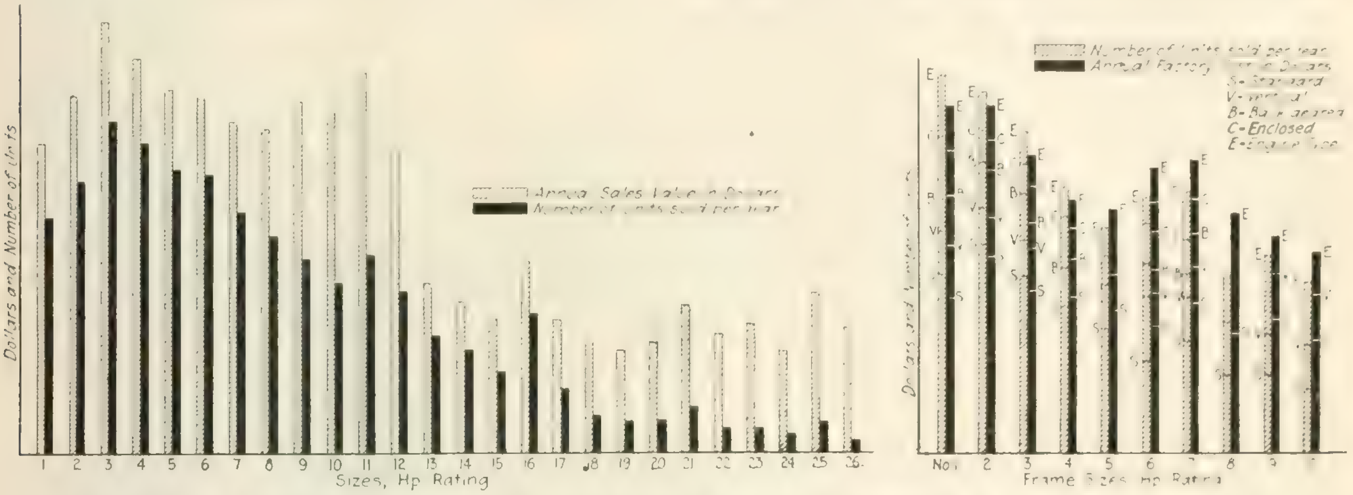
The writer has data from one company, manufacturing a rather limited range of electric motors, but having, for example, no less than sixty-five different types of brush holders, most of them made, at one time or another, in several different sizes; twenty-seven different sizes of oil rings and about as many varieties of bearings with odd bores and lengths, not to mention the fertility of its designers' brains in those small parts, such as oil-hole covers, tubes, washers, bolts, etc., which are generally called details but which in production usually cause delays and difficulties in obtaining material and keeping stocks.

That, under the condition described, economical manufacture is impossible will be understood. If, on the other hand, slot sizes, for example, are so designed that they are common for many different ratings and that, therefore, combination dies are warranted, or if bearing sizes, brush holders and slide rails are designed so as to be applicable to a great number of sizes, perhaps interchangeable between alternating current and direct current, then manufacturing cost is decreased by quantity production and best tool equipment, output is facilitated, and idle investment in the form of excessive stock is reduced. This feature is one of the important considerations in connection with the design of electric motors.

The "Uniform Design" Idea

If one manufacturer can standardize a certain limited number of bearing sizes, brush sizes, pulley bores and so on, it would seem that such standards could also be agreed upon between manufacturers. If one 5-hp., 1,800-r.p.m. motor has a 1¼-in. diameter shaft extension of certain length and keyway, there is no apparent reason why another make of motor, of the same rating, should have a shaft of 1⅛-in. or 1 5/16-in. diameter or different key, inconveniencing thereby the motor user as well as the manufacturers of pulleys, couplings, gears, etc. The point will be appreciated by those who have had to maintain a stock of repair parts for large motor users, as, for example, in steel mills.

This idea, it has been suggested, might be carried further. If a certain rotor diameter or slot number is found best by leading engineers—and it may be said that present practice differs in fact little, at least for certain smaller sizes of alternating-current motors—why not adopt it as a standard, permitting thereby uniform over-all dimensions, base drillings, etc.? It may rightly be argued that standardization always has proved an economic advantage and has furthered the industry rather than handicapped it or produced the dire results predicted by some. Take, for example, the fact that even the standard railroad track gage was objected to at one time on the ground that car control was not feasible unless each road or group of roads had a gage differing from others. On the other hand, take the incandescent lamp industry, where standard sockets, standard filaments and mountings have led only to greater expansion of trade and a greater number of companies engaged in profitable manufacture. The automobile industry, with standards for many parts, and other industries might also be cited. A closer approach to a mechanical standardization of electric motors seems bound to take place in due time. Unfortunate methods of attacking the problem have been in part answerable for the lack of progress to date.



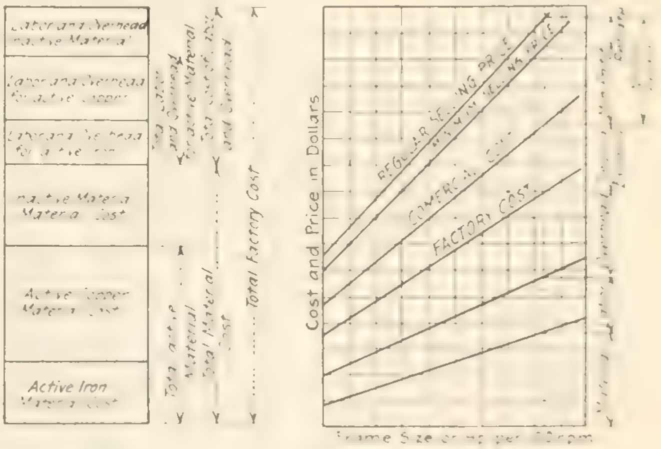
FIGS. 1 AND 2—RELATIVE IMPORTANCE OF VARIOUS MOTOR SIZES AND INFLUENCE OF FRAME MODIFICATIONS ON FACTORY COST

Fig. 1—Units used for horsepower rating are for various ratings reduced to a common basis, considering differences in speed, etc. Horizontal axis (Fig. 2) actually gives frame sizes of direct-current motors.

Relation Between Sales and Design

That designing is not merely a matter of engineering calculation and formulas, but rather a matter of judgment and experience, is further emphasized by considering the relative importance of various ratings and frame sizes according to the number of units sold per year. This may be shown graphically, as in Figs. 1 and 2. The former shows the annual sales value as well as the number of units sold of each frame size, while the latter illustrates the relative importance of the standard horizontal type as compared, for instance, with the vertical type, back-geared modification and so on. Similar curves or diagrams may be plotted for various ratings of a line of motors. If, then, it be shown, for example, that on a basis of annual sales value certain ratings greatly exceed others in importance, or if on some of them the sales volume is so small as to render them negligible, it is clear that the designer should concentrate on the large sellers and make no compromise in their design in order to accommodate, perhaps, a far less important seller. Obvious as this may seem, the point is often neglected. Designing is as much a commercial matter as it is an engineering proposition; the object is profits from sales, and the theoretically best design should not be chosen in every case.

A complete analysis of manufacturing costs for similar apparatus should be available to the designer of a new line of apparatus for his guidance as to material cost as well as labor items. A diagram may be plotted, as in Fig. 3, which shows, on the basis of cost, the relative proportion of active and inactive materials. A curve like this, plotted for an individual machine size, may be combined with a curve as Fig. 4, in order to tell a complete story. The proportion between labor cost and material varies with the size of machine. Labor cost is relatively highest with the smallest size. Material cost becomes of increasing importance with increasing size, while expense for machining becomes of less significance. This is a point worth remembering in designing and one that should be checked up as the design work progresses. With large machines the point just referred to fortunately harmonizes with the fact that these machines are usually sold in smaller yearly numbers; that is, they justify only a limited expense for tools, which, moreover, owing to their size, are costly. The cost per pound of a machine, it will be apparent, is therefore a criterion only within a limited range of machine capacity.



FIGS. 3 AND 4—DIAGRAMS SHOWING PROPORTION OF LABOR AND MATERIAL COST AND INFLUENCE OF MOTOR SIZE ON COST

Referring more particularly to material value, Fig. 3 shows the relation between active copper and active iron in the machine. A machine might be designed, within limits, with relatively more iron and less copper. The proper balance will depend on the relative cost of these two materials. In years past, with copper at 10 cents a pound, a design might well be different from a design correct on a 30-cent copper base.

Motor users as well as manufacturers are today under a handicap due to the many more or less obsolete types of motors still in use. Changing a design should be undertaken only after very careful consideration and only if warranted by marked progress in the art. There is nothing more costly and more disturbing to regular manufacture than continued changes in design of parts or of individual sizes of a line of apparatus. The example of the Ford Motor Company with its perennial design teaches a strong lesson of what may be accomplished in manufacturing processes by adhering to one design for an unlimited period. A motor design, therefore, should be thoroughly tested and tried out in service as well as by shop endurance tests to prove the design features before the apparatus is placed on the market. This plan not only eliminates changes afterward, but from the user's as well as the manufacturer's standpoint it is the only economical method and tends to safeguard the reputation of the manufacturer. An attempt at continuous improvements on a type of machines works in the opposite way.

If, finally, the time is ripe for a change in design, it should be undertaken with the definite idea in mind that the new type must stand unaltered for a long period of years. It is necessary, therefore, for the designers to look far ahead into the future. Special application studies must be made where motors are to be designed for special work, as, for instance, coal-mining motors, certain textile installations and others.

Water Power in Great Britain

Although the water power available in Great Britain for electrical development does not bulk largely, statistics printed for a combined steam and hydro-electric station established at Chester in 1913 show that as an auxiliary to steam stations, at any rate, it is by no means a negligible factor. At the station named the greater part of the energy sold is generated by water power and is produced at a cost per kilowatt-hour of 0.0823d. (0.16 cent at the old rate of exchange) as against 0.9308d. (1.86 cents) for energy generated by steam.

Wiring Layout for Large Repair Shop

Points Considered in Locating Load Centers and Installing Feeders for Direct and Alternating-Current Service—How Flexibility Is Obtained

BY H. L. CORNELISON
Electrical Engineer the Austin Company

BEFORE laying out the general wiring of the new locomotive repair shops of the Pennsylvania Railroad at Logansport, Ind., a detailed study was made of the locations of the various machines and their power requirements. The wiring layout that first suggested itself for the heavy machine shop consisted of a loop or ring bus system. This would have served the purpose admirably at some saving in copper costs. However, it was rejected for the straight-line wiring plan shown in the accompanying drawings, because the latter was better suited to the service requirements.

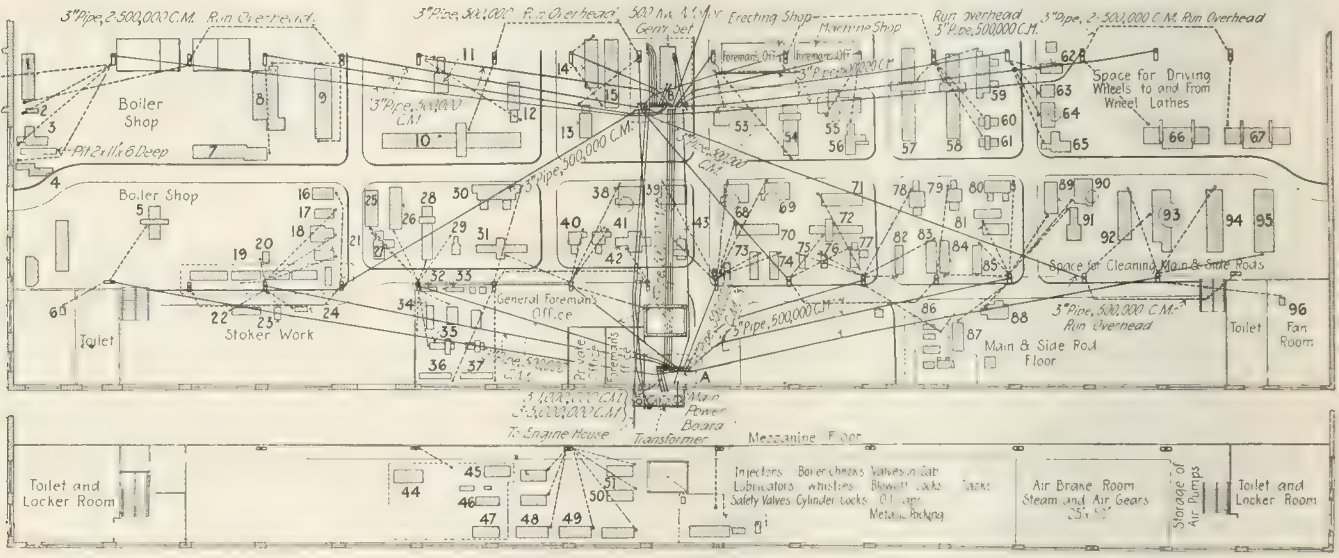


FIG. 1—POWER DISTRIBUTION SYSTEM IN THE LIGHT AND HEAVY MACHINE SHOPS

The main feeders are shown in solid lines, while the subfeeders to the machine panels are shown in broken lines. The key numbers refer to the motor-driven machines listed in the plate.

The ground area of this engine repair shop measured 600 ft. (183 m.) long by 350 ft. (107 m.) wide. Repair tracks for seventeen engines and storage space for fifty more were provided. The important sections included the machine and erecting shops, which in themselves measured 400 ft. (122 m.) long by 200 ft. (61 m.) wide, with varying heights up to 66 ft. (20 m.) An electrically operated transfer table 86 ft. (26 m.) wide alongside the erecting shop was a feature of the equipment. This table, which transfers "dead" engines to and from the repair stalls, is unique in itself because few of them used in this country are motor-driven. Man power was thought good enough until rising labor costs changed the viewpoint. Energy is taken from an overhead alternating-current No. 4/0 trolley system with a three-pole collector, the power required being 75 hp. The table travels parallel to the building and can pull an engine into or out of an erecting shop stall by means of a steel cable and sheave arrangement. Underground collector rails were considered for supplying this table, but the idea was discarded for fear of trouble from ice and snow.

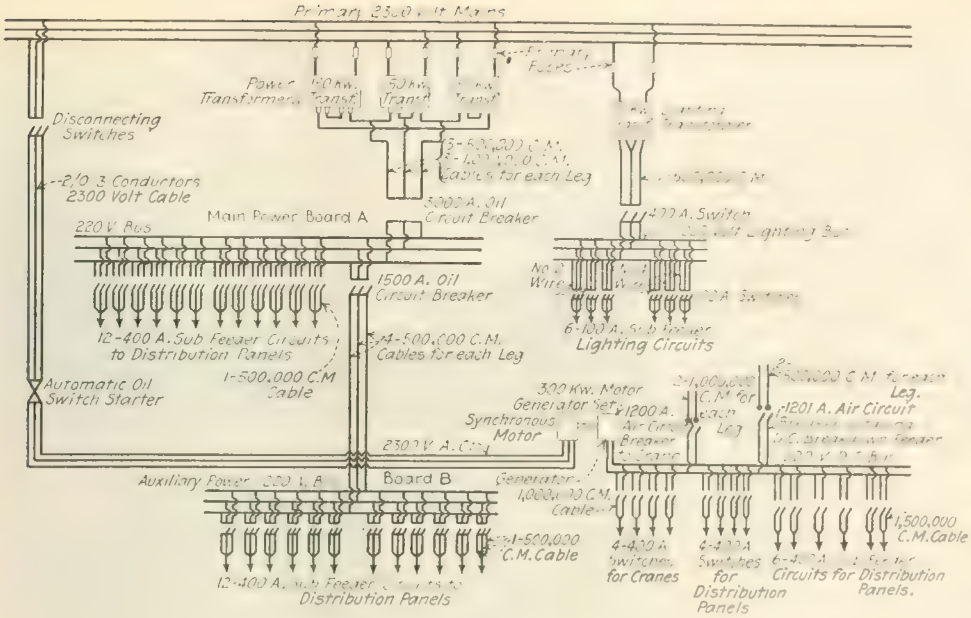

Primary 2300 Volt Mains
Primary Fuses
Power Transformers
50 Kw. Transf.
50 Kw. Transf.
Kw. Transf.
Lighting Transformer
Disconnecting Switches
3-500,000 C.M.
3-1,000,000 C.M.
Cables for each Leg
2-500,000 C.M.
2/0 3 Conductors 2300 Volt Cable
3000 A. Oil Circuit Breaker
400 A. Switch
220 Volt Lighting Bus
Main Power Board A
220 V. Bus
No. Wire
1500 A. Oil Circuit Breaker
A. Switches
6-100 A. Sub Feeder Lighting Circuits
12-400 A. Sub Feeder Circuits to Distribution Panels
4-500,000 C.M. Cables for each Leg
1-500,000 C.M. Cable
Automatic Oil Switch Starter
300 Kw. Motor Generator Set
Synchronous Motor
1200 A. Air Circuit Breaker to Crane
2-1,000,000 C.M. for each Leg
2-500,000 C.M. for each Leg.
1201 A. Air Circuit
220 V. D. C. Bus
2300 V. A. C.
Auxiliary Power 220 V. B
Board B
Generator 1,000,000 C.M. Cable
1-500,000 C.M. Cable
1,500,000 C.M. Cable
4-400 A. Switches for Cranes
4-400 A. Switches for Distribution Panels
6-400 A. Feeder Circuits for Distribution Panels.
12-400 A. Sub Feeder Circuits to Distribution Panels

FIG. 2—SIMPLIFIED WIRING DIAGRAM

Two main boards, *A* and *B*, are connected by 220-volt leads. The 500-kw. motor-generator set is connected ahead of the transformers through disconnecting switches and an automatic oil starting switch. In connecting boards *A* and *B* four three-phase lines have been paralleled. Each phase, therefore, has an equivalent of 2,000,000 circ.mil.

In making the layout for the wiring it was necessary to provide for both direct and alternating-current motors and to allow for sufficient flexibility to take care of any changes in locations or additions of machines. Direct current was decided upon for some motors on account of the fine speed control needed for certain machines.

Three-phase, 60-cycle, 220-volt alternating-current and 220-volt, two-wire direct circuits were selected for the power service. For lighting service 110/220-volt, three-wire, single-phase energy was decided upon because it was easy to balance the lighting load and because it was desired to get economical distribution and yet produce a voltage drop of not more than 1 per cent from the distributing panels to any one outlet and not more than 2 per cent from the main board to the panels. Two power switchboards rather than one were recommended because of the added convenience of two in case of trouble and also because of the saving in copper feeders. These two boards are installed at the future load centers of the shop, which in this case happen also to be the centers of the building areas.

The supply-line voltage—2,300—is stepped down to 220 volts for delivery to switchboard *A* (Fig. 2) through

RATINGS OF MOTORS USED IN MAKING FEEDER LAYOUT IN LOGANSPORT SHOPS OF THE PENNSYLVANIA RAILROAD

No	Machine	—Hp. of Motors— Alternating Current	Direct Current
1	4-ft special drill presses	...	20
2	One drill press	1	...
3	5-ft. radial drill press	15	....
4	Horizontal punch	5	...
5	Punch and shears	7½	...
6	Flanging equipment	20	....
7	Rolls for 12-in sheet	60	..
8	42-in. car-wheel lathe	...	40
9	54-in. x 20-in. lathe	...	35
10	60-in. x 60-in. x 30-ft planer	...	5–35
11	20-in. crank slotter	10	...
12	6-ft. 4-in. radial drill	7½	...
13	18-in. slotter	...	10
14	22-in. x 14-in. lathe	7½	....
15	24-in. x 20-ft. lathe	15	....
16	Large pipe cutter and threader	...	10
17	Pipe cutter and threader	2	.
18	Bolt-thread machine	7½	..
19	Group of four 18-in. and 16-in lathes	10	...
20	4-in. lathe	3	..
21	Unit thread machine	10	
22	18-in. x 8-ft. lathe	5	.
23	Drill press	1	.
24	Bolt-cutting machine	½	.
25	24-in. x 10-ft. lathe	15	.
26	24-in. x 10-ft. lathe	15	.
27	5-ft. radial drill press	15	.
28	48-in. boring mill	7½	..
29	10-in. vertical shaper	3½	...
30	22-in. traverse and crank shaft	.	7½
31	34-in. x 11-ft. planer	20	
32	Grinder	2	.
33	Grinder	5	..
34	Tool-room machine	10	...
35	20-in. shaper	5	....
36	16 in. x 8-ft lathe		11½
37	16-in x 8 ft. lathe	..	11½
38	53-in. boring mill	15	.
39	42-in. boring mill	15	..
40	20-in. stroke shaper	5	..
41	20-in stroke shaper	15	.
42	36-in drawout shaper	...	10
43	Milling machine	5	..
44	Group No. 5 lathe and grinding wheels	7½	
45	16-in. x 6-ft. turret lathe	3	
46	16-in. x 6-ft. turret lathe	3	
47	16-in. x 6-ft. turret lathe	3	
48	16-in. x 6-ft. turret lathe	3	
49	16-in. x 6-ft. turret lathe	3	
50	16-in. x 6-ft. turret lathe	3	....
51	16-in. x 6-ft. turret lathe	3	
52	Group No. 4 buffing wheels and lathe	5	
53	96-in. boring mill	15	
54	50-in. horizontal boring mill	7½	
55	Slab milling machine	50	
56	5-ft. radial drill press	15	
57	48-in. x 48-in. x 20-ft. planer	...	5–25
58	36-in. x 36-in. x 18-ft. planer	...	15
59	Traverse crank shaper	...	7½
60	32-crank planer	...	15–2
61	32-crank planer		15–2
62	Heavy-duty drill press	20	
63	Vertical hydraulic press	7½	
64	42-in. boring mill	15	..
65	5 ft radial drill press	15	...
66	90-in. drive-wheel lathe	..	50–8½
67	90-in. drive-wheel lathe	..	50–8½
68	42-in. boring mill	15	
69	42-in. boring mill	15	
70	24-in. x 12-ft. lathe	10	...
71	30-in. x 12-ft. lathe	20	
72	30-in. x 12-ft planer	..	15
73	18-in. x 8-in. lathe	5	
74	18-in. x 8-in. lathe	5	
75	Small drill press	1	
76	Small drill press	1	
77	4-ft. radial drill press	.	10
78	32-in. draw-cut shaper	7½	
79	Draw-cut shaper	.	10
80	20 in crank shaper	5	.
81	Heavy-duty drill press	20	.
82	Lathe	5	
83	Lathe (20-in. x 10-ft. lathe)	10	
84	Lathe (20-in. x 10-ft. lathe)	3	
85	11 ft lathe	5	
86	Group No. 3 lathes polishing wheels	5	..
87	Polishing machine	3	
88	Boring mill	5	
89	24-in. x 8½-ft. turret lathe	3	
90	42-in boring mill	15	.
91	Slotter	10	
92	22-in. x 14-ft. lathe	15	
93	100-in boring machine		25
94	Driving wheel press	15	
95	Quartering machine	3–3	
96	Fan	20	
97	Transfer table	75	
98	250-ton crane		450
99	Four 10-ton cranes		50
	Total	823	1129

a 450-kw. transformer bank. From this board a part of the load is transferred to board *B*. A 2,300-volt No. 4/0 cable feeder, which does not pass through the transformer, goes directly to the 729-hp. motor panel in switchboard *B* provided for a 500-kw. motor-generator set. The direct-current generator is connected to board *B* for distribution. Board *A*, therefore, is a main power board carrying only alternating current, while board *B* distributes both alternating and direct current.

From a detailed study of the machine layout, considering both present and future requirements, the connected motor load was determined and tabulated as shown in the table. This information was used in locating the distributing panels. The total connected load of 1,952 hp. was distributed as shown in Fig. 1. The key numbers refer to numbers on the machines. Forty distribution panels, each serving a certain area of machines, were finally decided upon. In order that either direct or alternating current service might be available in any part of the shop, the distributing panels on alternate building columns were for direct-current and alternating-current circuits respectively.

Feeders were placed in straight conduit runs in the concrete floor slabs, each 12 in. (30 cm.) to 18 in. (45 cm.) thick and covered by 3-in. (8-cm.) wood-block flooring. If conduit must be added for future machines not contemplated when the original design was made, the runs can be laid by taking up the block flooring, chasing the concrete floor slab and replacing the blocks. In making these feeder runs 1,000,000-circ.-mil cable was the maximum size used. In general it was endeavored to hold the size to 500,000 circ.mils because the larger cables are difficult to handle.

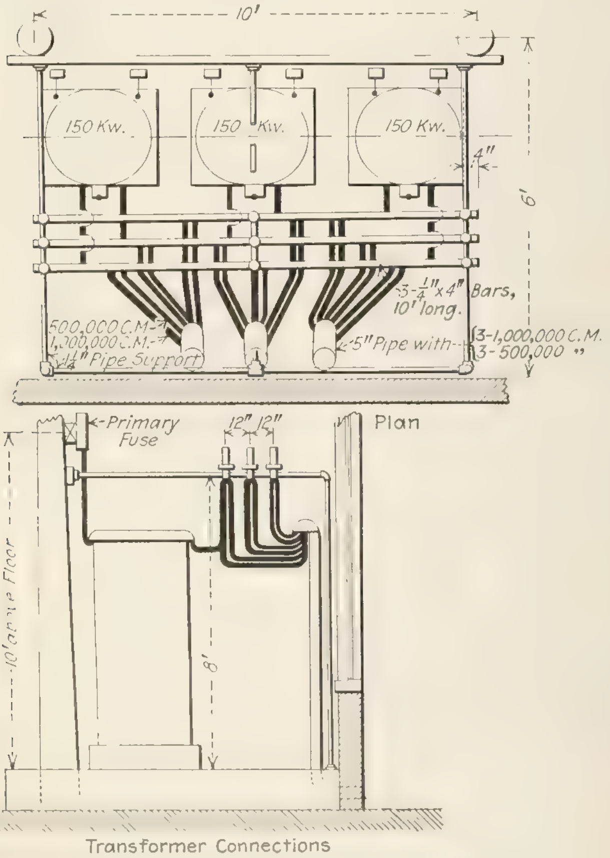


FIG. 3—DETAILS OF TRANSFORMER CONNECTIONS

In order to reduce the size of the single conductors the leads to switchboard *A* have been made up of six wires with two sets for each phase and the paralleling of three three-phase lines.

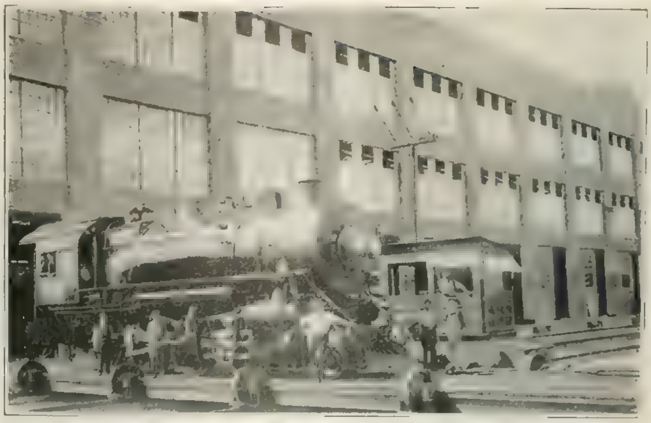


FIG. 4—MOTOR-DRIVEN TRANSFER TABLE USED TO MOVE LOCOMOTIVES TO AND FROM REPAIR STALLS

In mounting the panels on the building columns the panel box was allowed to extend out beyond the column about 6 in. (15 cm.) so that the gutter was accessible from the rear. This arrangement permits easy access to the panel through conduits coming from three directions. These panels were equipped with lugs at the top of the buses which permitted connection to panels on floors above without running extra circuits from the switchboards.

The entire job, was built by the Austin Company at a cost of $1,200,000, of which about $100,000 was for the electrical work. Power for operating this installation is taken from the Logansport municipal generating station, but there is in addition to this service an emergency feeder connected with an old power house of the Pennsylvania Railroad Company. This is made through a reverse current circuit breaker for the protection of the generator in the old power house. At the present time 450 kw. in transformers take care of the alternating current load, but in the future 950 kw. will be required.

Water Power Development in Uruguay

AN ERA of development in the Republic of Uruguay, South America, appears to be at hand, according to a recent report by W. W. Ewing, United States trade commissioner. The most interesting of the projects under consideration is that for an international power plant to be erected on the Uruguay River by Argentina, Brazil and Uruguay jointly, with guarantees for the equitable distribution of power to the three counties concerned. On the site being considered it is calculated that 2,500,000,000 kw.-hr. a year could be developed and distributed within a radius of 375 miles. The project contemplates the construction of two dams, one movable and one fixed, with canals to the power plant. It will utilize a fall of 77 ft. (22 m.). The installation would also open for navigation 419 miles (674 km.) of river which today are inaccessible and would permit the inundation of adjoining zones which are suitable for agriculture.

Other projects for the development of water power are also being considered by private persons and corporations. Notwithstanding the abundant water power in Uruguay, nothing hitherto has been done to develop it for irrigation or power purposes, and the opportunities now opening for investment are held to be promising.

Burning Low-Grade Coals of the Southwest

Operating and Test Results Attained with Chain-Grate Settings of Different Types—Recommendations for Companies Using the Fuels Available—Analyses of Several Varieties of Southwestern Coals.

By W. M. PARK
Construction Engineer Green Engineering Company, East Chicago, Ind.

PRODUCTION of coal in the Southwestern fields of the United States has not kept pace with that of Eastern fields, owing to the smaller demand. This demand is effected by the extensive oil developments of that section and by the lesser density of population and fewer manufacturing enterprises. The quality of coal in this region varies from a good grade of anthracite containing 14,000 B.t.u. to low lignite of 6,000 B.t.u. The anthracite field, which is in New Mexico, is of limited area and is mentioned merely to indicate the contrast in fuel quality found in small radius. The majority of the fuels of the Southwest contain ash in excess of 15 per cent and are of a composition that fuses readily into a sticky clinker. During the last eight years furnace design has developed beyond the experimental stage, however, and engineers can rationally design furnaces to use these fuels with the same assurance of ultimately satisfactory results that is felt when designing furnaces for Eastern coals. This article will describe a few modern settings with which creditable performance has been secured.

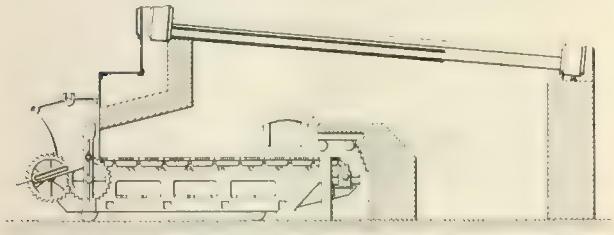


FIG. 1—TILE INCLOSING LOWER TUBES HELPS MAINTAIN HIGH FURNACE TEMPERATURES

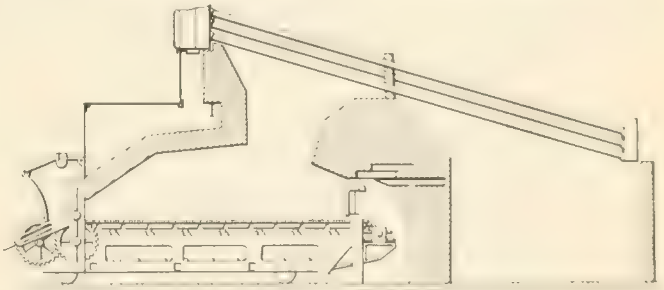


FIG. 2—EXPERIMENTAL FURNACE SUCCESSFUL IN BURNING SEMI-ANTHRACITE COAL

Fig. 1 shows a horizontal-pass boiler with a chain-grate stoker having a ratio of grate area to heating surface of 1 to 52, which readily ignites and burns 40 lb. of coal hourly per square foot (195 kg. per sq.m.) of grate area and which under test conditions readily gave 72 per cent efficiency when burning a northwestern New Mexico coal of the following analysis:

Moisture, per cent	17.0
Volatile, per cent	33.0
Fixed carbon, per cent	33.0
Ash, per cent	17.0
B.t.u., commercial basis	8,500

The higher grade coals of New Mexico are used quite extensively in El Paso, Tex., on a number of chain-grate installations. All of these coals are rich in volatile gas and some appear to contain, either in the volatile matter or in the lighter particles of ash, some element which attacks even the best grades of firebrick if the furnaces are so designed that high velocity of gas results.

A furnace for a vertically baffled boiler is represented in Fig. 3. The outstanding features of design are the ample combustion chamber provided by setting the boiler 11.5 ft. (3.5 m.) under the front header, the high set and steeply sloped arch which in connection with the vertical bridge wall allows intense reflection and radiation of heat on the entering fuel, and a large opening between arch and bridge wall to insure nominal gas velocity. This type of furnace has given highly satisfactory performance, operating continuously at averages of 15 per cent CO_2 and ash-pit loss of 2 per cent to 3 per cent when burning northeastern and north central New Mexico coals with the following analysis:

Moisture, per cent	2.87
Volatile, per cent	34.27
Fixed carbon, per cent	46.08
Ash, per cent	16.78
B.t.u., commercial basis	12,023

About 60 miles (100 km.) west of Fort Worth, Tex., is an isolated bituminous coal field of small area. The screened lump grades of this coal have a heating value of 12,500 B.t.u., and a large percentage of the output is used by the Texas & Pacific Railway, leaving a limited amount for domestic consumption in a territory traversed by this railroad. The screenings are burned on chain-grate stokers at several of the mine plants and at a large public service plant in Forth Worth. The better grades of screenings have a heating value of 10,500 B.t.u., while the lower grades run as low as 8,300 B.t.u. and have a proximate analysis of:

Moisture, per cent	3.50
Volatile, per cent	30.70
Fixed carbon, per cent	26.24
Ash, per cent	39.56

To burn this coal successfully it is necessary to cover approximately 90 per cent of the furnace with an arch set with a steep slope and ample height which in combination with a vertical bridge wall will cause intense reflection of heat upon the fuel bed at the entrance to the furnace. Such a furnace is shown in Fig. 4. Naturally, it is also necessary to provide unusually large grate surface to permit of burning large quantities of this low-grade fuel. Some of the stokers in operation at the mines have ratio of grate area to heating surface as low as 1 to 25.

In the western counties of Arkansas there is mined a grade of coal known as semi-anthracite, having the following average analysis:

Moisture, per cent	3.5
Volatile, per cent	14.0
Fixed carbon, per cent	60.5
Ash, per cent	22.0
Bt.u., commercial basis	11,400

In regard to the glossy appearance of freshly broken pieces and the nature of the fracture this fuel is similar to Pocahontas coal. The percentage of volatile matter and moisture also approximates that of the latter fuel, but the different nature of the volatile content and the considerably higher percentage of ash give the coal characteristics in burning which are quite different from Pocahontas coal. When heated the tars appear to volatilize before they reach the temperature at which they would become plastic, in contrast with Eastern coking coal.

Instead of coking together in lumps, the smaller chunks disintegrate under heat so that the fuel bed is like a mass of loose sand. Because the coal has these characteristics it produces a dense fuel bed, and therefore the depth of fire must be less than that used with coals of high volatility for corresponding drafts and combustion rates. These low-volatility coals are perhaps the most difficult fuels to burn of all encountered in this district, on account of the difficulties of ignition. Even with the furnaces designed for the most intense concentration of heat at the ignition point, semi-anthracite coals will ignite only on the surface if radiant and reflected heat alone are depended upon. The ignition of fuel in the lower part of the fuel bed can be accelerated by use of a special gate having corrugated face tile in contact with the fuel.

ANALYSES OF SIX VARIETIES OF COAL

Name of Coal	Gallup, N. Mex.	Raton, N. Mex.	Strawn, Tex.	Dewar, Okla.	Jenny Lind, Ark.	Huntington, Ark.
Moisture	19.55	2.45	2.81	6.27	4.25	3.88
Volatile content	69.53	34.99	35.41	27.93	14.28	16.93
Fixed carbon	......	46.08	40.23	46.37	58.89	56.06
Ash	10.92	16.48	21.55	19.43	22.58	23.13
B.t.u. per lb. as fired	8,367	12,059	11,200	10,706	10,874	10,912
Percentage of combustible in refuse	......	15.9	22.3	26.9	22.9	19.8
Furnace draft	0.27	0.12	0.11	0.23	0.27	0.38
Flue gas temperature	584	507	477	520	463	444
CO_2 at furnace	15.5	15.6	12.2	12.6	13.5	12.4
CO_2 at uptake	10.0	11.7	9.7	10.0	12.9	11.6
Coal burned hourly per square foot	40.2	26.6	24.65	27.5	32.1	28.5
Per cent builder's rating developed	146	154	134	139	170	148
Combined efficiency	71.8	72.8	73.6	71.7	74.1	72.2

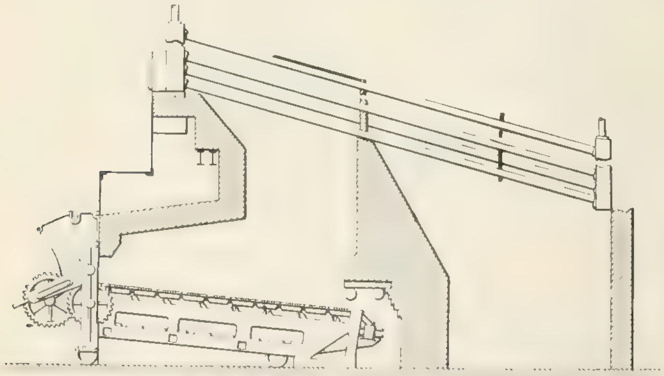


FIG. 3—FEATURES OF THIS DESIGN ARE AMPLE COMBUSTION CHAMBER, HIGH STEEP ARCH, LARGE GAS OUTLET

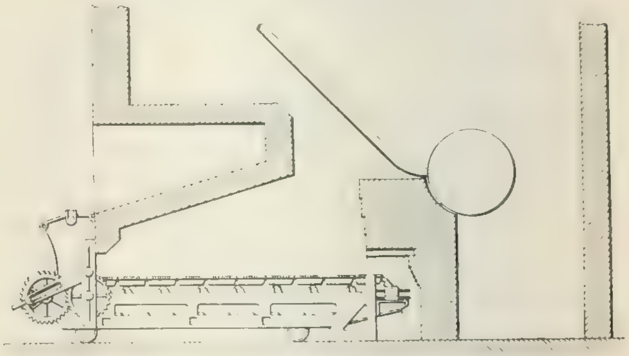


FIG. 4—HIGH STEEP ARCH COVERS ABOUT 90 PER CENT OF FURNACE. THIS WITH VERTICAL BRIDGE WALL CAUSES INTENSE HEAT REFLECTION

Fig. 2 shows an experimental design of furnace first worked out in connection with semi-anthracite coal-burning problems. It involves an expensive lot of special tile shapes, and the maintenance of the brickwork is high.

Equally good results may be expected with a simpler type of arch shown in Fig. 3, though for the boiler and for the length of stoker shown in Fig. 2 the furnace projection and length of arch should be increased when the reversed arch is eliminated.

From a long series of tests of from eight hours to twenty-four hours' duration, six are presented in the accompanying table. Efficiencies as high as 78.5 per cent were obtained where unusual pains were taken to maintain steady conditions, but the list chosen does not include the maximum results. Tests typical of results readily obtainable are of greater value to the engineer, and this point was borne in mind in making the selection.

The writer's experience in burning the Southwestern coals leads to the following conclusions:

1. On account of the high ash content and fusible nature of their ash, these coals can be burned with highest efficiency and with least labor by use of a chain grate.

2. Most of the coals are of high volatile content, ignite readily and burn freely if provided with long, high-set arches.

3. Semi-anthracite coal ignites least readily, but if load conditions permit maintenance of steady furnace conditions, this fuel can be burned with high efficiency. Good overload also is possible to secure with liberal grate area.

4. As semi-anthracite crumbles in the fire rather than coking together, it is desirable to reduce sifting of the fuel and resulting holes in the fire by the use of a stoker chain which has finally divided and ample air space.

5. To secure high furnace efficiency at high rating a large furnace volume is desirable. This is insured by setting horizontal water-tube boilers at a front header height of 8 ft. to 10 ft. (2.4 m. to 3 m.) if horizontally baffled and 10 ft. to 13 ft. (3 m. to 4 m.) if vertically baffled.

6. Provision should be made for furnace draft of 0.30 in. to 0.60 in. (7.6 mm. to 15.2 mm.), and liberal grate area should be furnished to insure good overload capacity when burning the medium and lower grades of these coals.

Calculating Substation Short Circuits—II

The Problem of Placing Reactance to Best Advantage in the 2,300-Volt Bus Is Considered—Several Feeder Arrangements Are Investigated for Getting Maximum Protection at Minimum Expense

By R. F. GOODING

A SYSTEM composed of generating plants and a substation was specified in the first part of this article, published in the ELECTRICAL WORLD April 3. This system was investigated to determine the reactance required in the high-tension bus system to keep short-circuit energy within control. With the high-tension bus taken care of, the next step is to consider conditions on the low-tension or 2,300-volt bus. First the bus or transformer reactance should be placed to the best advantage, and then various methods for avoiding the use of a heavy-duty breaker in each of the feeder circuits must be taken up. Several typical feeder arrangements are proposed, and the merits of each are considered.

For this study we shall assume three transformer banks, each rated at 6,000 kva., 13,200/2,300 volts, with a reactance of 5 per cent. (See Fig. 5 for arrangement.) When only one bank is operating, the equivalent power on the 2,300-volt bus is 100,000 kva., at 100 per cent reactance. The power on the 13,200-volt bus is 100,000 kva., at 16.2 per cent reactance, and this, added to the reactance of the transformer bank, 5 per cent at 6,000 kva. (83.3 per cent at 100,000 kva.), gives 99.7 per cent (say 100 per cent) reactance at 100,000 kva., as the power delivered to the 2,300-volt bus. 100,000 kva., at 100 per cent = 100,000 kva. = 25,000 amp. Table VI gives results for one, two and three banks.

The first scheme to consider for reducing this current will be to introduce extra reactance in the transformer circuits, and 3 per cent reactance will be added, making the total reactance of each transformer circuit 8 per cent at 6,000 kva. Then, using the same method of calculation as just described, with one bank operating we get 66,000 kva. = 16,500 amp. in case of a short circuit. Values for one, two and three banks are given in Table VII.

A reduction from 56,500 amp. to 41,000 amp. will help things very materially, but 41,000 amp. is still too high for the average 2,300-volt breakers, so a further reduction will be necessary. This time 5 per cent external reactance will be tried, making the total reactance of the circuit 10 per cent. (See Table VIII.)

A rupturing duty of 35,000 amp. is still too high for the 2,300-volt breakers we should expect to see used on a 2,300-volt distribution system, so a 10 per cent reactance will be tried—total reactance of each circuit 15 per cent. (See Table IX.)

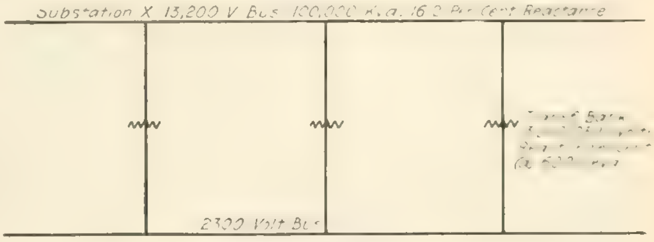

Substation X 13,200 V Bus 100,000 Kva. 16.2 Per Cent Reactance
2300 Volt Bus

FIG. 5

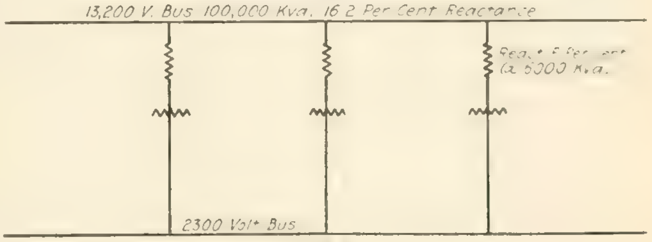


FIG. 6

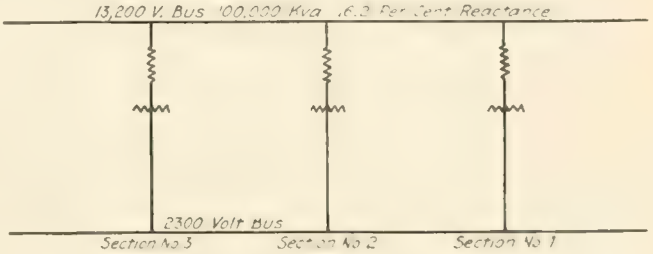


FIG. 7

FIGS. 5, 6 AND 7—SCHEMES OF REDUCING THE ENERGY DEVELOPED AT THE BUS BY SHORT CIRCUITS

It must be remembered, however, that while additional reactance will reduce the short-circuit currents, it will also make the voltage regulation on the bus that much worse, and this factor may decide how much reactance can be used. The regulation of a

TABLE VI—2,300 VOLT BUS, NO EXTERNAL TRANSFORMER REACTANCE

Transformer Banks Operating	Equivalent Reactance at 100,000 Kva. (Per Cent)	Short Circuit, Kva.	Short Circuit, Amp.
1	100	100,000	25,000
2	57.7	173,000	43,000
3	44	226,000	56,500

TABLE VII—2300-VOLT BUS, 3 PER CENT. EXTERNAL REACTANCE

Banks Operating	Equivalent Reactance at 100,000 Kva. (Per Cent)	Short Circuit, Kva.	Short Circuit, Amp.
1	150	66,000	16,500
2	83	120,000	30,000
3	61	164,000	41,000

TABLE VIII—2,300-VOLT BUS, 5 PER CENT. EXTERNAL REACTANCE

Banks Operating	Equivalent Reactance at 100,000 Kva. (Per Cent)	Short Circuit, Kva.	Short Circuit, Amp.
1	183	54,600	13,500
2	100	100,000	25,000
3	72	139,000	35,000

TABLE IX—2,300-VOLT BUS, 10 PER CENT EXTERNAL TRANSFORMER REACTANCE

Banks Operating	Equivalent Reactance at 100,000 Kva. (Per Cent)	Short Circuit, Kva.	Short Circuit, Amp.
1	266	37,800	9,400
2	141	71,000	17,800
3	100	100,000	25,000

transformer can be arrived at approximately from the formula

$$\text{Regulation} = X \sin \theta + R \cos \theta$$

where X = reactance and R = resistance, in per cent, and θ = phase angle. All the calculations made here will be for 80 per cent power factor when $\sin \theta = 0.6$ and $\cos \theta = 0.8$. For transformers of this size (3 — 2,000 kva. units per bank) R may be assumed as 0.75 per cent. Then, with no external reactance in the circuit, the regulation of a bank would be:

$$\begin{aligned} \text{Regulation} &= X \sin \theta + R \cos \theta \\ &= 5\ (0.6) + 0.75\ (0.8) \\ &= 3 + 0.6 \\ &= 3.6 \text{ per cent.} \end{aligned}$$

With 3 per cent external reactance (8 per cent total) the regulation of the transformer becomes 5.4 per cent, for 5 per cent external reactance the regulation is 6.6 per cent, and for 10 per cent external reactance the inherent regulation becomes 9.6 per cent.

Now, although the voltage of the system is normally 13,200, it is quite probable that the power station bus would be run at 13,500 volts at light load and 13,800 volts at heavy or peak load. These may be assumed to give at the substations 13,200 volts at light and 13,500 volts at peak load. As the transformers are 13,200/2,300-volt ratio, the normal no-load or light-load voltage on the 2,300-volt bus would be 2,300, with 2,350 volts—(13,500 ÷ 13,200) × 2,300)—at peak load. Then with no external reactance in the transformer circuit and a regulation of 3.6 per cent, this would give 2,350 — 3.6 per cent = 2,265 volts. With a normal no-load voltage of 2,300 this means an actual variation of only 35 volts, or 1½ per cent.

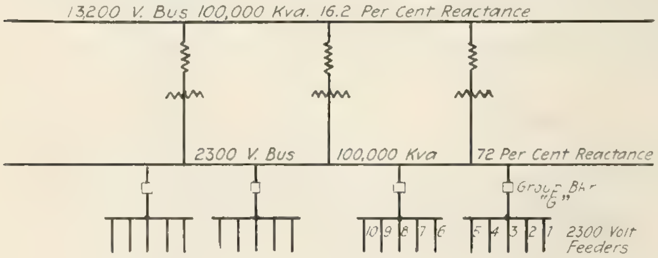


FIG. 8

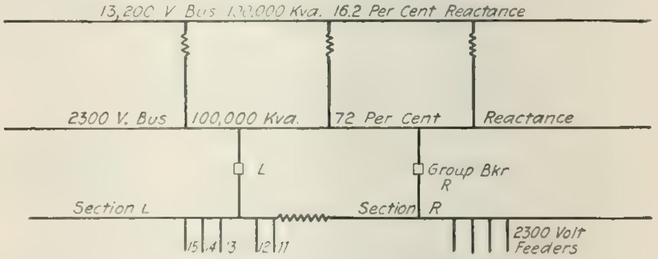


FIG. 9

FIGS. 8 AND 9—METHODS OF REDUCING THE USE OF HEAVY-DUTY BREAKERS ON EACH FEEDER

With 3 per cent external reactance in transformer circuit (8 per cent total) and a corresponding regulation of 5.4 per cent, the actual full-load voltage would be 2,223 volts. This gives a variation from no-load to full load of 77 volts, or 3.35 per cent. When the total reactance is 10 per cent (5 per cent external) and regulation 6.6 per cent the full-load bus voltage will be 2,195 volts—a variation from no-load voltage of 105 volts, or 4.6 per cent. Similarly, a 10 per cent external reactance gives a regulation of 9.6 per cent and a full load bus voltage of 2,125 volts—a variation of 175 volts, or 7.6 per cent.

High External Reactance Makes Good Regulation Difficult

A variation in bus voltage of 7.6 per cent might be permissible, if all of the load were right in the substation. This, however, would rarely be the case, and to this 7.6 per cent drop would have to be added the drop due to long cable runs. This could easily amount to 2 or 3 per cent, so the ultimate consumer would have to put up with a voltage drop of at least 10 per cent. Feeder regulators would eliminate this difficulty, but in this discussion it is desirable to consider only the inherent characteristics of the circuits. Therefore the question of 10 per cent external reactance will be disregarded, and all subsequent calculations will be based on an external reactance of 5 per cent in the transformer circuits, as shown in Fig. 6.

On the basis, then, of 10 per cent total reactance in each transformer circuit and three banks operating, the equivalent power on the 2,300-volt bus will be 100,000 kva., at 72 per cent. (See Table VIII.) This gives at short circuit 139,000 kva. = 35,000 amp. According to the curves already mentioned (A. I. E. E., 1918), a breaker opening in 0.4 second on a circuit with 72 per cent reactance would have to rupture approximately 1.37 times full-load current. In this case this would give 137,000 kva. But the total kva. was found to be only 139,000, so the breaker would have to rupture practically the entire initial short circuit.

Very few central stations would care to equip each 2,300-volt feeder with a breaker capable of rupturing 35,000 amp., so measures must be taken to reduce this value to allow the use of cheaper breakers. Probably the first suggestion to do this would be to have a sectionalized 2,300-volt bus, as shown in Fig. 7 on the preceding page.

With a bus reactance of 5 per cent at 6,000 kva. (83.3 per cent at 100,000 kva.) the power delivered to each bus section by its own bank would be 100,000 kva. at 183 per cent reactance (the same as the total power on the bus with only one bank operating). Then total power on, say, the right-hand section (No. 1) would be:

		Kva.	Per Cent Reactance
Power on section 3	=	100,000	183
Bus reactance (6,000 kva., 5 per cent)	=	100,000	83
Power section 3 to section 2	=	100,000	266
	=	69,000	183
Power section 2	=	100,000	183
Total power section 2	=	169,000	183
	=	100,000	108
Bus reactance (6,000 kva., 5 per cent)	=	100,000	83
Power section 2 to section 1	=	100,000	191
	=	96,000	183
Power section 1	=	100,000	183
Total power section 1	=	196,000	183
	=	100,000	93

100,000 kva. at 93 per cent reactance
= 107,000 kva. = 27,000 amp.

Power on section 3 would be the same as for section 1.

The power on section 2 would be greater than on either section 1 or section 2. Sections 1 and 2 would each deliver to it 100,000 kva. at 266 per cent reactance = 69,000 kva. at 183 per cent reactance. Then:

	Kva.	Per Cent Reactance
Power section 1 to section 2	= 69,000	183
Power section 2	= 100,000	183
Power section 3 to section 2	= 69,000	183
Total power section 2	= 238,000	183
	= 100,000	77

100,000 kva. at 77 per cent reactance
= 130,000 kva. = 32,500 amp.

Table X gives results using 5 per cent and 10 per cent bus reactances, the values given being for section 2.

TABLE X—2,300-VOLT BUS, SECTIONALIZED BUS

Bus-Sectionalizing Reactance	Equivalent Reactance at 100,000 Kva. (Per Cent)	Short Circuit, Kva.	Short Circuit, Amp.
5 per cent at 6,000 kva.	77	130,000	32,500
10 per cent at 6,000 kva.	81	124,000	31,000

As shown in Table X, a bus-sectionalizing reactance does not reduce the short-circuit current very greatly, a 10 per cent reactance causing a reduction of only 4,000 amp., so the value is still too high for the 2,300-volt breakers usually applied on such feeders. The introduction of more reactance would bring this value down lower, but would have the disadvantage of producing unequal voltages on the 2,300-volt bus sections when the sections have unequal loads.

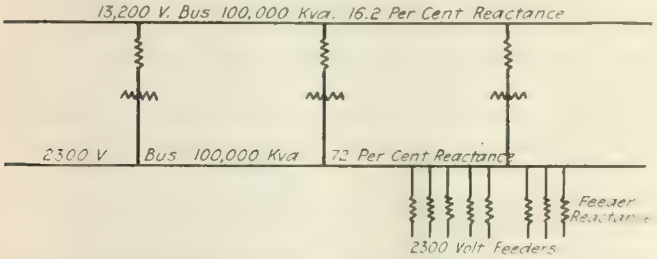


FIG. 10—PROTECTION IS GREATEST WITH FEEDER REACTANCES

Advantages of Grouping Feeders

Another way of reducing the short-circuit current on the feeder breakers is to divide these feeders into groups of, say, five each, having for each group a breaker capable of rupturing the full short-circuit current. These breakers would be so wired that a short-circuit on feeder 1 would trip the group breaker instantaneously. The breaker on feeder 1, however, would not trip until the group breaker was out. Then the tripping of the feeder breaker would reclose the group breaker, restoring voltage to the other breakers of the group. The operation (see Fig. 8) would be:

1. Short circuit on feeder 1.
2. Group breaker *G* trips instantaneously.
3. Feeder breaker trips.
4. Group breaker *G* recloses.

This arrangement would cause a slight interruption to the four good feeders in this group, but as it would last for only two seconds or less, this would not be a very serious difficulty. However, it has this decided advantage: If there are twenty feeders, it would require only four heavy-duty breakers, and the actual feeder breakers, being required to break no current, could be of an inexpensive type. A possible objection to this scheme might be that in case of trouble in the group breaker itself the whole group would be out of commission. If conditions warrant the extra precaution, an extra breaker could be installed for each group. The two breakers to each group could then be interlocked, either mechanically or electrically, so only one could be used at a time. The wiring scheme for this group arrangement will be considered in a later article under the subject of "Relays."

Two-Bus Scheme Saves Expensive Breakers

Still another possible scheme would be to have two 2,300-volt buses, the second one to be sectionalized as shown in Fig. 9, and all of the feeders supplied from this bus. With this scheme a short circuit on a feeder supplied from the left-hand bus section would instantly trip the breaker supplying it. Then the breaker feeding the right-hand section would have to supply power to section *L* over the bus reaction, and the feeder breaker would rupture this current instead of the entire short-circuit current. The sequence for this arrangement would be: (1) Short circuit on feeder 13; (2) breaker *L* trips instantaneously; (3) feeder breaker 13 trips; (4) breaker *L* recloses.

If the bus reactance be 10 per cent at 6,000 kva., the amount of power that section *R* could force through the bus reactance into the fault would be 100,000 kva. at 239 per cent reactance. (The power on the 2,300-volt bus is 100,000 kva. at 72 per cent reactance, and this added to the bus reactance of 6,000 kva. at 10 per cent or 100,000 kva. at 167 per cent gives this figure.) This would give a short circuit 44,000 kva. = 11,000 amp. If the bus reactance be increased to 20 per cent at 6,000 kva., this figure is reduced to 24,600 kva. = 16,100 amp., while a 40 per cent reactance will bring it down to 13,600 kva. = 3,400 amp.

While this scheme would require only two heavy-duty breakers, it would require the bus reactances which would practically offset the cost of the extra group breakers. A more serious point, however, is that a short circuit on a feeder would reduce the voltage of all other feeders on that particular bus section, due to the fact that all of the power would have to come through the bus reactance. In the scheme just previous to this, the only other feeders to be affected would be the four in the same group. The question to be decided then is whether to trip four feeders for one second to two seconds or to have reduced voltage on *all* feeders for the same length of time. This would very probably be decided in favor of the group system as against the one with the sectionalized bus.

Last of all, to reduce the feeder short circuits, we can put a reactance in each feeder as per Fig. 10. In this location they do the most good, but at the same time this arrangement takes the greatest number of reactors. This means increased cost of reactors and increased cost of bus structure, building, etc.

Assume the feeders to be 250-amp. capacity, 1,000 kva. per circuit. The equivalent power on the bus is 100,000 kva. at 72 per cent reactance. A feeder reactance of 1 per cent at 1,000 kva. would give 100,000 kva. at 172 per cent reactance as the power of the feeder. This gives 58,000 kva. = 14,500 amp. as the duty on the feeder breaker. Increasing the reactance to 2 per cent gives 37,000 kva. = 9,250 amp., and a 3 per cent reactance would give only 27,000 kva. = 6,750 amp. as the duty on the breaker.

It must be borne in mind that added reactance, while it reduces the short circuit, also means poorer voltage regulation for the customer. These two points must be considered, as well as cost, and an attempt must then be made to strike a happy medium.

Readers' Views and Comments

The Tariff on Research

To the Editor of the ELECTRICAL WORLD:

SIR: Your editorial in the March 20 issue, page 643, referring to the tariff bill on scientific apparatus now pending before the Senate, is most timely. If anything is to be done to remove some of its objectionable features, it must be done at once, and your criticisms point very plainly the direction which improvement should take. The writer believes sincerely in the protection of American industry, particularly at this time of industrial disturbances all over the world and in view of the very serious conditions which are disclosed by the sudden stress of war. We in this country had so long complacently imported technical material from Germany that the failure of supply was a grievous shock to our sensibilities. The proposed tariff will at least give continued encouragement to American makers in following the path along which necessity has led them. In amount the tariff proposed is substantially that in force before the war, except that it now covers some items, like raw optical glass, previously on the free list. For that matter it certainly would be a crime to let the optical-glass industry, which made such admirable progress in time of need, die from inanition due to free importation.

The chief feature of the present bill is that it throws the burden of tariff upon the educational institutions previously allowed to import duty-free. Even in this particular, difference of opinion has developed in the discussions of the subject, and not a few of those interested have felt that on the whole the burden could be well borne for the sake of bringing American manufacture of apparatus to a point where it would prove a dependable and convenient source of supply.

The matter of duty on apparatus not made in this country, to which you have referred, is one which certainly should be very thoroughly considered by the Senate before final action is taken. There are many items, not specific but generic, practically unobtainable from American sources—for example, polarizing apparatus of all kinds, surveying aneroids, direct-vision spectroscopes, a few types of electrical measuring apparatus and photometric devices, occasionally very useful, with not a few other things which will forcibly suggest themselves to those who have occasion to use them. A casual sample of any of these may have at some time been made in the United States, but so far as the writer has discovered they are not obtainable from stock as the regular product of any American maker. It certainly would be just and fair to add to the pending bill a provision that apparatus of kinds not obtainable in this country through regular commercial channels should be admitted duty-free to all alike on a clear showing of this condition. The writer would go far enough to hold that such a rule should not apply to peculiar modifications of apparatus made after the pattern of some particular foreign firm or to forms held against American manufacture by the patents of foreigners. The requirement for free admission should be that a generally similar article of similar grade is not obtainable from the regular product and stock of an American manufacturer. When such items are actually put in manufacture here they should automatically have full protection, which should prove stimulus enough for our makers to go ahead on anything that is worth the effort. Meanwhile the investigator would not be burdened by a tariff which is a direct tax on research without conferring benefit on the American apparatus maker or turning more than a petty amount into the treasury.

LOUIS BELL.

Boston, Mass.

The Small Consumer and the Kilowatt-Hour

To the Editor of the ELECTRICAL WORLD:

SIR: Gas companies have one advantage over their electrical competitors in gaining the confidence of the small domestic consumer. Most persons know what a cubic foot is and can imagine a symmetrical block of illuminating gas passing through the meter and being consumed at the burners. Comparatively few know what a kilowatt-hour is. Dictionary definitions do not help them much. Moreover, an up-to-date residence schedule, prepared by a professional rate expert, in small type on the back of the bill, however neatly printed, is likely to be mentally consigned by the recipient to the abode of defunct and unrighteous Philadelphia lawyers, who alone, he thinks, could understand it. He himself has no idea what he is paying for, but is quite sure he is getting "stung."

Electricity, of course, cannot be sold by the foot or the pound or the gallon; but is it not possible to dispose of it by some name more reassuring to the electrically ignorant than "kilowatt-hour"? In Great Britain the kilowatt-hour is called a Board of Trade unit, and it is proposed to change that designation to "kelvin." Neither of these names, however, would help much, for "unit" is meaningless and "kelvin," if a little easier to memorize, is just as mysterious as "kilowatt-hour."

What is the matter with "electrical hour"? And why not, having adopted the simpler and more persuasive term, print upon the face of the bill an explanation of the following nature:

> AN electrical hour — technically called a kilowatt-hour (that is, a 1,000-watt hour) — is the amount of electricity consumed by:
>
> A 40-watt lamp in twenty-five hours.
> A 50-watt lamp in twenty hours.
> A 100-watt lamp in ten hours.
> A 550-watt flatiron in a little less than two hours.
>
> Thus a new 60-watt lamp, for instance, burning two and one-half hours a night for thirty nights will consume $60 \times 2\frac{1}{2} \times 30$ watts, which gives 4,500 watts, or four and one-half electrical hours. But calculations made in this way will not, of course, be exact enough to agree absolutely with the bill.

Then the aggrieved householder by noting the rating of his lamps and appliances and the time that each of them was burned in a given month could by a simple arithmetical process arrive at an opinion on the accuracy of his bill.

C. S. MANN.

New York City.

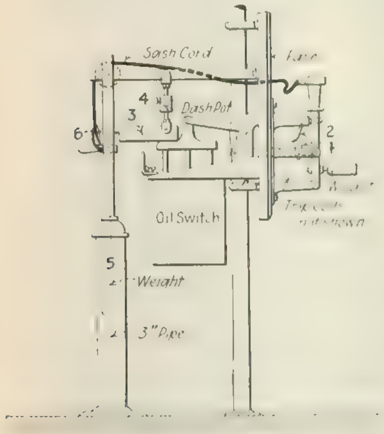
Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Device That Automatically Recloses Oil Switch After Tripping Out

AN ARRANGEMENT for automatically reclosing an oil switch which has been tripped out by overload has been developed by the Southern California Edison Company for use where an attendant is not constantly present. When a switch has been tripped this device will close the switch after the lapse of a certain interval of time which may be changed according to conditions. After the switch has reclosed once an attendant must set it before it again recloses.

The device has been designed for use in substations which have no independent source of energy, such as a storage battery, and therefore its action is entirely mechanical. The operation is as follows: The occurrence of a short circuit causes the trip coils attached to the switch mechanism in front of the panel to raise and break the toggle joint shown at (1). This toggle joint releases the trigger (2) which retains the switch handle in its vertical position. Owing to the weight attached to the switch handle it falls away from its vertical position, placing the sash cord under a slight tension. The change in the position of the switch handle permits the toggle joint again to straighten out so that the movement of the switch handle toward the panel will close the switch.



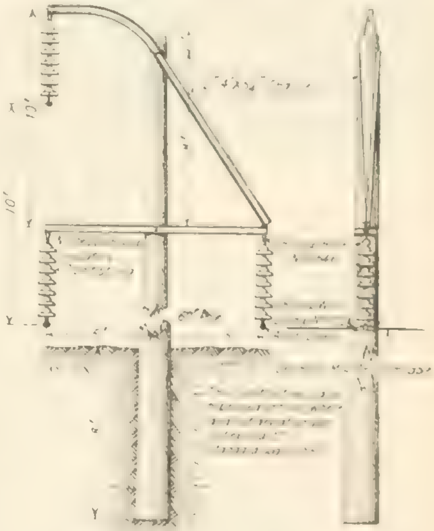
SWITCH AUTOMATICALLY RECLOSED BY DROPPING OF WEIGHT

As the switch opens, the arm (3) which had previously rested upon the yoke of the oil switch is now released and begins to fall, retarded by the dashpot. When this arm has fallen a certain distance the weight (5) is released by operation of the dog (6). The fall of this heavy weight, which is hung on the sash cord, pulls the switch closed. Should the switch be reclosed when the short circuit is still on the line, the switch will trip out immediately as the automatic mechanism on the switch is not interfered with by the weight pulling on the switch handle. Before the switch can again automatically reclose the weight must be lifted to its upper position by an operator. The dashpot is introduced for the purpose of preventing too rapid reclosing after the switch has tripped out. It may be adjusted to introduce an interval of thirty seconds or so between the opening of the switch and its reclosing.

These switches have been designed by the writer particularly for use in the agricultural sections of California in small substations where the operators make inspections only daily or twice a day. Most trouble occurring in the lines is cleared up after one operation of the switch, and if it is not, the switch is an indicator to the inspector that there may be serious trouble.

J. H. STOCKBRIDGE,
Southern California Edison Co., Superintendent.
Los Angeles, Cal.

Single Wood Poles for Use for 100,000-Volt Line



WISHBONE CROSS-ARMS FOR 110,000-VOLT WOOD POLE LINE

A CREOSOTED wood pole 60 ft. (18.3 m.) in height, with double channel-iron wishbone cross-arm, has been adopted by the San Joaquin (Cal.) Light & Power Corporation for the 110,000-volt transmission line which extends from the new Kerckhoff power project to Corcoran, a distance of about 70 miles (112 km.). The same construction will be used when the line is extended this summer a further distance of about 65 miles (104 km.), making 135 miles (216 km.) in all. It has been found that two 4-in. (10.2-cm.) channels give as satisfactory results on strength tests as one 7-in. (18-cm.) channel, saving both weight and expense. The spans are long, a 587-ft. (180-m.) spacing being standard and some spans occurring as long as 700 ft. (210 m.). The same double-channel wishbone construction on a single pole was used at these long spans, and four guys were installed on each pole, two side guys and two guys with the line.

Wind pressure is figured at 8¾ lb. per square foot (39.2 kg. per sq.m.), and there are no ice and snow considerations, so that the factor of safety for wind is reckoned at 3.1 for maximum wind. As a matter of fact, weather bureau records for this region show no wind pressure higher than 4½ lb. per square foot (22 kg. per sq.m.) during the entire period of record. This would give a safety factor of six, which complies with all requirements. As a column, a factor of safety of about ten is figured. Sag curves are figured on the same wind pressures as given above. It has been found that it is not advisable to dead-end on the arm because of the twisting effect which develops in the upper framework, so that all dead-ends are made vertically on the pole, except at slight angles where the line dead-ends both ways on the arm. The wishbone construction is slightly different from that of the standard wood pole in use by the company, which makes use of straight channels. In order to insure the clearance for the longer string of insulators on the high-voltage line, it was found necessary to go back to the curved form, as the straight wishbone would have had to be too long to be practicable.

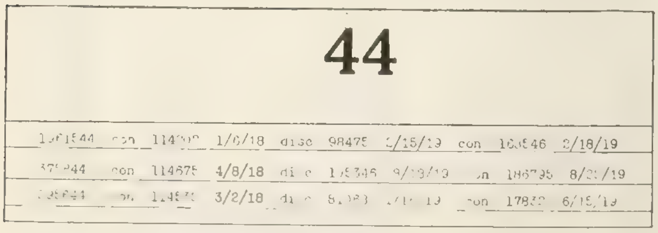
It is estimated that the money saved on wood-pole construction over steel poles is sufficient to replace the wood poles every twelve to fifteen years. As a matter of record, wood poles elsewhere on the lines under similar conditions have lasted considerably longer than this period, and some creosoted wood poles on another section of the system are in absolutely good condition after nine years of service, showing no deterioration whatsoever. Probably the poles on the 110,000-volt line will be about in a condition to stub at that time.

L. J. Moore.

San Joaquin Light & Power Corporation,
Fresno, Cal.

A 100-Page Book That Provides Records of 2,000 Meters for Five Years

A METER-RECORD book of 100 pages takes care of 2,000 meters for four or five years by the system used in the Christopher (Ill.) office of the Central Illinois Public Service Company. In entering a meter in the book the last two figures in the number determine the page on which it is entered. For instance, No. 1061544 and No. 375844 are both entered on page 44. The meter number is entered at the left of the page, as the reproduction here shows, and immediately to the right on the same line are entered the "connect" and "disconnect" data. This record consists of the "connect" or "disconnect" number and date, which are taken from the records which are kept separately when a service meter is changed. By referring to the "connect" number, which is numerically filed elsewhere, all details of the installation may be ascertained. In this meter book all "connect" data are recorded in black, while "disconnect" data are recorded in red. This system is much more practicable than entering the meters numerically. Each meter has a definite place in the book, and with a 15-in. x 18-in. (38-cm. x 48-cm.) 100-page looseleaf book records of 2,000 meters may be kept without crowding for four or five years.



44

1061544	con	[illegible]	1/6/18	disc	98475	[illegible]	con	[illegible]	2/18/19
375844	con	114675	4/8/18	disc	[illegible]	[illegible]	con	186795	[illegible]
[illegible]	con	[illegible]	3/2/18	disc	[illegible]	[illegible]	con	[illegible]	6/15/19

SECTION FROM PAGE OF METER-RECORD BOOK

On this page, 44, are recorded the "connect" and "disconnect" data of all meters whose numbers end in 44.

Christopher, Ill. James F. Meister,
Local Manager.

Analysis of Hydro-Electric Plant Costs

THE following analysis of the segregated costs of the San Joaquin Light & Power Company plants in central California is of considerable interest in connection with estimates of the future growth of Western systems. The costs cover all hydro-electric and steam-plant installations in operation Jan. 1, 1918, and include dams, roads, miscellaneous structures and transmission equipment at the power house.

These costs are tabulated under four heads. The first gives costs per kva., calculated from the total rated kva. of all generators in the system; the second cost is per kw. of output when all plants are delivering their actual maximum output; the third column of costs is based on the greatest possible output by the hydro-electric generators during the dry months of August and September, and the last column is based on the combined outputs of the water and the steam turbines during August and September.

POWER-HOUSE UNIT INSTALLATION COSTS

Accounts	Cost per Kva. of Total Generator Rating	Cost per Kw. of Greatest Peak Capacity of All Plants	Coet per Kw. of Hydro Capacity Available in August and September	Coet per Kw. of Hydro Capacity in August and September Plus Steam Capacity Available
Land	$1.84	$1.87	$3.30	$2.83
Storage reservoirs	20.69	21.05	37.14	25.71
Water conduits	28.58	29.09	51.32	35.53
Forebays	3.02	3.07	5.42	3.75
Penstocks	10.40	10.58	18.66	12.92
Buildings	6.97	7.09	12.51	8.56
Waterwheels	4.54	4.61	8.14	5.64
Boilers and equipment	6.62	6.74	11.88	8.23
Engines and turbines	7.23	7.35	12.97	8.98
Generators and exciters	4.67	4.75	8.39	5.81
Switchboards	1.60	1.63	2.88	1.99
Transformers	3.23	3.29	5.80	4.02
High-tension equipment	1.82	1.85	3.28	2.27
Miscellaneous structures	2.09	2.12	3.75	2.60
Miscellaneous construction costs	5.85	5.95	10.50	7.27
Totals	$109.15	$111.04	$195.94	$135.65
Capacity used	48,475 kva.	47,625 kw.	27,000 kw.	39,000 kw.

The figures given here, while they are of pre-war costs, are of value in that they represent the proportionate cost of the several major parts into which the total cost may be subdivided. G. R. Kenny.

Fresno, Cal.

More Than 123,000 Insulators Tested Alive at Cost of 2.13 Cents each

AT A COST of $2,624.58 total—about 2.13 cents each —123,069 insulators were tested during the year 1919 by the transmission department of the Georgia Railway & Power Company. In this testing, which was done by the "buzz stick," 13,196, or 10.7 per cent, were found defective. The annual report of the transmission department from which this information was obtained further states that 18,647 insulators were removed and 23,575 were installed on the 600 miles of line of this company. The increase in the number of insulators came about in changing about 100 miles to operate at 38,000 volts instead of 22,000 volts. Practically all of this insulator changing was done on live lines. Five hundred and one poles were reinforced. 105 were replaced and 219 were reset.

During the course of the year's operation it was necessary to open 158 transformers for inspection or repairs, and twenty-two of them had to be taken out of service. Each line of the company was patrolled twelve times a year by three men, who walked 2,696 miles (4,330 km.) each in the year. The fourteen cars and trucks of the department traveled 151,790 miles (243,000 km.), averaging about 10,800 miles (17,400 km.) each, while two ¾-ton trucks made 14,646 and 14,582 miles (about 24,000 km.) respectively. The department handled very little new construction, only 1.7 miles (2.7 km.) of 66,000-volt line of No. 2/0 copper.

How Standardized Switchboards Aid in Substation Enlargements

ECONOMY of space, safety, accessibility for making changes and ability to make extensions quickly are features of a switchboard, like that shown in the accompanying illustration, used to control a 7,400-amp., 250-volt synchronous converter of the Kansas City (Mo.) Power & Light Company. The entire control of the converter itself is mounted on three panels (Fig. 1), the center panel, which holds the controlling instruments and auxiliary operating devices, separating the heavy main direct-current switches of opposite polarity which are on the outside boards. A panel to the right holds voltmeters for reading the pressure on sixteen feeder wires which connect to different points on the Edison system. By turning a rotary handle on the board the voltage in any of these feeders may be read. Mounted below this rotary switch on the rear of the board are the three fuses (positive, neutral and negative) of each circuit (Fig. 2).

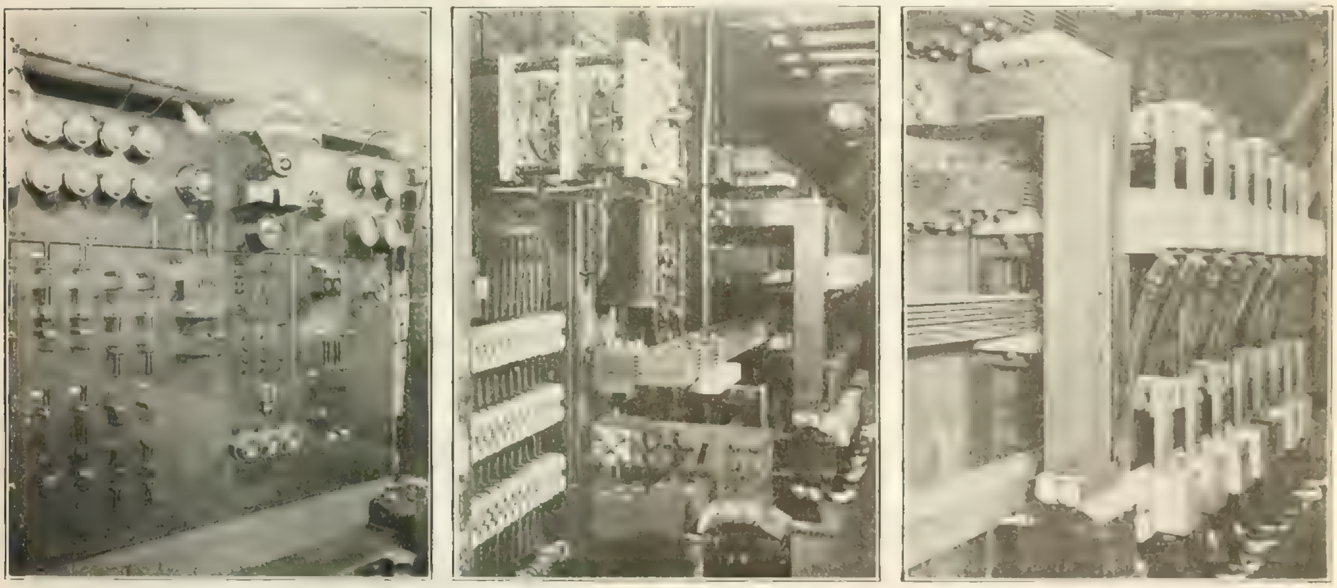


Fig. 1. Fig. 2. Fig. 3.

PANELS OF THIS BOARD MAY BE READILY REMOVED FROM THE FRONT.

Left—Control located on three panels, feeder panels to left and voltmeters reading at sixteen points to right. Center—Rotary voltmeter switch showing fuses for sixteen voltmeter leads. Right—Boxes inclose copper fuses for feeders; buses supported on stone slabs.

Four 1,500,000-cm. (760-sq.mm.) outgoing cables are connected to each of the 16-in. (41-cm.) distribution panels with all positive switches in the upper row and negative switches in the lower. Each cable terminates (Fig. 3) in a copper link fuse covered by an insulating flash guard to prevent harm to an attendant replacing an adjacent fuse. In order that this box may be quickly removed to replace a fuse it is held on by a single cotter pin.

The switchboards are fastened to angle irons by bolts which can be removed from the front so that after these bolts are removed and the back connectors of the switches are unbolted from the feeders the entire panel may be removed from the front without interrupting service. There is sufficient working space for tightening nuts, and the framework is insulated from ground to prevent short circuit by a wrench handle swinging against the structural parts. Moreover, as buses of opposite polarity are widely separated, a short circuit between buses is not possible.

The feeder terminals and the buses are mounted on stone slabs and the whole structure is made as rigid as possible to prevent any movement of parts that would loosen the copper connections. Expansion joints are inserted in the long bus runs to allow for changes of length under temperature changes. The circuit breakers, oil switch and oil transformers are installed in the basement to avoid congesting the space near the board. The general features of this board have been in use for some time in St. Louis, and standard drawings and templates have been made so that any of the substation switchboards may be added to quickly and at a reasonable cost.

D. D. CLARKE,
Electrical Engineer.
Kansas City Power & Light Company,
St. Louis, Mo.

Separate Exciter Desirable for Each Steam-Driven Generator

THE tendency in steam-station exciter practice is away from the common exciter bus and toward the practice of using a separate exciter on the shaft of each generator with an emergency unit so arranged that it can replace any direct-connected exciter in case of failure. The advantages of this arrangement are said to be those which accrue from segregation and simplicity in any electrical layout. These facts will be brought out at some length and instances of specific character will be discussed in the report of the electrical apparatus committee of the National Electric Light Association at Pasadena in May.

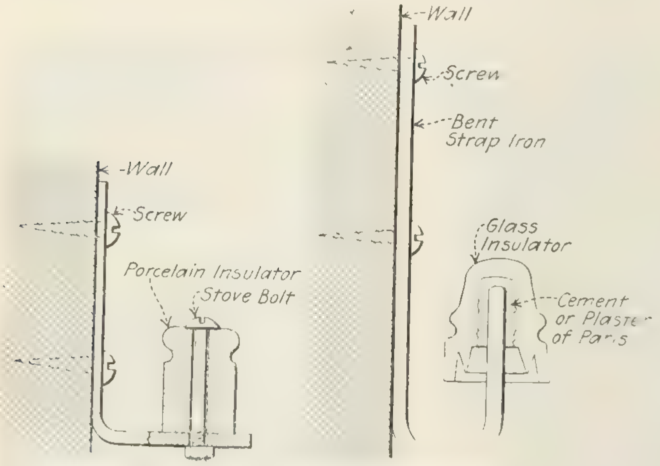
Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

Insulator Brackets Easily Made from Bent Strap Iron

IMPROVISED insulator brackets for use where the standard manufactured types are not available can be made from a bent piece of strap iron. Two such brackets shown in the accompanying drawing have proved useful in telephone and lighting wiring. The telephone insulator is fastened on the bracket by means of a common stove bolt, while the lighting insulator is fastened on the U-shaped strap with Portland cement or plaster of paris. On account of the rapid setting qualities the plaster of paris is often the more convenient to use. Both kinds of supports should have holes drilled through them to accommodate screws or bolts. **C. E. Cunningham.**

New Orleans, La.



TWO TYPES OF INSULATOR BRACKETS MADE OF BENT STRAP IRON

Electrical Equipment Used in Ohio Rubber Plants

THE types and sizes of motors used for driving machinery making rubber goods in a number of Ohio plants are given in this article, together with their operating conditions. By far the largest share of electrical power in a rubber-working factory is used for driving the mill lines. A common rule to determine the size of motor required for mills is shown in Table I. Any rule, however, must be adapted to the many factors, such as the nature of the gum and compounds, temperatures, feeding of the rolls, etc., which affect the power required. The motor speeds are 600 to 720 r.p.m. line-shaft speeds, 75 to 100 r.p.m., and mill speeds, 20 to 25 r.p.m. Magnetic clutches as well as reversing switches are installed on all mill lines. The load on a mill line consists of cycles lasting twenty to thirty-five minutes, in which a maximum input is reached at the beginning of the cycle when cold gum and raw rubber are started. The load gradually decreases, showing lesser peaks as other ingredients are added or the sheets are folded. It will be noticed that the daily peak comes at 8 a.m. to 8:30 a.m.

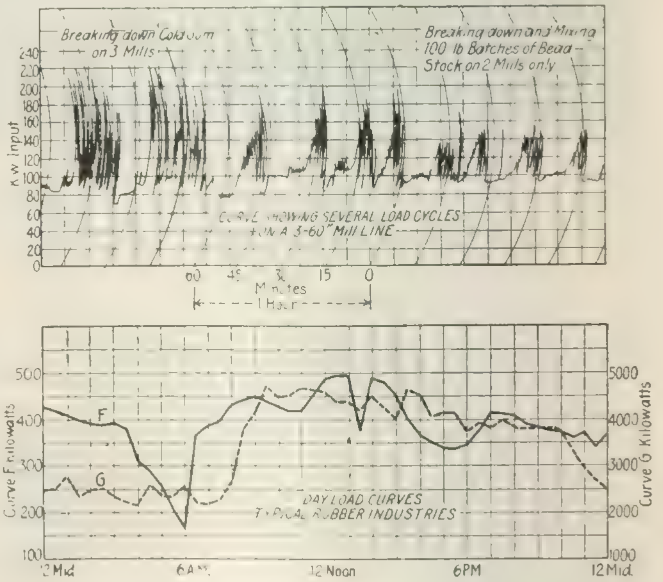
TABLE I—APPROXIMATE SIZE PER INCH OF MILL OF MOTOR FOR RUBBER-MILL LINES

1½ kw. when one mill is connected per motor.
1¼ kw. when two mills are connected per motor.
1 kw. when three mills are connected per motor.
⅞ kw. when more than three mills are connected per motor.
¾ kw. as a minimum value.,

TABLE II—SIZE OF MOTOR ORDINARILY USED WITH RUBBER CALENDERS

Size of Rolls (Diameter by Length)	Motor Hp.
18 in. x 54 in.	35
20 in. x 60 in.	50
22 in. x 60 in.	75
24 in. x 66 in.	90
32 in. x 90 in.	250

For calenders a shunt-wound interpole motor is employed to permit speed variation from about 225 to 900 r.p.m. and dynamic braking. To obtain a wide range of speed a three-wire 115/230-volt system is used. The size of motor, depending on the size of rolls, as shown in Table II, varies from 35 hp. to 250 hp. Rather elaborate control is necessary to obtain the wide speed variation required. By means of a rope accessible to the operator at the rolls the machine



LOAD CURVES OF RUBBER PLANTS

Above, load cycles on a mill line driving three 60-in. mills. Below, daily load curve of a large and a small plant. The peak comes in the morning.

may be quickly stopped by dynamic braking. For conversion the rotary converter is employed with about 75 kw. for each 24-in. x 66-in. (62-cm. x 168-cm.) calender. For operating tubing machines the motors vary, as seen in Table III, from 15 hp. to 25 hp.

Power is usually sold to rubber plants at 3,800 volts or 22,000 volts, which is stepped down to 440 volts for the smaller plants and to 2,200 volts for the larger motors of the more pretentious plants.

Table III—Size of Motors for Rubber-Tubing Machines

	Hp.
Royle No. 3 perfected tubing machine	15
8-in. tubing machine	35
10-in. tubing machine	75
Royle No. 2 perfected tubing machine	25

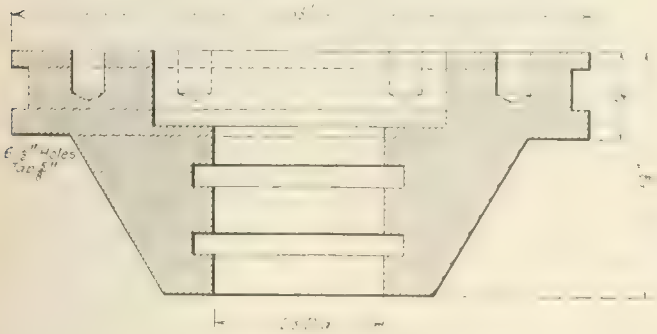
Stated briefly, a plant making 250 to 300 tires requires 375 hp. in motors, while one making 500 to 600 tires requires 750 hp. The demand factor ranges from 69 to 78 per cent. The yearly load factor averages between 20 per cent for a plant operating one shift and 35 to 40 per cent for three shifts.

To improve the low power factor, 60 to 65 per cent, which prevails on account of the general use of induction motors, synchronous apparatus should be more generally employed, especially for mill lines. One large manufacturer already has adopted synchronous motors with success. This type of motor has been developed to give 300 per cent of full-load torque and to operate at high efficiency, and it adds no complications to starting.

H. C. Stephens,
Power Engineer.
Northern Ohio Traction & Light Company,
Akron, Ohio.

Substituting Ball Bearings for Brass-Lined Ones Reduces Motor Repairs

Owing to trouble with the brass-lined bearings on motors of mine locomotives, the Quincy Mining Company (Mich.) found it necessary to replace these bearings with ball bearings. The trouble was due to the armature heating up at times of overload and melting the grease out of the bearings. With no grease in the bearing the shaft would cut the linings out and allow the armature to drop down on the pole pieces. To remedy the trouble it was decided to try ball bearings, so the bearing caps shown in the sketch were built to replace the old caps.



BEARING CAP FOR BALL BEARINGS

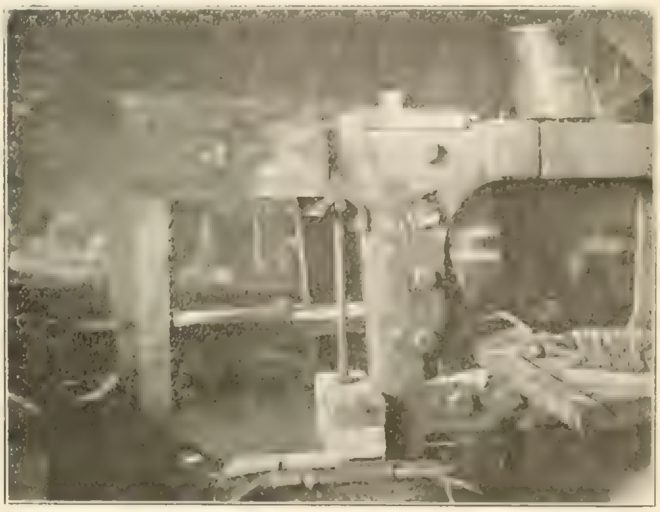
To prevent the ball race from turning on the shaft a jam nut is tightened against it on the pinion end of the shaft. On the commutator end a washer and cap screw perform the same function. The bearing shown in the sketch is for the pinion end, the one for the commutator end being slightly smaller.

Sixteen two-motor locomotives with sixty-four bearings were changed in this manner in 1916, and since that time no bearing troubles have been experienced.

J. C. Kendall,
Quincy Mining Company, Electrician.
Hancock, Mich.

How a Brass Bearing Was Used to Back Awkward Weld

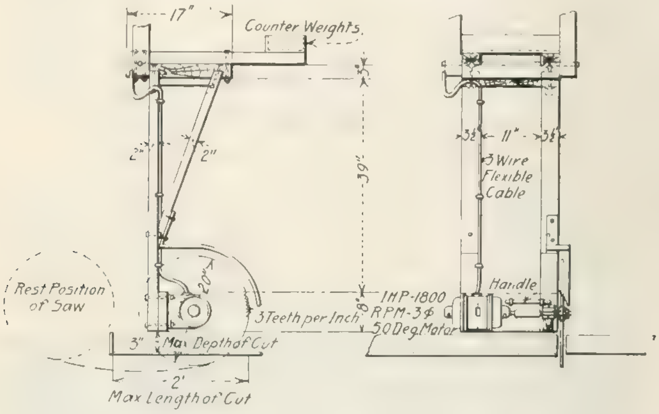
In welding a broken engine frame which could not be taken out of place for fear of misaligning the driver bearing, an old brass bearing lining was used by a Western shopman as a backing to give a curved shape to the weld. This lining was propped in position under the break and the hole was filled by electric welding. This brass piece, to which the welding material did not stick, was of the correct shape to give the proper curve to the weld.


PROPER CURVE TO WELD PROVIDED BY BRASS BEARING LINING

F. A. Anderson.
San Francisco, Cal.

Direct Connection of Motor to Swing Saw Permits Use of Smaller Size

Direct connection of motors to the swing saws in a Massachusetts box factory has allowed the size of motor used to be reduced from 3 hp. or 5 hp. to 1 hp., with a consequent saving in first cost and in energy consumption. The motor and saw are both mounted on an oak frame as the illustration shows and are connected by a short shaft running in a bearing. The shaft is about 1 in. (2.5 cm.) larger than the motor shaft, which fits into it and is keyed to it. The other end of the shaft is turned down to fit the saw arbor. An iron rod passing through the upper end of the frame fits in holes in supports hung from the ceiling so that the saw can be swung for cutting. A counterweight fastened on the upper part of the frame makes the saw hang in the proper position. The 20-in. (51-cm.) saw shown is driven by a 1-hp., 1,800 r.p.m. motor, although a 3-hp. or 5-hp. motor was formerly used with the usual method of connection. This new construction eliminates the bearings at the top of the saw frame which supported the frame and also drove the saw through a belt which was necessarily tight on account of being short and running in an almost horizontal position when cutting. Practically all of the power is transmitted to the saw, and when idling the wattless current is small compared with that of the larger motor. There is no power wasted through a belt and the loaded bearings. Another advantage is that there is no belt to break and cause injury.



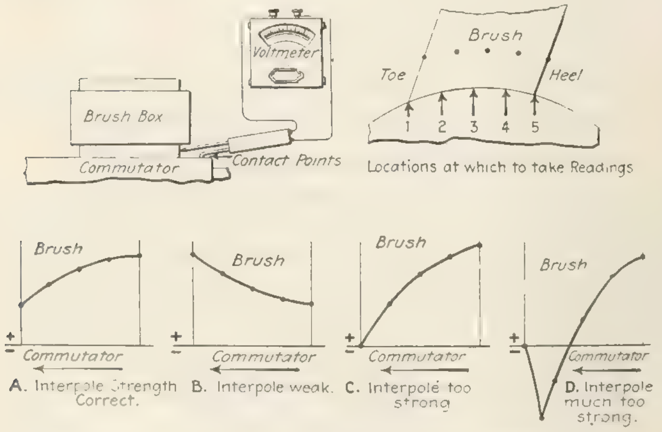
MOST ECONOMICAL DRIVE FOR SWING SAW

Such a saw is not desirable for very heavy cutting, but it has been used satisfactorily on ⅞-in. (2.2-cm.) stock of various kinds of wood.

JOSEPH FRANZ,
Power Engineer.
Southern Berkshire Power & Electric Company,
Stockbridge, Mass.

Method for Testing Strength of Interpoles

SUITABLE contact points and a low-reading voltmeter may be used to determine the strength of interpoles of direct-current machines. A curve plotted from voltage readings taken at points on the side of the brush should droop in the direction of rotation (*A* in the drawing) but should not reach zero. If the curve rises in the direction of rotation, the interpole is weak, while if it drops as far as zero the interpole is too strong.



A. Interpole Strength Correct. B. Interpole weak. C. Interpole too strong. D. Interpole much too strong.

CURVES SHOWING STRENGTH OF INTERPOLES

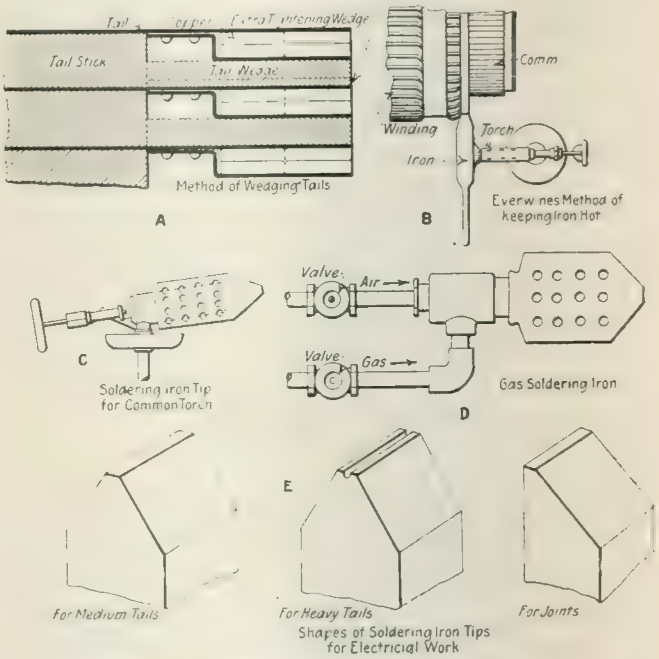
A—Correct strength; curve droops slightly in direction of rotation. B—Weak interpole; curve rises in direction of rotation. C—Too strong; voltage zero at toe of brush. D—Much too strong; voltage reverses about center of brush.

These contact points may be made of small wire taped to a wooden stick. Readings should be taken at the toe and the heel of the brush and at two or three points in between. If the interpole is weak, it should be brought closer to the armature by shimming, or maybe one or more turns of its winding are short-circuited and should be separated. If the interpole is too strong, it can be either moved further from the armature or part of the current may be shunted. This method cannot be depended on if it is not certain that the brushes are on the neutral point.

JAMES DIXON.
Cleveland, Ohio.

Tools and Methods for Correctly Soldering Commutator Tails

SOLDERING commutator tails must be well done, because a poor joint will cause trouble in the form of black spots on the commutator and hot joints. The difficulty of making a good joint at the commutator tail is due to the limited surface to which heat may be applied. Therefore care must be taken to clean the joints well, and in order to bring the tails as close as possible to the leads wedges (*A* in the illustration) must be driven in between the tails. The soldering iron should be well tinned by rubbing while hot on sal-ammoniac crystals and solder. Sufficient time must be allowed for the joint to heat up thoroughly before applying the solder. A torch flame held on the iron (*B*) will hasten the work. This requires two men, one to hold the torch and another to hold the iron and feed the solder. For small tails a tip made to fit directly on the torch (*C*) may be used to advantage. A gas-heated iron (*D*) is very good. This iron has valves for regulating both air and gas to obtain the maximum heat. Some useful forms for the tips of irons for this work are shown at (*E*).



IRONS FOR SOLDERING COMMUTATOR TAILS

Success in soldering depends probably 90 per cent on having the joints clean and 10 per cent on good tools properly heated. For a flux the fluid recommended by the National Electric Code is composed of saturated solution of zinc chloride, five parts; alcohol, four parts, and glycerine, one part. Another good flux may be made of rosin dissolved in benzine. In a pinch rosin alone can be used or even good rosin varnish.

Boston, Mass. **R. L. MCINTYRE.**

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

Employees' Commissions on Appliance Sales

WITH the idea of bringing in new appliance business without disturbing other channels through which it would naturally come to the company, the Worcester (Mass.) Electric Light Company is now giving to its employees commissions on all the sales they make. Special sales slips are being issued for this purpose, one commission only being allowed on any one article. This is paid to the one who first presents the sales slip made out and signed in proper manner.

A commission of 10 per cent is allowed on electric flatirons and toasters and 5 per cent on all other articles except washers, mangles, ranges and similar appliances, for which $5 is paid, and vacuum cleaners, for which $1.50 is paid when the "prospect" makes the purchase. On old house wiring one-half of the commission allowed is paid to employees when the contract is closed, provided that the prospect has not already been called upon.

When it is necessary to make the sale on a time-payment basis as large a first payment as possible is obtained and the time of deferred payments made as short as possible. The following schedule of time payments is followed:

Retail Price	Cash Payment	Balance
$10 or less	$2	Three equal monthly payments
$10 to $30	$3	Six equal monthly payments
$30 and up	Time limit of twelve months except for washers	

Demonstrations are made according to arrangements made by the employee turning in the name of the prospect.

What Water Heating Means in Central-Station Revenue

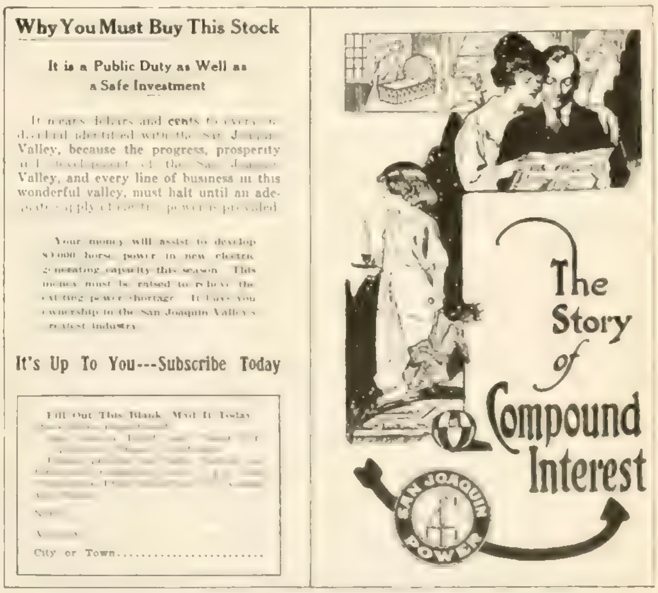
M. C. OSBORN, of Landers, Frary & Clark, New Britain, Conn., speaking of the domestic water heater as an indispensable adjunct to the electric range, before a group meeting of the New England Section of the National Electric Light Association, dwelt on the experience of Western hydro-electric companies in this connection. Flat rates have been made for the service with the water-heater feed cut in ahead of the range meter and with a double-throw, two-pole switch to cut out oven and broiler when the water heater is in operation, the heater being on one side of the three-wire circuit, the surface or broiling burners on the other side.

Thus the water heater demand does not show on the range peak at any time and does not necessitate increased expenditure for distribution and transforming meter. One kilowatt operating continuously will heat 75 gal. of water a day and consume 720 kw.-hr. a month. Assuming, however, that the average customer would use 30 gal. of hot water at 175 deg. F. a day, or 900 gal. a month, 360 kw.-hr. a month would be consumed, which at 1½ cents per kilowatt-hour would bring a revenue of $64.80 a year.

This Mr. Osborn believed to be a safe flat rate where there is thermostatic control, and although power conditions in the East are of course different from those in the Far West, where a large percentage of the available energy is unconsumed and could be marketed at a small additional operating cost, he contended that as a source of potential revenue domestic water heating compares most favorably with the manufacture of ice, street lighting and other business where there is no diversity factor.

Self-Interest Appeal That Gained New Stockholders

IN A PAMPHLET entitled "The Story of Compound Interest" the San Joaquin Light & Power Corporation, Fresno, Cal., has made effective use of a "self-interest" appeal in selling 7 per cent preferred stock to its customers, many of whom need additional power for irrigation of farm lands. Instead of basing a sales argument entirely upon the financial merits of the stock, customers are shown how their investment will furnish the company with new capital necessary for additional equipment, which in turn will make more power available for their requirements. The value of the stock as an investment is interestingly told in the following quotation from the pamphlet:



Why You Must Buy This Stock

It is a Public Duty as Well as a Safe Investment

It means dollars and cents to every individual identified with the San Joaquin Valley, because the progress, prosperity and development of the San Joaquin Valley, and every line of business in this wonderful valley, must halt until an adequate supply of electric power is provided.

Your money will assist to develop [illegible] horse power in new electric generating capacity this season. This money must be raised to relieve the existing power shortage. It gives you ownership in the San Joaquin Valley's greatest industry.

It's Up To You---Subscribe Today

Fill Out This Blank, Mail It Today

[illegible]

City or Town........................

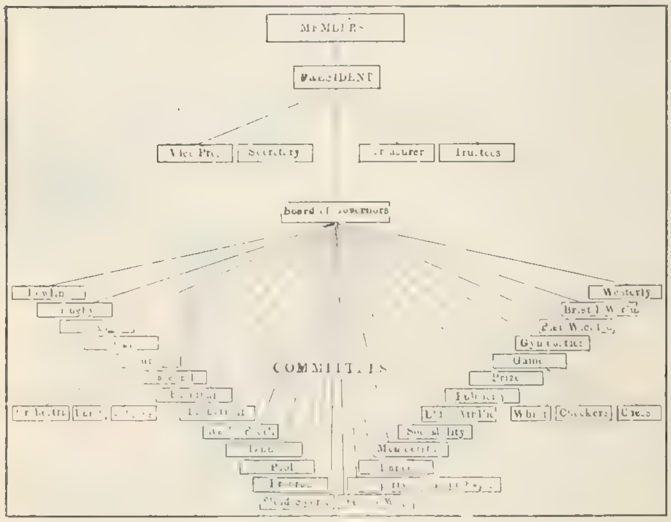
FRONT AND BACK OF "SELF-INTEREST" APPEAL ISSUED BY CALIFORNIA POWER COMPANY

"This stock makes an ideal 'nest egg' for your children. It will teach them the story of interest—how to save and practice thrift. The quarterly dividends, if deposited every ninety days in a savings account to accumulate and draw interest compounded regularly at 4 per cent, will equal the par value of the stock in eleven years and six months. Therefore, if you buy your child ten shares of stock for $985 now, eleven years and six months from now your child will have $1,013.07 on deposit in a savings bank account and $1,000 in San Joaquin Light & Power Corporation prior preferred stock, which undoubtedly will have increased beyond par value by that time. Your money will serve a twofold purpose. It will help to develop the San Joaquin Valley, to the benefit of every land owner, carpenter, banker, newspaper man and every person interested in every line of business activity. Second, it will provide a bank account and a sound investment for the future welfare of your children."

During the first month $500,000 of this preferred stock was sold. The average amount taken by each purchaser was ten shares, making 500 new customer-stockholders in the company.

Good Fellowship Club of the Narragansett Company

LAST November the Narranganseṫt Electric Lighting Company of Providence, R. I., organized what is known as the Nelco Athletic Club, whose object it is to promote good fellowship among employees in the Narragansett company and its associates, which include the Westerly Light & Power Company, Mystic Power Company, Narragansett Pier Electric Light & Power Company and Wickford Light & Power Company. The officers of the club include a president, vice-president, treasurer, secretary, three trustees and a board of eleven governors. All of these hold office for one year except the trustees, who are elected for terms of one, two and three years. Franklin L. Hall, secretary and treasurer of the Narragansett company, who was elected president of the club, has the following to say concerning its formation and work:



ORGANIZATION CHART OF NELCO ATHLETIC CLUB OF NARRAGANSETT ELECTRIC LIGHTING COMPANY

> I do not know of anything the company has ever done which has brought the employees of the various departments into such close touch with one another or has been of such benefit to the company as has the forming of this athletic club. The idea is, instead of having a few persons looking after everything in connection with the club's affairs, to have as many employees as possible each having a little to do. By this means the individual interest is kept at a high point at all times, and any employee of the company who has any red blood in him at all can find something among the various activities to take part in personally.
>
> Each one of the committees is composed of at least three persons. In the case of both the sociability and the membership committee there are twelve members. No one committee has two persons from the same department serving on it. In other words, the personnel of the committees is drawn from different departments as far as possible.
>
> Tournaments in the various athletic activities are arranged during different seasons. For instance, we have had a bowling tournament running all winter, in which fully seventy-five members took part each week. Other tournaments, such as boxing, handball, basketball, pool, tug-of-war, whist, checkers, chess, etc., have been carried on during the winter months inside. Baseball, tennis, field sports, swimming, etc., will be taken up during the summer months.
>
> Although the number of employees making up the committees and taking part in all of these activities might seem to be cumbersome to handle, it has, on the contrary, proved to be the easiest thing imaginable. As will be noted from the accompanying diagram of organization, all of these committees are responsible to a board of governors of eleven members. This board of governors holds regular monthly meetings in the directors' room of the company, at which the president of the club is present as chairman of the board.
>
> A special committee has been appointed to cover the athletic and social work in our subsidiary companies in different parts of the state. In the chart of organization these committees are headed Westerly, Bristol and Warren, Narragansett Pier, and Wickford, showing where these subsidiaries are located.

Other forms of welfare work carried on by the company include a group plan of life insurance, an installment plan for selling stock to employees, co-operative purchase of coal, and publication of an employee magazine of personal and educational value.

Advertising Appropriations for Central Stations

L. D. GIBBS, superintendent of advertising of the Edison Electric Illuminating Company of Boston, advocated consistent advertising year by year in a discussion at the recent question-box conference of the New England Section of the National Electric Light Association. He pointed out that if 5 per cent of the gross revenue can be used in this way the outlay will be ample, and that in most localities like the thickly settled districts of New England 2 per cent of the gross of the central station's business is sufficient. It is advisable to devote half this appropriation to so-called "good will" or "courtesy" advertising and the rest to merchandising.

"Our business," said Mr. Gibbs, "is too much like the way the average man works. The average man, if he would set himself a good average pace and stick to that pace every day, would accomplish much more than he even imagines now to be possible simply by keeping steadily at it. If the average sales person who goes out to sell or who is behind a counter would set himself or herself some sort of standard to sell up to and go straight on throughout the year, developing all the supporting lines through extending acquaintanceship and adding to the little services and attentions given to customers, this bogie or average would then become possible. It is the same with advertising. We are too much inclined when we have a little money in sight to use it all up before the sales organization really gets going;

after it gets going there is often nothing left with which to back it up and so a lag and loss of efficiency result.

"In our own minds, in the Boston Edison Company, we feel that we do very little display advertising in the newspapers compared with the size of our business and the territory we cover. I was talking not long ago with Mr. Richards, advertising manager for Jordan-Marsh. I asked him about the percentage of their gross that they allow for display advertising and about some of the different angles of their policies. He said: 'I should think that, in your electrical business, if a store on its own account, or a man running an appliance store by itself, or a central station, spent 5 per cent of its last year's gross on this year's advertising, this would be doing very well and would get wonderful results.

"You will be interested to know that it has been figured very carefully that if you spend $5,000 this year for advertising you will have $4,000 worth of that advertising coming to you next year, and $3,000 the next, $2,000 the next and $1,000 the next. Thus the $5,000 that you spend this year will have pulling power in diminishing ratio through five years, but it won't have that pulling power unless you add to it and keep it alive. So, if you put in $5,000 this year for advertising and $5,000 next year, you will really get $9,000 worth of advertising next year. You put in $5,000 in the third year and you have $12,000 worth of advertising; that is, you secure this effect in your third year if you keep your work going right along. That runs to a certain period and begins to build up again. Therefore a man beginning in business should use from 7 to 10 per cent of his gross in advertising. If part of his business is with nationally advertised commodities, he can reduce that 7 to 10 per cent to 5 or 7 per cent in the beginning of his business. When he gets well established he can do very well with from 2 to 5 per cent of his gross, and if he is handling national products he can easily go down to from 1 to 3 per cent of his gross."

W. F. Abely, Western Electric Company, Boston, said that, speaking nationally for the electrical contractors, a study made in the past year showed that for a progressive electrical contractor-dealer the first year the average appropriation would be about 8 per cent of the gross sales, for the second and third years 5 per cent, and for the fourth and fifth years 3 per cent. This estimate checks closely with Mr. Gibbs' figures.

Governor of Indiana Condemns Municipal Ownership

MUNICIPAL ownership and operation of utilities is condemned by Gov. James P. Goodrich of Indiana in a note published by *Flash*, the house organ of the Merchants' Heat & Light Company, Indianapolis. Declaring that "no business can thrive on politics and inefficiency," the Governor points to the poor showing of a typical municipal plant investigated by the Public Service Commission of the state. In this plant it was disclosed that fifteen of its thirty-two power consumers were paying less than the cost of generating the energy consumed, no allowance being made for the return on the investment. There was an inefficient combustion of coal at the plant, 7.92 lb. of coal being required to generate one kilowatt-hour, whereas efficiently managed private plants find 3 lb. or 4 lb. sufficient. The plant was poorly located, there was lack of centralization and of fixed responsibility in the management, a large overload existed but no reserve equipment, general incompetency marked its operation.

"Speculative features of public utility ownership and operation," the Governor concludes, "have been practically eliminated by regulation, so that under equal conditions the privately owned utility should be and is able to furnish the same service at lower rates than the publicly owned utility if the publicly owned utility is charged with interest on its investment and proper depreciation charges."

Central Station Merchandising Costs

THE Utah Power & Light Company has a system of analyzing its merchandising accounts which makes it possible to see from month to month just what portion of every dollar expended goes toward the various elements of overhead and other expenses. Such an analysis for two succesive months is given here:

INCOME AND EXPENSE STATEMENT
MERCHANDISE DEPARTMENT

Division Date ending 1918

	FOR MONTH		CUMULATIVE TO DATE	
	This year	Last year %	This year	Last year %
Revenue from Merchandise sales				
Cost of merchandise				
Cost of merchandise				
Storeroom salaries and expenses				
Defective merchandise replaced				
Total cost of goods sold				
Cost of installation				
Total cost of goods and installation				
Gross profit				
Selling expense				
Merchandise salesmen's sal. and com.				
Rental of stores				
Total selling expense				
Net profit				
General expense				
App. div. accounting expense				
App. general sales dept. expense ($ per month)				
Advertising and demonstrations				
Miscellaneous expenses				
Ins. and taxes (½ of 1% of total stock)				
Uncollectible accts. (¼ of 1% of total sales)				
Total general expense				
Net earnings				
Fixed charges				
Interest on investment (½ of 1% per month based on $ invest.)				
Interest on working capital (½ of 1% per month based on $ def. acct.)				
Depreciation and interest (10%) on store fixt. used for merchandising				
Total fixed charges				
Net income or loss				
Percent net income				
REMARKS				

	Cents
Cost of goods sold	72.66
Merchandise, salesmen's salaries, etc.	3.92
Cost of installation	2.93
Rental of stores	1.26
General expense:	
Accounting expense	1.50
General sales department expense	0.95
Advertising and demonstration	2.69
Miscellaneous expense	1.79
Insurance and taxes	0.95
Uncollectible accounts	0.25
Fixed Charges:	
Interest on investment	2.89
Interest on working capital	0.78
Depreciation and interest on fixtures	0.01
Net income	7.62

The total sales for the two months amounted to $54,16[illegible].72.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Locating Faults in Induction Motors.—A. M. DUDLEY.—This is the first of a series of three articles and deals in particular with problems indicated by noise and vibration. It is shown how to distinguish between mechanical and electrical troubles and it is pointed out that certain observations should be made of the behavior of a motor when started for the first time.—*Power*, Feb. 24, 1920.

Sine Wave-Testing Sets.—E. J. BURNHAM.—The author points out that there are many uses in the laboratories of colleges and research and testing departments for a sine wave generator, and it is to meet the demand that the sets described have been developed. Oscillograms and test data show that the generator maintains practically a true sine wave of voltage from no load to full-load unity power factor and full-load zero power factor. The generator is specially useful for testing the magnetic properties of iron and for meter testing.—*General Electric Review,* February, 1920.

Ventilation of Steam Turbine-Generators.—GEORGE MONSON.—This is a review of the development of forced air ventilation for cooling large generators. On the early machines salient poles were used which served to draw in the air and expel it through the ducts in the stator laminations. The next step was to provide passages through which air from the outside of the building could be obtained. The accumulation of dirt in the windings led to the introduction of air washers, which while removing the dirt at the same time reduced the temperature of the air. As the size of generators increased fans were introduced to increase a circulation of air. Separate blowers were used in some cases, but later designs embody the ventilating fans as part of the rotor structure. The latest system employs the closed air circuit and conserves space by mounting the humifying equipment and air driers under the generator foundation. The advantages are the elimination of numerous station ventilating ducts and quantities of dirt that are decrease in eye trouble among miners.—London *Electricity,* March 12, 1920.

Lamps and Lighting

Lighting Conditions in Mines.—An investigation of lighting conditions in mines was undertaken with special reference to protection of the eyesight of miners. It is estimated that up to the year 1914 the average illumination on the coal face in pits where safety lamps had to be used was about 0.018 ft.-candle, whereas in "safe" mines where candles can be used the average illumination was 0.09 ft.-candle. It is said that the introduction of the improved forms of electric lamps has led to a decrease in eye trouble among miners.—London *Electricity,* March 12, 1920.

Generation, Transmission and Distribution

Protective Apparatus for Alternating-Current Systems.—M. ROSEBOURNE.—The protective relays which serve to disconnect faulty elements in a distribution system by tripping the oil circuit breakers may either operate when the current passes a certain maximum value or they may be so connected as to operate when the currents become badly unbalanced. With the latter system the relays are fed from special differential transformers. As soon as a case of unbalance occurs and exceeds a certain limit the relays operate. To protective devices working on this principle a high degree of selectivity can be given, so that only the faulty member will be disconnected and the disturbance will be limited to a small part of the system. In adapting the principle of unbalance, for instance, to the protection of a transformer, relay transformers are inserted in each phase, one on the primary and one on the secondary side. By choosing the proper number of turns and connecting the secondaries of the two transformers in opposition a balance will obtain when supply currents and load currents have the proper relation. If a fault occurs in the transformer, the entering current will be abnormally large and the relays will trip out the breakers. Similar devices may be used to disconnect a faulty transmission line. For this purpose each line conductor is split into two parallel parts, which are both carried through the relay transformers so as to give a balance if the current divides evenly. If one conductor breaks off or is earthed, the balance is disturbed and the line is disconnected.—*Revue Générale d'Electricité,* Nov. 29, 1919.

Traction

Butt-Welded Joints Installed on the Lines of the Pittsburgh Street Railways.—Molds are placed around the rail joints to hold the heated flux while clamps force the rail ends together. The equipment used and the methods of making the weld are shown with illustrations in this article.—*Electric Railway Journal,* Feb. 21, 1920.

Automatic Railway Substations.—FRANK W. PETERS.—This paper reviews the broad range of conditions to which railway automatic substations have been applied and also discusses the economies and operating advantages effected by their use. A description is given of the modern equipment with details of its operation. Special reference is made to improvements in design of control apparatus, to the positive sequence of starting the machines and the protection afforded the apparatus against overloads or other irregularities either outside or internal to the stations.—*Journal A. I. E. E.,* March, 1920.

Installations, Systems and Appliances

Electricity in Gold and Silver Mining.—B. B. BECKETT.—This paper covers both the mining proper and the milling, since gold and silver ores are usually milled at the mines as part of the same enterprise. Of the two operations, mining and milling, the latter is the heavy power consumer, taking about three-fourths of the total. Milling also is the more desirable load from the central-station point of view, since it is steady and continuous twenty-four hours a day and every day of the month. The load factor of a mill load is about 80 per cent and that of a combined mine and mill load about 70 per cent. Power consumption for all purposes will be close to 40 kw.-hr. per ton of dry ore mined and milled, of which 30 kw.-hr. will be consumed by milling alone. An interesting table is given to show the actual power consumed in a typical property in Goldfield, Nev., for operation during the years 1915, 1916 and 1917.

POWER CONSUMPTION AT GOLDFIELD

Mines:	Motor Capacity, Hp.	Maximum Load, Hp.	All-Day Average, Hp	Kw.-hr. per ton Dry Ore
Light equivalent	....	15	10	.2
Compressed air	400	420	260	5.3
Pumps	280	210	93	2.0
Hoists	750	1,000	88	1.8
Miscellaneous power	100	30	7	.2
Total mines	1,530	....	458	9.5
Mill:				
Crusher (gyratory)	150	50	10	26
Conveyors to battery	60	40	12	.29
Stamp battery	250	240	212	4.26
Tube mills	400	480	448	9.20
Chilean mills	200	300	190	3.86
Concentrate tables	60	34	31	63
Air compressors (for agitation chiefly)	250	250	240	4.9
Pumps	340	215	156	3.3
Miscellaneous power	270	100	50	1.2
Light and heat	.	80	40	8
Total mill	1,980	....	1,389	28.70
General departments, light, heat, and power				1.4
Losses in line and transformers and in regulation				3.4
Total all				43.0

The production of this mine is 1,000 tons of dry ore per day. Mining is carried on through vertical shafts with an average depth of 600 ft. (180 m.), with a moderate amount of water to be pumped, and the mill was the usual stamp mill with cyanide treatment. The author analyzes the various processes in order to get at the power requirements.—*Journal of Electricity*, March 15, 1920.

How Electricity Helps Solve the Package Freight-Handling Problem.—F. T. SMITH.—It is said that freight is handled today at a great many of our seaport terminals by methods used several hundred years ago. The author shows that cranes, trucks and tractors may be used to advantage in loading and unloading operations at piers and railway terminals. The advantages to be expected from the adoption of electrical machinery are given as (1) decreased cost of handling per ton; (2) increased terminal capacity; (3) increased storage capacity; (4) increased handling capacity in the terminals; (5) decrease in the length of time in handling, and (6) increased prestige of the port terminal as the outcome of these results.—*Marine Engineering*, January, 1920.

Electrochemistry and Batteries

Theoretical Study of Nitrogen Fixation by the Electric Arc.—CHARLES P. STEINMETZ.—The second installment of the series dealing with the chemical dynamics of the nitrogen-oxygen reactions at the temperature of the arc and during cooling. In this installment the author gives the effect of the rate of cooling upon the dissociation of NO.—*Chemical and Metallurgical Engineering*, Feb. 24, 1920.

Melting-Point Methods at High Temperatures.—LEO I. DANA and PAUL D. FOOTE.—A description of the determination of melting points of metals, alloys, salts and refractory materials by the use of thermo-electric resistance and optical pyrometers.—*Chemical and Metallurgical Engineering*, Jan. 7 and 14, 1920.

Comparison of Existing Methods of Measuring the Temperature of Molten Steel.—F. W. BROOKE.—The author briefly describes the use of thermocouples and radiation and optical pyrometers in measuring the temperature of molten steel. He also explains how the film, rod and pouring tests are employed for the same purpose.—Paper presented at American Foundrymen's Association, Philadelphia, Oct. 2, 1919.

Units, Measurements and Instruments

A New Interferential Dilatometer.—IRWIN G. PRIEST.—Description of a dilatometer for measuring small differential thermal or other changes in length by means of the change in width of interference fringes.—*Scientific Paper No. 365, U. S. Bureau of Standards*, Feb. 28, 1920.

Telegraphy, Telephony and Signals

Line Fed by Undamped Oscillations.—L. LOMBARDI.—In a former article the author studied the behavior of an artificial line under the action of damped oscillations. In the present contribution the results of experiments made upon the same artificial line fed by undamped oscillations are published. The theory of the propagation of sinusoidal undamped waves in conductors in which resistance, inductance and capacity are uniformly distributed is given, and the corrections to be made to the results of this theory when the inductance and the capacity are not uniformly distributed are also stated. The experiments were made with the line open, short-circuited or closed through an ohmic resistance equal to the characteristic resistance of the line; with direct or indirect excitation by a Poulsen arc, and with the fundamental odd and even harmonics. The results of the experiments for the fundamental frequency and odd harmonics agree substantially with those given by the Kennelly theory, but for the even harmonics they are sensibly different, and precisely, the apparent impedance is found to be considerably smaller than that given by theory, such divergence being due to the presence of higher harmonics in the emf. furnished by the Poulsen arc.—*Science Abstracts, Section B*, Dec. 30, 1919. (Abstracted from *Elettrotecnica*, Sept. 15, 1919.)

Electric Signaling.—WOLF.—Electric signaling devices are rapidly displacing the old mechanical systems used for transmitting, for instance maneuvre orders to the engineer on a steamer. A great number of different systems for this type of electric signaling are described in the article. Methods for automatic blocking of the signal until a correct repetition of the order is given from the receiving end are also taken up. Modern signaling systems for steamers are often provided with electrically operated automatic recording devices for registering simultaneously the given order and the day, hour and minute when it was given.—*Elektrotechnische Rundschau*, Sept. 15, Oct. 1 and 15, 1919.

Long-Distance Radio Communication in Chile.—E. W. FIELDING.—The Chilean radio stations at Llanquihue and Punta Arenas are described in detail. The best wave length and power for this 875-mile (1,349-km.) transmission are given. The effects of strays, their reduction and signal fading are discussed.—*Proceedings Institute of Radio Engineers*, February, 1920.

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

DEMAND for building material, which has been slightly lower during the railroad tie-up, is now rapidly increasing on account of renewed activities in Boston, New York and Chicago. The outlook is better than it has been for many weeks. Perishable freight is now being moved on virtually all railroads, thus guaranteeing the delivery soon of much building material, including conduit, wire and porcelain, held up by the blockade.

LAMP CORD, loom and heating appliances have been unloaded from freight cars found by jobbers in the yards. In addition, stocks of porcelain material, fuses, heating appliances; line material and other miscellaneous supplies have been received by parcel post and motor trucks. These have been the only available methods of shipment, and many jobbers and manufacturers have used them.

GENERAL price changes are few. Increased delivery charges for trucking and parcel post will probably be met by the consumer. These charges are found to be about 15 per cent above former delivery charges.

WIRE mills are well up to capacity on rubber-covered wire orders and are able to ship quickly or at leisure as the necessity of the case warrants. Bookings are at a rate more than double last year's record volume. The proportion of orders of No. 14 to orders of other sizes of N. E. C. wire has been diminishing since the first of the year, giving rise to the belief that more larger size code is being ordered. Brass mills are working to capacity, where strikes and shortage of raw materials do not hinder, and are getting behind on orders for copper and brass rods, tubes and sheets. Insufficient labor precludes resorting to night shifts, necessary to supply the demand, although some mills are working well into the evening several nights a week.

A SUB-COMMITTEE of the British Board of Trade Committee on Trusts has reported that the Electric Lamp Manufacturers' Association is a combination of three large companies, one under American control, and that it has limited output and may, if not checked, lead to American control of the British lamp industry. English electrical and engineering papers characterize the report as ill advised.

A CONTRACT for the electrification of 28 miles of double-track railroad between Jundiahy and Campinas, Brazil, has been awarded to the International General Electric Company.

THERE was a chance that the Congressional water-power conferees would get together on Tuesday, but at the last minute the meeting was postponed.

IN THE legislative, executive and judicial appropriation bill, which has just been disposed of finally by Congress, the sum of $60,000 is made available for enforcing the wireless communication laws. An appropriation of $30,000 was made for the investigation and standarization of methods and instruments employed in radio communication. The work in that connection is to be done by the Bureau of Standards.

ENTERTAINMENT features of the Pasadena convention of the N. E. L. A. will include visits to Santa Catalina Island, Avalon, "Filmland" and the "Orange Empire."

MINNESOTA, South Dakota and North Dakota have been formed into the North Central Geographic Division of the N. E. L. A., the existing electrical associations of the two states first named being merged in the new body. T. D. Crocker of Minneapolis was elected president.

A QUESTIONNAIRE addressed to the members of the American Society of Civil Engineers shows the defeat by that body of the proposal to create a comprehensive organization to insure the united action of the engineering and allied technical professions in matters of common interest.

THE FIRST meeting of the Conference Club under the new plan which makes its membership representative of the entire electrical industry will be held at White Sulphur Springs, W. Va., on June 17, 18 and 19.

A RESOLUTION has been adopted in the New York State Legislature indorsing the federal water-power bill now in conference at Washington and urging that its passage be expedited.

PUBLIC utilities, in the opinion of J. G. White, have "passed the peak of the crisis" and would not be so seriously affected as other lines of industry by a period of liquidation and readjustment.

A CHARTER for a foreign banking association, the first issued under the Edge bill, a measure designed to enable American manufacturers to compete in foreign markets on a credit basis, has been granted to the First Federal Foreign Banking Association of New York, capitalized at $2,100,000.

FINAL approval to the proposed changes in the constitution of the National Electric Light Association has been given by the executive committee. An engineering department is to be established with W. J. Canada, as engineering expert. The name of the Technical and Hydro-Electric Section of the association will be changed to Technical Section.

THEODORE N. VAIL, chairman of the board of directors of the American Telephone & Telegraph Company and the man to whom the vast development of the American telephone is mainly due, died at Baltimore on April 16 in his seventy-fifth year.

FIGURES issued by the Federal Trade Commission for January, 1920, show that the cost of bituminous coal at the mine in that month averaged $2.34 for the whole country, as compared with $2.11, the monthly average for the whole year 1918.

PLANS for increasing generating facilities and bringing about operating economies in plants of the Cities Service Company situated at Toledo, Ohio; Amarillo, Tex.; Bartlesville, Okla.; Cheyenne, Wyo.; Durham, N. C.; St. Joseph, Mo., and other places are going forward.

INTERCONNECTING lines are now being constructed between the Pennsylvania-New Jersey system of the General Gas & Electric Company and other systems which will give to the combined companies a capacity of nearly 250,000 kw.

GROUNDING the neutral was the topic discussed at the Pittsburgh Section meeting of the Association of Iron and Steel Electrical Engineers, and the practice was generally favored for large power systems.

SIX TECHNICAL sessions will be held by the A. I. E. E. at its White Sulphur Springs (W. Va.) convention, June 29 to July 2, when committee reports will be made, symposiums held and many papers presented.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Elaborate Entertainment Program for the Pasadena N. E. L. A. Convention

ALTHOUGH the Pasadena convention of the National Electric Light Association, May 18 to 22, will be an extremely busy one, the entertainment features are not being overlooked. "Hillside," the beautiful home of John B. Miller, president of the Southern California Edison Company, and the wonderful grounds surrounding it will be the center of the chief social events for the ladies who attend the convention.

To make it possible for delgates who visit the convention to see every feature of southern California life within the shortest space of time, with the greatest possible convenience, and by special arrangements such as are not obtainable by the individual tourist, is the aim of the chairman of the entertainment committee, W. L. Frost. Among the points to be visited are Santa Catalina Island, Avalon, "Filmland," some of whose sixty motion-picture studios, ordinarily closed to the public, may be visited by delegates, and choice parts of the "Orange Empire." A trip has been planned to San Diego, which lies close to the Mexican border and is famed for its beautiful harbor and ocean scenery. Arrangements are now under way for an airplane "taxi" service, and it is hoped that a landing field can be established near the Hotel Huntington.

Those who desire to visit the great hydro-electric properties of the power companies of the Southwest will be provided with automobiles and guides for excursions into the mountains.

Cities Service Going Forward with Plans for Increased Capacity

PLANS to increase generating facilities and to bring about operating economies in the electric light and power subsidiaries of the Cities Service Company are going forward. The majority of the properties are unable to meet the demands being made upon them for power.

A second 20,000-kw. generating unit is being placed in commission at the Acme Power Company, in Toledo, Ohio, and installations have been made permitting the burning of coke oven gas under the boilers. The City Light & Power Company of Amarillo, Tex., will shortly start to use natural gas as fuel. The Bartlesville (Okla.) Gas & Electric Company is installing 1,000-kw. additional generating capacity, and the Athens (Ga.) Railway & Electric Company is putting in additional boiler capacity. The 1,000 kw. of generating capacity for the Western Light & Power Company at the Cheyenne (Wyo.) plant will soon be installed, and during this summer another boiler with spray-pond equipment will be added to the plant. The Durham (N. C.) Traction Company is making improvements in its generating station, and the United Water, Gas & Electric Company at Hutchison, Kan., will install 1,000 hp. additional boiler equipment. Improvements, including boiler equipment, are also being made to the plant of the Lincoln (Neb.) Gas & Electric Light Company. The Meriden (Kan.) Light & Railway Company has been converted into a fuel-oil-burning plant, and the new 10,000-kw. generating unit at the plant of the St. Joseph (Mo.) Railway, Light, Heat & Power Company was placed in regular service April 1.

American Equipment for the First South American Main-Line Electrification

THE first main-line railroad electrification in South America will be on the double-track line of the Paulista Railway Company between Jundiahy and Campinas, Brazil, a distance of 45 km. or about 28 miles.

A contract for nearly $2,000,000 in equipment for the electrification, it was announced this week, has been awarded to the International General Electric Company. This equipment consists of twelve locomotives—eight freight and four passenger engines—material for the transmission system and substation and for a 3,000-volt overhead line. It is one of the largest railway contracts awarded since the Chicago, Milwaukee & St. Paul electrification. This project anticipates further extensions amounting to 100 additional miles of route, which may eventually bring the total electrification up to 128 miles (205 km.), extending between Jundiahy and San Carlos. Power for the operation of the lines will be supplied by the Sao Paulo Light & Power Company at 88,000 volts, 60 cycles. The locomotives will be of the geared type, 3,000-volts direct current, and equipped with regenerative braking apparatus. The freight locomotives will weigh 100 tons each, and the passenger engine 120 tons. It is expected that the new line will be in operation in July, 1921.

Conference Club Meeting Planned for June 17-19

PLANS for the first Conference Club meeting with its new membership representative of the entire electrical industry are now being laid. It has been decided to hold the meeting at White Sulphur Springs, W. Va., June 17, 18 and 19.

Invitations went out a little over two weeks ago to twenty-one proposed members. At the time of going to press ten of these had accepted and other acceptances were expected in the course of a few days. The committee on constitution and by-laws, to which will be delegated the most important work connected with getting the Conference Club under way according to its new program, will probably be appointed some time during the coming week. The June meeting will be largely devoted to the report of this committee.

Death of Theodore N. Vail

THEODORE NEWTON VAIL, chairman of the board of directors of the American Telephone & Telegraph Company, died at Johns Hopkins Hospital in Baltimore on April 16 of a complication of cardiac and kidney troubles. Mr. Vail was in his seventy-fifth year at the time of his death.

For many years at the head of the most extensive privately owned public utility in the world, Mr. Vail built up a great reputation through his ability for organization, his indomitable courage and his adherence to the fundamental principle of the best service possible for the public. It was Alexander Graham Bell whose inventive genius brought forth the telephone. It was Theodore N. Vail, with the blood of pioneers in the realm of engineering development strong in his veins, whose clear vision made possible the perfection in the realm of telephony known today. As an organizer Mr. Vail knew no superior. He is sometimes spoken of as the organizer of the fast mail-train service. Certain it is that to him belongs the credit for building the Bell telephone system. When the system needed a strong man at the helm during the stormy period of the 1907 panic, the directors instinctively turned to Mr. Vail, although he had retired from the telephone field many years before. Desire to give the public the best possible service was almost a passion with him. "The prerequisite of a telephone service," he said in one of his annual reports, justly famed for their fullness and frankness, "is that it should be a continuous, immediate service, free as possible from any interruptions, and it must be possible for anyone in any one place to get into personal conversational communication with anyone in any other place. Any other service would be limited service." Again he said: "We recognize a 'responsibility' and 'accountability' to the public on our part, which is something different from and something more than the obligation of other public service companies not so closely interwoven with the daily life of the whole community."

THEODORE N. VAIL

It was Vail who brought the American telephone service up to its high plane in the days before federal control, who gave to American telephone subscribers coast to coast service, who for the short time he was head of the Western Union gave the American people the night letter and the week-end letter.

Mr. Vail was a staunch advocate of the theory of private control of public utilities. He was in sympathy with government regulation, but he was firmly convinced the government has no legal right to go beyond that point. He foresaw an attempt on the part of the federal government to take over the control of the telephones long before the war necessity arose. He then warned the American public what to expect, and he lived to see his prophecies fulfilled.

Theodore N. Vail was born in Carroll County, Ohio, on July 16, 1845. Stephen Vail, an uncle, founded the Speedwell Iron Works near Morristown, N. J., where was built the machinery for the first steamship which crossed the Atlantic Ocean. At these works Samuel F. B. Morse perfected and first operated the magnetic telegraph.

Theodore N. Vail was educated at Morristown, N. J., and after leaving school read medicine for two years with an uncle. During that time he acquired a working knowledge of telegraphy in a local office. When the family migrated to Iowa he went with them. In about a year he took a position with the Union Pacific Railroad and became an agent and telegraph operator at a small station on that line. In 1869 he became a clerk in the railway mail service, where his ability to systematize and organize was soon felt. Seven years later he was appointed general superintendent of that service.

In 1878 Mr. Vail was approached by Gardiner G. Hubbard, father-in-law of Alexander Graham Bell, and offered the position of general manager of the American Bell Telephone Company, formed to exploit the newly invented telephone. Mr. Vail accepted the position and immediately set himself to the task before him. He had visions of long-distance telephony far in advance of anyone else and one of his first achievements was to establish a line between Providence and Boston. Upon his initiative, improvements were made in telephone equipment and material so that little by little obstacles were overcome and long-distance telephony extended, until to-day New York talks to San Francisco.

In 1885 Mr. Vail resigned as general manager of the American Bell Telephone Company and was elected first president of the American Telephone & Telegraph Company. He resigned this post in 1887, and three years later he also resigned the presidency of the Metropolitan Telephone & Telegraph Company of New York and, retiring to a large farm in Vermont, settled down to the raising of blooded stock. Later he spent some years abroad, and in 1893 he made a trip to South America. He organized an electric street railway at Buenos Aires for British capitalists and for some time had his headquarters in London, returning to his Vermont farm in 1904.

In 1907, urged by prominent officials of the Bell Telephone Company, Mr. Vail re-entered the telephone field and again took the presidency of the American Telephone & Telegraph Company. In 1910, the American Telephone & Telegraph Company having acquired a controlling stock interest in the Western Union Telegraph Company, Mr. Vail became president of the latter company and proceeded to reorganize it along the lines which he had applied to the telephone business, greatly increasing its gross revenue, rehabilitating its equipment, and giving to the public new and improved service. On April 15, 1914, the American Telephone & Telegraph Company having disposed of its interests in the Western Union by agreement with the government, Mr. Vail resigned from the telegraph company.

In addition to his business activities, Mr. Vail founded the Lyndon Agricultural School at Lyndon, Vt. He was also a trustee of the Boston Museum of Fine Arts and a director of the Boston Opera House.

Civil Engineers Vote Down Federation Plan for Civic and Welfare Work

THE American Society of Civil Engineers has defeated by letter ballot the proposal to co-operate actively with other engineering organizations in the creation of a comprehensive organization to secure united action of the engineering and allied technical professions in matters of common interest. This decision is the outstanding feature of the vote on the questionnaire, canvassed April 14, containing ten specific inquiries as to the future conduct of the society's external and internal relations. The questionnaire was based upon the report of the society's committee on development and on the joint conference committee report made by representatives of the four national engineering societies.

By its vote on the questionnaire the membership of the society has expressed its wish to become an active national force in economic, industrial and civic affairs, co-operating with other engineering and allied associations in promoting the welfare of the engineering profession, but in so doing it has refused to be a party with other organizations in the creation of the "comprehensive organization" for civic and welfare work provided for in the report of the joint conference committee and involving acceptance of the principle of a federated engineering body.

Public Utilities Have Passed Peak of Crisis, Says J. G. White

ADMITTING that the strain on public utility credit throughout the whole country has been severe and that the difficulty in financing extensions and improvements for the normal growth of the business has been a serious problem, it is none the less the belief of J. G. White, chairman of the boards of directors of the various companies that bear his name, that the industry generally has "passed the peak of the crisis" and, except in isolated cases, will not be so seriously affected as other lines of industry by the period of liquidation and readjustment in values which Mr. White considers inevitable. This result would be in accordance with the history of public utilities.

The annual report of the J. G. White companies for 1919, in which the above opinion is expressed, says further:

"The 'Management Corporation' has made satisfactory progress in securing from various commissions and other regulatory bodies increased rates for all public utility companies under its management to offset increased costs of wages, taxes and other operating supplies. Practically all of the public utility properties under its management show substantial gains in both gross and net earnings."

W. J. Canada to Head N. E. L. A. Engineering Department

PROPOSED changes in the constitution providing for the reorganization of the National Electric Light Association at headquarters in New York and material changes in the form of organization throughout the country have received final approval from the executive committee. The plan of reorganization will be submitted to the convention in May for approval.

In furtherance of the plan for equipping national headquarters with a staff of experts responsible for carrying out the work of the association, upon recommendation of the several committees, Executive Manager Aylesworth was authorized to establish an engineering department. He was also authorized to employ W. J. Canada, formerly of the United States Bureau of Standards, as engineering expert and to employ some other expert on inductive interference as consulting engineer.

The name of the Technical and Hydro-Electric Section has been changed to the Technical Section and authority has been granted it to take up research and investigation on cable dielectrics, an appropriation being made for the purpose.

Power Companies of Minnesota and the Dakotas Organize

CONSOLIDATION of the South Dakota Electrical Association and the Minnesota State Electrical Association into the North Central Geographic Division of the National Electric Light Association, this body to include also North Dakota, which was without a separate association, was perfected on April 13 at a conference of electrical men of the three states in the Hotel Radisson, Minneapolis, Minn.

The conference was addressed by George F. Oxley, director of publicity of the National Electric Light Association, who explained in detail the reorganization plans of the national body and who told of the benefits to be derived from the carrying out of the national and divisional programs.

Officers of the new division elected were: President, T. D. Crocker, Minneapolis General Electric Company; vice-president, O. A. Rofelty, Northern States Power Company, Sioux Falls, S. D.; treasurer, F. C. Hoffman, St. Paul Gas Light Company; executive committee, W. H. Ryerson, Great Northern Power Company, Duluth, Minn.; Henry Lee, Anoka (Minn.) Light Company, and F. D. Brown, Huron (S. D.) Light & Power Company, in addition to the officers. The office of the secretary was temporarily filled by M. Barnett of the St. Paul branch of the Northern States Power Company, it being the intention of the division to employ a paid secretary as soon as necessary arrangements can be made.

The annual convention of the North Central Geographic Division will be held in the Hotel Radisson, Minneapolis, June 16 and 17. Prior to that time an intensive membership campaign will be conducted.

New York Senate Urges Congress to Hurry Up with Water-Power Bill

A RESOLUTION urging Congress to expedite its action on the water-power bill now in conference so that it may become a law at the earliest possible moment was adopted last Monday by the Senate of the State of New York. The passage of the bill, it was held, will greatly augment the industrial welfare of New York State because the use of water power is much to be desired. It was also pointed out that the state reserves its rights, vested or otherwise, in and to the waters within the state and upon and along the boundaries thereof.

In this connection a number of bills relating to water power have been introduced recently by Senator Sage at Albany. Among them is a bill providing for "reasonable rental fees" for the division of water from Lake Erie or Niagara River or other boundary waters. One bill would authorize the conservation commission to determine the equitable rental which the Niagara Falls Power Company shall pay the state for water diverted from Niagara River in excess of 15,100 second-feet.

Grounded Neutral Favored at Meeting of Pittsburgh Steel Engineers

GROUNDING the neutral on large power systems was the subject of considerable discussion at the April 17 meeting of the Pittsburgh Section, Association of Iron and Steel Electrical Engineers, when Robert Treat, General Electric Company, presented a paper on this subject. Mr. Treat stated that the question should be considered from the standpoint of safety to life, continuous service and protection of apparatus. He thought that as far as the life hazard was concerned it made no difference whether the system was grounded, but that in most cases service could be better maintained if such were the case. Grounding the neutral converts excess potential into excess current and prevents the oscillatory action which may occur when the system becomes accidentally grounded. Electrostatic disturbances are difficult to combat, he said, when there is no ground made. However, Mr. Treat thought that solidly grounding the neutral may result disastrously, so that it is preferable if some resistance is interposed between the neutral and ground.

In reference to results from an internal fault in generators when the system is grounded, the speaker said that if such an accident did occur, the resulting damage in the generator would not be emphasized because the ground was present.

Considerable advantage, it was pointed out, attaches to the fact that an accidental ground on a grounded system is immediately apparent, whereas on an ungrounded system a fault may be present for some time without detection. Furthermore, it is difficult to locate such a fault. On high-voltage systems arcing grounds are not immediately detected on ungrounded systems and insulator depreciation may result.

The central-station men and the representatives of manufacturing companies agreed with Mr. Treat that the grounded neutral was preferable in most cases, but the discussion resolved itself into the question of how large a system must be in order to justify grounding. The best way to decide, it was thought, is to operate the system ungrounded until a number of faults occur and then try grounding as a remedy.

F. S. Brown of the Duquesne Light Company told of how a good deal of trouble, such as generator fires, had been experienced by the Duquesne company before the system was grounded. At first it had been grounded solidly, but as this did not better conditions a resistance was placed in the grounding circuit.

It was pointed out that no company that has ever tried grounding the neutral has abandoned the practice on account of its non-success.

Super-Power Zones Urged by Mining Engineers' Committee

AS A MEANS for conserving coal and transportation facilities the committee of the American Institute of Mining & Metallurgical Engineers on coal economy through electrification of industries and railroads recommended that the Department of the Interior make an intensive survey of such zones in which the density of power requirements will support super-power systems. The committee, composed of W. S. Murray, chairman; W. S. Barstow, George Otis Smith and E. R. Welles, urged a definite national power policy along the lines of the establishment of super-power zones.

The inability of electric utilities because of regulation and taxation to obtain funds to increase capacity to keep pace with the increasing demand was touched upon, and because such conditions might later obtain when the engineering plans for the super-power zone are completed the appointment of a financial co-operating committee was recommended.

The personnel of the super-power committee of the A. I. E. E. appointed by President Calvert Townley was announced this week and is as follows: W. S. Murray, consulting engineer, New York,, chairman; H. W. Buck, of Viele, Blackwell & Buck, consulting engineers, New York; George Gibbs, of Gibbs & Hill, consulting engineers, New York; John W. Lieb, vice-president New York Edison Company, New York; Malcolm MacLaren, professor of electrical engineering, Princeton University; William McClellan, vice-president Cleveland Illuminating Company; Charles S. Ruffner, vice-president North American Company, New York; David B. Rushmore, General Electric Company, Schenectady; Charles F. Scott, professor of electrical engineering, Yale University; Percy W. Thomas, consulting engineer, New York; Harold V. Bozell, associate editor ELECTRIC RAILWAY JOURNAL, secretary.

Illuminating Engineers Plan Comprehensive Cross Index of "Transactions"

COMPILATION of an index and a cross index of the Transactions of the Illuminating Engineering Society since its beginning has been decided upon by the society. There is a strong feeling that individual publications should be available on each separate subject of illumination, such as photometry, color, glare, etc. The council of the society has this under consideration with the idea that if the society undertakes such work these publications will be brought up to date each year. The society feels that it should be in a position to supply quickly information relative to the developments in each phase of illuminating engineering.

Co-ordination of Engineering Interests Advanced in Chicago

PLANS for co-ordinating the efforts of all the engineers in this country were considerably advanced by meetings in Chicago this week between engineers of the Middle West, represented by the Western Society of Engineers, and the presidents of the four founder societies. The Western Society of Engineers invited these four national engineering societies to hold board meetings simultaneously in Chicago on April 19 and 20. At this time plans were discussed for establishing closer relations between all engineers and for making them better able to serve the public. The Western Society of Engineers tended a banquet to the visitors on Monday evening, when about 350 engineers and their wives listened to addresses by some of the leading engineers of the country.

Speaking at the banquet, Calvert Townley, president of the American Institute of Electrical Engineers, said: "Engineers, as a class, have yet to recognize the importance of team work. There have been many successful engineers, but they have won success by their own individual efforts rather than by any help from their fellows. Now, if we are to combine and do effective work it must be done for the purpose of rendering service to the city, state or nation and not for selfish reasons. They tell us it was an engineers' war; now let us make it an engineers' peace. The public cannot get along without us and they do not want to try, but we must recognize that it is our duty as citizens to devote ourselves to the progress of the country."

In discussing the plans for the formation of an association which would embrace the entire engineering profession of America, Fred J. Miller, president of the American Society of Mechanical Engineers, said: "It is generally expected that the joint engineering associations will deal almost entirely with the engineering aspects of problems of public concern without going too deeply into the public policy features."

California Power Shortage Less Serious

MARCH was the first month since September of last year in which rainfall in California was above normal. It has been estimated that each additional inch of rainfall from now on means $100,000 to each of the major power companies in California. The recent storm helped out the storage of the power companies, but does not begin to make up for the deficit in power shortage.

At a meeting of the San Francisco Electrical Development League April 12, H. G. Butler, power administrator of the California Railroad Commission, thus summed up the California power situation:

"In the southern part of the state the precipitation has been nearer normal than in the northern section and the supply of energy is proportionately greater. The watersheds are higher than in the north, and it is safe to say that if the agricultural and other loads can be shifed from night to day, no extensive new load taken on, and the resources carefully husbanded, it may be unnecessary to place restrictions on the south.

"In the northern part of the state the indications are that the Pacific Gas and Electric Company will have 10,000,000 kw.-hr. more than last year, but the upper reservoirs will not fill, and Lake Almanor, the chief reservoir of the Great Western Power Company, will only fill to 40 per cent of its capacity. Steam is a very uncertain factor, and to carry out the program these plants will have to generate 77,000,000 kw.-hr. per month, while the best they have ever done is 64,000,000 kw.-hr. per month, which was in August of last year. Stored water will be used to equalize the shortage over the seven months in which it will be felt. This shortage, based on estimated demand, will be 114,000,000 kw.-hr. for seven months, or about 10 per cent. The estimated demand is from 5 per cent to 9 per cent greater than for corresponding months of last year."

There are now under construction, or equipment has been ordered for, eleven plants for a total additional capacity of 208,000 kw. "All but 10,000 kw. of this will be available before low water next season," Mr. Butler stated, "and there are other plants in contemplation which could be completed by that time. So with a normal supply of water there should be no power shortage next year."

Scope of Work of Society for Electrical Development Told by Freeman

GOOD progress in its membership drive is reported by the Society for Electrical Development. The drive has been under way only a short time and already there are a number of applications coming in daily.

This week W. W. Freeman, president of the society, is sending out an open letter telling of the conditions in the society as he found them upon personal investigation prior to taking up the presidency of the organization. Of the results of this investigation Mr. Freeman says: "The scope and value of the work of the society during the past few years were far beyond my expectations, and I believe far beyond the realization of the electrical industry in general."

After pointing out that the society does not duplicate the efforts of any other existing organization, Mr. Freeman tells exactly how the organization functions.

The society will move next week from its quarters in the Engineering Societies Building to the Guaranty Building, 522 Fifth Avenue, New York, where slightly larger floor space will be had.

National Uniform Utility Accounting Virtually Assured

ALL public utility commissions will probably adopt a uniform classification of accounts as the result of a joint meeting in Chicago this week of accounting representatives of the National Electric Light Association, the National Association of Railroad and Public Utility Commissioners and the American Gas Association. As the National Electric Light Association and the American Gas Association had previously adjusted their accounting differences, their classifications of accounts were taken by the committee as a basis on which to work.

The first point agreed upon was that plant investment should not be segregated as of any fiscal date as is now the practice in some states. Then the National Electric Light Association and American Gas Association interpretation of retirement reserve was virtually agreed upon. There were sixteen representatives present at the meeting, which was still in session at the time the ELECTRICAL WORLD went to press.

Progress Made in First Meeting of Brotherhood with Contractors

A SPIRIT of good faith and confidence characterized the first meeting of the national council on industrial relations in the electrical construction industry, created through the joint actions of the National Association of Electrical Contractors and Dealers and the International Brotherhood of Electrical Workers, held in Washington last Tuesday.

A permanent organization was created by the national council, with L. K. Comstock of the contractors, chairman, and F. J. McNulty of the Brotherhood, secretary and treasurer. A committee on constitution and bylaws was appointed which is to report at a meeting to be held in New York April 30.

The council was fully conscious of the opportunity present for the assumption of a very helpful function of leadership, realizing that force would play no part in its programme and that it was entering a new field of activity. There seemed to be a feeling that the time had come when a method must be found for welding the interests of employer and employee in support of a single broad purpose which must give full recognition to the importance of building up the right relationship between the industry and the public.

Illinois Commission to Hold Hearing on High Cost of Financing

THE Public Utilities Commission of Illinois realizes that unless the utilities of the state are able to raise money promptly to finance indispensable extensions and enlargements to plants and equipment the public will be put to serious loss and inconvenience. In order to thrash out this problem and to find out what remedies the utilities and others have to suggest, the commission has issued an order setting two general hearings at which this entire question is to be discussed, in Chicago on April 29 and in Springfield on May 3. These hearings were requested by utilities which have been unable to finance extensions ordered by the commission and also by other utilities which have been unable to raise the money to finance additions and improvements that they consider necessary in order to keep up with the needs of the communities served.

In discussing this situation with a representative of the ELECTRICAL WORLD James H. Wilkerson, chairman of the Public Utilities Commission of Illinois, said: "The financial problems of the utilities of the state are independent of questions of their financial stability or of the rates charged for service. The companies say they are unable to get money by the sale of securities on any reasonable terms, and the commission has got to consider how far the utilities are to be required to make extensions under such financial conditions. The difficulties of the companies as presented to the commission are twofold. One difficulty is due to the general financial condition of the entire country. The other is local and has to do with the credit of this state where the misuse of public utility questions for political purposes has made persons with capital afraid to invest in the securities of Illinois' public utilities. In other words, the utilities which serve the public of this state are drifting into the condition of the railroads when they were unable to meet the demands of the public for adequate service. Very little new construction was undertaken by utility companies during the war, and additional equipment is needed to meet the greatly increased demands for all kinds of public utility service. Unless something is done promptly, the public will suffer severely."

Tentative Program for June A. I. E. E. Convention

THE tentative program for the thirty-sixth annual convention of the American Institute of Electrical Engineers, to be held at the Greenbriar Hotel, White Sulphur Springs, W. Va., June 29 to July 2, was given out this week. The convention will be opened with the president's address, followed by the presentation of technical committee reports. The following technical sessions will be held, presided over respectively by the chairmen of the committees named:

1. Electrical machinery committee (B. A. Behrend, chairman)—Symposium on temperature conditions prevailing inside large alternating-current generators; papers by Messrs. Torchio, Lamme, Foster, Fechheimer and Newbury and Gilman.
2. Protective devices committee (D. W. Roper, chairman)—Papers by Messrs. Steinmetz, Kierstead, Dwight and Gross.
3. Special committee on determination of power factor (S. G. Rhodes, chairman)—Preliminary report by committee and papers by Messrs. Holtz, Brown, Pratt, Silsbee, Wallace, Fortescue and Torchio.
4. Electrical machinery committee (B. A. Behrend, chairman)—Session on welding; papers by Messrs. Hansen, Bergman, Churchward, Candy, Turbayne and Miner.
5. Power stations committee (Philip Torchio, chairman)—Symposium on excitation; papers by Messrs. Bauhan, Ross, Vogel, and two others.
6. Miscellaneous session—papers as follows: "Alternating-Current Commutator Motors," by J. I. Hull; "High-Tension Insulator Porcelain," by W. D. Peaslee; "Wattless Power and Magnetic Energy," by J. Slepian; "The Corona Voltmeter—II," by J. B. Whitehead and Mr. Ishiku.

Radio Engineers Are Working on International Regulations

A COMMITTEE appointed by Secretary Alexander of the Department of Commerce is now ready to submit a report on proposed revision of international radio regulations which will be acted upon by an international radio congress at some future date. An encouraging aspect of the matter is that the government agencies have recognized the Institute of Radio Engineers by including the membership of its radio regulation committee, Dr. A. N. Goldsmith, chairman, in the Department of Commerce radio conference committee.

A protocol was drawn up by representatives of the United States, France, Great Britain and Italy proposing amendments to the London conventions of 1912 and submitted to the countries last summer for consideration. In this country the protocol is under consideration by the Army, Navy, Post Office and Commerce Departments, the latter representing commercial radio interests. It is said that the Department of Commerce committee will submit its report to Secretary Alexander on April 30, and that a general meeting will be held in Washington on May 13 at which the report will be publicly discussed.

Slight Improvement in New England Coal Situation

A CONFERENCE relative to the coal situation was held Tuesday at the office of the Massachusetts Department of Public Utilities by members of the commission and representatives of gas companies, electric service companies and the railroads. The railroad men present expressed their desire to facilitate coal movement to the utmost, but pointed out that it is at present physically impossible to transport a normal amount of coal into this district on account of the interruption of supply and freight congestion existing.

F. H. Smith, assistant general manager Worcester Electric Light Company, stated to the ELECTRICAL WORLD Wednesday that the outlook is somewhat improved for his company, as the railroads have delivered seven carloads a day to the Worcester plant since Monday from their own holdings. Conditions are better at tidewater central stations.

Commissions Must Allow Utilities to Earn More, Says M. R. Bump

RULES of regulatory commissions must be changed to allow a more adequate rate of return if the utilities are to attract the capital necessary for new equipment and extensions of their systems to meet the demand for service, M. R. Bump, chief engineer of Henry L. Doherty & Company, and vice president of the National Electric Light Association, stated to a representative of the ELECTRICAL WORLD this week in commenting on the credit situation of the electric light and power industry.

"There has never been a time, even during the height of the war," Mr. Bump pointed out, "when the demands upon central stations for additional service were as insistent and as great as they are today. Central-station power is practically without a competitor, and rates have ceased to be a controlling factor for the moment. The ever-increasing demand is for power and more power to meet industrial growth.

"At the same time, the investor, whose income depends upon the return secured from his investments, finds he must seek fields that are yielding larger returns than were formerly considered necessary, because, if his entire income is from investment, it is obvious that he must realize more from his capital to meet present living costs, taxes, etc.

"Central-station companies are therefore faced with a situation of providing additional capital to meet the present growing demands at a time when the cost of that capital is higher than it ever was before. Plant construction costs have more than doubled, and the rate for money has increased so materially that the fixed charges per unit of capacity installed today are from three to four times as great as in the pre-war period.

"The man who demands the services is willing to pay this charge, but in many instances no financial plan has been evolved that will permit the company to obtain the necessary capital for extensions. Very few of the state utility commissions have recognized this as a controlling factor. The rate of return which they permitted before the war upon investments made at that time is no longer an adequate return, for the very good reason that capital cannot be secured within the limits fixed by many commissions, and unless their rules in this respect are changed, it is inevitable that the central-station industry must suffer because of its inability to attract capital.

"It remains for the industry to meet the demands by placing its plight before every commission or regulatory body, stating its case clearly and plainly and proving beyond question the need of relief from the old basis in order that it may go on and meet the ever-increasing demands made upon it."

Lighting Company Allowed Temporary Rate Relief in Record Time

WHAT is probably a record for promptly meeting an emergency condition threatening the credit of an electric light and power utility was established by the Railroad Commission of California in a recent decision wherein a temporary rate relief was granted the Southern Edison Company six weeks after filing of application.

The unexpected subnormal rainfall conditions in California this year, making three successive years of subnormal precipitation, seriously reduced the output of hydro-electric plants, causing unusual increases in operating expenses to make up the deficiency, and because of this the Southern California Edison Company on Feb. 27 filed with the Railroad Commission an application for a temporary increase in its rates. Hearings were held in Los Angeles March 25, 26, 27 and 31, at which both the company itself and all of the cities and farming communities served by the company were represented.

Under date of April 15, the commission handed down a long decision allowing the company a temporary increase in all its rates of 27 per cent from April 20, 1920, to Jan. 20, 1921. This increase provides the company with an additional revenue during the period of $2,106,600, in partial compliance with the company's application for a 32½ per cent temporary increase. The temporary rates will be in effect pending the establishment by the commission of standard rates after a full and complete valuation.

The text of the decision says, in part:

> It is increasingly evident that the business life of a community such as southern California is in a very large measure dependent for its growth and expansion, and in some instances even its continued operation, upon electric energy, and as the cost of steam generation is constantly increasing, the necessity for the cheaper production of electricity by hydro-electric development has become more and more recognized. Of course, it is not to be understood that the Railroad Commission urges the payment of unreasonable rates to stimulate investment in this public utility, but when it is considered that to place this company in a position where it can successfully finance will not result at this time in even an 8 per cent return on investment, it will at once be realized that the burden upon the consumer is not unreasonable. In considering the granting of an increase in rates of the amount herein contemplated, we are especially mindful of the fact that applicant has been diligently active in the enlarging of its production and transmission facilities since the consolidation of the properties in 1917. It has shown an active determination to carry on development and, from the evidence presented, has exerted every reasonable effort to meet the demands of the territory served in the face of difficulties arising from the war period of 1918 and period of readjustment and high cost of money, material and labor which have continued since. Applicant's evidence shows that it has definite plans for the development of both water and steam power for at least eight years in the future, and at an estimated cost of $100,000,000.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Quicksilver Produced in 1919. — The production of quicksilver in the United States in 1919 was 21,348 flasks, according to F. L. Ransome of the United States Geological Survey. This was a decrease of 11,535 flasks as compared with 1918.

Fifty Per Cent Increase in Minimum Rate Needed.—The Florence Electric Company of Oregon, whose plant was recently destroyed by fire, has applied for permission to increase its minimum rate from $1 to $1.50. Unless the increase is granted, the company asserts, it will be unable to rebuild its plant.

Getting Weather Reports by Radio.—The Kansas State Agricultural College is sending weather reports by radio six days a week for the benefit of rural residents who have wireless plants and who in turn transmit the reports to farmers in the neighborhood. In this connection it is reported that the government weather reports sent out from the wireless station at Arlington, Va., have been picked up by amateur operators living as far away as North Dakota.

Generating Electricity by the Use of Wind.—In Sweden there is a plant which combines ancient and modern power sources in an unusual way, generating electricity by means of wind. A windmill with four 18-ft. sails making thirty revolutions a minute produces 6.22 hp. when the wind has a velocity of 23 ft. a second. The wind lifts a 2-ton weight which in its fall develops the energy to drive the dynamo. The mill produces about 4,800 kw.-hr. a year, which is used for agricultural and pumping purposes.

U. of P. Adds to Its Electrical Equipment.—Recent additions to the apparatus of the electrical engineering laboratories of the University of Pennsylvania, Philadelphia, include a complete machine shop. The equipment is particularly adapted to the needs of research work. Additions to the laboratory equipment now on order include a 37½-kva. three-phase generator with driving motor, two direct-current 3-kw. interpole compound-wound generators with driving motors, field rheostats, tachometer equipment and measuring instruments.

Analysis of Complaints to Commission.—Verification of the California Railroad Commission's contention that an increase of rates under the abnormal conditions prevailing is an act of necessity, fair alike to the utility and the consumer, is seen in an analysis of the complaints received in 1919. With a total of 748 informal complaints to the commission regarding rates, electric companies were third on the list, there being 137 counts against them, and with 828 complaints regarding service, the electric companies again rated third, with 147 appeals. As there are approximately a million persons paying light and power bills in California, the number of complaints against service and rates is remarkably small.

Metropolitan Edison's Stock-Selling Campaign.—During April the Metropolitan Edison Company has been offering to its employees and customers a limited number of shares of 7 per cent preferred stock, par value $100, for $95 less interest on a monthly installment plan, or at $93 cash with accrued dividend. The offer is made to induce as many employees and customers as possible to become financially interested in the company, which announces earnings, after paying interest on its funded debt, of three times the amount necessary to pay the 7 per cent dividend on outstanding preferred stock.

Electrical Rules of International Electrotechnical Commission.—Vol. I of the "I. E. C. Rules for Electrical Machinery," as adopted at the plenary meeting held in Lndon, in October, 1919, has been issued by the commission and may be obtained from its secretary, whose address is 28 Victoria Street, Westminster, S. W., London. The publication comprises forty-two pages, the text being printed in French and English in facing paragraphs. Besides stating the scope of the rules, with definitions and I. E. C. rating, information to be given with inquiries and orders for electrical machines is printed, conditions to be fulfilled by electrical machinery are laid down and the markings of rating plates are signified.

Electrical Development in Japan.—Announcing the existence of 652 electric power companies in Japan, as of September, 1919, with a capitalization of $220,000,000, and the authorization by the government of 281 hydro-electric plants in nine months, with an aggregate rating of 452,000 hp., *Denkinotomo* ("The Electrician's Friend"), a Nippon contemporary, says: "The rapidity of the growth of water-power project was one of the marvels in industrial circle. The dawn of peace has given another dose to the ever-increasing demand on electric power. The higher price of coal and oil has acted coaxially with the natural growth of power demand. One of the grave questions confronting the far-sighted people in connection with water-power development is the desultory deforestation. The high price of lumber has caused the shiftless felling of forests regardless to the imminent danger to water source. Measures are being taken, however, to check the shiftless felling and to promote forestry, and it is hoped the ill tendency will be curtailed in time to come."

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

American Society for Testing Materials.—The annual meeting of this society will be held at Asbury Park, N. J., June 22-25.

National District Heating Association.—The eleventh annual convention of the National District Heating Association will be held at the Hotel La Salle, Chicago, May 25, 26 and 27. A paper on the later types of bleeder turbines will be presented.

Society for the Promotion of Engineering Education.—This society will hold its twenty-seventh annual meeting on June 29 to July 2 at the University of Michigan, Ann Arbor. The general topic of the meeting will be co-operation. Ira N. Hollis, president of the Worcester Polytechnic Institute, will speak on "Co-operation with the National Engineering Societies."

Ohio Electric Light Association.—Coming committee meetings scheduled by this association are as follows: New-business co-operations committee, lighting and merchandising section and power and heating section, Coshocton, April 28; station-operating committee, Pittsburgh, May 5; meter committee, Columbus, May 7 (postponed from April 22). Arrangements are progressing for the Cedar Point convention, July 13-16.

American Association of Engineers.—The tentative program for the fifth annual convention of this association, which will be held at the Planters' Hotel, St. Louis, on May 10 and 11, has been issued. On the first day, besides committee reports and group meetings, the following topics will be discussed: "Shall a Special Charge for Special Service Be Made by the Employment Department?" "A Permanent Home for the A. A. E.," "Getting Pay Schedules Into Budgets for the Public Service Engineer," "What Part Shall the A. A. E. Take in the Presidential Campaign?" "Americanization and Man-Power Engineering," "Making the Chapter a Force in the Community," "The Federal Department of the A. E. E. at Washington," "Opportunities for the Engineer in Civil, Structural, Mechanical, Mining and Chemical Fields," "Co-ordinating A. A. E. Activities in the State," and "Reorganization of the A. A. E. on a Business Basis." On the second day amendments to the constitution and by-laws will be considered, "Unity of the Engineering Profession in the United States" will be discussed, and the annual dinner will be held.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Adjusting Loss by Accidents.—Unavoidable extraordinary expenses of an electric utility, such as those occasioned by lightning or a short circuit, should, according to a decision of the Missouri Public Service Commission, be charged to operation and amortized over a term of years.

Unnecessary Expenditure for Hauling Coal.—In granting increased rates for electricity and water to the municipal plant of Algoma, Wis., the Railroad Commission of Wisconsin pointed out that the city paid from $60 to $66 a month for hauling coal from the railroad to its plant, a distance of only 175 ft., and that the construction of a spur track at a cost of $500 would obviate this expense and save enough to offset a wage increase that had recently been made.

Ten-Day Discount Period Enough.—Declaring that the primary reason for allowing a discount for prompt payment of bills is not to obtain additional revenue through late payments, but to encourage early payments in order that the utility may itself be able to discount bills owed by it, the Wisconsin Railroad Commission granted an application from the Seymour Electric Company for authority to change its discount period so that it would expire on the tenth of each month instead of the twenty-eighth of each month as formerly.

Comparative Minimum Rates.—Complainants against a minimum residence rate of $1.50 adopted by the Northwestern Electric Service Company of Pennsylvania submitted to the Public Service Commission of that state for comparison the minimum rates made by seven electric companies in adjacent territory, which in two cases were 71 cents, in two cases 75 cents, in two cases $1 and in one case $1.25. The commission, finding that the cost of serving this class of customers had not increased 57 per cent, as would have been necessary to justify the new minimum rate of $1.50, reduced this rate to $1.20.

Increase of Rates with Change of Frequency.—Application having been made to the Wisconsin Railroad Commission by the Friendship Electric Light & Power Company for authority to increase its rates, the company alleging that a change was demanded from 133-cycle energy to 60-cycle energy, which would necessitate extensive reconstruction, the commission denied the plea on the ground that a substantial increase in revenue should result when the change was made and that increases in rates prior to improvement and enlargements are not justified unless present and past return has been unusually small and future prospects for a more profitable business are in no degree better.

Reasonable Rates for Large Electric Utility.—Among the pronouncements of the Missouri Public Service Commission in the matter of the application of the Kansas City Light & Power Company for increased rates—a case in which the commission overruled a motion for rehearing and mandatory proceedings covering a writ of review were taken in the Supreme Court of the state—are the following: (1) An estimate of a just and reasonable return to have been received by an electric utility operated in connection with a heating utility is adjusted, with the plant value and its application, to 50 per cent of the additions instead of the total monthly additions. (2) An electric utility having property of the value of approximately $8,139,319 is permitted to add a surcharge of 10 per cent to rates heretofore found just and reasonable where it was shown that the application of such rates results in a considerable loss to the utility, taking into consideration operating expenses, depreciation and return on the property. (3) Reorganization expenses assigned by the federal court to an interrelated electric utility in the reorganization of a bankrupt street railway are not, upon the unscrambling of interests in the joint holding company, to be capitalized by or amortized out of earnings of the interrelated utility in the absence of satisfactory evidence for such action or responsibility therefor on the part of the utility's consumers. (4) The value of the property of an interrelated utility formed for serving consumers across the state line and owned by an electric utility doing business in Missouri does not receive consideration in arriving at the value of the property of the utility for rate-making purposes to consumers in the latter state. (5) In estimating the operating revenues of an electric utility charges for energy furnished an interrelated utility were based on the production cost plus 17.7 per cent for losses and 10 per cent profit, although a lesser charge was made to the interrelated utility. (6) A net income of 7 per cent for return, surplus and contingencies on the combined property of an electric and heating utility is considered reasonable to a utility forced to pay 6, 7 and 8 per cent on short-time loans, as the net income should be somewhat higher than the cost of money. (7) An electric utility valued at $8,487,000, rendering adequate service and suffering a slump in return to approximately 3.32 per cent on account of increased costs of fuel, labor and materials, is permitted to increase its rates approximately 5 per cent.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Estimating Crop Damage from Flooding.—It was not an error, according to the Supreme Court of Minnesota, for a judge to instruct the jury that it might estimate the damage done to crops by the overflow of ditched water by the difference between the value of land with the crop and the value of the land without the crop. (176 N. W. 754.)

Excessive Penalties Imposed by Commission Illegal.—In an action brought by a railroad company to recover fines imposed upon it by the Railroad Commission of Florida, the Supreme Court of that state found that while the state may inflict penalties to insure obedience to lawful orders of the commission where no test of validity has been entered upon, it is none the less a denial of due process of law if a review of the legality of a statute may be had only at risk of penalties so great that it may seem wiser to yield to orders of uncertain legality. Rates or orders of the Railroad Commission do not have the attribute of finality and may be judicially reviewed, the court declared. (83 So. 708.)

Loss of Water Power Through Improvements on Public Canal.—The Court of Claims of New York State has dismissed an action brought by the American Woolen Company against the state to recover damages because of the temporary diversion of water while work on the barge canal was proceeding. The claimant asked that it be reimbursed for the cost of operation by steam power during two periods when the work on the canal deprived it of water power and also for the cost of constructing a new hydro-electric plant which it asserted was made necessary by the state's action and for the value of the use of the water power of which it was deprived during the year necessary to build the new plant, when the company was unable to use the old water-power machinery. The court found that diversion of water by cofferdam without any physical invasion of the lands or structures of a mill owner did not, as asserted by the plaintiff, constitute an "appropriation" by the state, and that a claim for damages could not be entertained by the court because the complainant had not, as required by law, filed a notice of intention to claim compensation within six months from the time of the accrual of any of the damages complained of. (180 N. Y. S. 759.)

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Reinier Beeuwkes, chief electrical engineer of the Chicago, Milwaukee & St. Paul Railway, with headquarters in Seattle, has been responsible for a substantial part of the work involved in the electrification of the Pacific Division of that road, which was placed in operation March 5, 1920. As recorded in the ELECTRICAL WORLD for March 13, page 619, this road is now electrically operated from Renton, on the western slope of the Cascades, to Harlowton, on the eastern slope of the Rockies, with the exception of a gap between Avery, Idaho, and Othello, Wash. Mr. Beeuwkes received his training in railroad electrification as assistant to C. T. Hutchinson, consulting engineer of the Great Northern Railroad, while on the Cascade Tunnel electrification. Mr. Beeuwkes in his present position has had charge of the transition of the lines from steam to electricity, and to him belongs much of the credit for their successful operation.

R. BEEUWKES

Henry M. Brooks, who has for a number of years been connected with the Insull interests, most recently as manager of the bond and stock department of the Middle West Utilities Company, Chicago, Ill., has resigned to go with W. G. Souders & Company, an investment house, and will be stationed in their New York office.

Charles Warren Hunt a few weeks ago accepted the office of secretary emeritus of the American Society of Civil Engineers, having on his own request been relieved of the duties of the active secretaryship after twenty-five years' incumbency of that office. Dr. Hunt's active interest in all that pertains to the engineering profession at large has given him an influence and reputation transcending the bounds of his own association. In 1903, for instance, he supervised and directed the work of organizing the International Engineering Congress held at St. Louis in connection with the Louisiana Purchase Exposition. He has long served as a representative member in such bodies as the John Fritz medal board of award, the Engineering Foundation and the United Engineering Society. He was born in New York City sixty-two years ago.

Bancroft Gherardi, who was made chief engineer of the American Telephone & Telegraph Company on July 1, 1919, was elected vice-president of the company on April 11 of this year. Mr. Gherardi has served for a little more than twenty-five years as a telephone engineer. He started in the office of Col. J. J. Carty, then engineer of the Metropolitan Telephone & Telegraph Company, in 1895. In 1900, when the traffic engineering department of the New York Telephone Company was created, he was transferred to that work and in 1901 became chief engineer of the New York & New Jersey Telephone Company. When these two companies were consolidated in 1906 Mr. Gherardi was made assistant chief engineer of both. In 1907, when Mr. Vail became president of the American Telephone & Telegraph Company, Mr. Gherardi was made equipment engineer, later being promoted to be engineer of equipment and buildings and engineer of plant in charge of plant development and standardization of the Bell system. On July 1, 1919, he was appointed chief engineer of the American Telephone & Telegraph Company, a position he held until his recent promotion to the vice-presidency. Mr. Gherardi was born in San Francisco on April 6, 1873. His father, Rear Admiral Bancroft Gherardi, U.S.N., took a leading part in the laying of the first transatlantic cable as lieutenant in charge of the boat Niagara, which landed the American end.

B. GHERARDI

Romaine W. Myers, chairman of the California Industrial Lighting Committee, is one of the prominent consulting electrical and illuminating engineers of the West. The new lighting orders drawn up by his committee, now being put into effect by the California State Industrial Accident Commission, are recognized as among the most modern illumination codes enforced by any of the states. Mr. Myers was born June 14, 1880, and was educated in Oakland, Cal., his present home. He received his first technical instruction there at California College, later going to the University of Pennsylvania for post-graduate work, specializing in illumination engineering. After professional service with the Southern Pacific Company and the General Electric Company, San Francisco, he became associated as civilian engineer with the Engineer Corps, U. S. A., and for five years had charge of all electrical work on the fortifications of the Pacific Coast and Hawaii. As private consulting engineer he has had much to do with the design of illumination installations in the industrial plants of California, as well as in the schools and the great Oakland Civic Auditorium. Mr. Myers has long been an active member of the Illuminating Engineering Society, being the Western representative of that organization.

R. W. MYERS

W. L. MacFarlane has been appointed general manager of the Cornwall Street Railway, Light & Power Company, Cornwall, Ont., succeeding C. U. Peeling, resigned.

W. H. Smaw, who for a number of years held the position of purchasing agent of the Georgia Railway & Power Company, has resigned to accept the position of Southern sales representative of the Electric Service Company of Philadelphia. Mr. Smaw joined the Georgia Railway & Power Company in 1903 as assistant purchasing agent and was made purchasing agent in 1910. During the last eight years he has served in that capacity for both the gas company and the electric company.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler
and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities
and Business Methods

Report on Combination of English Lamp Interests Ill Advised

According to information received this week, little attention is being given now in England to the report by the sub-committee on trusts of the British Board of Trade which investigated the alleged existence of a harmful combination in the English electric lamp industry. The English electrical and engineering papers characterize the report as ill advised and apparently prepared from only a superficial investigation by members having no prior knowledge of the industry investigated.

The report stated that there was a combination known as the Electric Lamp Manufacturers' Association, created primarily in the interests of the British Thomson-Houston Company, a company controlled by American interests; the General Electric Company and Siemens Brothers, which includes from 90 to 95 per cent of the industry. Prices are fixed which become a national standard. These prices, it was held, were too high, as was the price of lamps imported last year from Holland. It was further stated that there was, as a result of this control, a limitation of output which was injurious to the public.

The fact that the largest of the three dominant member companies is under American control led the sub-committee to state that there was some danger of the interests of the British lamp industry being subordinated to American interests. Furthermore, it was stated that there is a possibility of an international combination comprising British, Dutch and American manufacturers, which would be able to control supplies and dominate prices over a considerable part of the world.

The Electric Lamp Manufacturers' Association of Great Britain has issued a statement taking exception to some of the statements contained in the report of the British Board of Trade. The public summary of the report is likely to be misleading to readers outside of England where it refers to the General Electric Company, which is in fact the General Electric Company, Ltd., of Great Britain, a competitor of the General Electric Company of America.

Rubber-Covered Wire Sales Hold at High Level

With one quarter of the year gone, manufacturers of rubber-covered wire are still holding the high rate of code wire bookings which they held over the first six weeks of the year. Orders received for total code wire for the first thirteen weeks of 1920 are estimated at $10,500,000. This is five and one-half times the volume estimated over the same period of 1919, and represents a booking rate for the year of $42,000,000. It was estimated that total code wire bookings for 1919 amounted to $21,000,000 (Electrical World, Jan. 17, 1920, p. 160), and according to the records of the Underwriters' Laboratories, the production of rubber-covered wire in the United States in the year 1919, based upon the number of labels delivered, amounted to $22,341,000. The quantity estimated was 1,400,000,000 ft., or a figure 6 per cent higher than that of the Underwriters' Laboratories of 1,314,168,000 ft. Consequently double last year's rate is being accepted.

No. 14 solid rubber-covered wire has been ordered to an amount estimated at $4,200,000 for the first quarter of 1920. This is seven and one-half times that of the first quarter of 1919, but it must be remembered that last year only one-sixth of the No. 14 wire booked in the first half year was ordered in the first thirteen weeks. From April on the amounts of orders increased tremendously. Bookings of No. 14 are now averaging 40 per cent of the total code wire booked, which compares favorably with the figure of 38 per cent in 1919, first quarter. The booking of No. 14 code wire now is a smaller per cent of the total code wire being ordered than it was over the first six weeks. Hence it is reasonable to conclude that the ordering of larger current-carrying capacity code wire than No. 14 is increasing from month to month. Booking of total code is increasing, while the percentage which No. 14 bears to the total is falling off. Total code sales have been estimated at over a million dollars for each of the last two weeks.

Rubber-covered wire mills are running at a good capacity and as far as could be learned have sufficient stocks of raw materials to continue the production of this wire for some time to come. Shipping conditions now, of course, are extremely bad, and auto-trucks are being brought into play to make deliveries of the finished product. The mills can make virtually any shipments desired. If cars were available, 500,000 ft. of rubber-covered wire could be delivered tomorrow if it were necessary, or in one month or in six months. Shipments in general depend upon the necessity, and orders are being booked at that rate. The Mid-West is the best buyer at the present time, although the New England and Middle Atlantic States are taking a good volume of business.

Shipments of Copper and Brass Products Lengthened

In the face of a heavy buying movement and a high volume of inquiries, the copper and brass mills are having their own troubles filling their orders. Several mills in the New England and New York territories are in whole or in part shut down because of labor troubles and shortage of raw materials and coal, while many mills which are running have only enough operatives to run one shift, with sufficient work on hand to run night shifts, too. One mill in particular is working four nights a week at full capacity until 9 o'clock, and has not enough labor available to run a regular night shift. Productive capacity is in general booked up to a heavy excess.

Shipments are long. If transportation were available now, the mills of course could begin moving much of the material that is piling up in their warehouses. Motor trucks are moving quantities of it, but this method is merely taking the edge off the stocks piling up and is taking care of only rather local traffic. The mills that are running are quoting from six to twelve weeks for shipments, while at least one of those shut down is not quoting any shipping date. Copper sheets and brass shapes are in a condition somewhat analogous to that of the steel industry. Hot copper sheets are in heavy demand and are carrying a six weeks' shipping date. Cold-rolled copper sheets can be turned out in about double the time.

There does not seem to be any immediate prospect of relief for the situation outside of a resumption of rail traffic. This, of course, will release pent-up finished stocks, but it will in no wise increase the supply of labor which is necessary if more business is to be handled. Except in finished products, it is reported that little or no brass is being exported, the New England mills supplying domestic trade only. The electrical industry is taking more and more copper and brass tube, rod, wire and sheet, and it is expected that mill conditions and shipments will become increasingly more unsatisfactory as the summer advances. In connection with the export trade there is reported a heavy demand from India for sheet copper and brass for cooking utensils.

Prices of finished and semi-finished materials have held quite steady for several weeks. Copper itself has been holding within a cent of 19 cents all this year and so has had little effect in changing prices of its products. The price of copper is not likely to advance materially unless a heavy foreign buying movement sets in. It would not be surprising, however, to see a slight advance in the raw metal when domestic buying for the third quarter opens up. This would probably be reflected in higher prices of copper and brass products. At any rate, production costs, in particular in the mills where strikes are on if labor obtains an increase, are liable to have a greater effect in increasing prices of brass and copper products than advances in raw materials. Prices have been withdrawn where strikes are holding up production because of the uncertainty of future producing costs.

Trucking and Mails Help Delivery of Electrical Supplies

THE electrical supply trade in the neighborhood of manufacturers is faring better during the transportation tie-up than is the trade at a distance from them. Motor trucks are moving quantities of materials into jobbers' stocks and from jobbers' stocks out into the trade. Then, too, certain raw materials are being trucked in to manufacturers in quantities just about sufficient to keep up a small volume of output.

Boston jobbers are being greatly benefited by the concentration of shipments to Boston stock from electrical manufacturing plants in Connecticut and Massachusetts, resulting from freight embargoes outside New England. Switches, sockets, fuses, wire and some heating appliances are in better stock, but there is a famine in small-size rigid conduit, porcelain fittings and loom. The railroad strike did not make any serious inroads into local New England transportation service, but through freight, including coal and many raw materials, was cut into heavily by tie-up in New York and in the Middle West.

Motor-truck routes have been established from New York to Boston, Providence, Schenectady, Philadelphia and many other New England and Middle Atlantic States points. Truck rates, however, have advanced. One New York jobber considered sending a truck to Pittsburgh for pipe and found the rates had gone up from $1 per mile to $1.25 per mile. Houses owning their own trucks are not hesitating to travel long distances for their raw materials. Steel strip is being brought from Trenton to New York in quantities sufficient to allow the finishing mills to keep up a small volume of production of flexible armored conductor. The rate of production, however, is much too small to fill even daily needs. One jobber reports additional transportation costs of 15 per cent because of suburban trucking.

Virtually no steel, except for a small amount by truck, is moving to finishing mills, and production of rigid conduit is almost at a standstill. In one case where outlet boxes have been stamped out of strips of sheet steel, that supply has stopped and a few boxes are being made out of a small supply of large sheets on hand. This cannot last long, however.

The parcel post has been another life-saver. Electrical material is moving all over the country by that method, the only limit being that of dimension and weight. The New York post office is handling the greatest amount of parcel-post matter in its history and is adding men and trucks to take care of it. It is understood that that office will continue to employ additional men and trucks necessary to handle the increasing number of parcels. The main office and branch offices in the city are still piled up with packages, but it is reported that the situation is being handled better every day.

Among the shipments by post noted recently have been pole brackets, pins and other pole material of steel which have come from Chicago to New York and heating appliances in great number from New England to New York. Schedule material is a common commodity from New England points to stations all over the country.

With the increased demand for paper and corrugated paper containers for this class of shipment, it would not be surprising to find the supplies of that stock rapidly dwindling. One paper box mill near New York is shut down because of coal shortage, and packing materials are reported to be the shortest in stock of any of the materials required by one lamp factory to continue its output. In some quarters paper for paper-insulated power cables is short in supply. Insulation manufacturers seem to have a fair supply of paper for present needs, in so far as the probable life of the freight tie-up is concerned.

Freight yards are congested beyond all previous records. Once the switch engines are released for clearing up, it can hardly be expected that the unscrambling can be effected within two to three weeks. Many cars containing electrical apparatus and materials have been located in the yards, but they are so inaccessible that it is impossible to unload them to trucks. At the same time a large amount of material has been accessible in the freight yards and has been trucked in to destination.

American Manufacturers Find Ready Market in Mexico

SELLING American electrical goods in Mexico is both pleasant and profitable, according to Charles E. Sharp of St. Louis, who specializes on the sale of electrical and mechanical apparatus and supplies to firms south of the Rio Grande. He finds no prejudice against American goods, and says: "Mexican buyers have always considered them highly. Virtually all the electrical machinery and supplies shipped into Mexico during the war and even now are of American manufacture. German goods have always been of cheap grade and sold accordingly. Some little French and Swiss apparatus is imported, but practically none of English make.

"Money is so plentiful that part or even full payment is often given with an order for goods," Mr. Sharp continues. "Buyers, therefore, are asking new salesmen for production and credit references instead of the salesmen asking them. However, personality, recommendations from other Mexican buyers and service count more than the rating of Dun or Bradstreet.

"Lighting, power and transmission material and apparatus are in great demand. Some electric irons are sold, but labor is cheap and as a general rule few electrical household devices are used. Large orders are the rule because of the heavy stocks that are maintained to supply their local needs."

Mr. Sharp finds it a good business policy to encourage his Mexican customers to call on him for everything they need in this country. He goes on:

"Since the Mexican government took over the railways in 1913 it has been impossible to ship orders through from the United States to Mexican points without the execution of a bond for the return of the railroad equipment. As a result shipments are sent to forwarding agents on the border who accept delivery, pay freight to the border, reload the goods in Mexican cars, pay custom duties and put the goods through the custom house. Shipments by sea are handled in a similar manner by forwarding agents at the port of embarkation.

"Any one wishing to visit Mexico need not have the slightest fear of being molested in any way whatever. Trains are running on a normal schedule with regular Pullman equipment. All money transactions are made with coins, as there are virtually no bills in circulation. Sometimes one is forced to sacrifice on change because of the lack of coins of small denomination. In addition to a passport a traveler will be required to produce an income-tax receipt for the current calendar year before he will be allowed to cross the border. By this ruling any one leaving this country at the beginning of the year is required to prepay his income tax, which under ordinary conditions would not be required until March 15. A knowledge of Spanish is desirable but not essential. Most of the electric light, power and street-railway companies have engineers who speak English."

Metal Market Situation

LITTLE change in position of the basic metals which are used in the electrical industry has taken place in the past week. As a whole the metal market has been extremely dull. Electrical manufacturers have been well booked up on most of their requirements for April, May and June, and buying in the last few weeks has been carried on mainly by a few of the larger consumers who needed a little more for the second quarter and by some of the second-hand dealers.

Within the past week there have been reported sales of 3,000,000 lb. of copper, mostly for May and June delivery. Virtually none changed hands for immediate delivery because of the impossibility of transporting it. Producers are not at all apprehensive over the future copper market, but on the other hand are not at all disposed to quote for deliveries beyond the end of June. They realize that second-quarter consumption is already virtually closed up on their books, and that as matters now stand third-quarter bookings can be made later on in the present quarter at a rate higher than consumers would be willing to pay at this time. When the buying for third-quarter does start in the first few consumers undoubtedly will obtain copper at a rate little above second-quarter quotations. Beyond that it is expected that prices will advance at least to 20 cents. Copper has been characterized as a metal the price of which is relatively lower than that of almost every other metal used in the electrical industry. Producers continually refer to the small margin now obtaining between cost of production and selling price.

Producers are quoting their nominal price of 19.25 cents a pound for April, May and June copper, delivered. In the open market there have been some recent sales of small amounts for from 18.50 to 18.75 cents. It is expected that deliveries of this cannot be made much within two weeks.

The railway strike is holding up shipments from the West to refineries in the East, besides deliveries to consumers. These consumers will have to get along as best they can with present stocks, which in most cases will probably be ample within the probable life of the tie-up. Where refineries have small stocks on hand, and some of them are now virtually not operating, a shortage of refined copper may be expected at the end of the next sixty-day refining period.

Lead is holding a quiet market, although the price is rather steady. Leading quotations give 9.25 cents, but it may be had in the outside market for a quarter cent less for nearby delivery and at about 8.75 cents for May delivery.

NEW YORK METAL MARKET PRICES

	April 14			April 21		
Copper	£	s	d	£	s	d
London, standard spot	104	10	0	100	5	0
	Cents per Pound			Cents per Pound		
Prime Lake	19.00			19.00		
Electrolytic	19.25			19.25		
Casting	18.37½			18.37½		
Wire base	23.00			23.00		
Lead, trust price	9.25			9.25		
Antimony	10.75			10.50		
Nickel, ingot	43.00			43.00		
Sheet zinc, f.o.b. smelter	12.50			12.50		
Zinc, spot	8.75 to 8.85			8.35		
Tin	63.00			61.50		
Aluminum, 98 to 99 per cent	33.00			33.00		

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.50 to 17.25	16.50 to 17.00
Brass, heavy	10.25 to 10.50	10.25 to 10.50
Brass, light	9.00 to 9.50	9.00 to 9.50
Lead, heavy	7.50 to 7.62½	7.25 to 7.50
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

WITH railroads over the country moving perishable freight, with a shipbuilding boom starting in the Northwest, with increased building operations commencing in the South, and with supplies rapidly pouring into New York and Boston by parcels post and by truck, the outlook in the supply jobbing field is better today than it has been for a number of weeks.

Heavy demands in Chicago for building materials such as conduit, outlet boxes, wire, etc., are expected to be partly filled by delivery there of some freight before the week is out. On Tuesday 500 out of 765 switch engines were running, and much of the congestion there, it is thought, will soon be over. In Seattle contracts have been let for eighteen tankers of 10,000 tons or more, and business is normal. A slight decrease is reported from Portland. Boston and Atlanta have not suffered from the railroad tie-up as badly as other sections, although much freight for Boston from the West, passing through New York, has been held up. In New York, Boston and Chicago a considerable number of large buildings are going up, and this number is rapidly increasing. Demand for building materials is felt in all sections, with jobbers confident that a large amount of business will be transacted during the next six weeks.

NEW YORK

With virtually all railroads in the New York district again handling perishable freight, danger of a serious shortage of building materials has passed. Jobbers are optimistic about the amount of business to be transacted during the next month. This is dependent to a large extent, however, on the amount of conduit, flexible armored cable, outlet boxes, wire, porcelain knobs, tubes and switches that will arrive meanwhile. Considerable stocks of porcelain material, fuses, heating appliances and line hardware have been received during the week by parcels post. Both manufacturers and jobbers are using this method to good advantage.

Many truckloads of building materials have reached the city during the week. The present price of $1.25 per mile per truck for long-distance hauling has, however, prevented jobbers from bringing large quantities of materials over long distances. Jobbers who have been compelled to ship goods to the suburbs by truck find that shipping expense has increased 5 to 15 per cent.

Demand, as indicated by business contracted for on the first three days of the week, has shown improvement over previous weeks.

Fuses.—Demand is normal with fair supply on hand. Plug fuses in 10, 15, 20, 25 and 30-amp. sizes are $7 per 100 in less than 100 lots. List price on standard cartridge fuses up to 30 amp., 250 volt, is 25 cents; for 30-amp., 125-volt, 25 cents, and 35 cents for 60-amp., 250-volt. Discounts range from 30 to 50 per cent, depending on quantities. The 50 per cent discount is applicable to standard packages.

Lamp Cord.—Several jobbers have secured shipments of lamp cord. Supply generally is low. Cotton lamp cord, size No. 18, is quoted at $25 per 1,000 ft.

Non-Metallic Flexible Conduit.—Many jobbers are completely out. Some loom has been received during the week, but stocks are badly broken wherever any is to be had. Prices vary from $36 for 7-32-in. size to $40 per 1,000 ft. for ¼-in. size in lots of 500 ft. to 1,000 ft.

Transformers.—Demand is heavy for distribution type, and local stocks are being kept up with difficulty.

Lightning Arresters.—Spring demands are being filled in good shape, and stocks of low and medium voltage pole-type arresters are holding out well.

Wire.—Rubber-covered wire bases have been holding at 28 and 30 cents. Two mills have just raised their bases from 26 to 28 cents because of increased labor charges, it is reported. Shipments from mills really depend on urgency of the order.

Outlet Boxes.—Demand continues heavy with extremely poor stocks from which to fill orders. The call for 3-in. boxes has fallen a bit, it is reported.

Conduit.—There is very little rigid conduit in the territory, many jobbers being cleaned out of stock. There is little prospect of relief until freight moves again in good volume.

Schedule Material.—Stocks are in better shape than those of the other kinds of wiring materials and supplies. Parcel-post shipments are helping the situation materially.

Flexible Armored Conductor.—Stocks are virtually non-existent. Mills are trucking in steel strip and producing finished conductor in small amounts.

BOSTON

Continued active business expressed in an almost overwhelming rush of orders and deliveries in a state of upheaval due to the railroad strike are outstanding features of the week in New England trade. Local jobbers benefited greatly by the concentration of shipments to Boston stock from electrical manufacturing plants in Connecticut and Massachusetts resulting from freight embargoes outside New England. Switches, sockets, fuses, wire and some heating appliances are in better stock, but there is a famine in smaller-sized rigid conduit, porcelain fittings and loom. Leading Boston jobbers are shipping lighter material from New York by motor trucks. Collections are improving this month. Prices are firm and unyielding. Jobbers report that central-station business is slow to develop this spring. Some talk is heard as to the need of higher lighting rates. A few industrial plants were shut down from coal shortage, but most electrical concerns ran through the week.

Fuses.—Fuses are in excellent stock. Prices are as follows on the standard non-renewable types: Plug fuses, up to 30 amps., 125 volts, $5.75 per 100 in less-than-carton lots to $4.75 per 100 in standard-package lots. Cartridge fuses, non-renewable, to 30 amps., 250 volts, 25 cents list, and from 31 amp. to 60 amp., 35 cents list, with the following discounts: Less than carton lots, 12 per cent; carton to standard packages, 23 per cent; standard packages, 42 per cent off. These discounts apply from list on all inclosed non-renewable fuses up to 600 amp. at 600 volts.

Flexible Armored Conductor.—Stocks are running low. One jobber received 50,000 ft. Friday, but even so, it is necessary to parcel out deliveries. Single-strip No. 14 is quoted around $110 to $115 per 1,000 ft., with $120 on double-strip. The demand far exceeds the supply.

Non-Metallic Flexible Conduit.—The market is almost bare of loom for the time being, some of the larger houses reporting no stocks. Nominal quotations are steady at $37 per 1,000 ft. on 7-32-in. and $40 for ¼-in. Shipments into this district are bad.

Wire.—Bare copper wire is steady at 24 cents base and weatherproof at 28 cents. Rubber-covered wire is in good supply in eastern New England, a representative price being $16 per 1,000 ft. on No. 14 in less-than-coil lots and $13 in coils.

Porcelain Fittings.—Leading jobbers are virtually stripped of tubes and "Nail-it" knobs and are none too well supplied with cleats.

Sockets.—Heavy shipments are being made from Connecticut into Boston. Prices hold firm, with pulls at 50 cents, keys at 28 cents and keyless at 26 cents net in case lots.

Motors.—Stocks of smaller-sized motors are of poverty-stricken size. Few motors below 50-hp. rating can be had except on from four to five months' delivery from the factories.

Washers and Cleaners.—Jobbers representing New England producers are receiving these outfits in quantity, owing to embargoes on outside railroads. It is not expected that stocks will hold up long, but the strike has not been without its compensations. Retail deliveries are correspondingly stronger.

Fiber Conduit.—Business is rather dull. Quotations are on the basis of list less 12 per cent in small quantities.

Lamps.—Immediate requirements are being well met, notwithstanding a shortage in gas-filled lamps of larger sizes. Regional factories help.

Hollow Ware.—Shipments to Boston are in prospect from New England factories hitherto able to dispatch goods to all quarters, thus affording temporary relief to an active buyers' market.

Rigid Conduit.—The market is practically bare of ½-in. and ¾-in. pipe. Deliveries are at the lowest ebb for months.

CHICAGO

The railroad strike has each day been of varying intensity for the past week, with conditions steadily improving, so far as southbound shipments are concerned. Necessarily, foodstuffs are receiving first consideration in the clearance of congestion, electrical dealers and manufacturers getting small consideration. Coal shortages resulting from the strike have not caused many shutdowns in Chicago, but the situation is serious.

Placing of new business continues in heavy volume. Banking interests, which in the past have feared that the approaching return of business to a condition more nearly normal would be in the nature of a sudden crash, express the opinion that indications are for a gradual readjustment. Electrical manufacturers seem to share in this opinion. The proposed $15,000,000 bond issue to cover street-lighting work in this city was defeated at Tuesday's election. The fact that economy rather than disapproval of the improvement was the cause of its failure is borne out by the simultaneous rejection of large issues for needed bridges, a convention hall and playgrounds.

The week's building undertakings in the city amounted to $1,750,000. Of this amount only $300,000 goes in residences and $100,000 in an apartment building.

Bare Copper Wire.—Current quotation on No. 8 bare copper wire in 200-lb. lots is $26.25 per 100-lb., and on No. 12 is $26.50 per 100-lb. In larger quantities prices are $25 and $25.50 respectively. This is merely following fluctuations of electrolytic copper.

Second-hand Apparatus.—Dealers are unable to maintain stocks in the face of heavy demand, particularly for all sizes of motors from fractional up to 25 hp. or 30 hp. Certain concerns report March as the largest month in their history as regards actual sales.

Electric Trucks.—Manufacturers report business as excellent, though subject to inconvenience from the rail strike. Plants are running double shifts in an attempt to make prompt deliveries.

Sockets.—Demand is so heavy as to keep dealers' stocks continually at a minimum. Prices which have been in effect for some time are as follows: Key, $28.05 per 100; keyless, $25.50 per 100; pull chain, $51 per 100. These are for standard package lots.

Flexible Armored Conductor.—Jobbers and manufacturers are booked up to such an extent that orders are being taken only on the basis of price ruling at date of shipment. Jobbers' stocks are very low and factory deliveries uncertain.

Black Conduit.—Certain manufacturers are now working on new card No. 45, which is eight points higher than No. 44. A short time will probably see all prices uniform on the new basis. Jobbers have vast quantities on back order and new business is being placed to be billed at prices ruling at time of shipment.

Insulating Varnish.—Steady, heavy demand with plentiful supply and prompt deliveries is the feature of satisfactory business in this line. Prices remain on the same base as for some months past, but advanced costs of raw materials point to early increases, particularly in asphaltum products.

ATLANTA

Jobbers report that the railroad strike has had a noticeable effect on the receipt of material only in isolated cases, though they have had numbers of communications from manufacturers stating the latter's inability to make shipments. Failure to receive material on account of the strike will be noticed in from ten days to two weeks from date. Freight embargo and car shortage have seriously affected local jobbers, particularly in the heavier lines, and stocks in general are becoming more and more scant as a result. This is particularly true in steel and porcelain lines.

The business outlook throughout the territory continues excellent and a spirit of general optimism prevails. This is reflected by the growing tendency of the small-town contractor to enter the merchandising field in addition to his contracting activities.

Wire.—Fair stocks of rubber-covered wire are in the territory, but weatherproof is in poor shape, some jobbers being completely out of the popular sizes with no immediate prospects of replenishing stocks.

Motors.—Stocks of alternating-current motors are very scant, one of the largest jobbers in this line having none on hand. Great difficulty is reported in obtaining small sizes, particularly of the single-phase variety, and there are virtually no motors of the latter type in the territory.

Distributing Transformers.—The available supply continues to be comparatively fair, although stocks still remain somewhat spotty. Sizes up to 50 kva. can be obtained with reasonable promptness, but the large units are quoted at from eight to fourteen weeks.

Oil Switches.—The supply of the popular sizes of oil switches is very low, only a scattering of odd sizes being available, while shipments are being quoted at fourteen weeks for material not in stock. Price, 2,300-volt, 220-amp., $55.

Fixtures.—The demand is reported as holding up well and stocks are becoming depleted, owing to poor shipments. A price advance averaging 10 per cent became effective the first of the current week.

Porcelain.—Stocks continue in miserable shape. There are practically no tubes or cleats in the territory, although one jobber reports a big shipment of cleats in transit. Only one jobber reports sufficient supply of knobs to be worthy of mention, while the supply of rosettes and other porcelain material is very scarce. Manufacturers will make no promise of delivery.

Meters.—The demand for all sizes of meters is phenomenal, but house-type meters of from 5 amp. to 25 amp. are still obtainable in limited quantities from stock. The larger sizes of the low-voltage and all sizes of the high-voltage equipment are hard to obtain, shipments on 2,300-volt apparatus being quoted at fourteen weeks.

Schedule Material.—Practically no class of schedule material is on hand in sufficient quantities, the most acute shortage existing in boxes, sockets and material containing porcelain.

Fuses.—Jobbers report scant stocks of both plug and cartridge fuses, while the demand is strong. Such stocks as they have are very spotty and shipments are unsatisfactory. Plug fuses sell in lots of fifty at 6.3 cents each, while standard packages are 5.05 cents. Cartridge fuses in standard packages, 1 amp. to 30 amp., are 14.5 cents; 35 amp. to 60 amp., 22.5 cents; 65 amp. to 100 amp., 52 cents; 110 amp to 200 amp., $1.16; 225 amp to 400 amp., $2.08; 425 amp. to 600 amp., $3.20.

SEATTLE—PORTLAND

Conditions in the electrical business in the Northwest show no particular change. Both jobbing and retail trade is good, being restricted, however, by extremely slow shipments from Eastern factories and depleted stocks. The Portland district intimates that the volume of sales shows decreases and further decreases in prospect. However, this is not true in Seattle, where demand for schedule materials, domestic appliances, small motors, wiring devices and fixtures is steadily on the increase. Prices are trending upward, although no startling changes were noted during the past week. Improved weather conditions are expected to release materials en route, thereby solving to a considerable extent shortage problems which are overwhelming jobbers.

Renewal of steel ship construction in the Northwest is assured by award of contracts for eighteen 10,000-ton tankers.

Portland district reports that there has been little change in business during the past two weeks, although the general impression seems to be that it is gradually falling off. Credit is inclined to be a little bit tighter than formerly, and collections from some sources are reported appreciably harder to make than they were a few weeks ago. Pole-line hardware has advanced 20 per cent, and an advance is also reported in insulators. Both copper and conduit show a very strong upward tendency, although no advance in prices has been announced. There is a great deal of hesitancy shown about building more homes, although the shortage is pronounced. Large quantities of merchandise are already on order which, it is felt, will not arrive before late next fall. Retail business continues just as good as it has for some time past, featured by sales of domestic appliances. Sales of fractional-horsepower motors are being maintained, although stocks are depleted and shipments hard to obtain.

Lamps.—An exception to the general shortage of merchandise in the Northwest is the lamp supply. In the smaller wattages stocks are exceptionally good, but the demand is showing a constant dropping off. Stocks in the 100-watt size are in good shape in spite of steady demand from industrial sources. Sizes ranging from 100 watts to 300 watts are in fair demand and stocks are ample.

Batteries.—Considerable stimulus is noted in the buying of the past two weeks and stocks are very low. Shipments are long. Prices are tending upward, although no unusual change has been noted.

Glassware.—Demand is showing a gradual increase in face of a shortage in stocks and extremely indefinite deliveries.

SAN FRANCISCO

Freight embargoes caused by the switchmen's strike have sorely hurt Western shippers, who are not only hampered by tied-up Western shipments but are harassed by a local strike of their own. The Great Western Power Company, as well as the Pacific Gas & Electric Company, has appealed to the California Railroad Commission for permission to raise its power rates, claiming that the increased cost of fuel oil, among other items, has decreased its earnings. Heavy and widespread rains over the state have removed finally the fear of any serious drought.

Steel shortages have tied up some big buildings under construction in San Francisco and Los Angeles. The range campaign of the Great Western Power Company has been temporarily slowed down to await the arrival of Eastern stock. Recent range increases have put prices to a point that will require considerable explaining to consumers, justified though the increase may be by raw-material and labor conditions. A standard household range of good quality now retails for more than $200. Water heaters have increased in price, but as they are practically unobtainable in the size generally sold, the price influence on business cannot be so apparent.

Porcelain Material.—Household porcelain material is running true to form, with good stocks, which, however, will be heavily hit should the freight embargo continue. No. 5½ knobs sell for $15.90 per 1,000 in barrel lots, $\frac{5}{16}$-in. x 3-in. tubes for $10.53 per 1,000 in barrel lots.

Telephones.—The boom in apartment-house building has re-created the keen demand of several seasons ago for interphones or house telephones. Local stocks are only fair and shipments are slow. Save for an occasional extension, there is little call for rural telephones, and such accessories as bare galvanized iron wire have correspondingly suffered.

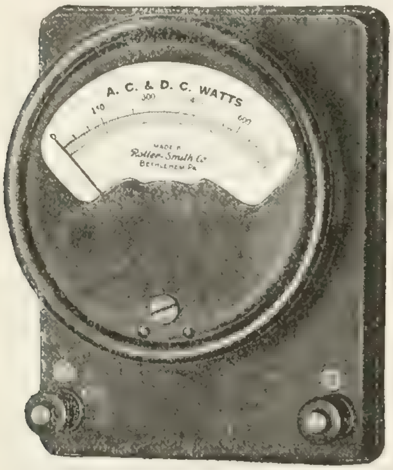
Switches.—Flush push switches are in tremendous demand; shipments for several weeks to come are sold.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Pocket Portable Alternating-Current Meters

The Roller-Smith Company, 233 Broadway, New York City, has just put on the market type HA pocket portable ammeters, voltmeters and wattmeters for alternating current. This type of meter was designed, the manufacturers say, to meet the demands for small, inexpensive alternating-current portables similar in appearance to the type HD direct-current meters and comparable with them in both quality and price. This type HA comprises ammeters up to and including 50 amp., voltmeters as high as 300 volts and direct-current and single-phase wattmeters with maximum capacities of 30 amp., 300 volts. The ammeters and voltmeters are of the electromagnet type and the wattmeters of the electro-dynamometer type with efficient air damping. The construction is durable and rugged and the entire mechanism is mounted on one base. The manufacturers state that practically all these instruments are so designed that they may be used on direct current also with good accuracy, this being particularly true of the ammeters and wattmeters.



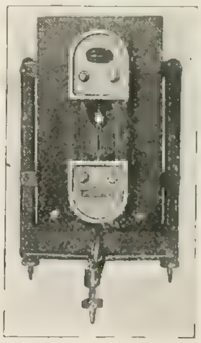
THIS METER CAN BE CARRIED IN THE POCKET

Sterilizer Heating Element

The Halverson Company, 180 North Dearborn Street, Chicago, has recently put on the market a new type of heating element for its medical and dental sterilizer. The sterilizer is equipped with a three-heat indicating switch, and the automatic safety fuse screw shuts off the current when the water is exhausted. The manufacturer asserts that it is a wet sterilizer, a dry sterilizer, a tumbler and atomizer warmer all in one. The dry-air unit has a temperature of 290 deg. to 300 deg. Fahr., has a separate heating element which is ready for service by turning an individual indicating switch, and can be used at the same time as the wet or boiling water sterilizer. It is made in 10-in. and 12-in. sizes.

Direct-Current Galvanometer

Direct-current galvanometer No. 2,000, manufactured by the Pyrolectric Instrument Company, 636-640 East State Street, Trenton, N. J., is a new instrument designed upon thoroughly practical lines, making it a general purpose galvanometer of widest usefulness. Among other desirable features it embodies the following, says the manufacturer: Sensitivity is high, ½ megohm for each ohm of coil resistance; period is only two seconds when critically damped; deflections are proportional; working system is always fully in view; a simple and new method of zero adjustment is provided; it has an unusually sturdy upper suspension practically non-breakable) and a long lower suspension that will not tangle; large coil clearance permits great ease in adjusting for working conditions; construction throughout has been such as to produce a very substantial instrument of simple form but excellent operating characteristics. It may be mounted on wall or on tripod.



IMPLE GALVANOMETER WITH EXCELLENT OPERATING CHARACTERISTICS

When used in connection with lamp and scale reflection indicator it is said to furnish a most desirable instrument for general electrical laboratory use and for research work. The coil resistance is only 16 ohms; total resistance between binding posts, 28 ohms; length of upper suspension, 4 cm.; upper suspension made of 1½-mil phosphorous bronze strip; length of lower spiral suspension when straightened out, 10 cm.; lower suspension made of 1-mil copper strip; volts at galvanometer terminals required to produce a deflection of 1 mm. on a scale 1 m. from mirror, 0.27×10^{-6} volt; current through galvanometer to give 1 mm. deflection on a scale 1 m. from galvanometer mirror, 0.094×10^{-6} ampere; resistance with which galvanometer must be shunted to produce critical damping, 6 ohms; figure of merit (based on formula 11, page 356 of "Methods of Measuring Electrical Resistance" by E. F. Northrup) is 2.4 d'arsons.

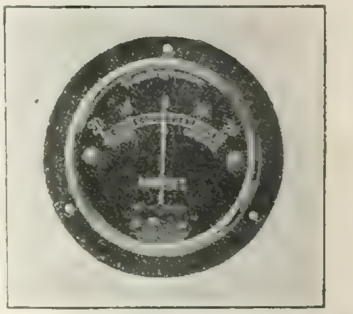
White-Glass Bathroom Fixture

The marble-like appearance and simplicity of design of the "Aglite" lighting units manufactured by the Luminous Unit Company, St. Louis, Mo., make them especially suited for use in bathroom, hospitals, etc., in the opinion of the maker. All visible parts are made of white glass, thus eliminating the annoyance of tarnishing or discoloring. The type illustrated here is equipped, besides, with a pilot-light lamp.

Small Direct-Current Ammeters

Although designed for use on automobiles, the type BI ammeter, recently placed upon the market by the Westinghouse Electric & Manufacturing Company, is applicable for use on motor boats, yachts, small direct-current switchboards and for charging batteries. This instrument utilizes the portable vane construction, comprising a moving soft-iron vane polarized by a stationary permanent magnet and deflected over its scale by the action of a stationary current coil. No springs or moving coil are used, thus resulting in great simplicity and ruggedness. The indications are made dead-beat by means of an efficient damper.

As the coil of this meter is below the movement, the electromagnetic field from the coil does not pass through the magnet sufficiently to affect its strength at short-circuit current values which can occur. The meter is mounted in an open-faced circular pressed-metal case arranged for flush mounting. The terminal studs are for rear connection. The instrument is furnished in sizes of 0 to 15, 0 to 20 and 0 to 30 amperes.



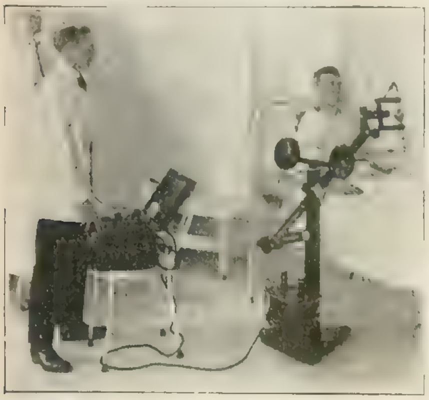
POLARIZED VANE CONSTRUCTION USED IN THIS METER

A Portable X-Ray Outfit

Dr. W. D. Coolidge and his associates in the Research Laboratory of the General Electric Company at Schenectady have recently perfected a portable X-ray. It is now possible, the manufacturers say, for any doctor to transport the entire new outfit, packed in four hand-borne units, to any home wired for electricity, or to the hospital bedside, and produce ratiographic results as good as those secured in a completely equipped X-ray laboratory. The process of operating the machine is simplified for him by control systems enabling him to use the exact ray intensity he needs and a time switch that accurately controls the length of each exposure.

The portable Coolidge set has been greatly compacted and simplified over the army type familiar to medical corps men. The bulb itself has been reduced in size to 2½ in. By making the tube of thick lead glass, thus replacing a heavy lead shield, the total weight of the tube and its protection was reduced 5 lb. with a consequent lightening of the frame which supports it. This lead glass, made from a formula developed in the Schenectady laboratory, contains about 57 per cent metallic lead and in its resistance to X-rays is equal in protective power to lead $\frac{1}{16}$-in. thick.

The new tube rectifies its own current, thus doing away with a heavy, bulky rectifier and adding to the efficiency of the set as a whole. The transformer has been reduced in size by the use of smaller windings and a case shaped to fit the coils. A minimum of weight and bulk is secured in all other parts of the outfit by a careful choice of materials and a study of sizes and shapes. Thus, when the outfit is ready to be taken out for use, the doctor carries an ordinary-size suitcase containing the tube, reels, cables, base of the stand and other small parts, the transformer borne by a special carrying cover, the tube stand in a cloth container resembling a golf bag and a small instrument and control box. The whole load is such as can be put easily into the tonneau of a small automobile and as easily carried in or out of a house. The transformer, which is the heaviest unit of the four, weighs 43 lb. with its case. It is oil-insulated and delivers to the tube 10 milliamperes at 60,000 volts.

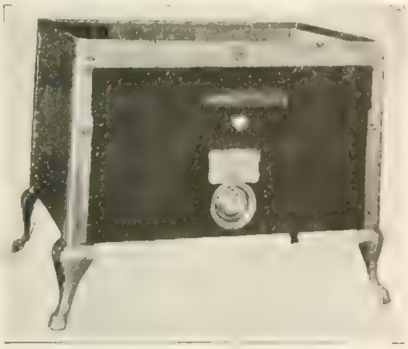


SIMPLE AND COMPACT PORTABLE X-RAY OUTFIT

One of the obstacles to radiography in homes is the variation in circuits between city and city or even between different parts of the same city. This is overcome by the control system of the portable outfit, by means of which it is possible always to deliver the same definite voltage to the transformer primary.

Utility Electric Heating and Warming Unit

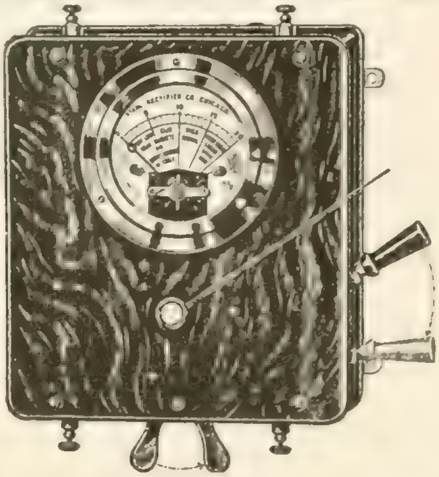
The Duparquet, Huot & Moneuse Company, 108 West Twenty-second Street, New York City, has placed on the market a new utility unit. It is essentially a toaster, with a capacity of twenty slices at a time, toasting on both sides at once. The top may be used as a griddle or fry plate. The unit is particularly adapted, the manufacturers say, to short-order business or hotels, lunchrooms, cafeterias, etc. It is also made with a warming compartment in place of the fry top. This compartment is heated by water, which is turn is heated by the upper heating element in the toasting chamber; consequently the heat applied in the warming chamber does not conduce to drying out the toast which may be stored there for reserve.



WARMING AND HEATING UNIT USEFUL FOR SEVERAL PURPOSES

Magneto Fault Finder

The Stahl Rectifier Company, 1,401 to 1,405 West Jackson Boulevard, Chicago has placed on the market a new type of instrument which locates and corrects faults in magnetos. The "Magfixer" is intended to take care of any troubles arising in the magneto of the Ford but will not take care of troubles arising in the wiring or in the ignition coils. It will, says the manufacturer, successfully recharge the magnets of the Ford magneto, regardless of the extent to which they have been demagnetized. The only condition under which it will not do this is where some of the magneto coils are broken down and grounded completely, owing to their insulation having burned off. In addition, the "Magfixer" will remove any shorts in the magneto due to pieces of wire, cotter pins, nails, etc., making contact between the coil connections and the case. It is also possible to detect any end play in the crankshaft of the Ford engine and to determine whether the magnets in the magneto have been installed in their proper order.



THIS INSTRUMENT LOCATES AND CORRECTS FAULTS IN MAGNETOS

Notes on Recent Appliances

Suspension Hanger

A new "Red Spot" suspension for hanging the Ivanhoe "Trojan" commercial lighting unit has been designed by the F. W. Wakefield Brass Company, Vermilion, Ohio.

Air Compressor

The United States Air Compressor Company, Cleveland, Ohio, has developed an electric air-compressor for garage use.

Resistance Unit

The Wirt Company, Germantown, Pa., has developed "Di-el-ite" resistance unit No. 42-B for heavy duty.

Lighting Unit

A lighting unit designed to eliminate the casting of dark shadows on the ceiling has been brought out by the Panama Lamp & Commercial Company, San Francisco, Cal.

Table Stoves

Four models of electric table stoves have been developed by the Bestov Manufacturing Company, Seattle, Wash.

Bake Ovens

The Duparquet, Huot & Moneuse Company, New York City, has developed electric bake ovens of the air-circulation type.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE BENJAMIN ELECTRICAL MANUFACTURING COMPANY has moved its San Francisco office from 590 Howard Street to 580 Howard Street, occupying the entire four-story building. This change to new and more spacious quarters has been made to provide room for the greatly increased stock now carried, which is needed to meet the demand of contractors and dealers who are being rushed by the great amount of building now going on all over the Pacific Coast.

THE WICO ELECTRIC COMPANY, formerly the Witherbee Igniter Company, of Springfield, Mass., has purchased seven acres of land in West Springfield. A new plant will be erected, the initial installation costing about $150,000. With the completion of the new plant the number of employees will be increased from 300 to 1,500. The company manufactures igniters and automobile storage batteries.

THE M. S. WRIGHT COMPANY, Worcester, Mass., manufacturer of "Sweeper-Vac" vacuum cleaners, has purchased the plant of the Mills Woven Cartridge Belt Company, 164 Fremont Street, Worcester. The productive floor space of the Wright company will be more than doubled and the force of employees increased from 650 to 1,300. The Cartridge company will lease for two years a section of the weave shed in order to care for its peace-time business.

D. GLEISEN, manager of the industrial bearing division of the Hyatt Roller Bearing Company, New York City, announces that its offices have been moved to a new building at 100 West Forty-first Street, where much larger quarters have been secured for the advertising, sales and engineering departments of the division

L. A. S. WOOD, prominent in illuminating engineering circles both in this country and in Europe, has been appointed manager of the illuminating section of the supply department of the Westinghouse Electric & Manufacturing Company, with headquarters at South Bend, Ind. Mr. Wood was born in London, and received his education at the University of London, afterward studying electrical engineering under Prof. Sylvanus P. Thompson at Finsbury Technical College. He was connected with the Edison and Swan United Electric Light Company in the early days of the incandescent lamp and later devoted many years to the development of the arc lamp. He took a leading part in laying out street-lighting systems in the larger European cities and also the lighting of many public buildings for the British government. He came to the United States in 1911 to introduce the flame carbon lamp and was shortly afterward appointed as arc-lamp expert of the Westinghouse Electric & Manufacturing Company, with headquarters at East Pittsburgh, Pa. Soon after the introduction of the "Mazda C" lamp he became associated with the George Cutter Company of South Bend, Ind., as illuminating engineer, and during the past nine years has traveled extensively, taking an active interest in street-lighting improvements in all parts of the country.

WALTER S. HOYT, who has been for two years assistant to C. A. Greenidge, chief engineer of the J. G. White Management Corporation, New York City, has become sales engineer of the Graphite Metallizing Corporation, Yonkers, N. Y., which manufactures oilless bearings and impregnates carbons for brushes.

THE INNOVATION ELECTRIC COMPANY, New York City, has transferred its vacuum cleaner business to the Electric Vacuum Cleaner Company, Cleveland, Ohio. Frank N. Davison, sales manager of the Innovation company, has become sales manager of the Appliance Distributing Corporation, 673 Eighth Avenue, New York City, distributer of electric appliances.

THE ALL-STEEL-EQUIP COMPANY, Aurora, Ill., manufacturer of electrical boxes and specialties, etc., has issued a new price sheet, No. E-25, on its outlet box covers. The principal point of interest in this sheet is that it shows the addition to its line of the several "approved" covers, and also the addition of covers to take the P. & S. sign receptacle. Previous covers were unapproved, while now all covers are made in the approved style.

GEORGE BAILY, formerly manager of the supply division of the Cincinnati office of the Westinghouse Electric & Manufacturing Company, has been appointed industrial assistant to the manager of the supply department of that company at East Pittsburgh, Pa. Born and educated in Baltimore, Md., Mr. Baily served on an engineering corps in Baltimore and on the United States Engineering Corps in 1898. Later he spent considerable time with the United States Geological Survey. After being graduated from Lehigh University in 1904 as a civil engineer, he became associated with the Dravo Construction Company of Pittsburgh, where he remained until 1910, at which time he went into business for himself in Cincinnati as sales agent and contracting engineer. He remained in this occupation until 1913, when he joined the Westinghouse organization.

GEORGE BAILY

THE ELLIOTT COMPANY, Pittsburgh, Pa., manufacturer of power accessories, is now placing upon the market an apparatus which removes substantially all of the air and dissolves gases from boiler-feed water.

THE AMERICAN STEAM CONVEYOR CORPORATION, Chicago, has developed an air-tight ash-pit door which has a number of features that make it attractive to the power-plant engineer.

THE VOLTA BATTERY COMPANY, Indianapolis, Ind., has increased its capital stock from $10,000 to $100,000.

THE MITCHELL-RAND MANUFACTURING COMPANY, 18 Vesey Street, New York, announces that it has become the agent and representative of the Sterling Varnish Company and that it will sell its products at factory prices, making prompt deliveries either from a complete New York stock or from the factory direct.

E. B. BADGER & SONS COMPANY, 63 Pitts Street, Boston, Mass., announces that it has acquired the American Spray Company, including its engineering personnel. The American Spray Company manufactures spray ponds and air washers designed especially for cleaning the air used to cool generators.

THE POLLY MANUFACTURING COMPANY, 431 Chestnut St., Milwaukee, Wis., has been incorporated with a capital stock of $25,000 to manufacture and job popular-priced lighting devices. William Polacheck is president of the company.

THE AMERICAN EVER READY WORKS of the National Carbon Company at Long Island City, N. Y., announce the appointment of H. S. Schott as Eastern sales manager, succeeding J. H. Somers, resigned. Mr. Schott first became connected with the company in 1913 as a clerk, and after a term as salesman he was transferred to the Canadian Ever Ready organization, where he was promoted to be assistant sales manager.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, announces that on April 24 the New York office of the company, which has been for twenty-two years at 100 Broadway, will be removed to the National Association Building, 23-31 West Forty-third St.

EDWARD J. JEEP, for many years city sales manager of the Commercial Electrical Supply Company, St. Louis, Mo., has resigned and accepted a position with the Fairbanks Company, Seventh and Market Streets, St. Louis, as manager of its electrical department.

VANCE McCARTY, general sales manager of Edw. R. Ladew Company, Inc., manufacturer of leather belting, has been made vice-president of the company. Mr. McCarty's connections with the house of Ladew covers the past twenty years and embraces every phase of the leather-belting business, including manufacture, sale, branch management and general sales direction. He will continue in direct control of Ladew sales policies and has retained as assistant general sales manager Russell B. Reid, another Ladew belting expert with twenty years of leather-belting experience.

THE LUTHY STORAGE BATTERY COMPANY, 215 Emmet Street, Newark, N. J., is arranging for the removal of its plant to a new building in Frelinghuysen Avenue at an early date. A portion of the company's present works, including the boiler plant, was recently destroyed by fire.

THE ENGINEERING & APPRAISAL COMPANY, INC., 103 Park Avenue, New York, announces the addition to its engineering staff of Ralph G. Macy, who has been elected vice-president of the company. Mr. Macy has accordingly resigned as chief engineer of the construction department of the Walter Kidde Company. Mr. Macy has had a long experience in engineering and industrial work, and prior to the war was in charge of the operation of five plants making liquid oxygen and nitrogen. He was commissioned in the United States Army and ordered to Fort Worth, Tex., to construct the first helium-gas plant of the war establishment. Upon the completion of this plant he went to Aberdeen as ordnance-proof officer and was then sent to Sandy Hook as armament officer in the coast defence.

THE GENERAL ELECTRIC COMPANY'S WINDSOR PLANT.—The new addition to the Windsor works of the General Electric Company will be completed about the first of June and will be ready for occupancy about July 1. The building will be 200 ft. x 70 ft. and will contain two floors and basement, providing 40,000 sq.ft. of floor space. Small electric motors of various horsepowers for direct current are manufactured at the Windsor works.

THE GENERAL ELECTRIC COMPANY, owing to the unprecedented demand for electric motors to drive household equipment, machine tools, etc., has decided to use its Pittsfield (Mass.) works to aid in producing small motors, and is advertising for female workers with this object in view.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY announces that it has opened an office and warehouse at Jacksonville, Fla.

THE SQUARE D MANUFACTURING COMPANY, Detroit, Mich., has purchased the property of the Peru (Ind.) Electric Manufacturing Company, manufacturer of standard and special porcelain wiring devices.

THE MOHRLITE COMPANY OF AMERICA, Nashville, Tenn., recently incorporated, is planning to establish a $300,000 plant in Nashville for the manufacture of the Mohrlite reflector. W M. Dixon, who has charge of the plant of the Mohrlite Company of Urbana, Ohio, will be in charge of the Nashville plant. Eventually the plant at Urbana will be removed to Nashville.

Supply Jobbers' Notes

THE JULIUS ANDRAE & SONS COMPANY, Milwaukee, Wis., celebrated its sixtieth anniversary with a banquet held Jan. 8. The event was attended by the executives of the Andrae organization, guests and a large number of co-workers. The evening was given over to a discussion of the potentialities of the electrical industry, the speakers paying a high tribute to the company in recounting its achievements and success. H. P. Andrae, president of the company, gave an outline of the different steps in the progress of the organization, commended the Andrae men on their efforts in making such remarkable showing last year and spoke enthusiastically on the outlook for even a greater year in 1920.

A. M. LITTLE, president of the Mohawk Electrical Supply Company, Syracuse, N. Y., who was elected chairman of the Atlantic Division of the Electrical Supply Jobbers' Association on Feb. 9, has been in the electrical business since 1889, starting with the Central Electric Company as office boy. For the last ten years he has been president of the Mohawk company, and for seven years prior to that time he was salesman in the eastern part of the country for Pass & Seymour, Inc., Solvay, N. Y. As chairman of the publicity committee of the Electrical Supply Jobbers' Association, Mr. Little initiated the National Trade Journal Publicity Campaign of that association. He takes the stand that the greater publicity the supply jobber can secure, individually, as regards the personnel and the company itself and for the business as a whole, the more that end of the industry is advanced and brought to the attention of every one.

A. M. LITTLE

A. W. LINDGREN, for many years manager of the Duluth branch of the Northern Electric Company, having headquarters at Minneapolis, Minn., has announced the purchase by himself and associates of the Duluth branch of the Northern Electric Company. The name of the new corporation which is now being organized will be the Duluth Electrical Supplies Company. There will be no change in management, organization, location or policy. It is the intention to operate for the present in the same territory in which the Duluth branch of the Northern Electric Company has operated, although it is quite possible that the territory of the new company may be extended in the near future. The new company expects to maintain relations with the same manufacturers which the old company represented. The Duluth Electrical Supplies Company will be entirely independent, however, of all connection with any other jobber.

FRANK R. VENABLE has been appointed purchasing agent for the Montana Electric Company and the Washington Electric Supply Company, Butte, Mont. In 1907 Mr. Venable became purchasing agent for the Cœur d'Alene Hardware & Foundry Company, Wallace, Idaho, which handles Westinghouse equipment, remaining with that company until last December.

THE CARTER ELECTRIC COMPANY, Atlanta, Ga., held a meeting of its sales agents in Atlanta on April 6 and 7, approximately 125 dealers being present. In addition to the business meeting, when talks were made by well-known manufacturers' representatives, a dinner and theater party were tendered to the visitors by the company on the night of April 6.

Foreign Trade Notes

MUCH ELECTRICITY USED FOR DOMESTIC HEATING IN URUGUAY.—On account of the exorbitant prices for fuel, the use of electricity for cooking and heating purposes in Uruguay has become necessary. The Public Service Electric Company, owned by the national government, has maintained the low prices that were in force before the war, making it possible for the people of the country to secure the necessary heat for domestic purposes at a reasonable cost.

HIGH DEMAND FOR ELECTRICAL FIXTURES IN ONTARIO.—Because of the utilization of the water power in the Province of Ontario by the Hydro-Electric Power Commission, there is an increasing demand in that province for electrical fixtures and labor-saving equipment. American-made products command the market, and from large cities and rural communities served by the lines of the commission there is a call for more electricity to light houses and operate washing machines, vacuum cleaners and other modern appliances. While at the present time the demand is limited to this section of the Dominion, it is probable that similar developments will take place in other parts of the country at an early date, and a still greater demand may be expected.

Foreign Trade Opportunities

Following are listed opportunites to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A manager of a sales company in Spain (No. 32,470) desires to secure an agency and also purchase one or two electric autotrucks, equipped complete, capacities from ½ ton to 7 tons.

A commercial representative in Asia Minor (No. 32,471) desires to establish an American exhibit in that country of electrical machinery.

A firm of engineers and contractors in Siberia (No. 32,473) desires to get in touch with manufacturers and exporters in order to secure agencies in Russia and Siberia for electrical machinery.

An inquirer in Mexico (No. 32,490) who is about to establish a new bakery desires to purchase baking ovens that can be heated by electricity.

A firm of commercial representatives in Spain (No. 32,530) having an exclusive publicity and sales service department desires to receive from American manufacturers the exclusive agencies for the sale of supplies for street-railway cars.

Trade Publications

PUBLIC UTILITIES.—The Charleston Industrial Corporation, operating in the city of Nitro, W. Va., has published a booklet on the "Public Utilities of the City of Nitro." It gives a technical description of the various public utilities of Nitro which have been and are now in constant operation.

INSULATING VARNISHES AND COMPOUNDS.—The Mitchell-Rand Manufacturing Company, 18 Vesey Street, New York, has issued a booklet giving prices and data of the Sterling insulating varnishes and compounds.

BRASS MAKING.—"Seven Centuries of Brass Making" is the title of a seventy-eight-page booklet issued by the Bridgeport Brass Company, Bridgeport, Conn. It contains a brief history of the ancient art of brass making and its early (and even recent) method of production contrasted with the electric furnace process. Illustrations are given showing anicent and modern methods of manufacturing brass and its products. Considerable space is given to the use of electric machinery and equipment in connection with the brass industry.

MACHINE-TOOL CONTROL.—Bulletin No. 100, issued by the Monitor Controller Company, Baltimore, Md., gives descriptions and illustrations of its Monitor automatic starter and other devices used in connection with the Monitor system of machine-tool control.

INDEXES.—The General Electric Company, Schenectady, N. Y., has issued indexes to its descriptive bulletins and sheets and supply-part bulletins, both dated January, 1920.

New Incorporations

THE CASTLEBERRY (ALA.) UTILITIES COMPANY has been incorporated with a capital stock of $20,000 by G. G. Kramp, and Robert A. Baird to construct an electric plant and ice factory.

THE COACO (FLA.) ICE & LIGHT COMPANY has been chartered with a capital stock of $50,000. The officers are: Fred Bryan, president, and S. F. Travis, secretary and treasurer.

THE NORTHERN NECK RAILWAY & POWER COMPANY of Fredericksburg, Va., has been incorporated with a capital stock of $5,000,000. The officers are: Willis H. Fowle, president; G. D. Happer, vice-president, and M. Glennon, secretary.

THE H. & H. STORAGE BATTERY COMPANY of Pawtucket, R. I., has been incorporated by Edward Hackney, Edwin Hackney and E. Butler Moulton. The company is capitalized at $10,000 and proposes to manufacture motors and electrical equipment of all kinds.

THE AUTO ELECTRIC SERVICE COMPANY of Montgomery, Ala., has been chartered with a capital stock of $20,000 by Henry C. Fite and others. The company proposes to conduct a general automobile and accessories business.

THE HUNTINGTON (IND.) ELECTRIC COMPANY has been incorporated by Harry C. Mitten, Harry E. Helm and Edward Correll The company is capitalized at $15,000 and proposes to manufacture electric lighting fixtures.

THE MILLER ELECTRIC COMPANY of Terre Haute, Ind., has been chartered with a capital stock of $10,000 by Frank B. Miller, Frank E. Wissel, E. C. Kadel and Albert F. Fischer.

THE PORTLAND (IND.) ELECTRIC COMPANY has been incorporated with a capital stock of $35,000 by O. F. Bickel, A E. Chew and J. A. Morrison to deal in electrical supplies.

THE KRUSE ELECTRIC COMPANY of Fort Wayne, Ind., has been incorporated with a capital stock of $75,000 by F. G Kruse, C. W. Tracht and C. P. Squires. The company proposes to deal in electrical equipment and supplies.

THE LAFAYETTE (IND.) SERVICE COMPANY has been incorporated by F. H. Cutshall, J. M. Barrett, Jr., and Henry Williams Jr. The company is capitalized at $10,000 and proposes to supply electricity for lamps and motors.

THE INDIANA POWER & LIGHT COMPANY of Butler, Ind., has been incorporated by L. Hooper, C. A. Olson, Don J. Blair, A. W. Wright and C. A. Engel. The company is capitalized at $100,000 and proposes to supply electricity for lamps, heaters and motors.

THE LEIGHTON (IOWA) ELECTRIC COMPANY has been incorporated with a capital stock of $10,000 to supply electricity for lamps and motors at Leighton. John R. Brower of Leighton is one of the incorporators.

THE ELECTRIC SPECIALTY COMPANY of Indianapolis, Ind., has been chartered with a capital stock of $30,000 by Isaac P. Geese, K. G. Whitney and F. M. Dickerman. The company proposes to deal in electrical devices and supplies.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

AUGUSTA, ME The Central Maine Power Company has applied to the Public Utilities Commission for authority to purchase plants and system of the Knox County Electric Company, the Androscoggin Electric Company and the Oxford Electric Company Harvey D Eaton of Waterville is president.

WOODSTOCK, N. H.—The McNorton Falls water power, owned by the Publishers' Paper Company, it is reported, has been sold to parties who will soon develop it.

PITTSFIELD, MASS.—The Pittsfield Electric Company has applied to the Department of Public Utilities for permission to issue $125,000 in capital stock for extensions and improvements to its plant.

SOUTHWICK, MASS.—The question of issuing $10,000 in bonds to establish an electric light plant within the town limits is under consideration.

SPRINGFIELD, MASS.—The Wico Electric Company is contemplating the erection of a new plant in West Springfield. The first of the four units is to cost about $150,000.

WORCESTER, MASS.—The Worcester Electric Light Company has petitioned the City Council for permission to make additions to its street-lighting system.

NEW LONDON, CONN.—The United States Electric Company, 108 State Street, it is reported, is planning to erect a new power plant.

STAMFORD, CONN.—The South New England Telephone Company is planning to construct a telephone exchange on Main Street, to cost $100,000. L. W. Robinson, 42 Church Street, New Haven, is architect.

Middle Atlantic States

BATAVIA, N. Y.—The Genesee Light & Power Company has petitioned the Public Service Commission for permission to extend its transmission lines to Darien.

BUFFALO, N. Y.—The Olympia Amusement Company, 130 Broadway, is planning to construct a theater and office building, to cost $750,000.

DUNKIRK, N. Y.—Plans are being prepared by the Atlas Crucible Steel Company for extensions to its local plant, to cost about $1,800,000. Among the new buildings to be erected are an electric melting building, inspecting and annealing buildings, extensions to four mills, and a new transformer station, 40 ft. x 140 ft. The new equipment will include a 6-ton Heroult furnace, heating and annealing furnaces and other electrical equipment

FILLMORE, N. Y.—The Fillmore Electric Company has taken over the plant of the Genesee Valley Power Company and will soon build a hydro-electric plant in Fillmore to develop 600 hp., and also extend its transmission line to Belmont, Belfast and other adjoining towns.

HAMILTON, N. Y.—The White Company, Norwich, N. Y., has purchased the municipal electric light plant for $70,000. Extensive improvements, including the installation of new generating equipment, is planned by the new owners.

MEDINA, N. Y.—The Western New York Utilities Company has applied to the Public Service Commission for permission to issue $208,000 in bonds and $94,300 in capital stock, for new construction work, the cost of which is estimated at $260,000. The company is developing a hydro-electric plant at Waterport.

NEW BERLIN, N. Y.—Application has been made to the Public Service Commission by the Berholme Power Company for permission to issue $25,000 in bonds. The company is planning a hydro-electric development, including power house and generating unit, to cost about $13,000, and the erection of transmission lines to cost $6,775.

NEW YORK, N. Y.—The New York Edison Company is planning to build a substation on Cedar Street, to cost about $75,000. William Whitehill, 12 Elm Street, is engineer.

NEW YORK, N. Y.—Bids will be received by the superintendent of school buildings of the Board of Education, Room 2800, Municipal Building, New York, until April 27, for installing electric light equipment in Public Schools 9 and 121, borough of Manhattan, and in Public Schools 51, 57, 67 and 70, borough of Brooklyn. Blank forms, plans and specifications may be obtained or seen at temporary estimating room, 6th floor, Brooklyn branch of the Board of Education, 131 Livingston Street, Brooklyn, N. Y. C. B. J. Snyder is superintendent of school buildings.

OLEAN, N. Y.—The Olean Electric Company is planning to extend its transmission lines to the towns of Bolivar, Wirt, Genesee and adoining villages to furnish electricity for lamps and motion.

ROCHESTER, N. Y.—Authority has been granted to the Rochester Gas & Electric Corporation by the Public Service Commission to issue bonds for $500,000 for contemplated additions.

ROME, N. Y.—Plans have been prepared by C. W. Knight, engineer, Rome, for the construction of a 350-hp. hydro-electric plant at Ridge Mills, on the Mohawk River, to cost about $65,000.

ROSSIE, N. Y.—Plans are under consideration by George N. Wilson for a 500-hp. hydro-electric development on the Indian River.

SONYEA, N. Y.—Bids will be received by Percy L. Lang, president of the board of managers, Craig Colony for Epileptics, Sonyea, N. Y., until May 11, for insulation of refrigerator rooms, dining room and kitchen buildings. Plans and specifications may be obtained at the Department of Architecture, Capitol, Albany, N. Y.

UTICA, N. Y.—Bids will be received by S. W. Haven, chairman of the Board of Supervisors of Oneida County, until May 12, for 1,000 and 2,000 25-watt and 40-watt lamps, respectively.

NEWARK, N. J.—Contract has been awarded to the Fleischman Construction Company, New York City, for the erection of a theater by Loew's Enterprises, to cost $400,000. T. W. Lamb, 644 Eighth Avenue, New York, N. Y., is architect.

ROCKAWAY, N. J.—The Borough Council is planning to have improvements made to the street-lighting system. The service is supplied by the New Jersey Power & Light Company of Dover.

TRENTON, N. J.—The Nearpara Rubber Company, 79 Prince Street, has awarded contract to the Bethlehem Construction Company, Bethlehem, Pa., for the construction of a new rubber plant and power house, to cost $150,000.

TRENTON, N. J.—The Pocono Rubber Company has had plans prepared for the construction of a power house in connection with the establishment of its proposed local plant. The company recently took over the property of the Howard Demountable Rim Company, 1851 East State Street.

TRENTON, N. J.—The Tri-County Electric Company has increased its capital stock from $25,000 to $125,000.

PHILADELPHIA, PA.—Contract has been awarded by H. C. Aberle, A and Clearfield Streets, for the construction of a five-story hosiery factory, 80 ft. x 200 ft., and a power house, 60 ft. x 60 ft., to William Steele & Sons, Sixteenth and Arch Streets.

PHILADELPHIA, PA.—The Standard Electric Welding Company, 1939 East Sergeant Street, is planning the installation of new electric welding apparatus.

CLAYMONT, DEL.—The Town Council is considering the installation of a new electric street-lighting system on the Philadelphia turnpike. The Claymont Community League is interested in the project.

BALTIMORE, MD.—Plans have been prepared by the Globe Shipbuilding & Dry Dock Company for the erection of a power plant, 35 ft. x 110 ft., on the south side of the Patapsco River, between Brooklyn and Fairfield Avenues.

CECILTON, MD.—Plans are under consideration by the Town Council for reconstruction of the municipal electric light plant, recently destroyed by fire.

CUMBERLAND, MD. — The Crystal Laundry Company is having plans prepared for the construction of a laundry, garage and power house, to cost about $200,000. T. W. Biddle, care of Springfield Tire Company, Cumberland, is architcet.

LAUREL, MD.—A bond issue has been approved by the State Legislature for construction of an addition to the municipal electric light plant.

KANAWHA, W. VA.—The Libby-Ownes Company is contemplating building an addition to the power plant at its glass works, to cost about $50,000.

MARTINSBURG, W. VA.—A new electric power plant, to cost about $100,000, will be erected at the local mills of the Interwoven Mills, Inc. The main offices of the company are at 390 George Street, New Brunswick, N. J.

SOUTH CHARLESTON, W. VA.—Bids will soon be asked by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for electrical equipment for main substation, furnishing and installing switchboards, oil switches and barriers, buses and connections, storage battery motor generator set, transformers, disconnecting motor starters, and other electrical equipment furnished by the government; and making the necessary connections for a complete indoor substation ready for operation at the naval ordnance plant. Drawings and specifications may be obtained on application at the Bureau of Yards and Docks or inspector of ordnance in charge of plant named. Cost is estimated at $195,000.

FREDERICKSBURG, VA.—Contract has been awarded to the Fredericksburg Power Equipment Company by the Rappahannock Electric Light & Power Company for the construction of an addition to its plant, to cost about $35,000. E. C. L. Ficklen is secretary.

SCOTTSVILLE, VA. — The Scottsville Power Company, recently organized, is planning to build a hydro-electric plant on James River with transmission system connecting Richmond, Lynchburg, Roanoke, Charlottesville, Staunton and Orange. John L. Pitts of Scottsville is president.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 5, for furnishing and installing electric lighting fixtures in the United States post offices at Hone Grove, Texas; Mount Pleasant, Mich.; Rhinelander, Wis.; Sunbury, Pa., and the United States post office and courthouse at Woodward, Okla.

North Central States

BAY CITY, MICH.—The American Worsted Yarn Company is planning the construction of a four-story factory, to cost about $300,000.

KALAMAZOO, MICH.—Contract has been awarded by the Handley-Knight Company to Henry L. Van der Vorst of Kalamazoo for the construction of a three-story automobile factory, 80 ft. x 800 ft. The plant will be equipped for electrical operation.

MUIR, MICH.—The Council has voted to install an electric street-lighting system in the village.

RIVER ROUGE, MICH.—The Ford Motor Company is constructing a 25,000-kw. power plant at River Rouge, to be completed by next winter. The equipment will include two generators having a total capacity of 25,000 kw., four boilers with a total rating of 10,560 hp., and eleven motor-generators with a total rating of 8,050 kw. The company will continue to purchase energy of the Detroit Edison Company.

SAGINAW, MICH.—The Consumers' Power Company of Jackson proposes constructing a power plant at Zilwaukee, on the Saginaw River. The work includes a generating station of 30,000 kw. capacity. The cost is estimated at about $4,893,000

CLEVELAND, OHIO.—The Cleveland Railway Company is having plans prepared for the construction of three substations, to be located at West Seventy-third Street and St. Clair Avenue, East Eightieth Street and St. Clair Avenue and at East 152d Street and St. Clair Avenue. The cost is estimated at $100,000 each. L. P. Crecelius is engineer

INDIANAPOLIS, IND.—The Acme Aluminum & Brass Works, 420 South Harding Street, is contemplating extensions to its works, including a new power plant, to cost about $40,000.

MARION, ILL.—Improvements to the street-lighting system, to cost about $54,000, are under consideration.

MILWAUKEE, WIS.—Bids will be received by the Sewerage Commission, City Hall, until June 3 for construction of sewerage disposal plant. Proposals will be received on four different types of plant, one of which may be selected as follows: Proposal 1, plant R-R—For four 30,000-cu.ft. compressors of the reciprocating type, which may be operated by a reciprocating steam engine or by Diesel oil engines; one 10,000-cu.ft. compressor of the reciprocating type, which may be operated by a reciprocating steam engine or by a Diesel oil engine; five air washers and coolers; three 626-kw. generators, which may be operated by high-pressure steam turbines, Diesel oil engines or by reciprocating steam engines; one switchboard complete with instruments, switches and wiring; one oiling system. Proposal 2, plant H-T-R—Four 30,000-cu.ft. compressors of the horizontal hydro-turbine type, which shall be operated by a vertical reciprocating steam engine; one 10,000-cu.ft. compressor of the horizontal hydro-turbine type, which shall be operated by a vertical reciprocating steam engine; three 625-kw. generators, which may be operated by high-pressure steam turbines or by reciprocating steam engines; one switchboard complete with instruments, switches and wiring, one oiling system. Proposal 3, plant T—Four 30,000-cu.ft. blowers of the horizontal centrifugal type, which shall be operated by horizontal high-pressure steam multistage turbines; one 10,000-cu.ft. blower of the horizontal centrifugal type, which shall be operated by horizontal high-pressure steam multistage turbine; five air washers and coolers; three 625-kw. horizontal high-pressure steam turbines and generators; one switchboard complete with instruments, switches and wiring; one oiling system. Proposal 4, plant D-H-T—Four 30,000-cu.ft. compressors of the horizontal hydro-turbine type, which shall be operated by full Diesel oil engines; one 10,000-cu.ft. compressor of the horizontal hydro-turbine type, which shall be operated by a full Diesel oil engine; three 625-kw. horizontal engine-type generators, which shall be operated by full Diesel oil engines; one switchboard complete with instruments, switches and wiring; one oiling system. Specifications, etc., may be obtained at the office of the Sewerage Commission upon deposit of $5. John H. Fowles is secretary of the commission.

SHEBOYGAN, WIS.—Steps have been taken to organize a co-operative company for the purpose of furnishing electricity for lamps and motors to farmers between Sheboygan Falls, Five Corners, Waldo and Cascade and ultimately to provide for the districts surrounding Hingham, Adell and Random Lake. It is proposed to secure the electricity from the Eastern Wisconsin Electric company at Sheboygan. Henry Timmer of Waldo is interested in the project.

FRAZEE, MINN.—Bonds to the amount of $34,000 have been voted to erect a high-tension transmission line from Frazee to Perham, and also to build a distributing system and a white way in this city. Work will begin at once by the Otter Tail Power Company of Fergus Falls on the proposed line.

MINNEAPOLIS, MINN.—Bids will be received by the Board of Charities and Correction, Court House Building, Minneapolis, until April 28, for a complete refrigeration plant for Lymanhurst Hospital. Charles L. Pillsbury Company are engineers.

NEW ULM, MINN.—Bids will be received by the Mayor and City Council, addressed to William P. Backer, city clerk, until May 13, for the construction of a new municipal light, water, power and heating plant as follows: (1) General contract; (2) reciprocating steam engine, alternating-current generator, exciter, switchboard, moving and resetting present McIntosh-Seymour unit, foundations, wiring between generator, exciter and switchboard; (3) water tube boilers, breeching boiler foundations, and brick settings; (4) stokers, air ducts, fans, regulators, and all necessary auxiliary equipment; (5) repairing present reinforced concrete chimney; (6) pipe, fittings and valves for steam plant and connections to heating mains, feed water heater, feed water meter, boiler-feed pumps and all necessary auxiliary equipment. A. J. Mueller is superintendent of electric light and water departments.

ST. PAUL, MINN.—The City Council has awarded contract to the Electric Construction Company for the installation of an ornamental street-lighting system on University Avenue, to cost about $109,000.

ST. PAUL, MINN.—The City Council is considering replacing the gas street lamps now in use in the district bounded on the north by Summit Avenue, south by St. Clair Street, west by Short Line tracks, and east by Pleasant Avenue, with electric lamps. There are in this district between 500 and 600 lamps.

MOUNT AYR, IOWA.—The municipal electric light plant was recently destroyed by fire, it is reported, causing a loss of $35,000.

ST. LOUIS, MO.—Arrangements have been made by the Union Electric Light & Power Company for an issue of $2,500,000 in bonds, part of the proceeds to be used for extension to its system.

WORTHINGTON, S. D.—Improvements are contemplated to the municipal electric light plant, including the installation of a 20-hp. engine and a 12-kw. generator. W. F. Berens is manager.

MILFORD, KAN.—The construction of an electric light and power plant, waterworks system and ice factory in Milford is under consideration. A good water power is available.

OTTAWA, KAN.—Bonds to the amount of $20,000 have been voted for improvements to the municipal electric light and water plants.

Southern States

ASHEVILLE, N. C.—Work will soon be started by the Carolina-Tennessee Power Company on its proposed hydro-electric plant on the Hiawassee River, to develop 60,000 hp.

KINGSTON, N. C.—Bids will be received by the Mayor and City Council, City Hall, until May 11, for power plant equipment as follows: One 1,500-kw., 1,875 kva. at 80 per cent power factor turbo-generator unit; one surface condenser complete with dry vacuum and hot-well pumps, expansion joint, exhaust valve and atmospheric valve; one 25-kw. turbine-driven exciter unit, one seven-panel switchboard, two 25-kw., 6.6.-amp. series street-lighting transformers, two horizontal motor-driven centrifugal circulating pumps, two 500-hp., 225 lb. horizontal water-tube boilers, one steel breeching, one 1,500-hp. open feed-water heater, two superheaters, two underfeed mechanical stoker units complete, two outside-end-packed, pet-valve-type boiler-feed pumps, two brick settings for boilers, two sets soot cleaners, two sets automatic feed-water regulators, one radial brick chimney. Specifications, etc., may be obtained on application to W. C. Olsen, consulting engineer, Sumter, S. C. John E. Weyher is superintendent of the municipal electric plant.

TAHOKA, TEX.—The City Council has authorized an issue of $15,000 in bonds for the installation of equipment in the municipal electric light plant.

WACO, TEX.—The Central Texas Electric Railway Company has rejected all bids submitted for the construction and equipping of the first section (6½ miles), of its proposed railway from Waco to Temple. New bids, it is understood, will be asked for

ST. JOSEPH, LA.—City officials are considering a bond issue for financing construction of a municipal electric light plant.

MIAMI, OKLA.—Bonds to the amount of $420,000 have been voted for water and light plant, and also for sewers and sewage disposal plant at Miami.

TONKAWA, OKLA.—Preparations are being made for extensions to the electric light plant and waterworks for which bids have been received. Johnson & Benham, Firestone Building, Kansas City, Mo., are engineers.

COLUMBIA, S. C.—A new heating and electric plant, to cost about $50,000, will be installed in the State Capitol. S. W. Cannon is state electrician.

SAVANNAH, GA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 10, for construction of medical officers' quarters for the United States marine hospital at Savannah, including heating, electric conduits and wiring.

JACKSONVILLE, FLA.—The City Commission has authorized the expenditure of $6,000 for the reconstruction of certain foundations at Talleyrand power plant upon which to install a new 10,000-kw. turbine generator.

CLEVELAND, TENN.—The Council is considering the purchase of an electrically-driven pumping unit having a capacity of 500 gal. per minute under a 200-ft. head.

LEXINGTON, MISS.—Preparations are being made for the construction of a new municipal electric light plant to cost about $60,000. Williams & Lebby of Yazoo City are constructing engineers.

BRINKLEY, ARK.—The Brinkley Water & Light Company, it is reported, contemplates the erection of a transmission line to Cotton Plant and Claredon to cost about $260,000.

WALTERS, OKLA.—A bond issue of $125,000 has been voted for the construction of an electric light plant and a waterworks system and sewers

DENISON, TEX.—Bonds amounting to $244,000 have been voted for the installation of electrical equipment in two local pumping stations and to install an ornamental electric street-lighting system.

LIBERTY, TEX.—The Liberty Light & Power Company, recently incorporated, plans to construct an electric light and power plant. A. J. Riviere is interested.

NEWCASTLE, TEX.—The Newcastle Light, Power & Ice Company, recently organized with a capital stock of $50,000, contemplates the installation of an electric light and power plant. Incorporators are W. F. Nance, W. H. Husted and J. H. Arnold

Pacific and Mountain States

SALEM, ORE.—Negotiations are under way by the Oregon Pulp & Paper Company for the purchase of all "north power" on Mill Creek from the Salem Flouring Mills Company. The paper company is seeking additional facilities for power development which will be needed for its new mill. It proposes to erect a power plant, to cost about $50,000, on the site known as the Scotch mill, at the foot of North Mill Creek. The plans provide for a development of 1,000 hp.

SAN FRANCISCO, CAL.—The State Railroad Commission has granted the Pacific Gas & Electric Company permission to issue $10,000,000 in bonds, the proceeds to be used to finance the Pitt River project.

SAN FRANCISCO, CAL.—Plans are under consideration by the Pacific Fruit Express Company, 65 Market Street, for extensions and improvements to its icing and pre-cooling plants at different locations, to cost, including equipment, about $1,500,000. The conversion of several plants from steam to electric operation and the erection of new cold storage plants are included in the proposed work. C. M. Secrist is vice-president and general manager.

SALT LAKE CITY, UTAH.—The Utah Power & Light Company has applied to Public Utilities Commission for permission to extend its lines in Juab County.

PUEBLO, COL.—Work will begin at once on the construction of a new 10,000-hp. electric generating station, for the Arkansas Valley Railway, Light & Power Company. George F. Pythian, constructing engineer for the H. M. Byllesby Company of Chicago, Ill., is in charge.

Canada

LONDON, ONT.—The construction of a dam at Springbank, on the Thames River, to develop 1,000 hp., is under consideration by the Public Utilities Commission. The cost, including equipment, is estimated at $[illegible]. F. A. [illegible] is engineer.

MONTREAL WEST, QUE.—Plans are being prepared for the installation of a new street-lighting system in Montreal West, to cost about $100,000.

Record of Electrical Patents

Notes on United States Patents

(Issued April 6, 1920)

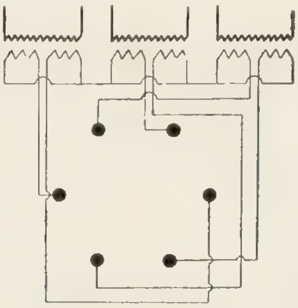
1,335,338. Electrolytic Cell; Henry C. Jenkins, London, Eng. App. filed Sept. 3, 1919. Promotes uniform circulation of electrolyte in region of exposed electrode but hinders circulation in region of protected electrode.

1,335,357. Controlling Means for Electric Motors; Frank G. Warburton, Montreal, Quebec, Can. App. filed Feb. 11, 1915. For motor-driven paper-making machines, paper and cloth printing and coating machines operating in any desired speed relation.

1,335,392. Heater for Carburetors; Charles L. Rayfield, Chicago, Ill. App. filed Dec. 26, 1917. Hydrocarbon liquid circulates through device or is heated by convection.

1,335,417. Electropneumatic Organ Action; Basil G. Austin, Hartford, Conn. App. filed May 29, 1916. Magnetically operated valve structure.

1,335,418. Motor Controller; Thomas E. Barnum, Milwaukee, Wis. App. filed June 21, 1917. Obviates noise of operation and subsequent hum resulting from use of alternating-current electromagnets and solenoids as in hospitals.



No. 1,336,017. Electric Blast Furnace

1,335,423. Electrical Radiator; Robert Bonnaval, Pittsburgh, Pa. App. filed Aug. 30, 1919. Fan wheel diffuses heat from transformer secondary.

1,335,428. Rail Bond; Lawrence P. Crecelius, Cleveland, Ohio. App. filed May 3, 1916. Both conductor and terminal sleeve conductor brazed to rail.

1,335,483. Electric Heating Apparatus; Ora A. Colby, Larimer, Pa. App. filed Sept. 9, 1916. Resistance element strip of conducting material wound upon insulated supports serves as terminal conductor.

1,335,507. Electric Starting System for Internal-Combustion Engines; August Kazenmaier, Stuttgart, Germany. App. filed Dec. 2, 1915. Initial operation for meshing normally disengaged motor and engine gears and for driving engine up to critical speed at which it starts under its own power.

1,335,536. Shaft Construction for Generators; Ira T. Swartz and Alvine T. Wallace, Indianapolis, Ind. App. filed Oct. 22, 1917. Avoids use of stepped sections or threaded parts.

1,335,541. Booster System; Frederick W. Walker, Port Washington, Wis. App. filed Aug. 5, 1914. Electrolytic rectifier or converter prevents excessive drop in voltage.

1,335,542. Pot-Head Connector; Paul F. Williams, Chicago, Ill. App. filed March 15, 1910. Bowl for three cables with removable cover.

1,335,550. Separable Contact Device; Reuben B. Benjamin, Chicago, Ill. App. filed June 24, 1915. Binding terminal carrying member is provided with contacts for detachable engagement with contacts of device electrically connected with supply circuit.

1,335,578. Electrical Transmitting Apparatus; Henry K. Harris, Westminster, London, Eng. App. filed July 1, 1916. Resembles typewriter and causes electrical impulses produced and transmitted for operating advertising mechanisms.

1,335,584. Method of and Apparatus for Welding; Simon Lake, Milford, Conn. App. filed Dec. 3, 1919. Combines steps of heating and hammering in welding operation.

1,335,592. Transmitting Device for Micro Oscillations; Birger Meidell, Christiania, Norway. App. filed March 8, 1918. Weakest oscillations reach working part of mechanism without loss of energy.

1,335,595. Sound-Recording Means; Christian Moore, Akron, Ohio. App. filed Feb. 7, 1919. Recording vibrations on a strip of celluloid.

1,335,596. Indicating and Recording Apparatus; Donald B. Morison, Hartlepool, Eng. App. filed April 9, 1918. Impulses act cumulatively to impart movement to an indicator.

1,335,634. Insulator; Frank M. Amos, Wheeling, W. Va. App. filed May 7, 1919. Wire automatically forced into groove in base.

1,335,644. Portable Electric Light; Bernard Benedict, New York, N. Y. App. filed June 17, 1919. Flashlight placed on table and used as a lamp.

1,335,646. Electrical Testing Device; Richard C. Bierbower, San Antonio, Tex. App. filed Aug. 20, 1917. Compact board for testing armatures, condensers, magnetos, lamps, insulation, spark plugs, etc.

1,335,647. Electrical Testing Device; Richard C. Bierbower, San Antonio, Tex. App. filed June 11, 1918. Fluxmeter for testing strength of magnets.

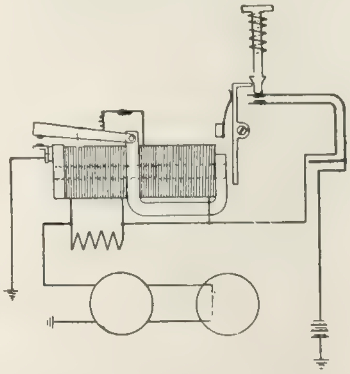
1,335,650. Combined Lamp and Heater; Philip C. Browne, Portland, Ore. App. filed Feb. 11, 1919. Lamp stand contains resistance elements.

1,335,707. Electric Alarm System; Max Yarow, Philadelphia, Pa. App. filed Oct. 10, 1918. Alarm sounded to telephone central office when wires are cut.

1,335,709. Electrical Time Switch; Lauritz H. J. T. Bjornsen, Copenhagen, Denmark. App. filed Aug. 29, 1917. Expansion and subsequent contraction utilized to close or interrupt an electrical circuit.

1,335,738. System of Electrically Indicating on Board Ship the Depth of Sea Water; Yoshinao Kawakita, Hongo-Ku, Tokyo, Japan. App. filed July 5, 1918. Two balanced alternating-current circuits, including sea water, become unbalanced owing to influence of ground, and unbalanced current is measured by means of a sensitive dead-beat galvanometer.

1,335,739. Telephone System; Charles W. Keckler, Newark, N. J. App. filed Oct. 2, 1917. Intercommunicating systems provided with a trunk circuit extending to a central office and multiplied to each of stations included.



No. 1,336,158. Automatic Circuit-Opening Switch for Ignition Systems

1,335,801. Insulator; Louis Steinberger, Brooklyn, N. Y. App. filed Nov. 14, 1916. For high voltages and high frequencies in wireless work.

1,335,803. Transformer Mounting; Chester H. Thordarson, Chicago, Ill. App. filed Jan. 6, 1919. For cylindrical oil-cooled transformer.

1,335,828. Lamp-Socket Structure; Henry A. Framburg, Berwyn, Ill. App. filed May 7, 1919. Container for lamp-supporting socket.

1,335,837. Induction Coil; Edward B. Jacobson, Pittsfield, Mass. App. filed Dec. 17, 1918. Spark coils for ozonating and ignition.

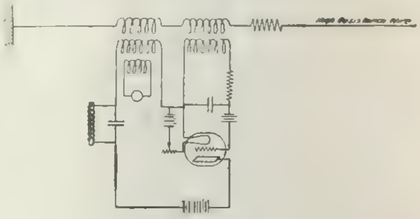
1,335,846. Electrolytic Process and Product; Matthew M. Merritt, South Middleton, Mass. App. filed Nov. 2, 1917. Deposits copper or other metal on non-conductive bodies such as surface of aeroplane propellers.

1,335,875. Electrical Arc Welding; Jack Churchward, New York, N. Y. App. filed Jan. 14, 1920. Monel metal conducts current and also supplies the non-corrosive metal to be deposited by welding process.

1,335,895. Electrode Holder; Johnson Hughes, Philadelphia, Pa. App. filed March 24, 1919. Light-weight water-cooled holder.

1,336,017. Electric Blast Furnace; James Bibby and Jens O. Boving, London, Eng. App. filed Jan. 16, 1919. Current from transformers produces heat by ohmic resistance between electrode entering charge as distinguished from arc heat between electrode above charge.

1,336,127. Terminal Means for Battery Plates; Campbell C. Carpenter, Niagara Falls, N. Y. App. filed Aug. 13, 1917. Connects straps and plates to withstand shocks.



No. 1,336,378. Antenna with Distributed Positive Resistance

1,336,158. Automatic Circuit-Opening Switch for Ignition Systems; Gordon A. Ream, Detroit, Mich. App. filed April 18, 1917. Solenoid operated switch for internal-combustion engines.

1,336,196. Magneto with Water-Tight Casing; George A. Chailliey, Lyon St., Clair Caluire, France. App. filed March 6, 1918. Field frame carries pole pieces cast together; water-tight casing has oil holes covered by rings.

1,336,199. Trolley; Edgar S. Combs, Rochester, N. Y. App. filed April 8, 1918. Wheel keeps in proper alignment with trolley wire.

1,336,253. Telephone Support; Willis I. Miller, Cleveland, Ohio. App. filed March 31, 1919. Means for elevating or lowering mouthpiece.

1,336,281. Process and Apparatus for the Electrolytic Decomposition of Chlorides; Beniamino Cataldi, Turin, Italy. App. filed May 12, 1919. Forms hydrated oxide, also chlorine and hydrogen in free state.

1,336,290. Electrical Fitting; Morris F. Finkelstein, New York, N. Y. App. filed Feb. 8, 1919. Connecting ends of wire in an insulated casing.

1,336,306. Automobile Protective Device; Otto C. Lohse, Bloomington, Ill. App. filed July 9, 1917. Unauthorized persons in starting car cause horn to sound.

1,336,318. Electric Clock and Signal System; Herman C. Prey, Watertown, S. D. App. filed Dec. 19, 1917. Signal operated from a master clock at a remote point and at any predetermined time.

1,336,378. Antenna with Distributed Positive Resistance; Michael I. Pupin, Norfolk, Conn. App. filed Oct. 1, 1915. Receiving wave conductors loaded with resistance to screen them against waves which have the character of electrical pulses of short duration known as atmospherics or strays.

1,336,395. Lamp-Socket Construction; Oscar S. Swanson, Jamestown, N. Y. App. filed Dec. 10, 1918. Cap with insulation molded into it.

1,336,398. Radio-signaling Apparatus; Roy A. Weagant, New York, N. Y. App. filed Feb. 1, 1918. Conductors for radio-frequency currents.

1,335,933. High-Voltage-Current-Distributing Apparatus for the Electric Ignition Apparatus of Internal-Combustion Engines; Jacques Bohli, Obach, Solothurn, Switzerland. App. filed May 13, 1919. Arranges points of ignition for several engine cylinders in two ignition circuits connected in parallel.

Electrical World

The consolidation of Electrical World, Electrical Engineer *and* American Electrician

Volume 75 New York, Saturday, May 1, 1920 *Number* 18

Western Ideas in Utility Financing

SO LONG as electric public utility companies remain unable to finance themselves adequately, expansion of the entire electrical industry will be handicapped. For of what use are motors and appliances if there is no electric service?—and electric service in this day and generation presupposes an electric central station with its transmission and distribution lines. Now, whatever difficulties an Easterner may have in proving this relationship, a Westerner, and especially a Californian, has none, because there is no escaping the fact that the growth of California is intimately associated with and dependent on the continued growth of the electric public utility companies within its borders. Hence the necessity of expansion of electric public utilities in the state, and hence also the interest in the method pursued by the San Joaquin Light & Power Corporation as outlined by A. Emory Wishon of that company in this issue. While the idea has been worked out in Fresno, it is applicable to any other city in the country, and the plan may be copied by other utilities with profit to themselves and the communities which they serve.

A New Field for Electrical Men

WHEN handled by an experienced operator the electric furnace produces a higher quality of steel, brass and other non-ferrous metals than the older processes. Skill in electric furnace operation, however, is one of the factors on which an approximation to 100 per cent quality depends. At present electric furnaces are being installed faster than operators are being trained, with the result that there is an urgent need for men who can fill the position of metal superintendent. This work calls for a knowledge of electric furnace designs, a practical understanding of central-station operation and the problems of furnishing service to furnaces, a working knowledge of metallurgy and ability to handle furnace operators or melters. To students in electrical engineering who are being graduated this year the position of metal superintendent offers an interesting future leading to responsibilities commensurate with initiative and ability, for the extent of applications of the electric furnace and all the uses of its products are by no means yet known.

Cumulative Effect of Electrical Aids

INCREASED production follows the installation of electrical service in countless examples, but the effect of adopting electrically operated equipment is often more far-reaching. Thus the industrial electric truck quickens the loading and unloading of freight cars, road trucks and vessels, cuts down demurrage charges, and through release of vitally needed transportation equipment adds to the nation's capacity for moving men and materials. At a time of disturbances in rail transportation and car shortage like the present who can measure the economic value to the country of every such electrical labor and time saving device enlisted and mobilized for intensive service?

Training the Electrician's Helper

THERE has always been a shortage of first-class electricians in industrial work. The policy of a majority of the plants has been rather indefinite as regards the training of their unskilled hands working as helpers to wiremen. Under present conditions it would appear that a more definite policy along educational lines would be a good plan purely from a business standpoint. When a young man who has been driving a team or following some such occupation joins the "gang" he is usually left to his own fate as to whether he absorbs enough knowledge from his companions to reach finally a stage where he is competent to handle a job on his own responsibility. It is not unusual to find that he is discouraged or rebuffed if he attempts to find out the why and wherefore. Journeymen are sometimes prone to think that any knowledge they have is their own personal property, forgetting that they acquired most of the information they possess through association with their fellow workers. Some plan whereby these beginners could be helped along by schools of instruction during working hours and encouraged to take an interest in their work may prove a solution of the replacement problem, which is becoming more acute as the industry expands.

Solving the Daylight-Saving Problem

IT IS becoming more and more evident that a thorough investigation of the daylight-saving question must be made, based on fundamentals, and that there are going to be dissatisfaction and waste until a solution is worked out. The rejection at Washington of the daylight-saving bill in no way changed the minds of the adherents of the bill. Some state legislatures have enacted laws to straighten the matter locally, while others are planning to do so. More and more cities and their councils are favoring the fast time, while strenuous objections to such time come from farmer organizations. Valuable information may be obtained from some of the European countries that seem to have solved their daylight-saving question. Our problem, however, is distinctly more complicated, since people all along the thousands of miles that separate our eastern and western shores must be satisfied. There has been a great amount of loose talking and very little serious investigation. Preston S. Millar's paper before the midwinter convention of the American Institute of Electrical Engineers very ably pointed the way in which to attack the problem. We need more work of this nature. It should be pointed out that daylight saving is the concern of the engineer. It is his duty to solve the problem, not so much because there is a small saving of energy possible but mainly because it will take the engineer's training to carry on the investigations, to compile the data and to draw the conclusions.

A Current Balance for Meter Calibration

IN CALIBRATING and checking alternating-current measuring instruments of the ammeter and watt-hour-meter types it is very advantageous to provide a suitable range of testing-current strengths, with a suitable degree of precision. Otto A. Knopp describes in an article this week a very convenient apparatus for providing such a current range, utilizing the well-known principles of the alternating-current current transformer. By suitably designing the transformer, an extended range of alternating-current testing-current strengths on closed circuit can be obtained with practically constant precision. By this means the testing set required for checking and recalibrating ammeters, wattmeters and watt-hour meters can be made very compact and easily controlled. The plan will commend itself to the attention of central-station meter-testing departments.

Electric Furnace Leads

GREAT care must be exercised in designing the leads of electric furnaces in order to keep the circuits in balance and the inductance to the lowest feasible value. Electric furnace practice differs from most other branches of engineering in the relatively large currents which have to be carried, from 10,000 amp. to 50,000 amp. in each unit. Obviously, when currents of this magnitude are to be considered the ordinary skin effect becomes a very large factor in the resistance of the conductors. At 60 cycles, for example, a 2-in. (5-cm.) solid conductor shows about 75 per cent increase over its direct-current resistance. From this standpoint a conductor of round cross-section is the worst possible, and the best, when the return circuit is close, is a thin, flat sheet. The result is that by using a solid conductor built up of thin sections with ventilating spaces between, the current-carrying capacity and effective conductivity are both materially increased. Likewise, in these low-tension leads the interlacing of the positive and negative bars tends to keep down the inductance, and this interlacing even in the short run between the transformer and furnace is advantageous, although at the furnace the leads must of course be separated in order to form the connection with the flexible cables.

In an article in this issue by C. B. Gibson this whole matter is gone into in a very striking and interesting way, showing the scheme of carrying out effectively the subdivision and interlacing of leads necessary to limit the effective resistance and improve the power factor. Failure to appreciate the importance of this matter is quite capable of leaving the furnace short of power and of seriously injuring transformer and generating apparatus. The electric furnace is one of the relatively few appliances in which sheer magnitude of current leads to engineering problems of a very serious nature.

The Graduating Class of 1920

THE young men who will be graduated in electrical and mechanical engineering next June are in an exceptional position as regards the opportunities for choosing a preferred line of work in a preferred location. There is an unprecedented shortage of young engineers in practically all lines of work. Manufacturing companies, operating concerns, sales organizations, telegraph and telephone companies all began sending their representatives to the principal colleges of engineering before New Year's, apparently in accordance with the old adage about the early bird and the worm.

The results so far have hardly been gratifying from the point of view of either the companies or the students. It seems to be a case of unrestricted competition which demoralizes both the seller and the buyer. The companies will adjust themselves in time when the present feverish period of activity is over, but the young graduates may become imbued with an exaggerated notion of their importance and of the need for their services. This notion may warp their sound judgment and true perspective of things for many years to come.

Confronted by numerous offers of employment, bewildered by alluring pictures of the type of the army recruiting posters, seeing many notices on the employment boards, receiving letters and telegrams from the representatives who interviewed them, the present seniors have been literally taken off their feet. The quiet scholastic atmosphere is gone and with it much of the inducement for hard study. The regular schedules are disturbed by interviews with the representatives and by "talks" given by them. The spirit of gambling and of getting the best bargain is rampant, and as a result the best part of the senior year with its special advanced studies is largely wasted.

Even though this situation may never repeat itself, even if the graduates of the future will have no such extraordinary choice of jobs, it still remains a pity to see the present scramble for employees involving thousands of young men who each can have a job for the asking and who in the meantime can waste their time in college. The young men are not in a position to change the abundance of luck that confronts them, even if they wished to. It is for the employers and for the administrations of the engineering colleges to adjust the conditions.

Another undesirable feature of the situation is that in this competitive bidding for young graduates the industrial concerns are forced to offer compensation far higher than the knowledge or the ability of the men would entitle them to. Moreover, the companies cannot consistently pay this higher compensation to new men without raising in proportion the salaries of the older men doing similar work. Thus the operating expenses are unnecessarily increased at a time when the efforts of the best managers of industry are directed toward a gradual reduction in expenses with a corresponding decrease of the market prices of essential commodities. During the war we were short of bread and coal, and so the powers that be designated priority and limited consumption in a well-regulated fashion. We are now short of young engineers, and a proper central body should regulate their employment and not permit them to be debauched by competitive offers; for human lives are infinitely more precious than flour or coal.

Visual Instruction from Load Curves

THE trained eye gathers much from the load chart or daily record of the power company without taking the time to analyze the actual reason for the impression as a whole. By cutting out the daily charts and keeping them in specially prepared receptacles year in and year out unusually instructive hills and valleys appear that offer a perspective in power study difficult to duplicate. Those companies that have followed the practice of keeping their load charts in this manner have found that they serve as useful studies for many departments in the power company organization. Such charts are particularly to be commended at this time where there is a shortage of power on systems covering large areas of country dependent on both hydro-electric and steam electric supply and where a wide variation in power consumption is to be found. Under such a system of visual instruction the eye can at once detect the effect of a rainfall in the mountains or the falling off in power uses for railway electric power supply due to an epidemic such as influenza. Even a street-railway strike is at once reflected in the configuration. The demands of the hour in industrial activity make necessary the invention of means by which a fuller and better perspective may be had in all factors affecting industry. In the electrical industry the load curve can be made truly instructive by properly filing the daily report, and its wide use is to be commended.

Why This Indifference to Plant Maintenance?

IT IS surprising and disappointing to find numerous large industrial plants which have so little regard for the welfare of their electrical equipment that they will not employ an electrical man to superintend its operation, inspection, maintenance, testing, etc. That such a condition does exist is known by visits to plants picked at random, some of national note industrially. Some of the plant executives say: "What is the use of engaging an electrical man? All we have to do after the equipment is installed is to throw a switch. We have never had a breakdown in five years." When questioned regarding the attention given the motors, many reply that they give them none. Considering the records of uninterrupted service secured in these plants, the replies are the highest recommendations of the equipment.

Of course, when everything is running properly and there have been no interruptions to production, it is difficult to convince executives who are interested solely in production in the regular inspection and maintenance of electrical equipment. If they can't be made to visualize the losses which might be incurred by a possible breakdown (even electrical equipment cannot be abused forever), the opportune time to convince them that such work is important is immediately after an interruption in production. Then the expense for an inspection and maintenance crew can be shown in its real proportions and justified if ever. In this connection it is interesting to note that one large industrial plant was able to eliminate breakdowns and electrical maintenance expense almost entirely by inspecting equipment periodically to forestall trouble.

While production has been the chief consideration of industrial plant executives, economy should no longer be overlooked. One of the best ways to check economy of energy consumption is to provide meters which can be switched into any circuit quickly or to make periodic tests with portable apparatus. With the information thus obtained the electrical engineer can suggest better grouping of machines (as regards motor drive) that will improve the power factor, reduce the demand charge, enable a plant to get along with the least investment in motors, etc.

Like a few other services, unfortunately, an inspection department is never appreciated until it has once been tried and has to suspend or curtail operations for some reason or other. Then the recognition of its value is expressed in the form of "Why didn't you attend to that bearing?" or "Why didn't you replace that motor by one better adapted to the load before we were forced to shut down the whole department?" The moral is for industrial executives to study the excellent results that other companies have secured through their electrical organizations.

Overhauling Hydro-Electric Plants

MUCH attention is at present being given to the subject of overhauling hydro-electric plants. The shortage of power due to the postponement of the power development program during the war period and the subsequent enormous increases in power demand, coupled with the shortage of rainfall in certain districts of the nation, makes this a timely and interesting engineering topic.

An instance of what has been found possible along this line of economic salvaging is afforded by one of the hydro-electric power plants of California, namely, that of the Stanislaus development of the Sierra & San Francisco Power Company. In this particular instance two penstock pipe lines were originally designed to convey sufficient water to develop 20,000 kw. with a friction loss of 5 per cent. It is now found possible at certain periods to develop as much as 33,000 kw. with the same installation, but under such circumstances the friction loss in the penstock pipes is increased to from 13 to 14 per cent. As a consequence this company has undertaken the installation of additional power-plant facilities which will extend the installed capacity of this power plant to 40,000 kw. without increasing the actual water development formerly existing in the ditches and canals. This is brought about largely by the installation of a third penstock pipe, thus increasing the pipe line capacity by 50 per cent. By making use of the forebay facilities feeding into the penstock pipes a saving of peak to the extent of about 3,000 kw. will become possible, and an actual saving in energy of over 600,000 kw.-hr. will be realized.

In other districts of the West the overhauling of flumes and a slight changing in grades in many instances are also aiding in power development, though otherwise uneconomical. Taking it all in all, power companies will do well in these times of emergency to view with considerable care the possibility of increasing power development by taking advantage of economies and slight increases in power outlay already existing and thus bringing about new and enlarged installation capacity. This, too, applies to the overhauling of hydraulic machinery, the readjustment of blades, the cleaning of turbine wheels and all the other factors that go toward increasing the efficiency of operation on down through the generating apparatus.

Photo by Underwood & Underwood.

Elmer Ambrose Sperry

An engineer and inventor of remarkable versatility, the holder of patents covering electric lighting and transmission, electrically operated mining machinery, electric railways, electric vehicles, electrochemistry, ship navigation and searchlamps

THE numerous inventions of Elmer Ambrose Sperry, president of the Sperry Gyroscope Company, date back to the early days of electric lighting. In 1879 he produced an arc lamp and system of lighting and soon after secured patents on motors, generators and regulators. In 1880, when twenty years old, he organized the Sperry Electric Light Company in Chicago to produce apparatus and machines from his designs. For the Board of Trade in that city he erected in 1883 the first high-powered electric beacon, consisting of a steel tower 303 ft. high, carrying twenty arc lamps of 40,000 cp. A few years later he became interested in mining operations and was the first to apply electricity in the operation of mining machines, such as pick cutters, chain cutters, etc. He also developed an electric locomotive which found application in electric railway work and caused the founding of the Sperry Electric Railway Company in Cleveland, Ohio. His patents controlled by this company were purchased by the General Electric Company in 1894. When the automobile industry was born Mr. Sperry designed and built a successful electric car.

In 1890 Mr. Sperry began the work that has brought him the greatest fame, the commercial applications of the gyroscope. First came the gyroscopic compass, then the use of the gyroscope for stabilizing ships—a field in which commercial failures had marked the efforts of other inventors. Mr. Sperry's methods have not only proved successful on very large ships but apply equally well to aeroplanes. This work has been widely recognized by many medals and honorary awards. Important among his recent developments are inventions covering searchlamps that produce an intense beam, as high as 500 cp. per square millimeter. In the electrochemical field he has also done much original work and his patents are employed by several prominent companies.

Mr. Sperry was one of the founders of the American Institute of Electrical Engineers and the American Electrochemical Society and chairman of the committee that called the first meeting of the National Electric Light Association. He is also a member of the American Society of Mechanical Engineers, the Naval Architects and Marine Engineers and several other semi-technical organizations. During the war Mr. Sperry rendered valuable service to the government as a member of the Naval Consulting Board. On Oct. 12 of this year he will celebrate his sixtieth birthday.

Interlacing Furnace Transformer Busbars

Heavy Currents Make It Necessary to Consider Cross-Section, Shape and Relative Position of Conductors—Induction Reduced by Interlacing

By C. B. GIBSON
Westinghouse Electric and Manufacturing Company

IN ELECTRIC furnace installations, where heavy alternating currents are involved, the difficulties of conducting the current from the transformer to the furnace terminals are very pronounced and unusual care must be taken in arranging the low-tension buses. Two essential requirements are: (1) That sufficient cross-section be provided to conduct the extremely heavy current without excessive heating and energy loss; (2) that the conductors be so arranged that the inductance of the circuit will be a minimum.

A factor that is of decided importance in determining the proper cross-section of conductor is "skin effect," or the tendency of alternating current to seek the section of the conductor nearest the surface. When currents of from 10,000 amp. to 50,000 amp. are used, therefore, conductors large in cross-sections are required, for alternating current does not take full advantage of the conductivity of an ordinary conductor. It does not distribute itself uniformly throughout the cross-section but favors the area near the surface and shuns that near the center of the conductor. This is due to the fact that it encounters less inductance and impedance near the outer surface than it does near the center, and it is for this reason that large cables are often built up around a non-conducting core.

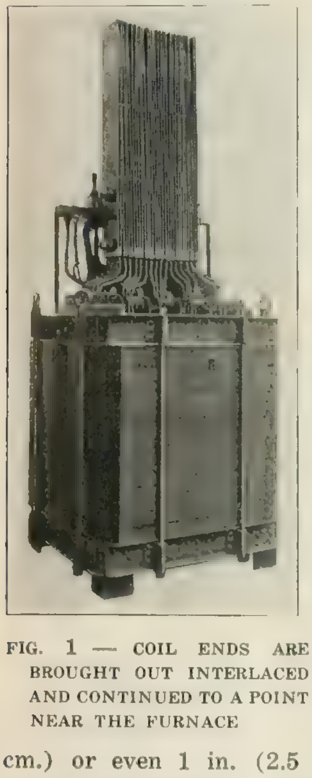


FIG. 1 — COIL ENDS ARE BROUGHT OUT INTERLACED AND CONTINUED TO A POINT NEAR THE FURNACE

With cylindrical copper conductors of ½ in. (1.25 cm.) or even 1 in. (2.5 cm.) in diameter, the "skin effect" at 25 cycles is negligible, but with a 2-in. (5-cm.) conductor it reaches such a value that the effective resistance has increased approximately 25 per cent over the corresponding resistance to direct current. With 60 cycles, the ½-in. cylindrical conductor offers a small increase in resistance to the passage of alternating current, the 1-in. conductor has an 11 per cent increase and the 2-in. conductor has approximately a 75 per cent increase over the resistance to direct current. From these figures it will be seen that a solid cylindrical conductor with a diameter slightly over 2 in. offers virtually twice the resistance to a 60-cycle current that it does to direct current. For copper and aluminum sections of equal resistance the increase in resistance to alternating current is practically the same, but for conductors of the same cross-section it is less for aluminum. These values are true regardless of current density used.

In addition to the sectional area of the individual conductor, the shape must also be considered when heavy alternating currents are to be transmitted. For a given cross-section area of conductor, as far as effective resistance is concerned, the poorest solid section form is round, and the best, where the return is near, is a thin flat sheet. If a solid cylindrical conductor be rolled into a sheet and then formed into a thin walled tube of the same cross-section area the effective resistance of the tube will be considerably less than that of the solid cylinder. By separating a solid conductor into sections, with ventilating spaces between them, the current distribution or effective resistance is not affected, but the current-carrying capacity is increased.

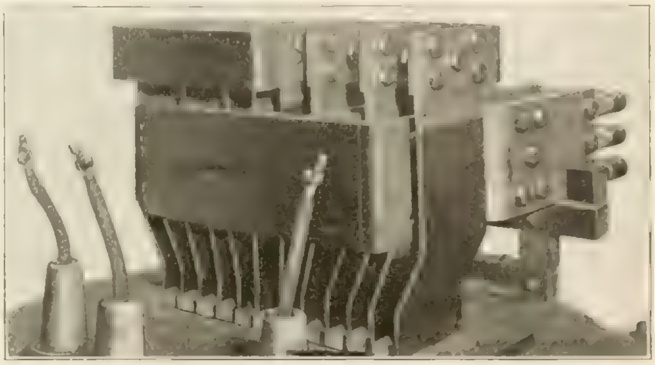


FIG. 2—FORMING THE DELTA ON THE TRANSFORMER

In case the transformer can be installed near the furnace the delta is made up on the transformer and the furnace flexibles carry the current to the furnace

With the shape of the conductors determined so that they will be used to the best advantage without excessive heating, the next problem to be solved is to insure the proper relative position of the positive conductors with respect to the negative conductors so that the inductance of the circuit will be kept at a minimum. Current distribution within a conductor is also affected by an adjacent conductor of opposite polarity, as the current tends to take the surface near to it. This is because on the near surface the mutual inductance is at a maximum and it therefore has a greater effect in reducing the self-inductance.

Effect of Interlacing Leads on Reducing Inductance

Low-tension leads of furnace transformers are generally interlaced alternately positive and negative when brought through the transformer case. In this way the inductance of the leads is kept at a minimum because of the subtractive effect of the mutual inductance of adjacent bars of opposite polarity. Because of this the resulting inductance of a negative bar, with a positive bar placed on both sides of it, is considerably reduced by the mutual inductance subtracting from its self-inductance.

This condition also holds true for the bars after they leave the transformer so that they should be kept interlaced to a point as near the furnace as is possible, where it is necessary to separate the leads and form the delta connection for the flexible cables. By this method the inductance of the interlaced section will be very small as compared with that of the section where the leads are separated for the flexible cable running to the furnace mast.

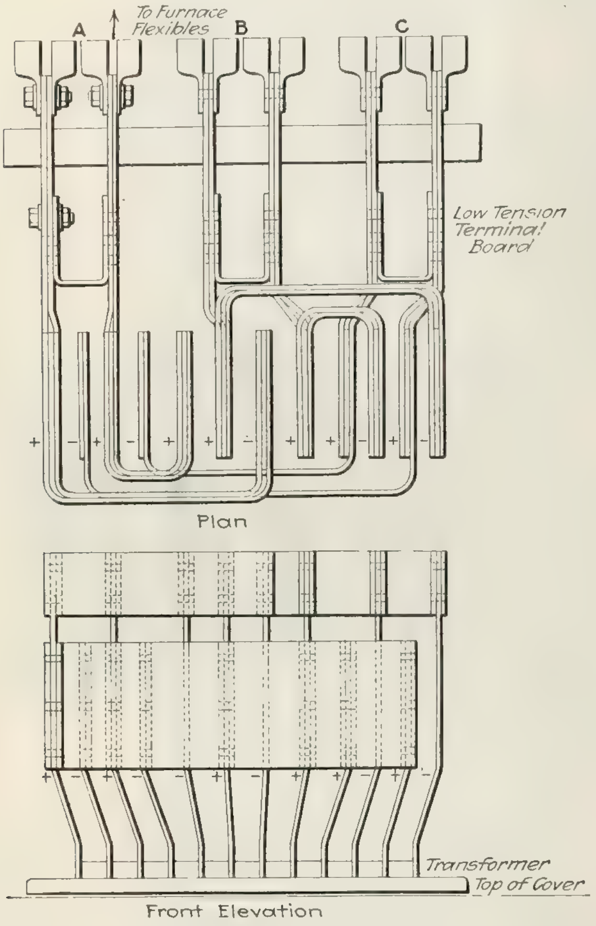


FIG. 3—DETAIL LAYOUT OF DELTA FORMED AT TRANSFORMER

In an installation where the transformer can be placed very near the furnace the delta connection can be made at the transformer terminals on top of the tank, and in this case the flexible cables will run from here directly to the furnace mast. With this method the total distance from the transformer to the electrodes must be kept low as the inductance of the circuit increases rapidly where the phase leads are separated and not interlaced. These same methods apply equally well for a star or "Y" connected secondary, the star connections being made either at the end of the interlaced run or on top of the transformer case.

Because the low-tension run is usually short transposition of the busbars is not considered necessary. However, it is desirable if possible, for with three separated phase groups of bars in one run the two outer groups will have a greater inductance than the center group.

Where transposition is advisable and feasible it should be within each phase group of the flexible cable, so that each cable will have an equal impedance and there will be no excessive heating in some of the cables. The aim is to have each cable of the group kept in the same average relative position over the run, and if this condition is obtained, then each cable will take an equal current and there will be no excessive heating.

To illustrate some of the limitations encountered in practice, a furnace installation will be assumed operating at 100 volts, 25 cycles, with the conductor arrangement and service such that a power factor of 90 per cent is obtained at rated full-load current. By forming a voltage triangle it will be seen that 100 volts, the hypothenuse, represents the applied voltage, and 90 volts, the base, represents the component of voltage in phase with the current. The resultant reactance component is found to be 43 volts. With this same furnace operating on 60 cycles for the same current value, the reactance component will be proportional to the frequency, or equal to 103 volts, which value is more than the impressed voltage. This means that the furnace, even with the electrodes short-circuited, would not quite take full load current from a 60-cycle supply circuit. On 25 cycles, with the electrodes short-circuited, the maximum current that will flow is somewhat less than two and one-half times full-load current.

With a furnace circuit of constant reactance and varying resistance the maximum power input occurs when the reactance drop is equal to the resistance drop, or when the power factor is 71 per cent. With the furnace assumed above this condition would be reached by moving the electrodes and decreasing the resistance until the current reaches 165 per cent of full-load current.

Under this condition, with the power factor 71 per cent, the energy input is 130 per cent of the full-load condition assumed above. This is then the maximum amount of power that can be put into the furnace when operating at 100 volts. Further reduction of the resistance and increase of the current would result in such a low power factor that the energy input would decrease below that obtained at 71 per cent power factor.

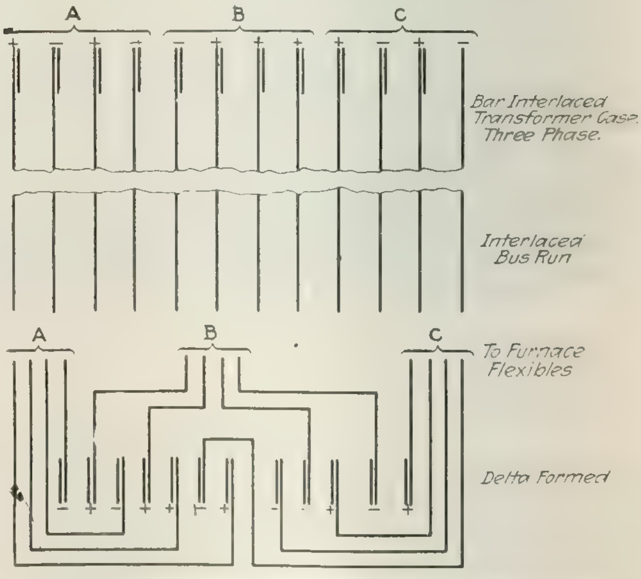


FIG. 4—INTERLACING BUS-BARS FOR A THREE-PHASE TRANSFORMER

There are in this case two low-tension coils for each phase and therefore twelve ends which are brought out interlaced as shown and carried to a point as near the furnace as possible before forming the delta.

However, where a power factor of 71 per cent is obtained from a furnace load, it means that the capacity of the electrical equipment must be 141 per cent of that required for supplying the true power component of the load.

From the standpoint of the central station, this will not be so satisfactory a load as one with a power factor around 90 per cent, nor does the furnace operator care to purchase equipment 41 per cent in excess of his needs and of useless reactive capacity. On the other hand, the arc furnace requires a certain amount of reactance in its circuit which serves to store energy momentarily and return it to the circuit during the period of the cycle when the alternating current passes through zero value. In general, approximately 30 per cent reactance, corresponding to 95 per cent power factor, must be inherent to the electric arc-furnace circuit in order to stabilize its operation. From an electrical standpoint, therefore, the arc furnace should always operate between approximately the limits of 71 per cent and 95 per cent power factor, and commercial furnaces of all types usually do operate within this range.

The heating of electrical equipment is influenced by power factor, and alternating-current machinery is rated according to the product of the volts and amperes (kilovolt-amperes), which takes into account the limiting values of capacity as imposed by the current and its attendant heating effect. This is true not only of generating machinery but also of the transformers. The heating effect of the current is proportional to the square of its value, so that as the power factor decreases losses due to current flowing through the conductors will increase rapidly. Evidently it is an advantage to the furnace operator to secure a transformer of minimum kva. rating which will perform the service. The lower the reactance of the circuit, the higher will be the power factor and the lower will be the first cost of the transformer and the conductor losses. Because of these factors too much care cannot be taken in planning a heavy-current bus layout in order to secure low reactance and a high power factor.

The weight of conductors for heavy current is an important factor and ample provision must be made for their support. Besides having mechanical strength, these supports must serve as insulators, although the potentials involved will not usually be in excess of 100 volts. The necessity for laminating and interlacing the conductors in heavy current work complicate the support problem. In addition, the contacts and connections between different parts of the circuit and the terminals of the apparatus carrying the heavy current must also be laid out with the greatest care.

New Current Balance for Calibration Work

Ammeters, Wattmeters, Watt-Hour Meters and Current Transformers May Be Tested Over Wide Ranges with High Accuracy by Means of a Magnetic Current Balance—Greatly Reduces Time and Tedious Operations Required in Ordinary Calibration Work

By **OTTO A. KNOPP**
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A TESTING device has been developed by the writer and used extensively in the electrical laboratory of the Pacific Gas & Electric Company which is extremely useful in the routine calibration of ammeters and wattmeters. In testing wattmeters, particularly, the device eliminates much of the time and tediousness of calibration work as usually carried out. It also offers a convenient and absolute method of testing current transformers for ratio and phase angle. The principle is that of a magnetic current balance. The purpose of the present article is to explain fully the principle and applications of this apparatus.

It is well known that if the product of amperes times turns is constant, no matter what the factors are of this product, the magnetic effect under like conditions will be the same. For instance, if we wind a ring-shaped solenoid, of say 1,000 turns, and send a current of 1 amp. through it, we get a certain field inside the solenoid corresponding to the 1,000 ampere-turns. If we wind a second ring-shaped solenoid on and concentric with the first, of say 100 turns, and send a current of 10 amp. through it, we again obtain inside of the solenoid the field due to 1,000 ampere-turns. Then if the two fields are in opposition there will not be any magnetic flux inside the smaller solenoid. This applies to both alternating current and direct current.

The expedient of producing like fields with different currents but equal ampere-turns has been used extensively in this laboratory in the development of new measuring apparatus and numerous test methods. Two of these devices for direct-current measurements were developed some seven years ago, the direct-current line-current testing set and the direct-current ratio relay,* in which an iron ring core, slipped over the conductor whose current is to be measured, is magnetized by the latter and by means of a small current passed through a winding wound around this iron core the magnetic flux is neutralized (see Figs. 1 and 2). In the direct-current line-current testing set the fluxes are balanced by regulating the secondary current by hand (see Fig. 1), and in the other, the ratio relay, the fluxes are balanced automatically (see Fig. 2). In each case the small secondary current is always in a fixed proportion to the current flowing in the conductor, this proportion being the inverse ratio of turns. Where it is not objectionable to open the circuit whose current is to be measured, the iron core is wound with suitable primary turns so as to give these current balances (both the automatic and the non-automatic) numerous current ranges. All that is essential is to wind for each primary range all turns concentric to the secondary winding. In this way it is possible to provide a great many ranges to cover a wide field of testing. The particular advantage of such a multiple-range magnetic current balance over the present multiple-shunt or millivoltmeter measuring outfit is that its accuracy is not impaired by any changes in secondary resistance. It is possible to insert any instrument—indicating, curve-drawing or integrating—without affecting the accuracy of the measurement.

Such a multiple-range or multiple-ratio magnetic current balance can also be used to proportion currents in certain ratios as follows:

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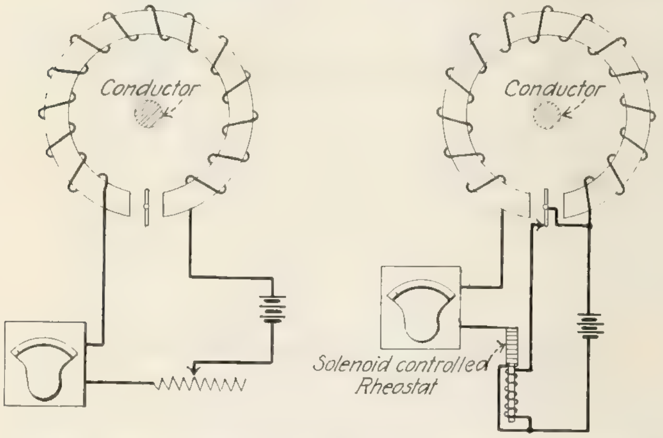
*Described in the ELECTRICAL WORLD, [illegible]

If a current of known value is passing through a certain range of the primary winding (see Fig. 4), we obtain a fixed secondary current. If we now send a current through another range of the primary winding and make it of such a magnitude that the secondary current is the same again, we shall have established a new primary current, which will bear to the former primary current the inverse ratio of the turns of the two primary windings. For instance, if our current was 50 amp. flowing through 36 turns and we change the turns successively to 45, 60, 90 and 180, then we shall have to change our primary current, in order to keep the secondary current the same, from 50 to 40 to 30 to 20 to 10. In other words, it will be possible, after having accurately measured one value of primary current, to establish with equal accuracy as many other current values as there are sections in the primary winding of the magnetic current balance.



FIGS. 1 AND 2—BALANCING AMPERE TURNS FOR CURRENT MEASUREMENT

This principle of the magnetic current balance can also be applied to alternating current, using the same apparatus (Figs. 1 and 2), with the only difference that an alternating-current excitation is provided for the magnet needle *M*. The alternating primary flux in this case is opposed by an alternating secondary flux in phase and synchronism with the former. But now we know that the alternating-current current transformer approximates very closely to a magnetic flux balance, the only difference being that the secondary current is not furnished from a separate source, but the energy flowing through the secondary circuit is derived from the primary circuit. If we assume that the energy required to send the secondary current through the circuit is so small as to be negligible, a true magnetic current balance will be obtained. For commercial measurements, using low secondary loads, the ratio of such a transformer is practically a fixed one. The advantage of the alternating-current current transformer as an automatic flux balance over the mechanical automatic flux balance is in its greater simplicity and therefore reliability, and if we assume the resistance of the secondary circuit of a current transformer constant over a comparatively short period of time, we can apply the proportioning method described before with a high degree of accuracy by using a current transformer suitably wound for a large number of ratios.

The knowledge of this simple truth has resulted in the development of a very convenient calibrating apparatus (see Fig. 3), and method for alternating current, which in many respects can be compared with the potentiometer method for direct current. With the potentiometer, after balancing by means of the galvanometer a known standard emf. value against the voltage drop of a current flowing through a resistance, we are enabled to balance larger or smaller emfs. against the drop of the same current in larger or smaller sections of the resistance. With the magnetic current balance, after balancing by means of the auxiliary secondary instrument a known primary current flowing through a given number of turns, we are enabled to balance larger or smaller primary currents flowing through smaller or larger number of turns against the same current flowing in the secondary.

Proper multiple-ratio transformers have been built, covering a range of amperes from 0.25 to 5 and from 10 to 200, which will take care of practically the whole field of calibrating commercial ammeters. These transformers have sufficient intersections whereby it is possible to obtain every current value in the limits specified which may be required to calibrate the ten or fifteen calibration points of all ammeters falling within the range of the transformer. For instance, a 150-amp. ammeter can be calibrated on fifteen points of its scale, or a 10-amp. ammeter on its ten calibration points, etc. To make it possible to apply the above principle to proportioning currents in as great a number of current values as possible without making the mechanical construction too complicated, a number of special features enter into the make-up of the apparatus, which are briefly as follows:

INCREASING THE CURRENT RANGE

Arrangements are made so that each primary winding section can be used for different current values ranging from 10 per cent to 100 per cent of its rated capacity. To make this possible, sections in the secondary winding are provided for 10 per cent to 100 per cent of its total turns. The same secondary meter will thus balance current values ranging from 10 per cent to 100 per cent of the normal rating of each range. For instance, if we take a 5-amp. value as known and indicated by standard *S* (Fig. 5), and assume the lever *L* set on the 5-amp. range, the 5-amp. current from the source *B* will be transformed in the transformer *T* to, say, 5 amp., as indicated by the auxiliary secondary meter *A*. This current, as read on auxiliary meter *A*, will balance correctly a multiple value of 5 amp. according to the rating of the different primary ranges. If, for instance, we want to calibrate the meter *A* of, say, 200 amp. capacity, we short-circuit the standard *S* and raise the primary current step for step to the current values required for calibrating the meter *A*; that is, 20, 40, 60, 80, 100, 120 and so on, and with each raise move the lever *L* to the corresponding current range—20, 40, 60, 80, 100, 120, etc.—and maintain for each step the same magnetic balance as was indicated by the meter *A* when 5 amp. was flowing through the 5-amp. primary winding. With the proper balance each of the ampere values will be as correct as the 5-amp. value used as standard value. If we want to calibrate a smaller capacity meter, say 20 amp., we have to give the same ranges used before, one-tenth the value, which is done by sending the standard current of 5 amp. through the 50-amp. range and connecting the secondary meter to the 10 per cent tap. The 20, 40, 60, 80 ranges will then be of 2, 4, 6, 8, etc., amp. capacity. It can easily be seen that in this way any ammeter in the prescribed limits can be calibrated accurately and with great speed and with only one current value, say 5 amp., known.

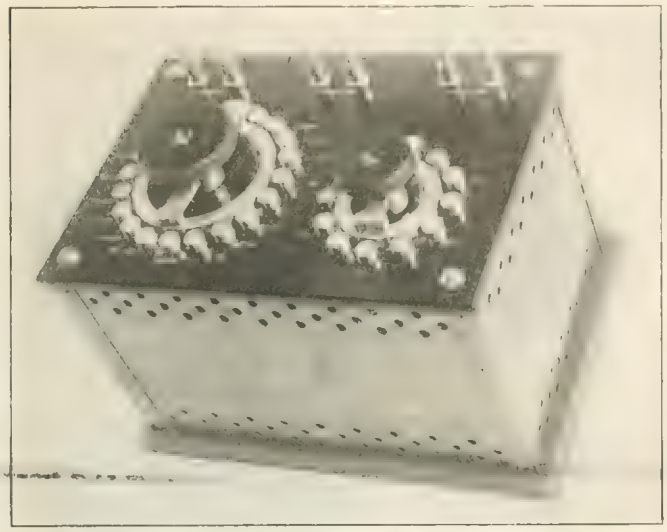


FIG. 3—CONVENIENT ARRANGEMENT OF CURRENT BALANCE

In order to establish the same magnetic balance for all ranges with current values reciprocal to the number of turns of the ranges, it is necessary to keep the leakage reactance of the secondary for a given ampere-turn value the same for all ranges. Two methods have been pursued to obtain this end. One was by using a ring core with all ranges wound concentric thereon and concentric to the secondary. Another way, more practical from a manufacturing standpoint, was to interlace the winding in such a manner that the magnetic center of effect for each section is on the same point. It is then possible to use any standard core construction and form-wound coils. In order to make use of one ampere-turn value for the calibration of any one ammeter or wattmeter, ampere-hour meter or watt-hour meter—in other words, to get along with only one standard reference value of current or wattage for such work and thus maintain magnetic balance by means of only one secondary current value—it would be necessary theoretically to find an ampere-turn value which is evenly divisible by every one of the figures from 1 to 15 inclusive. Such a value is many times too large to be practicable for current-transformer design, and therefore the problem had to be solved to produce the same results with a small number of ampere-turns, say 1,000 or 2,000. Three different methods have been pursued to obtain this end. One was by providing three special calibrating taps which made it possible to obtain from the original standard 5-amp. value two other standard ampere values, so that for the calibration of every 100 or 150 division instrument three ampere-turn values were used. Most suitable for this purpose were found the values 1,760, 1,800 and 1,820, as there is no value from 1 to 15 which is not divisible into one of the three figures. This method works out well. The calibrating ranges of the transformer are distinguished by colors, red, white and black in three groups. The 10-20-30-40-50-60-90-100-120-150-180-200-amp. range falls in the 1,800 group; the 80-110-160 falls in the 1,760 group, and the 70-130-140 falls in the 1,820 group. The only disadvantage is that for the complete calibration of almost every instrument reference has to be made to three readings. To cut this down to one, a second method was used by employing instruments in the secondary which have three ranges, so that for the 1,760, 1,800 and 1,820 ampere-turn group, and with the respective instrument range cut in, the same readings would secure the proper balance. This second method worked out well for wattmeter calibration where it was easily possible to provide three ranges by means of a potential resistance. For ammeters it was more difficult, but assuming that a satisfactory ammeter could be built the above method would still have the disadvantage that special auxiliary instruments have to be provided. This disadvantage was finally overcome by using a third and most satisfactory method; namely, that of ratio correction.

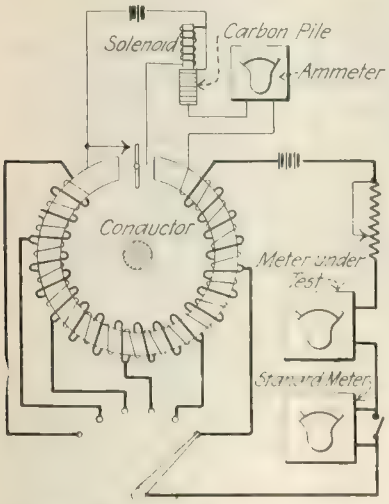
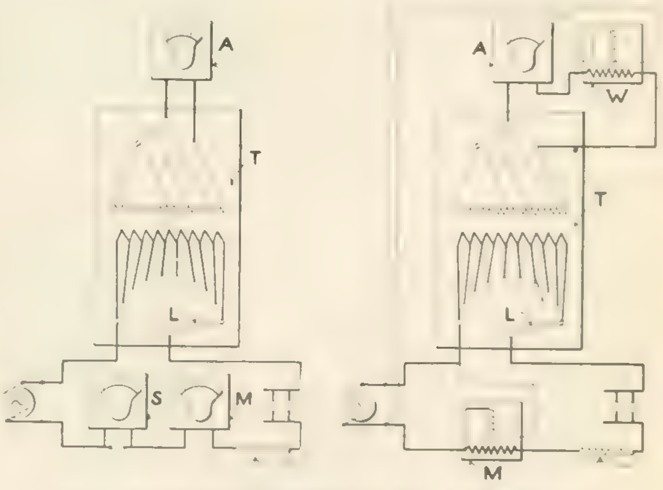


FIG. 4—SEVERAL RATIOS ARE READILY OBTAINED

As has been pointed out above, the 1,800-ampere-turn group embraces all but six ranges; therefore, it is only necessary to alter the current flow in six of the odd primary ranges slightly more than 1 per cent or 2 per cent for the 1,760 and 1820-ampere-turn groups, respectively, to bring the ampere-turn values all up to 1,800, with the result that only one reference reading is required and no distinction has to be made between the ranges and no special auxiliary instruments have to be employed.

Application to Wattmeter Calibration

Primarily the magnetic current balance is intended for current calibrating work, for which a very high degree of accuracy is attainable; but its application can also be extended to the work of calibrating wattages with very good accuracy. Assuming that we apply to the meter under test, the standard meter and the auxiliary meter the same potential in a fixed phase relation to the current, we will proportion our wattages in the



FIGS. 5 AND 6—CONNECTIONS FOR AMMETER AND WATT-HOUR-METER CALIBRATION

same ratio as the currents; but if the phase relations vary during our test, the accuracy of the test will suffer.

To what extent this affects us will be shown in the following:

Assume: I = primary current,
E = potential,
i = secondary current,
ρ = angle between primary current and potential,
α = phase angle between I and i,
r = current transformation ratio,
C = coefficient.

Then:

$$IE \cos \rho = CriE \cos (\rho - \alpha).$$

As $ri = I$, we get: $C = \cos \rho / \cos (\rho - \alpha)$.

Our test accuracy will vary in the same proportion as C varies. If C is constant during test, the accuracy will be 100 per cent. We can see from the formula that with $\alpha = O$ our accuracy is not affected by any changes in the angle ρ, and with α small C will vary very little if ρ is small. It, therefore, is advisable to work as near as possible to unity power factor, if variation in ρ cannot be avoided. If we assume ρ to vary between 2 deg. and 5 deg. and the angle α to be 30 min., C will vary:

$$\frac{\cos 2^\circ}{\cos 1.5^\circ} - \frac{\cos 5^\circ}{\cos 4.5^\circ} = \frac{0.9994}{0.9997} - \frac{0.9962}{0.9969} = 0.0004,$$

or approximately 0.04 per cent.

The error, as can be seen, is thus reduced to an amount negligible for ordinary calibrating work. To make this variation of ρ extremely small and thus cut out every possible error, a small transformer can be provided to furnish the testing current with numerous secondary voltage taps, corresponding to the current ranges of the magnetic current balance. With voltages varying reciprocally to the current values held, the power factor will automatically stay constant.

Rapid Testing of Watt-Hour Meters

To determine the characteristic of watt-hour meters under various conditions of voltage, power factor, temperature, etc., the magnetic current balance is of great help. Heretofore such work has been very tedious and the results obtained have been more or less unsatisfactory from the standpoint of accuracy. In most of these tests we are not interested in the absolute accuracy of the meter, but in relative performance; that is, we want to know if on 10 per cent or 50 per cent of full load the meter runs 10 per cent or 50 per cent of full-load speed.

To determine the characteristic of a meter, therefore, all that is required, besides the magnetic current balance, is another uncalibrated watt-hour meter W and an ammeter A (see Fig. 6). These meters are connected as auxiliary meters across a suitable section of the secondary. The disk of the auxiliary meter should be scaled for 100 divisions, or if a small capacity rotating test meter is available which has a 100-division scale, it could be used to advantage. Assuming that the meter under test M is a 50-amp. watt-hour meter, we set the lever L on the 50-amp. range and the 5-amp. auxiliary meter across the full 5-amp. secondary winding. A common potential is applied to the meter under test and to the auxiliary meter. If we now pass a current through the meter under test so that, say, 5 amp. is read on the ammeter, we shall have very close to full-load current on our meter M, and if we then start both watt-hour meters simultaneously and stop them simultaneously after the meter M completes, say, ten revolutions, we obtain a certain speed ratio which, for convenience of calculation, can be made close to 1 by shifting the magnet on the auxiliary meter until the meters run at approximately the same speed.

With a primary lever setting of, say, 5, 10, 20, 30, 40, 50, and the current held roughly constant on the ammeter, the meter M should complete 1, 2, 4, 6, 8, 10 revolutions, respectively, for the auxiliary's ten revolutions. The number of revolutions made by the auxiliary meter for each setting divided by ten represents numerically the correction factor of the meter under test M for the loads of 10, 20, 40, 60, 80 and 100 per cent relative to the full-load point. For instance, if the auxiliary meter when stopped had completed 10.055 revolutions and the run was made with lever setting for 20 amp., the correction factor of the meter on 40 per cent load is 1.0055, or the meter is very close to 0.55 per cent slow relative to the full-load point.

In this manner the characteristic of a meter can be determined with extreme accuracy by one observer, without accurate standards, without perfectly steady current, without timing devices, and without calculations, in a remarkably short period of time, giving the meter under test little chance to change its characteristics during the test owing to varying room temperature, self-heating or frictional changes. The characteristics can be determined for overloads by choosing lever settings above 50, say 100. 150 and 200 amp., corresponding to 200, 300 and 400 per cent load. To determine the characteristic at a different frequency, wave shape or temperature, all that is necessary is to maintain during the test the same voltage, power factor, frequency, wave shape or temperature. If it is further desired to know how the different characteristic curves are located relative to each other, it is only necessary to determine with a 5-amp. standard, cut into the primary circuit for the lever setting 5 amp., the absolute record of the auxiliary meter with 5 amp. flowing through it at the beginning or the end of each run for the different voltages, power factors, etc.

Calibrating Current Transformers

In order to determine the ratio and phase-angle errors of current transformers of different capacities, it is customary to compare them with standard transformers of the same ratio. Here the magnetic current balance furnishes a very convenient multiple-ratio standard, doing away with a large and expensive set of calibrated transformers. Further than that, it is self-checking; we can standardize it by using its one-to-one range and comparing the primary directly against the secondary current.

This method of establishing a current ratio standard is an absolute method and was developed and used by the writer in 1912 and first described by him in his article in the Electrical World, Vol. 67, page 92.† A "two-watt-hour-meter method" was used, which is described in the same article and is similar to the method independently developed by P. G. Agnew, associate physicist Bureau of Standards, and published in Scientific Paper No. 233. In later years numerous improvements have been made in the application of this simple and useful method of establishing a standard by the development of a differential watt-hour meter and other modifications, the description of which will be left to a later article.

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†A similar method was described by H. M. Crothers in the Electrical World, Feb. 7, 1920.

Self-Interest a Key to Utility Financing

Manufacturers, Dealers, Contractors, Jobbers, the Public and Employees Should All Be Brought to Realize What Central-Station Expansion Means to Them—What California Has Done and Hopes to Do Along This Line

By A. EMORY WISHON
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HOW ARE the public utilities of the United States to be financed? How are the American people to be impressed with the necessity for supplying and safeguarding the billions of dollars required to develop further the great electrical industry? These are two problems every utility management is endeavoring to solve. A comparatively simple solution offers itself.

A. EMORY WISHON

First, the entire electrical industry—central station, manufacturer, jobber and contractor-dealer—must be infused with the electrical idea; second, the electrical industry itself must bring about a general public understanding of what electrical development is doing for the nation and what it means in dollars and cents to every individual in the nation.

Before a sympathetic response can be expected from the public the industry itself must be prepared to stand inspection. This done, there is nothing to fear from public scrutiny. Before the industry as a whole can make the expansion required of it its different branches must shoulder their respective responsibilities and do for the industry as much from the inside as they expect the public to do from the outside.

An idea of how vital and far-reaching this responsibility is can be gained by reviewing what electrical development means in only one section of the nation, the Far West. California power companies will require $332,000,000 of new capital in the next eight years if they are to meet the public demand for more electricity. The capital now invested in electric plants in California is $158,480,000, with an installed steam and hydro-electric rating of 792,400 kw. The estimated hydro-electric resources of the State are 7,818,000 hp. maximum. The present installed steam and hydro-electric capacity of ten states west of the Rocky Mountains is 1,664,267 kw. The water-power resources of this section would generate 30,000,000,000 kw.-hr. annually. Therefore, on the basis of California's requirements, it may be conservatively estimated that the Far West will need $30,000,000,000 of new money if colonization, irrigation, mining and manufacturing in this great territory are to be extended.

The development of the West is entirely dependent upon the development of its hydro-electric resources. This is a territory equal to 40 per cent of the nation's area. It contains only 8 per cent of the nation's population, but it is consuming 20 per cent of the nation's output of electrical energy. The per capita use of the Westerner is more than three times that of the Easterner, the average cost of a kilowatt-hour in the West being about one-half that in the East. This demand is rapidly increasing and is so far ahead of the available supply that Western power companies are rushing construction on 190,825 kw. of additional capacity for 1920.

This increasing demand is based upon an unparalleled prosperity. The chief industries are agriculture, mining and lumbering. The exports are mostly raw products, bringing large financial returns and ability to purchase the manufactured articles of the East. The West produces 35 per cent of the nation's petroleum, 85 per cent of the copper, 91 per cent of the gold and 96 per cent of the silver; agriculturally it produces 17 per cent of the wheat, 15 per cent of the cattle, 25 per cent of the orchard fruit and 47 per cent of the nuts. It contains the largest reserves of standing timber and has built up a flourishing shipbuilding industry. Electricity is virtually the only power used in the mines, in pumping for irrigation, in fruit packing, sugar refineries and shipbuilding. Furthermore, 90 per cent of the Western homes are wired for electricity, and there is a widespread use of electric labor-saving devices—past sales being $30 per capita as compared with $7 in the East.

The "Near West"—the Pan-Pacific area—is also looking to the United States for most of its electrical equipment and offers a rich field for the American manufacturer. Whereas the Atlantic is bordered by countries inhabited by 325,000,000 people, the countries bordering the Pacific contain 630,000,000. The Pacific area contains nearly half the globe, and its possibilities for electrical merchandising are enormous.

Central-Station Development the Fundamental Need

Central-station development is the thermometer that indicates the degree of prosperity of the entire electrical industry. While it is true that manufacturers and dealers in many lines of appliances have more business in prospect than can be cared for, nevertheless they are rapidly approaching a point of temporary saturation. Business men with a turn for analysis in electrical merchandising and manufacturing circles are beginning to take stock of the merchandising possibilities of the future. Throughout the eastern section of the nation there is a woeful lack of wired houses. In all sections of the nation there is a woeful lack of wiring standards, outlets and other facilities, this lack preventing the sale and use of appliances after they have been offered to the trade. Furthermore, it is beginning to appear that intensive competition in some lines, particularly washing machines, is rapidly bringing the point of temporary saturation very much closer than the casual observer realizes. More discouraging than all is the general shortage of central-station power. At the rate electrical equipment and appliances are now being manufactured it will be several years before there will be sufficient power available to put them all into use. In some sections of the nation—California for instance—there is an actual ban upon the purchase of all equipment and appliances that require additional installations of central-power distribution capacity, the only exception being in cases of vitally essential industries. This is because the California power companies have no power to sell. Unless more power is immediately developed more appliances cannot be sold and all the present activity for better merchandising methods and more energetic sales efforts will have gone for nothing.

Therefore it behooves the entire electrical industry to take the broader view of the situation. At present three branches of the industry—manufacturer, jobber and contractor-dealer—are riding on the crest of the wage of flourishing business. One hears on every hand of manufacturers bidding for more capital to increase their plants. But what is the use of this expansion if the prime movers of the industry—the central stations —do not grow in proportion? What is the use of larger factories and more stores filled with newer merchandise if the central stations cannot produce the electricity required to keep the new plants busy?

Why the Central Station Is Falling Behind the Other Groups

The reason the central stations are not keeping pace with the other branches of the industry is that they are handicapped in their ability to finance new developments. The steadily mounting costs of operation, without adequate increase in rates to offset the loss in net earnings, has reduced the ability of the central stations to issue securities and has likewise reduced the public demand for these securities.

To finance electrical development a protected investment and a fair rate of return for capital are necessary. To provide this safeguard for investors legislative measures, both national and local, are essential. But before this can be brought about in most localities the people as a whole must be convinced that further electrical development is going to make more business and more prosperity for them—in a word, that it is to their self-interest.

Demagogues and cheap politicians have always held "open season" on public utilities. The utilities generally, for one reason or another, have considered it an improper policy to fight back. However, those who have had the courage to fight back and the facts behind them have always succeeded in making this sort of business very poor sport for public agitators. The great American public can be depended upon always to be fair. The utility that is clean and just in its dealings has nothing to fear from taking the public into its confidence. The company that will not sell stock to its consumers, its employees and the public in general, because of a desire to preserve the usual calm of the annual stockholders' meeting, is falling behind in the race. The public and the employee have the right to purchase ownership in their public utility. The utility should be concerned in giving the maximum of efficiency in service to the public with adequately paid and courteous employees. As a matter of fact, public utility employees should be the most efficient and the best paid of any class of employees coming in contact with the public.

California Commission Says Rates Must Be Increased to Attract Capital

When a utility is worthy of the respect of its public, there usually is little difficulty in commanding it. In this connection the wording of a recent decision of the Railroad Commission of the State of California, which exercises regulation and jurisdiction over all California utilities, in granting an increase in rates to a central-station company, is interesting:

"The money necessary to develop the power plants of the applicant is costing it in excess of 7 per cent per annum, and in the present case, where applicant is expending during the years 1919 and 1920 in excess of 50 per cent of the capital previously invested, it is very apparent that applicant's consumers cannot and should not expect to receive service at rates which will not make possible payment by applicant of the cost of money and something additional as compensation for the effort exerted to serve the public.

"It is well to emphasize in connection with the matter of increase in rates for electric service that even with the increase herein authorized the percentage of increase in the cost of electric service over pre-war conditions will be materially lower than the general increase in the cost of labor and supplies which applicant has had to pay, and is less in general than the increase in the price received by applicant's consumers for their products, whether the same be labor, manufactured products or products of the farm. Applicant's agricultural consumers are, in general, receiving prices for their products approximately 100 per cent in excess of those received prior to the war, and the prices of labor and supplies have also increased from 50 to 100 per cent.

"I feel certain that applicant's consumers will gladly meet their responsibility by paying the increased rates when they realize that it is vitally essential to the prosperity of the valley that the San Joaquin Light & Power Corporation be granted an increase in rates in order that it may continue to serve its patrons adequately and meet the increasing demands for power which are continually being made upon its system."

The California commission could well have gone further. It could have pointed out to the other branches of the electrical industry their responsibility to the central station in interesting themselves in the present-day central-station financial problem. A regulated and protected central-station security is the highest type of investment obtainable. It offers an opportunity for the three other branches of the industry to invest in a way that will bring a safe and satisfactory return and also cause greater results in the enlargement of the business horizon, to the benefit of all lines of industry and activity in the entire community.

Gaining More Speed in the Laying of Conduit

Use of Concrete Spacers Between Layers of Ducts Eliminates Need of Pouring Cement on One Layer of Ducts at a Time

BY T. C. RUHLING

IN CONSTRUCTING 15 miles (24 km.) of underground transmission line from its Northeast power plant to three substations, the Kansas City (Mo.) Light & Power Company worked out some ideas that saved time in laying duct lines. The lines consist of eight-duct runs of 4.5-in. (120-mm.) fiber conduit laid two ducts wide and four ducts high, with at least a 3-in. (75-mm.) separation of concrete, and 3 in. of concrete over all. At entrances to manholes the ducts are fanned out to spacings of 18 in. (457 mm.) between centers in width and 12 in. (304 mm.) between centers in height. Each duct line contains a 13,200-volt mineral-base cable capable of carrying from 5000 kw. to 6000 kw., making the maximum power per duct run about 48,000 kw.

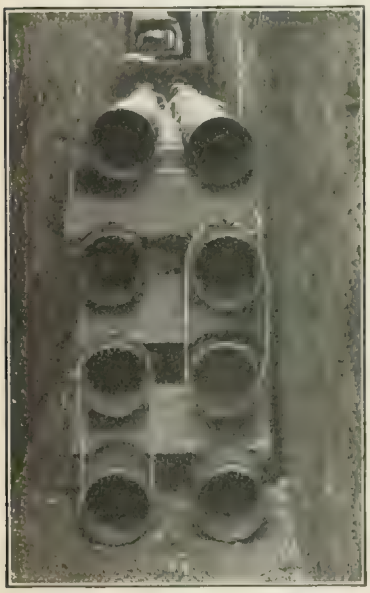


FIG. 1 — STANDARD 3-IN. SEPARATORS IN PLACE

It was desirable to pour the concrete for the entire run at one time, but there was objection to the use of wooden spacers between ducts because they are likely to absorb moisture and swell, which may crack the concrete, and because they do not have the same high value as separators which is given by concrete. The idea of manufacturing concrete separators was advanced and worked out successfully.

Several types of concrete separators have been used, some grooved to fit the fiber ducts and some simply square concrete blocks. They were all made by a crew of four men using wooden molds. This crew in a nine-hour working day would make about 400 separators. The concrete was a one-to-three mixture of Portland cement and clean sharp sand. For convenience and to save labor the separators were made at the underground material storage yard.

In laying the conduit with this scheme a 3-in. (75-mm.) base of concrete was laid comparatively dry in the bottom of the trench. Upon this the entire duct structure was built up with the concrete separators between the layers of ducts, as shown in Fig. 1. Hemp twine was used to tie the layers of conduit together and to tie the whole duct structure down so that it would not be floated when the concrete was dumped into the trench from wheelbarrows. After the conduit was built up and tied it was possible to move it about the trench to insure more perfect alignment. A straight spade or hoe with an extended blade 18 in. (45 cm.) long was used to get the concrete between the lower ducts, since any voids would reduce the protection to the ducts. While none of this trouble occurred at Kansas City, the possibility of it should be realized and guarded against. At Kansas City the conduit was covered with a 12-in. (30 cm.) plank where concrete was thrown on top of a duct in order to prevent breakage.

Special separators were used for supporting the ducts where the process of fanning out to approach a manhole was necessary. The spreading begins 25 ft. (7.5 m.) from the manhole. Graded separators placed every 5 ft. (1.5 m.) gradually increase the distance between ducts. Such a graded line set up on top of the ground where it could be easily photographed is shown in Fig. 2.

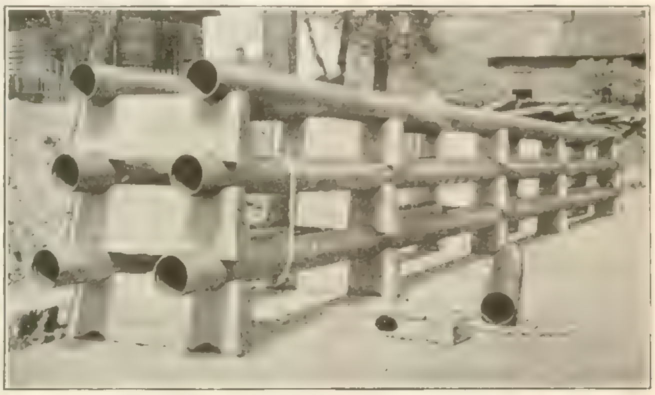


FIG. 2—GRADED SEPARATORS FOR APPROACHING MANHOLE

In addition to these grooved separators the company has also developed square separators such as are shown in Fig. 3. These are less expensive to make than are the grooved separators. Moreover, it is found that less hemp twine is required to tie the conduit in place when square separators are used. The picture showing the square separators in use was taken where special construction prevails. However, they may also be used on straight duct runs four ducts high and two ducts wide. In such places it is the practice to use short separators between the horizontal layers of ducts and long separators vertically between the two tiers of ducts. The conduits are then tied to the separators.

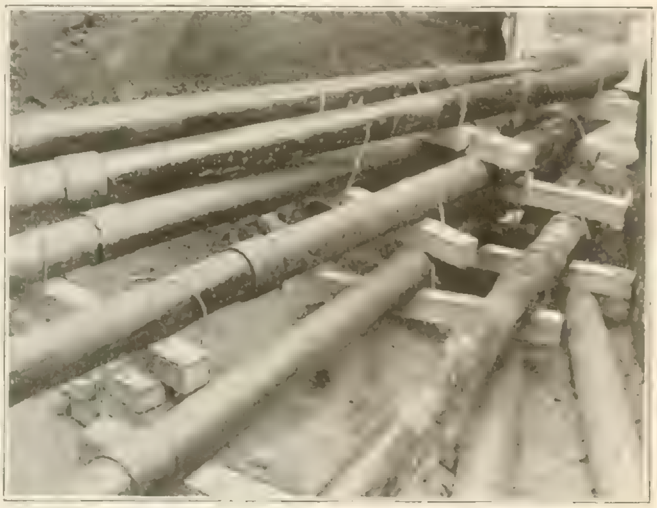
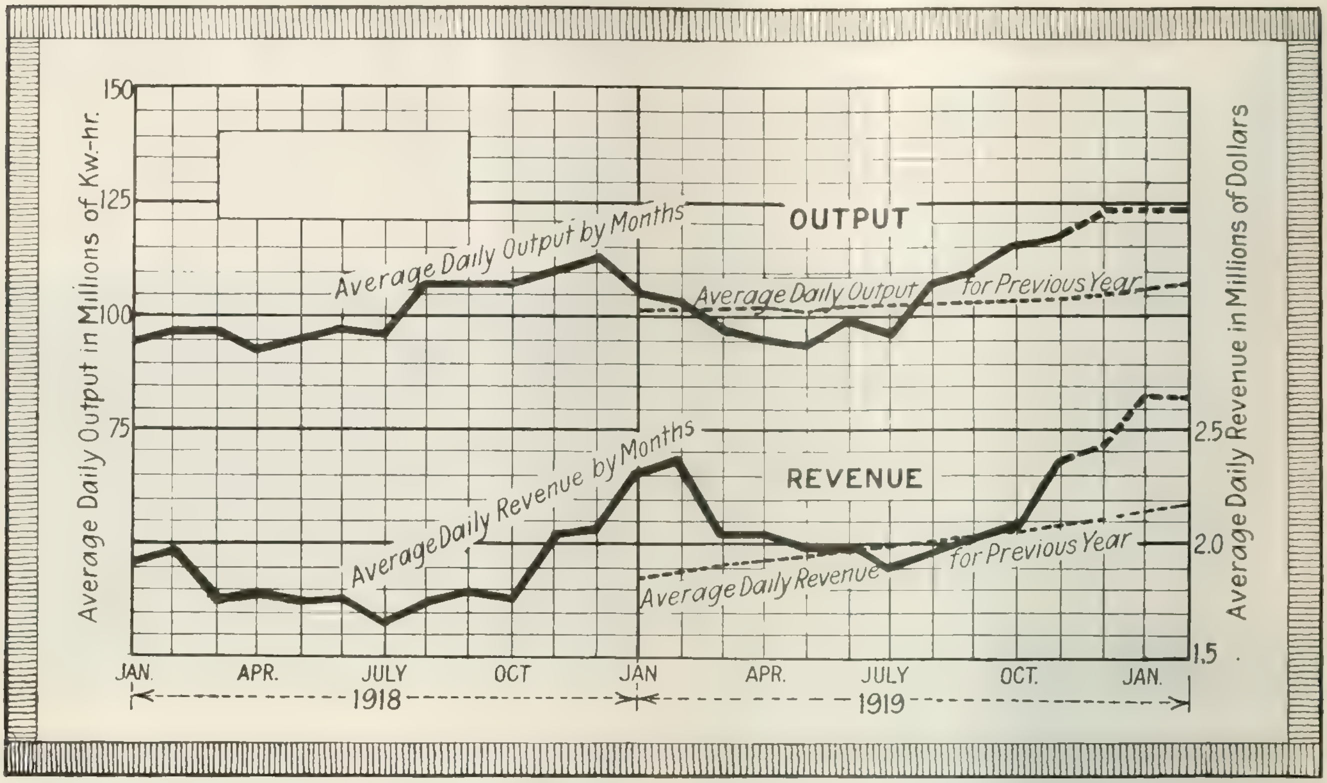


FIG. 3—SQUARE SEPARATORS ARE LESS EXPENSIVE

For a description of the manholes on the system see the ELECTRICAL WORLD for Feb. 22, 1919.

Adverse Conditions Fail to Lower Output



THE recent large growth in the utilization of electrical energy in American industry is clearly accentuated by the central-station returns received by the ELECTRICAL WORLD for the month of February. Severe weather conditions, unusual car shortage and seasonal variation in illumination requirements were factors tending to lower the output materially, but despite these three adverse conditions the daily output for February was 123,200,000 kw.-hr. against 123,500,000 kw.-hr. for January. The period during which the output of the central stations of the country can be estimated by the seasonal requirements for illumination is past, and it is evident that as electrical energy permeates the industrial world the relative importance of the illuminating branch of the industry will steadily decline.

During February the New England States experienced snow and ice conditions without parallel since 1857, resulting in a severe tie-up in the transportation of fuel and raw materials. Many factories were forced to suspend operation for lack of raw material or from inability to ship manufactured goods. But labor troubles were unusually conspicuous for their absence, and as a result the factories were able to work at nearly maximum capacity when the raw material was available, resulting in a demand for electrical energy for the month exceeding any previous record. The increased output for this section over February of last year was 27.5 per cent.

Similar power demands were exhibited in the Atlantic States. The production of pig iron was at the rate of 37,850,000 gross tons per year, representing a plant capacity of 84 per cent, and the output of steel ingots was over 44,000,000 tons per year, representing an 83 per cent capacity. This production and consequent enormous demand for electrical energy prevailed in the Birmingham district as well as in the iron regions of the Middle Atlantic States. More than 200 textile mills are under construction in the Southern States, 90 per cent of which will probably use electrical power. Demands for electrical energy by textile mills are increasing monthly, especially in North Carolina. Textile mills in Gaston County of that State contain 1,012,696 spindles, which is exceeded only by Bristol and Middlesex Counties in Massachusetts and Providence County in Rhode Island.

The Central States present a condition which is especially indicative of the increasingly large demand for electrical energy by manufacturing industries. The gain of this section as a whole over February of last year was 29.8 per cent. A close study of the returns, however, indicates that the South Central States, which are not essentially manufacturing communities, showed an increase of only about 12 per cent over February of 1919, while the energy demands of the North Central industrial States were from 33 to 36 per cent in excess of February, 1919.

The Mountain and Pacific States again emphasize the

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Per-centage of Installed Capacities Represented	Revenue from the Sale of Energy			Per-centage of Installed Capacities Represented	Kw.-Hr. Output		
		1919 Thousands	1918 Thousands	Per Cent Increase		1919 Thousands	1918 Thousands	Per Cent In-[illegible]
Mar.	45	$28,579	$24,447	17.3	45	1,359,296	1,340,210	1.0
Apr.	45	27,740	23,919	16.0	45	1,279,274	1,240,782	2.9
May	45	27,795	24,291	15.5	45	1,306,622	1,314,206	—1.0
June	47	28,175	24,701	14.1	47	1,399,951	1,367,908	2.3
July	44	25,794	22,568	14.1	44	1,309,301	1,281,874	2.0
Aug.	54	32,756	29,006	13.0	54	1,801,836	1,793,706	0.5
Sept.	53	32,344	28,336	14.0	53	1,761,582	1,695,862	4.3
Oct.	55	35,492	30,077	18.0	60	2,175,636	1,987,004	9.0
Nov.	53	37,439	31,927	17.2	58	2,055,428	1,895,693	8.2
Dec.	59	44,125	37,978	16.0	65	2,509,571	2,270,833	10.0
		1920	1919			1920	1919	
Jan.	54	44,531	37,169	20.0	64	2,450,924	2,078,880	18.0
Feb.	*57	43,835	36,020	22.8	67	2,395,065	1,920,428	24.1

*Includes estimates for twenty-five companies, representing 6.2 per cent of the total installed capacity of all central stations.

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Installed Capacities Represented.	New England States			Percentage of Installed Capacities Represented.	Atlantic States			Percentage of Installed Capacities Represented.	Central States			Percentage of Installed Capacities Represented.	Pacific and Mountain States		
			1919	1918	Per Cent Increase.		1919	1918	Per Cent Increase.		1919	1918	Per Cent Increase.		1919	1918	Per Cent Increase.
REVENUE	Mar	71	$3,561,000	$3,020,000	17.9	44	$11,809,000	$10,312,000	14.5	36	$8,991,000	$7,430,000	20.9	54	$4,218,000	$3,685,000	14.1
	Apr	71	3,468,000	2,942,000	17.8	43	11,516,000	10,213,000	12.3	36	8,427,000	7,009,000	20.3	56	4,329,000	3,755,000	16.5
	May	70	3,190,000	2,781,000	14.9	43	10,817,000	9,826,000	10.1	36	8,320,000	6,910,000	20.5	56	5,468,000	4,764,000	14.2
	June	71	3,317,000	2,904,000	14.1	43	10,605,000	9,537,000	12.0	38	8,757,000	7,504,000	16.2	63	5,496,000	4,767,000	15.2
	July	70	3,406,000	2,995,000	13.7	40	9,320,000	8,375,000	12.0	38	8,854,000	7,442,000	19.0	49	4,214,000	3,756,000	12.1
	Aug	74	4,225,000	3,693,000	14.4	57	12,174,000	10,995,000	11.1	45	10,942,000	9,309,000	17.1	61	5,415,000	5,009,000	8.5
	Sept	73	4,019,000	3,536,000	13.6	53	11,429,000	10,069,000	13.5	44	11,395,000	9,766,000	16.2	63	5,501,000	4,965,000	10.9
	Oct	72	4,127,000	3,453,000	19.1	53	12,684,000	10,822,000	16.9	50	13,241,000	11,003,000	20.1	62	5,440,000	4,799,000	13.9
	Nov	71	4,432,000	3,800,000	16.2	56	14,738,000	12,761,000	15.7	44	12,604,000	10,383,000	22.1	63	5,665,000	4,983,000	13.9
	Dec	73	4,908,000	4,254,000	15.1	57	15,926,000	13,806,000	15.8	51	14,156,000	11,903,000	18.5	77	9,135,000	8,015,000	14.2
			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan	77	5,605,000	4,695,000	19.4	57	16,237,000	13,373,000	22.0	52	15,301,000	12,779,000	20.0	75	7,388,000	6,322,000	16.1
	Feb	82	5,219,000	4,344,000	20.5	58	15,779,000	13,151,000	11.7	54	15,705,000	12,504,000	25.8	78	7,132,000	6,021,000	18.6
			1919	1918			1919	1918			1919	1918			1919	1918	
KW.-HR. OUTPUT	Mar	71	125,411,000	122,541,000	2.3	44	461,567,000	462,972,000	-0.1	36	441,604,000	422,928,000	4.1	54	330,714,000	331,769,000	-0.3
	Apr	71	123,111,000	116,411,000	5.7	43	431,572,000	424,049,000	2.0	36	382,779,000	358,858,000	6.9	56	341,812,000	341,464,000	0.1
	May	70	120,856,000	120,908,000	0.1	43	413,043,000	430,729,000	-3.9	36	390,667,000	377,525,000	3.6	56	382,056,000	385,054,000	-0.9
	June	71	127,260,000	119,217,000	6.7	43	408,335,000	419,060,000	-2.5	38	418,542,000	386,422,000	8.0	63	445,814,000	443,209,000	0.5
	July	70	141,551,000	130,393,000	8.2	40	373,105,000	378,053,000	-1.5	38	428,370,000	408,165,000	5.3	49	366,275,000	365,263,000	0.1
	Aug	74	161,431,000	153,266,000	5.1	57	640,616,000	662,120,000	-3.2	45	555,763,000	513,591,000	8.1	61	444,026,000	464,729,000	4.2
	Sept	73	153,837,000	146,209,000	4.5	53	610,254,000	610,179,000	0.1	44	573,835,000	518,767,000	11.0	63	423,656,000	420,707,000	0.5
	Oct	72	162,859,000	142,326,000	14.4	53	694,584,000	659,859,000	5.3	62	882,439,000	766,407,000	15.2	62	435,754,000	418,412,000	4.1
	Nov	71	153,171,000	140,240,000	9.2	56	724,607,000	707,347,000	2.4	56	754,838,000	657,362,000	14.8	63	422,812,000	390,744,000	8.2
	Dec	73	180,493,000	152,304,000	18.0	58	803,165,000	733,222,000	8.9	65	913,971,000	787,687,000	16.1	77	611,942,000	597,620,000	2.5
			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan	77	206,290,000	159,199,000	29.8	58	776,286,000	656,879,000	18.2	66	930,044,000	802,581,000	16.0	75	538,304,000	460,221,000	16.2
	Feb	82	186,685,000	147,659,000	27.5	58	738,677,000	618,890,000	18.0	68	963,246,000	743,719,000	29.8	78	506,457,000	460,160,000	23.4

increased importance of the industrial power demand. Activities in the copper regions were about the same as in January, and car shortage and unsettled labor conditions in the coast states affected business in all its aspects. Yet this section consumed 23.4 per cent more electrical energy than in February, 1919.

Need of Trained Electric Furnace Operators*

By Acheson Smith

President Electric Furnace Association

THE weight of steel castings made in the electric furnace has increased from 9,207 gross tons in 1913 to 108,296 gross tons in 1918. The number of electric furnaces in operation has increased from 22 in 1913 to 363 in 1919. The crucible-steel industry is one of great magnitude and is of the highest importance, but in 1918 the production of electric steel exceeded the tonnage produced by the crucible process by nearly 400 per cent. Tables I and II show comparative outputs of steel ingots and castings made by the crucible and electric steel processes in the United States since 1913.

While a large number of electric furnaces were installed for war production during the years from 1914 to 1918 inclusive, compared with previous years, the operators of electric furnaces in the United States have been busy during 1919 and have operated at a very considerable percentage of their capacity. During 1919 there were at least thirty-three new electric furnaces sold for the production of steel and at least eighty-eight for the melting of brass, which indicates that the demand for products of the electric furnace was apparently exceeding the ability of manufacturers to supply them during last year.

The possibility of using the electric furnace in the production of brass and other non-ferrous metals has just begun to be appreciated, and it is only recently that a considerable number of electric furnaces have been used in this field. At the beginning of 1919 there were possibly fifty-eight electric furnaces producing brass, while at the beginning of 1920 there were at least 146 electric furnaces engaged in this work. The results already accomplished indicate that the application of the electric furnace in this field has been highly successful, and the demand for more furnaces will follow rapidly.

The manufacture of steel and brass in the electric furnace is not simply the application of electrically produced heat in place of heat generated by gas or other means. If this were so, it would simply be a question of which gave the lowest cost. The movement in favor of electrically produced metals is far more fundamental and is based primarily upon the high quality of the products made in the electric furnace. In many classes

TABLE I—PRODUCTION OF STEEL INGOTS AND CASTINGS

Year	Crucible Process, Gross Tons	Electric Furnace, Gross Tons
1913	121,226	30,180
1914	89,869	24,009
1915	113,782	69,412
1916	129,692	168,918
1917	126,716	304,543
1918	115,112	511,364

TABLE II—PRODUCTION OF ALLOY STEELS, 1918

Process	Ingots, Gross Tons	Castings, Gross Tons	Total, Gross Tons
Open-hearth, basic	1,013,913	10,724	1,024,637
Open-hearth, acid	323,913	29,191	353,104
Bessemer convertor	41,286	23,430	64,716
Crucible steel	54,370	64	54,434
Electric steel	287,885	3,076	290,961
Total	1,721,367	66,485	1,787,852

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*Abstract of a paper presented at the joint meeting of the A.I.E.E., American Electrochemical Society and Electric Furnace Association at Boston, Mass., April 8 to 10, 1920.

of modern machinery, such as locomotives, tractors, trucks, automobiles, etc., great strains are brought upon various parts, due to road shocks and other conditions which develop during their operation. The demand for electric steel and electric brass is a result of the necessity for providing the highest possible quality of metals, in order to provide for such strains. Not only do the industries mentioned require a better grade of cast steel, forged steel and other ordinary steel parts, but they are requiring larger quantities of alloy steel, for the production of which the electric furnace is the ideal instrument where quality and uniformity must be considered.

During the war it was very difficult, and at times practically impossible, to find men to operate electric furnaces, as the furnaces were being installed more rapidly than men were being trained. After the signing of the armistice the demand for furnace operators was less acute. It was found, however, that while the supply seemed to be adequate, there was still a marked scarcity of desirable men. The trouble seems to have been that many men were drawn into this work who were not naturally fitted for it or not suitably trained, with the result that they either dropped out and took up other work or were set aside for better talent as soon as the higher-grade men could be procured. The result of this condition is that there is still a real need for competent men in practically all lines of electric furnace work.

The term "melter" is now used to designate the man in immediate charge of a furnace. "Metal superintendent" designates the man to whom the melter is responsible. He may have any title in the foundry or steel works, but his duties are primarily to operate successfully one or more electric furnaces. Such a man should have a thorough knowledge of the metallurgy involved, a complete understanding of the design of the furnace, an adequate knowledge of the electrical problems met by both the designer of the furnace and the supplier of power, and a practical understanding of the power service situation and how the operation of the furnace affects the power company. If the man has such comprehensive technical and practical knowledge of the ramifications of electric furnace work, he will so operate the furnace that he will not only get highly satisfactory results as to the quantity and quality of his output but will avoid mechanical and electrical disturbances which injure the operation of the furnace and disturb the power service by throwing undue load fluctuations on the line.

While the work of a "melter" is rough and at times arduous, it probably offers one of the best opportunities now open to young men who are not afraid of hard work. In addition to being highly remunerative, it is likely to lead to a position of greater responsibility, owing to the fact that the making of steel and other products of the electric furnace is in its infancy and will grow to very great proportions as the years go by. There is also probably no quicker way for a man to establish a reputation as a metallurgist than to engage in the production of metals in the electric furnace. Universities are providing technical courses to fit their graduates for electrical engineering and metallurgical work, and undoubtedly some of them are teaching the principles involved in the use of the electric furnace, but there seems to be a serious lack of practical training to fit men to fill positions with companies operating such furnaces.

Manufacturers' Enlarged Co-operative Effort

The Manufacturers' Council Is Developing an Organization to Afford Different Branches of the Industry a Point of Contact

When the needs of the nation in war time made better organization and increased production imperative, the associations of the electrical manufacturing industry proved their immediate usefulness as a basis for enlarged co-operative effort. Now it is planned to apply the experience thus gained and to direct the organization of the industry so that it will yield advantageous results under peace conditions.

By their work in standardization and in the settlement of many problems touching the manufacturing industry as a whole, the electric manufacturing associations have well earned a place in the economic life of the industry. In general, the primary organization of the industry includes separate associations for the manufacturers of apparatus and of supplies, the Electric Power Club embracing manufacturers of apparatus and the Associated Manufacturers of Electrical Supplies embracing manufacturers of supplies. It was because no means existed for co-ordinating the work of these organizations and the oldest association of manufacturers, the Electrical Manufacturers' Club, that a further step was taken four years ago, when the Electrical Manufacturers' Council was formed then as a connecting link.

Although the Electrical Manufacturers' Council has been in existence, as just stated, for more than four years, the importance of its work has not heretofore been understood generally outside perhaps of the manufacturing part of the industry. While its work in the main is to co-ordinate the organizations of manufacturers in the industry, it also recognizes an obligation to the entire industry and in its policies and action it seeks to advance the interests of all.

As the result of an informal discussion of the fact that the existing organizations of manufacturers had no means of co-ordinating their work, a meeting of representatives of the three associations was held in New York on Feb. 7, 1916. It was decided to form a unifying council and formal organization was thereupon effected. At the second meeting a constitution and by-laws were adopted. Later, as the scope of the work was broadened, these were amended. Following are the objects of the council as now set forth in its constitution:

1. To recommend to the member organizations such policies as will in its judgment promote the welfare and interests of the electrical manufacturing industry.

2. To co-ordinate by all lawful and proper means the work of all member organizations.

3. To furnish to member organizations a clearing house for all questions of common interest which may be presented by any member organization, so that conflicting action may be avoided and concerted action taken where necessary.

4. To afford facilities for conferences between member organizations and other organizations, so that close co-operation may be secured.

5. To exercise such functions and undertake such work as it is specifically authorized to perform by favorable action upon the part of each member organization.

In carrying out the objects of its creation the council has construed its functions broadly. The immediate opportunities for its work arise in the divergent lines of activity in the three associations. As those who are familiar with the electrical manufacturing industry know, the existing organizations have a total membership of from about 275 to 300 companies.

BROAD SCOPE OF COUNCIL'S WORK

A review of the proceedings of the council on several of the matters of general interest which have been brought before it indicates the broad scope of its work.

One of the first subjects suggested for consideration was that of uniform cost accounting. As a result of the work of a standing committee a system was developed which met the approval of Edward N. Hurley, then chairman of the Federal Trade Commission. This system is designed for use by either large or small companies, and it has been installed by many manufacturers. Revisions in the system to keep it up to date are made by the committee, whose work is continuous.

Another subject which is more indicative of the public-policy character of part of the work of the council was the action taken upon recommendation of a committee after consideration of the question of safety codes. The result of this was the formation of an Electrical Safety Conference, consisting of representatives from the Bureau of Standards, the National Workmen's Compensation Service Bureau, the Underwriters' Laboratories and the Electrical Manufacturers' Council.

Upon request of one of the constituent organizations of the council an extended study was made by a special committee for the purpose of effecting standardization of trade literature in the electrical manufacturing industry. The outcome of this study was the recommendation that standards be adopted of 8½ in. by 11 in., side binding, for all electrical catalogs, bulletins, data sheets, contract forms, letterheads and large price sheets, and of 4 in. by 7 in., side binding, for small price lists and data sheets accompanying them.

In the interest of the entire industry a committee was appointed by the council at the request of one of the member associations to give careful consideration to the subject of electric shows and exhibits. As a result the council is promulgating rules which it recommends to manufacturers as a guide in maintaining a high standard in such shows.

WAR SERVICE THAT WAS RENDERED

A plan for the organization of a general war service committee of the electrical manufacturing industry was adopted at a meeting called by the council on Nov. 2, 1917. The effectiveness of the organization during the war attracted much attention from government officials, who stated that the industry was better organized to assist in meeting the war requirements.

From the governmental contact thus formed there developed naturally other activities which under the different conditions of peace are still being conducted with a view to aiding both the governmental departments and the electrical manufacturing industry as a whole.

To further the transaction of its growing work the council decided recently to open an office in New York. Frederic Nicholas has been appointed executive secretary to carry out the policies of the council. It is the desire to enlarge the work in every possible way which will co-ordinate the existing associations of manufacturers and promote their useful development.

The members of the council are as follows:

Representing the Associated Manufacturers of Electrical Supplies—J. F. Kerlin, Corliss Carbon Company, Inc., Bradford, Pa.; W. T. Pringle, Pringle Electrical Manufacturing Company, Philadelphia; Warren Ripple, George Cutter Company, South Bend, Ind.; J. H. Trumbull, Trumbull Electric Manufacturing Company, Plainville, Conn.

Representing the Electrical Manufacturers' Club—D. R. Bullen, General Electric Company, Schenectady, N. Y.; LeRoy Clark, Safety Insulated Wire & Cable Company, New York; E. B. Hatch, Johns-Pratt Company, Hartford, Conn.; S. L. Nicholson, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Representing the Electric Power Club—J. C. Hobart, Triumph Electric Company, Cincinnati; C. L. Collens 2d, Reliance Electric & Engineering Company, Cleveland; E. R. Harding, Holtzer-Cabot Electric Company, Chicago; H. C. Petty, Crocker-Wheeler Company, Ampere.

VIEWS OF THE COUNCIL'S CHAIRMAN

S. L. Nicholson served as chairman of the council since the day of organization. In discussing its work Mr. Nicholson said:

"The main affiliations of the council are, of course, with the associations from representatives of which its membership is made up. It does, however, act as the co-ordinating body in reference to general matters affecting the relations of the Electrical Manufacturers with other organizations, those, for instance, with regulatory or engineering functions and those which may be classified as customer organizations. In other words, the council co-operates with the other associations on general matters and co-ordinates their activities. After the council has established the contact between different associations as a matter of general practice, specific questions or subjects, touching, for instance, the standardization of particular lines of products or conferences in reference to particular lines of products, are handled directly between the respective organizations or their sections, groups or committees and the committees of the other organizations. After the establishment of the initial contact, therefore, in many instances the work would not of necessity be sent to the council again. By maintaining constant contact with the various associations and the various governmental departments the council will, it is believed, render a service to them as well as to the manufacturers. There are many ways in which the different branches of the industry want to have contact with the manufacturers as a unit in order that results may be worked out which will promote the best interest of the industry as a whole.

"The Electrical Manufacturers' Council has done its work in the past without seeking any publicity. The work has now increased to such a point that it has become necessary to have a permanent office and to develop an organization to operate continuously, and this is being done by making the position of secretary an executive one instead of an honorary one as previously.

"A permanent office will be opened in New York in the near future, thus enabling the council to come into closer contact with other branches of the industry and thereby facilitating the work for the constituent organizations of the council. Heretofore there has been no single headquarters in New York for the electrical manufacturing industry as a whole. The great growth of the industry and the promising outlook for its future make it desirable now to have such an office with facilities for constructive upbuilding work."

Readers' Views and Comments

Need for Testing Rope Used by Linemen

To the Editor of the ELECTRICAL WORLD:

SIR: The Dayton Power & Light Company recently had an unfortunate experience in the use of ropes on 6,600-volt lines about which other central stations should be informed. The company has always endeavored to buy the best manila rope for use by its line department. Recently a coil of half-inch rope was purchased from the usual supply house and sent out on the line. One line crew were working over a 6,600-volt line, and as the groundman took hold of the lead line he was severely shocked and slightly burned. Another line crew shorted a 6,600-volt line before the rope was removed. In another case, when a street-lighting patrolman attempted to lower a street lamp, his hand line dragged over a railway feeder, severely shocking him.

All these cases occurred on two consecutive days, and samples of all ropes in supply and in use by the line crews were called in and given a high-tension test. The trouble was traced to a new coil. All of the rope from this coil broke down at from 500 to 7,000 volts per foot, while other samples withstood 36,000 volts per foot. The rope from the defective coil was immediately pulled out of service and on investigation was found to contain a small steel wire 0.007 in. in diameter. The wire was very difficult to find, but by fringing several inches of the rope and burning it off its presence was detected. The rope contained the usual marker, but the manufacturer claimed that by mistake the strand containing the steel wire, which is used as a marker for another style of rope, had been included in the coil.

This mistake, having happened at least once, may happen again. An order has therefore been issued that all rope purchased by the company, before being placed in stock, shall be subjected to a high-potential test.

F. A. KENTIG,
Dayton, Ohio. Dayton Power & Light Company.

Teachers Need Recognition More Than Salary

To the Editor of the ELECTRICAL WORLD:

SIR: The remarks which appeared in your issue for Jan. 31, page 269, under the title "Supporting Educational Institutions," are very interesting. Every one seems concerned about the question of financial support and the necessity of increasing the salaries of schoolteachers and college and university professors and instructors. It seems to the writer, however, that this is particularly important in the case of the schoolteachers; in the case of colleges and universities he is inclined to believe that the problem was before the war and still is infinitely more complicated than would be the mere matter of raising salaries. The writer remembers distinctly the remark of an educator to the effect that a certain leading university had done more important work while it was housed in wooden shacks than it had since it acquired beautiful and well-equipped laboratories and buildings.

It seems to me that what the instructional staff of universities and colleges needs is *recognition.* By recognition I mean academic recognition which would allow these men the time and facilities to undertake researches. By academic recognition I mean support and encouragement of the staff as well as of the students who give promise of making noteworthy contributions to letters and art as well as science. In order to impress the reader with the importance of this, let me quote W. R. Whitney:

"We are generally superficial. The interesting lives of a few exceptionally able American inventors have led us to overprize engineering short cuts. We are patenting inventions at the rate of nearly 50,000 a year, but very few Americans are advancing the sciences at all. We need to be told that beneath national supremacy must lie some sort of national foundation, and if we are considering technical, industrial or engineering supremacy, we must expect to need some constructive work in the bases of physics, chemistry, electricity, etc."

These remarks might sound rather academic, particularly to the materially successful man in the ordinary sense of the word; but as the war of the last five years has shown, and as any one who is willing to look up the history of ancient civilizations such as those of Athens, Sparta, Rome and Egypt will find, in the last analysis our national greatness in a generation or two will depend upon and will be in the measure of our fundamental contributions to the arts, letters and pure and applied sciences—and in the last-named classification I include all engineering activities. What we need is academic recognition, community and state recognition and national recognition of students and instructional staffs who show promise or do actually attain leadership in pure and applied politics, in pure and applied economics, in pure and applied art and in pure and applied science, including not only chemistry, physics and mathematics and all their engineering applications, but also the pure sciences of biology, psychology and their medical applications.

What is needed is a sane, sound, spontaneous and genuine recognition. The kind of recognition needed is the kind that Greece accorded to its athletes by tearing down part of the walls of the city to show that " 'tis not the walls that make the city, but the men," and that a city which had such men did not need its walls. It is this type of recognition—spontaneous, whole-hearted, accorded by an intelligent, educated, appreciative public—that is needed.

In the extraordinary times in which we are living, with Europe war-torn, her central nations unsettled, Russia a prey to the bolsheviki, China still slumbering, Japan expanding, the Near Eastern problem unsolved—and these things all unfortunately do affect our national and international policies and render them more complicated—let us recognize the necessity pointed out by E. H. Behrend more than a year ago "to turn to our schools and colleges and demand a degree of excellence such as we have demanded in our industrial achievements on the largest scale imaginable, with unparalleled and unexampled results. Then, and then only, may we face the future calmly; thus, and thus only, can we merit our place as the arbiter of the world."

Yes, let us demand "Homeric excellence" from our schoolteachers and university men, and in proportion to their "Homeric excellence" let us reward and honor them.

Lockport, N. Y. N. S. DIAMANT.

Station and Operating Practice

A Department Devoted to Problems of Installation,
Operation and Maintenance of Equipment for Economical Generation and
Distribution of Electrical Energy

Itemized Cost of 33,000-Volt Line and Substation

ABOUT $16,700 was the cost of a 2,250-kva., 33,000/-2,300-volt outdoor substation and $13,300 was the cost of a 1.5-mile (2.4-km.) feeder line completed in the Middle West in March, 1919, itemized costs being shown in the accompanying tables. The transformers in the station were old indoor transformers made over for outdoor service and the cost of the change only is included (b). One set of lightning arresters (a) is at each end of the line, and no oil switches are included in the costs, though the four bushing transformers (l) which were installed in the KO-26 oil switch at the substation are listed at $434 each. The ten disconnecting switches (h) are at the central-station end, as well as the majority of the 1,000,000-circ.mil cable (l) which feeds three 3,750 kva. transformers about 110 ft. (33 m.) from the 2,300-volt buses. The tubing in (l) was used for high-tension buses and connections at both sides. The twenty 70,000-volt insulators (k) are likewise in the central station, as are three roof bushings (c). Three more bushings were installed at the same time for a future feeder, but they have been charged only in the labor and miscellaneous materials items. The secondary meters and switches are in a small steel switchhouse at the substation. The line was run with No. 2 solid copper on pin-type insulators supported on 60-ft. (18-m.) cedar poles.

TABLE I—COST OF 1.5-MILE, 33,000 VOLT LINE TO 2,250-KVA. SUBSTATION

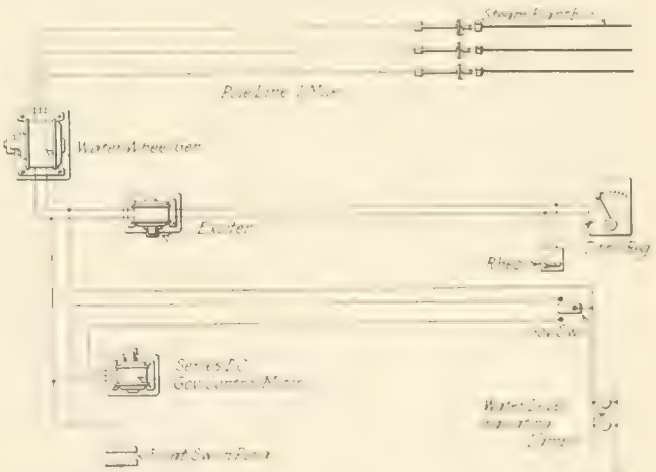
	Item	No.	At	Cost
A.	Copper wire, all sizes	10,505	$0.29029	$3,049.46
B.	Insulators	500	....	845.16
C.	Reels	1	....	1.50
D.	Cedar poles	98	29.33	2,872.15
E.	Cross-arms	165	1.54	254.61
F.	Angle-iron cross-arm braces	145	1.135	164.56
G.	28-in. braces	8	0.146	1.17
H.	Iron pins and thimbles	335	0.624	209.04
I.	Pins, all kinds	428		88.14
J.	Pole steps	2,665	0.0502	133.39
K.	Guy wire	4,645	....	109.33
L.	Ground supports	90	1.117	100.53
M.	Bayonets	40	0.635	35.40
N.	Miscellaneous hardware	....	.....	177.78
O.	Miscellaneous material		......	127.54
P.	Labor	.....	......	2,465.18
Q.	Storage, freight and trucking	.....	.....	779.41
R.	Ford automobile	....	...	486 83
S.	Liability insurance	....	......	139.82
T.	Contingencies	....	.. .	10 75
U.	Engineering and supervision	.....	.. ...	1,234.52
	Total			$13,286.27

TABLE II -COST OF 2,250-KVA. OUTDOOR SUB-STATION FOR TRANSFORMING FROM 33,000 VOLTS TO 2,300 VOLTS

	Item	No.	At	Cost
a.	Banks of outdoor lightning arrestors	2	$2,600	$5,200.00
b.	Changing transformers, bushing and supplies	...	....	1,565.25
c.	Roof bushings	3	91.67	275.00
d.	Potheads for 1,000,000-circ. mil cable	18	8.55	153.90
e.	Copper tubing and cable		.....	832.76
f.	Copper	.	..	25.36
g.	Disconnecting switches	3	21.67	65.00
h.	Disconnecting switches	10	46.56	465.60
i.	G-1 bus insulators	10	10	100.00
j.	Insulators	10	0.152	1.52
k.	20,000-volt pin insulators	20	9.55	191.00
l.	Bushing transformers	4	434	1,736.00
m.	Relays	.	.. ..	139.25
n.	Pipe and pipe fittings		. .	16.75
o.	Conduit	1,100	0 05203	57.23
p.	Cross-arm braces	4	0.092	0.37
q.	Panels	2	700	1,400.00
r.	Panel cut-out	1	1 20	1.20
s.	Structural material			411 95
t.	Foundations			315.45
u.	Link and fabric fence	185		179.00
v.	Miscellaneous hardware			159.14
w.	Miscellaneous material			246.31
x.	Labor			1,528.03
y.	Storage, freight and trucking			468 65
z.	Liability insurance			29 47
aa.	Contingencies			21.87
ab.	Engineering and supervision			1,112.14
	Total			$16.698.20

Home-Made Remote Control for a Small Water Power

REMOTE control of a small Western hydro-electric plant was accomplished by running two light control circuits to the main steam plant one mile (1.6 km.) away. Remote control was thought advisable in this case because the size of the hydro-electric plant did not warrant maintaining an operator, yet there were times of light load when this plant could carry the total output. Therefore, as the hydro-electric plant was fed through the busbars at the steam plant, it was decided that the Tirrill regulator connected to the bus in the latter could control the voltage of the hydro-electric plant when operating alone. This necessitated a small circuit for carrying only the exciter-field current of the hydro-electric plant to the Tirrill regulator.



TIRRILL REGULATOR USED TO CONTROL WATER TURBINE ONE MILE AWAY

When the hydro-electric plant is operating alone this regulator controls the voltage on the exciter field of the hydro-electric plant in accordance with the bus voltage at the steam plant. For controlling the gates on the water turbine a line of copper-clad No. 10 wire was run to the governor motor in the hydro-electric plant. By this means the speed and load of this plant are controlled from the steam plant. In order to let the steam-plant operator know when the water in the pond is low, a float switch is arranged to make contact with a grounded connection, which causes two signal lamps in the steam plant to light as they are connected from ground to one of the control wires. FRANK D. ELWELL.

Dayton, Ohio.

Fish Keep Water Fresh in Cooling Towers

BY PLACING carp in their cooling towers, the Utah Power & Light Company has solved the troublesome problem of preventing an accumulation of algæ and other water growths. This company studied the problem for some time without success until the present system of keeping the cooling towers stocked with fish was hit upon. Chemical solutions designed to prevent water life did not seem to help, but shortly after placing a few carp in each tower the water cleared up, and it has since remained in a satisfactory condition. The fish require no special care and do not interfere with the purpose for which the cooling tower was designed. This method has proved so simple and satisfactory that it is being adopted by other Western companies to meet similar conditions. L. J. MOORE,
Electrical Engineer.

San Joaquin Light & Power Corporation,
Fresno, Cal.

How Electrode Regulators and Proper Reactance Help Furnace Operation

ALL electric furnaces demanding 300 kv. or more of power should be equipped with automatically regulated electrodes, and the impedance of the furnace circuit should be proportioned to give a power factor between 80 per cent and 90 per cent for normal operation on hot metal. Such was the gist of recommendations of a recent conference of engineers which studied furnace loads from the central station's viewpoint. The conclusions of this conference were as follows:

"When an electric arc furnace is used for melting cold scrap, certain momentary fluctuations in power demand will occur which are so violent that neither electrode regulators nor feeder regulators can respond quickly enough to suppress circuit voltage fluctuations entirely, especially if the furnace is of any appreciable size and is somewhat removed from the generating station. As electrode regulators, however, will immediately endeavor to restore the equilibrium, the fluctuations will not persist for as long a time or be quite as frequent as when electrodes are controlled by hand. After cold scrap has been melted down very violent fluctuations do not as a rule occur. The committee therefore feels that all furnaces demanding power in quantities of 300 kv. or more should have automatically regulated electrodes.

"The impedance of the furnace circuit is the only limiting factor controlling the more violent fluctuations. The committee recommends that the impedance of the furnace circuit shall be such, either by inherent transformer reactance or by installation of external reactance, that the furnace, when operating normally on hot metal, shall operate at a power factor not less than 80 per cent and not more than 90 per cent."

Bearing Clearance Measured with Lead Fuse Wire

THE efficiency of operation of a steam turbine depends to a great extent on the condition of the bearings and lubricating systems. Therefore they should be carefully watched for any trouble. Bearing clearance on turbo-generators of 200 kw. to 5,000 kw. should be kept from 0.005 in. to 0.0010 in. (0.12 mm. to 0.25 mm.). This clearance may be tested by use of a lead fuse wire. After removing the top shell of the bearing two or three pieces of this wire are placed on the journal, and then the top shell is replaced and bolted down to its usual position, thus flattening the soft wire to the thickness of the clearance. The fuse wire is removed and by measuring with a micrometer the clearance is ascertained. If a bearing is allowed to run loose, the journal will wear out of "round" and eventually cause serious trouble.

As important as the bearings is the condition of the oil which lubricates them. Some oils form a thick coating on the oil-cooling coils, and this makes an effective heat insulator, preventing proper cooling of the oil. Therefore it is advisable to install a thermometer in the oil lines feeding the bearings and coming from the bearings. Records of occasional readings on these thermometers will show any excessive temperature rise so that the trouble may be investigated. Although the thrust bearings of steam turbines sometimes reach a temperature of 175 deg. Fahr. (65 deg. C.) without causing damage, they should, if possible, be kept below 160 deg. Fahr. (50 deg. C.). THOMAS HALL.

Ridgway Dynamo & Engine Company,
Ridgway, Pa.

Handling Ashes from Twenty-two Boilers by Centrifugal Pumps

BY USING water to wash away the ashes from twenty-two 500-hp. Babcock & Wilcox boilers in the Lake Linden (Mich.) power plant of the Calumet & Hecla Mining Company only two eight-hour shifts of two men are required. In this system the ashes are dropped from ash hoppers into a 30-in. (75-cm.) semicircular steel trough, supported on a metal framework as shown in the accompanying photograph. The ash hoppers are large enough to hold the ashes from two cleanings of the boiler under any conditions, and if the coal is of a fair quality, the hoppers will hold three cleanings of ashes. The pipe leading into the trough is an 8-in. (21-cm.) water main, and after the valve in this main has been opened the ashes are gradually dropped into the trough and washed away to centrally located pumps. The troughs are arranged in the shape of a letter H with boilers along each side and with the dumping place for the ashes in the center. The ashes are washed on to a grating from each side and dropped down into duplicate centrifugal pumps each of which is of sufficient capacity to handle the ashes. Any large pieces of clinker are broken up when they get on to the straining bars.

The storage capacity of the ash hoppers permits the use of only two shifts of ash handlers, each working eight hours. Two men work from 7 a.m. to 4 p.m., and two others work from 7 p.m. to 4 a.m., with one hour off each shift for meals. This leaves a three-hour stretch between each shift and two meal hours when there are no ash handlers on duty. In this way it requires only thirty-two man-hours to handle about 50 tons of ashes, which is at the rate of more than 1.5 tons of ashes per man-hour. This proved a very convenient and economical method of handling the ashes in the power house, but the principal gain over the old ash-car system is in the elimination of the cost and inconvenience of attempting to remove the ashes in cars.

ASH TROUGH AND WATER CONNECTIONS FOR REMOVING ASHES BY PUMPS

The pumps each have a maximum capacity of 1,800 gal. per minute (110 l. per second) against a hydraulic head of 30 ft. (9 m.). Each pump is driven at 510 r.p.m. by a belt from a 50-hp., 440-volt, three-phase, 25-cycle, 750-r.p.m. squirrel-cage induction motor. The pump impellers were specially designed of hard cast iron to withstand the action of the ashes. It has been found that the impellers have to be renewed about every seventh week, and the cost of every such change is about $30. The pumps are so connected that they may be operated independently or together, as desired.

ARVID BAALACK,
Calumet & Hecla Mining Co., Mechanical Engineer.
Calumet, Mich.

Street Light Troubles Caused by Bugs

SOME unusual troubles from bugs and breakage of globes have been encountered in the lighting fixtures of Lincoln Park, Chicago. This park lies along the shore of Lake Michigan, and at certain seasons of the year numbers of small semi-transparent sand flies settle in droves on the globes, in some cases completely covering them. Their bodies stick to the globe and melt and no ordinary solvent has been found to take them off. Scouring with sand is the only ready method of removing them. Another source of trouble is spiders and spider webs, which accumulate on the compensator, socket and interior of the globes. As many as 200 or 300 spiders have been found in one globe. For removing them air is blown into the globe through a small nozzle supplied with air from a tank carried on a tower wagon.

Breakage of globes is another serious source of loss encountered. During 1919 171 20-in. globes of Alba glass which cost about $16.40 each were broken, amounting to 10.45 per cent of the total number installed. This breakage is caused by malicious throwing of stones, by vehicles colliding with the lamp posts and by handling the globes for cleaning, etc. In handling the globes, as their cost is so high and as the cleaner sometimes is seriously injured, only careful and trained men are used. They work from a wagon tower. Dry rags are ordinarily used in this work, and waste saturated with alcohol is employed to remove sticky substances. The cleaners first replace lamps reported "out" the night before, which average two or three per man, and then start cleaning. The number cleaned varies from forty to seventy per day, depending on the weather.

C. S. SHEPHERD,
Chicago, Ill. Electrical Engineer.

Accurate Timer Holds Voltage Constant When Testing Meters

FOR testing watt-hour meters a device has been developed by the Merchants' Heat & Light Company, Indianapolis, Ind., which allows the meter to run exactly thirty-six seconds, or one-hundredth of an hour. By this instrument computations of the meter speed are greatly simplified. The operation of the equipment is as follows:

Alternating current passing intermittently through the series arc-lamp coil *C* moves a ratchet wheel carrying pins which close contacts energizing first a coil *A*, which closes the meter potential circuit, and thirty-six seconds later energizing coil *B*, which opens the circuit. A clock pendulum carries a pin which swings the sector of a small meter gear in alternating directions. When the sector swings to the right it rests on a pin connected to one 2,300-volt terminal of a potential transformer. The other side of the transformer is connected to the brass base in which the sector is pivoted. The 2,300-volt side of the transformer is thus short-circuited. The 110-volt side is connected across a 110-volt alternating-current line in series with the coil *C*, the lamp *L*, which limits the current, and the auxiliary coil *D*. When the high-voltage side of the transformer is short-circuited its induction is low, and current passing through *C* pulls down the core to which is attached a spring which moves the ratchet wheel one notch. On the wheel are two pins which close two spring contacts.

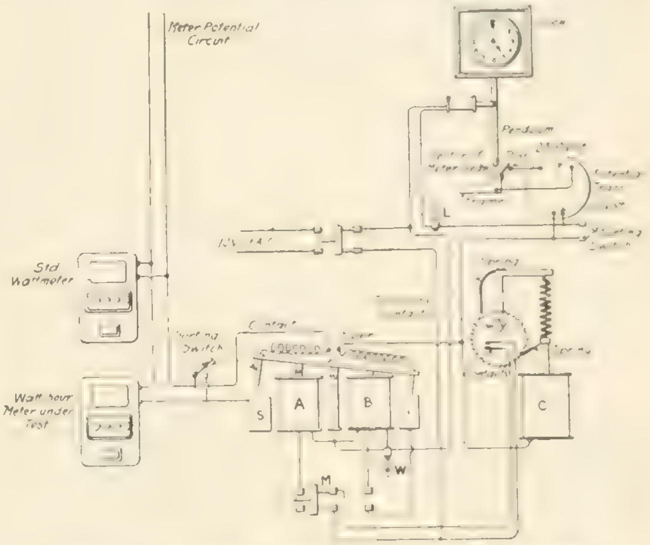


DIAGRAM OF DEVICE FOR TIMING WATT-HOUR METER

To start, the switch *M* must be thrown to the left. Then, when the contacts first close they energize the coil *A*, which closes the potential circuit on the meter through the contact, which is lowered into the mercury in the brass cup *S*. The spring contacts will again close in exactly thirty-six seconds. In the meanwhile the switch *M* must be thrown to the right. When the contacts again close, the coil *B* is energized, opening the meter circuit, short-circuiting the coil *C* and thus stopping the motion of the wheel. The lamp *W* lights as a signal. The auxiliary coil *D* was attached to assist the clock spring in swinging the pendulum, but it was found to be unnecessary with a good clock.

A single-pole switch is connected to the potential leads so that the meter may be run for trial.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

Home-Made Emergency Motor Starters

UNDER conditions where it is necessary to start a motor without the use of its regular starting devices the emergency methods outlined here have proved very useful. In the case of small direct-current motors up to 25 hp. an emergency starter can be made of iron wire, such as bale wire, fence wire or stove-pipe wire, wound in open spirals or on wooden sticks with switches connected so that the starting resistance can be shorted. For small motors a single step (Fig. 1) will answer, while for larger motors two or more steps are advisable (Fig. 2). The field should be connected so that its current does not go through the starting resistance. Larger direct-current motors up to 100 hp. or more can be started on a water barrel. The best upper terminal for this barrel is a piece of chain as its loose construction gives a large number of contact points and low resistance when it is lowered to the bottom of the barrel. For motors over 25 hp. a switch to short-circuit the water barrel after starting is advisable. If the barrel is of metal, it should have wooden slats arranged inside to prevent accidental contact with the chain.

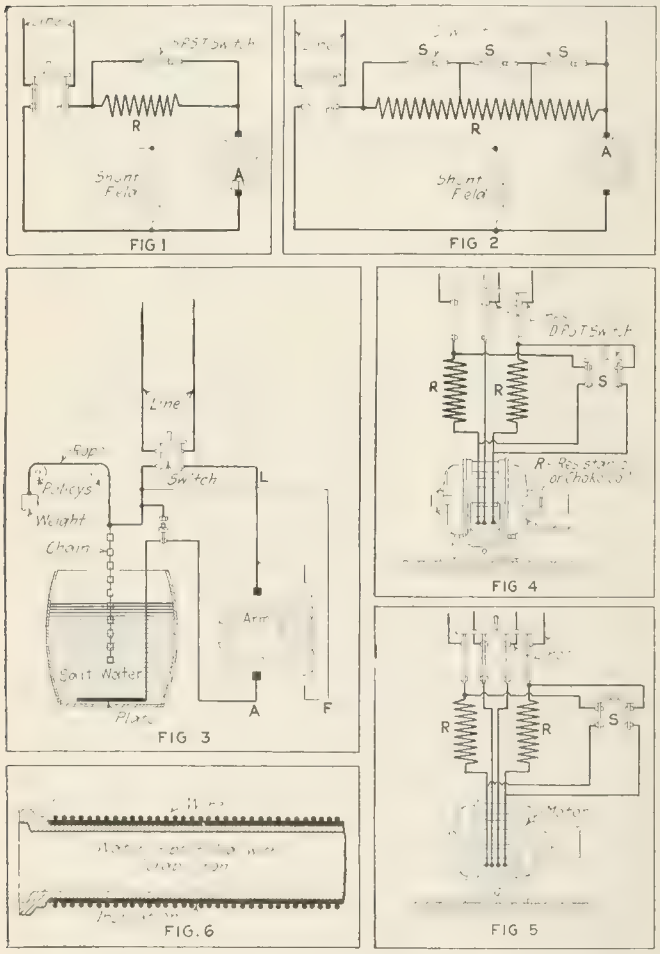


FIG 1 FIG 2 FIG 3 FIG 4 FIG 5 FIG. 6

EMERGENCY STARTERS FOR DIRECT-CURRENT AND ALTERNATING-CURRENT MOTORS

Alternating-current motors can be thrown directly on the line with less chance of trouble than can direct-current motors, and in case of damage to a starter this method can often be used for motors as large as 20 hp. An emergency starter for alternating-current motors may be of either the resistance or the impedance type. A resistance starter made of iron wire, box strap or any available resistance material which will carry the current should usually give the motor about 50 or 60 per cent of voltage at the start. Fig. 4 shows the arrangement for a three-phase motor and Fig. 5 for a two-phase motor, *RR* indicating the starter resistances and *S* a two-pole switch for short-circuiting them after the motor is up to speed.

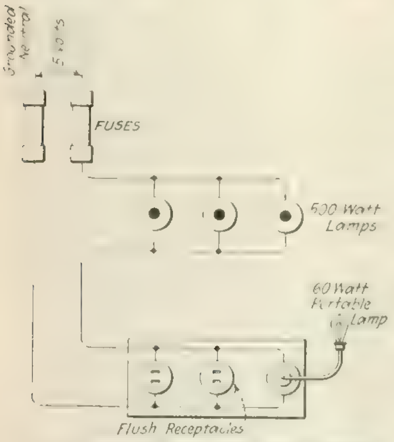
With a resistance starter all power not used by the motor is wasted in the resistance, and to reduce this waste it is sometimes desirable to use impedance or choke coils, particularly for large motors. Usually the only impedance coils that can be obtained in the field are transformers. By connecting a transformer winding in each phase (at *R*, Figs. 4 and 5) the motor can be started just as if resistance were used. The windings used should be able to carry full motor current, and the other windings of the transformer should be left open and carefully insulated, as nearly full voltage will be induced in them. Impedance coils can be made by winding insulated wire around iron cores such as iron water pipes filled with scrap iron. The better the magnetic circuit the greater choking effect will be obtained; therefore, it is well to lay the two coils close together so that the iron in one will help the other. A starter of this kind built to start a 400-hp., 6,600-volt motor was made with a coil in each phase consisting of about 500 ft. (150 m.) of No. 14 (2.1 sq.mm.) bare iron wire. The 12-in. (30-cm.) pipes were first lagged with wood and then the wire was wound on tightly with occasional staples to hold the turns ¼ in. (6 mm.) apart. The wire was a little too light for the job, and the pipes were placed in a tank of transformer oil, but even then it ran hot on every start and burned in two occasionally. The resistance or impedance starter gives a very smooth start.

On another occasion the same 400-hp., 6,600-volt synchronous motor was started by connecting directly to a 1,200-kva. generator after the voltage at the generator was reduced to 4,800. The voltage drop on the line with the heavy, low-power-factor starting current was about 1,000 volts, giving 3,800 volts, or about 58 per cent of rated voltage on the motor. As the motor came up to speed the voltage was slowly raised at the generator until 6,600 volts was reached, after which the motor field was connected to the line. Several starts were made in this way without difficulty of any kind.

Cleveland, Ohio. **JAMES DIXON.**

Large Lamps in Series with Portable Lamps Save Fuses

BY CONNECTING three 500-watt lamps in series with receptacles for 60-watt portable lamps in the Missouri, Kansas & Texas railroad shops at Parsons, Kan., a large number of fuses have been saved. The rough usage given flexible cords and portable lamps in this shop formerly resulted in the loss of much time and many fuses from short circuits. When a portable lamp is short-circuited the men usually try it on another circuit to find out if the portable or the circuit is at fault, with the result that a second set of fuses is blown. The entire trouble has been eliminated by connecting a bank of three standard 115-volt, 500-watt lamps in parallel, with one lead from the bank connected to the lighting circuit and the other lead to a group of the receptacles used for portables. The other side of the lighting circuit leads directly to the receptacles, which are installed in groups of three on convenient pillars in the building. By this arrangement when one of the portables is short-circuited the three large lamps in parallel limit the current to about 14 amp. or 4.5 amp. per lamp. As the fuses in this branch circuit are rated higher than 14 amp. they will not be blown. In fact, all of the portables may be short-circuited without materially increasing the current above 14 amp. In order to indicate that a portable is short-circuited a hole is cut in the bottom of the protecting iron box in which the large lamps are mounted so that they may be seen when they light. In addition to indicating a short-circuit, the lamps indicate and also protect against a grounded portable lamp or cord. In order to insure this, the large lamps are always connected to an outside wire of the three-wire, grounded-neutral lighting circuit. When operating normally the voltage drop across the three large lamps in parallel is only about 4 volts for each portable in use on a receptacle, so the portable lamps burn with sufficient brightness for the mechanic's needs.



LARGE LAMPS LIMIT CURRENT WHEN PORTABLE LAMP IS SHORT-CIRCUITED

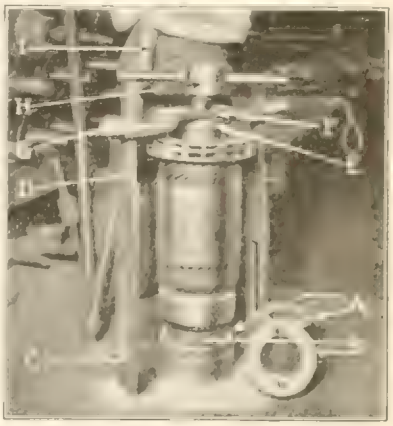
C. H. GRIFFITH,
Electrical Engineer.
Parsons, Kan.

Method of Tightening Commutators on Large Motors

THERE are two general methods of clamping and holding commutators on direct-current motors—the bolted and the ring-nut methods. In the first instance a number of hexagonal-headed bolts are equally spaced around the V-ring. These are drawn tight by means of a standard socket wrench. For the ring-nut method of tightening the commutator a small ring nut is threaded on the commutator bushing. The side of this nut is drilled with two small holes in which dowels on a special spanner wrench are engaged to draw this nut into place.

It is usually a rather difficult matter to obtain a tight commutator when a ring nut is used, even where a suitable spanner wrench is available, as there is a tendency for the dowels on the wrench to slip out of the holes in the ring nut. In order to avoid this trouble the workman will resort to a hammer, a chisel or a punch, and as a result the nut is soon ruined.

In order to obtain a foolproof method the simple apparatus illustrated here has been developed. The commutator, after being heated to approximately 125 deg. C., is up-ended and placed in the fixture as shown, with the small dowel pins on the cast ring *B* fitting in the holes of the ring nut. This cast ring is made in various sizes to receive different sizes of ring nuts. Two large holes are drilled in *B* as shown, to engage the two dowels on casting *A*. The armature is then locked just tight enough to hold the dowels on ring *B* in the dowel holes on the ring nut in such a manner that the armature may be rotated. The upper end of the armature is held by means of the structure, which consists of parts *C* and *D*, the metal collar *E* and the clamping plate *F* being placed in position with the wrench *H* fitted on the armature shaft. By means of the iron pipe *I* the armature can be rotated to draw the ring nut into place, thus producing a tight commutator.



DEVICE FOR TIGHTENING RING-NUT-TYPE COMMUTATOR

The parts labeled are used as follows: *A*—Heavy casting fastened securely to floor. *B*—Cast ring which fits on *A* and receives ring nut. *C*—Two slotted metal bars held securely on floor of shop supporting bars *D*, which have equally spaced holes for height adjustment. *E*—Metal collar used as a filler and seat for clamping plate *F*, which is a metal clamping plate placed on top of armature. *G*—Wooden wedges used to take up slack between clamping plates and adjusting pins *D*. *H*—Heavy socket-type wrench that fits end of armature. *I*—Iron pipe to increase leverage on wrench *H*.

J. S. DEAN.
Westinghouse Electric & Manufacturing Co.,
East Pittsburgh, Pa.

Electric Ovens Bake 11.6 Lb. of Green Cores Per Kilowatt-hour

AN AVERAGE weight of 11.6 lb. (5.26 kg.) of green cores has been baked with an energy consumption of 1 kw.-hr. in tests made at the Muncie Foundry & Machine Company, Muncie, Ind. The cores which were dried varied from small piston cores weighing 1⅜ lb. (750 gr.) to large chunk cores weighing 128 lb. (58 kg.) each. The weight of cores which could be dried per kilowatt-hour varied with the size of the cores and ranged from a minimum of 10.88 lb. (4.93 kg.) to a maximum of 14.6 lb. (6.62 kg.) per kilowatt-hour. During the period of the test a total of 108,730 lb. (49,200 kg.) of cores were dried, with an energy consumption of 9,389 kilowatt-hour.

These tests were conducted in four ovens, each having a connected load of 72 kw. in heaters. The results proved so satisfactory that twenty-four additional ovens of the same capacity have been ordered by the same concern. This will give a total connected load of about 2,000 kw. and an estimated monthly energy consumption of 550,000 kilowatt-hour at 100 per cent power factor.

Although the cost of power for the electric oven exceeds the fuel bill of the old fuel-fired ovens, the greatly increased production and the assurance of getting perfectly baked cores continuously with a minimum of attention was considered as more than offsetting the increased operating cost.

These data were presented at the Fort Wayne meeting of the Commercial Section of the Indiana Electric Light Association in a paper on "Industrial Heating" by R. Thurman, new business manager of the Indiana General Service Company.

Easily Made Test Boards for Repair Shop

A TEST board suitable for a shop repairing small motors, both direct and alternating current, is shown in the accompanying drawing. This board is 24 in. long and 14 in. high (60 cm. x 34 cm.). In Fig. 1 only the direct-current wiring is shown. The alternating-current wiring is an exact duplicate.

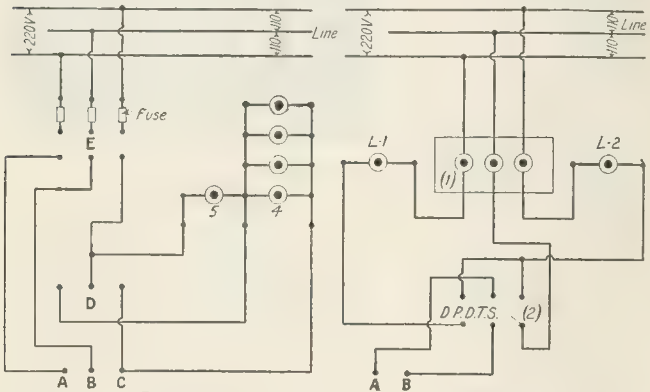


FIG. 1 FIG. 2

FIGS. 1 AND 2—CONNECTIONS FOR REPAIR-SHOP TEST BOARD

Fig. 1—For direct-current 110-volt test attach test leads to *BC*, close switch *E* and throw switch *D* to left. For direct-current 220-volt test attach test leads to *AC*, close switch *E* and leave switch *D* open. For 110-volt direct-current direct—that is, for running motors, etc., without any lamps in series—attach test leads to *BC*, close switch *E* and throw switch *D* to the right. For 220-volt test, attach test leads to *AC*, close *E* and throw *D* to right.

Fig. 2—For 110-volt test, throw switch 2 to the right, test leads attached to *AB*. For 220-volt test, throw switch 2 to the left, test leads attached to *AB*.

In wiring the board a three-wire, 110-220-volt direct-current line is connected to the three-pole, single-throw fused switch *E*. *A*, *B* and *C* are the three binding posts to which test leads are attached, but only two test leads should be used, one permanently attached to *C* and the other shifted from *A* to *B* for 220 volts and for 110 volts respectively. For 110-volt tests with lamps in series switch *D* is thrown to the left and the current may be regulated by the four lamps. For 220-volt tests the leads are connected to *A* and *C* and switch *D* is left open. If *D* is closed and a heavy current is drawn by the tested apparatus, the lamp (4) may burn out. For direct connection to the line the switch *D* is thrown to the right.

Another convenient board, shown in Fig. 2, gives 110 or 220 volts through a lamp resistance. The line comes into the board through the fuse block (1), the outside wires each leading to a lamp and the neutral to the double-pole, double throw switch (2). On the posts *A* and B 110 volts or 220 volts may be obtained by throwing the switch respectively to the right or the left.

Bronx, N. Y. C. A. Johnson.

Graphic Ammeter Adapted for Use as Voltmeter

IN SOME recent tests on variation of service voltage on a 250-volt direct-current line an Esterline graphic shunted ammeter was employed as a voltmeter by connecting a suitable resistance in series. Measurements showed that the ammeter without its shunt took 0.29 amp. at 60 millivolts for full-scale deflection. For 0.29 amp. at 250 volts 862 ohms would be required. Therefore an 860-ohm, 1-amp. continuous-duty resistor was purchased. The 1-amp. resistor was large enough to eliminate heating and consequent change of resistance. As the tests did not require extreme accuracy, this resistor answered the purpose and a special resistance alloy with zero coefficient was not required. Eight dollars spent for this resistor saved the expense of a graphic voltmeter—$125. E. E. George.

Chicago, Ill.

Penthouse Above Machine Shop Used as Substation

A SEMI-OUTDOOR substation has been provided in a Massachusetts factory by utilizing a penthouse above one of the machine rooms and mounting the transformers on the 6-in. (15-cm.) reinforced-concrete roof. Inside the inclosure was mounted the main service switchboard, with the principal oil switches and metering equipment, the floor being left open to form a grated ceiling for the room below. Planking provides a path for walking about in the switch room without interfering with the ventilation of the shop below. The transformer banks are connected to cables carried on porcelain insulators mounted on angle iron frames, and the principal overhead circuits are provided with pole-type disconnecting switches as shown.

TRANSFORMERS ON TOP OF PENTHOUSE AS SUBSTATION WITH SWITCHBOARDS INSIDE

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

A Case Where Public Suffers More Than Utility

WORKMEN in Flint, Mich., lost $52,000 in wages because a tree was felled across a 140,000-volt line of the Consumers' Power Company and interrupted the supply of energy to the factories in which the men worked. In comparison with this loss the cost of repairs to the company's equipment—$8,000—was small. The tendency of the general public to think that the company is the sole sufferer when its lines are put out of commission received a check when the facts about the accident were made known through the local press, which pointed out that much the larger part of this loss from an act of carelessness came out of the pockets of workingmen and not out of the utility treasury. Such occurrences drive home to the consciousness of the people the way in which electrical service is bound up with the welfare of the community and the interest that every one has in the uninterrupted operation of the plant.

How a Western Company Caused a Wide Distribution of Stock Among Customers

THE sale of stock to customers is becoming recognized as a permanent part of central-station policy in maintaining public good will. The results obtained by the Pacific Power & Light Company of Portland, Ore., in its recent campaign for the sale of stock to customers indicate that correct sales methods make it possible to insure a wide distribution of the shares sold among both small and large users of service.

Preferred stock was used as a basis for the campaign, which was opened through the district offices with a newspaper advertising broadside and by mailing circulars to customers with monthly bills. Certain banks and investment houses later handled the stock, and the employees of the company were encouraged to sell shares on a commission. The ideal result aimed at was to secure as large a number of shareholders among customers as possible, and in consequence the most desirable sale was one of a small number of shares. With this end in view commissions were graduated so that a number of small sales brought higher returns than one large scale. On a one-share cash sale, for instance, a commission of $3 was allowed, while two shares sold to the same customer brought only $3.50. Individual commissions were allowed even if the sales were made to different persons in the same family. In practice this method worked very well, and few instances of artificially divided sales occurred. About $300,000 worth of stock was sold altogether, at least $200,000 worth being subscribed by customers. Six hundred customers in all are now on the books, the number of shares held by each customer averaging about three.

Following the active campaign, advertisements continued to be inserted from time to time in the newspapers and stock was handled by local banks. A transfer agent in Portland handles the details of the sale for the company. Stock is also sold on the installment plan, allowing 6 per cent on deferred payments.

Power Versus Lighting Rates for Moving-Picture Machines

By Kassandra

WHEN central-station service is alternating current and must be transformed to direct current by a motor-generator for the operation of moving-picture machines, the claim is often made that this service should be charged at power rates rather than at lighting rates, and the decisions have almost always been that the power rate is the proper one. In the writer's opinion this is the correct decision, but the reason is not that the current is transformed by a motor-generator rather than by a transformer. While the work done is in one sense lighting, the characteristic of the demand is a power application and not a lighting application.

When power rates are allowed for electric heating it is clear that a luminous radiator is permissible if it is used only for heating and not to replace lighting. If resistances are used to charge a storage battery at a voltage lower than the supply voltage, such resistance could be replaced by bank of lamps. Here again it is understood that the bank of lamps is not used to replace lamps used for lighting and therefore, again, the application is entitled to the power rate. Once more, the use of electric lamps for therapeutic purposes is clearly not lighting in the ordinary sense. Likewise the signal lamps of a telephone switchboard or an electric elevator are clearly not ordinary lighting units.

One convenient test for the above and similar cases is whether the use of the lamps competes with the sun or daylight. A lighting use that competes with the sun or daylight produces the low load factor that is one of the reasons for charging a higher price for light. A lighting use like that of signal lamps or electric bath cabinets or moving-picture machines produces, by reason of the diversity factor, a load factor at the generating station similar to the load factor produced by ordinary power. It follows, therefore, that the use of electricity for the lighting of moving-picture screens—but, of course, not for the lighting of hall or entrance—may properly come under the power rate whether or not it is passed through a motor-generator. The fact that the power rate has been allowed or required for moving-picture machines in those particular cases where the power is passed through a motor-generator is not only an argument but a proof that the power rate should be allowed for all such uses. On the other hand, the allowance of the power rate in these cases should not be a precedent for allowing a customer to buy all his electricity at the power rate and then to install a motor-generator and transform it to electricity that will replace the general lighting service.

Generally, to use motor-generators merely in order to buy at the power rate rather than at the lighting rate would be an economic waste and would only have the effect of forcing central stations to increase the price for power. On the other hand, it is perfectly sound to allow the power rate for moving-picture machines, whether the power is used directly or through a motor-generator.

Electric Range Load in a Small Town

INTERESTING data on electric range operation in a town of 5,000 people are furnished by E. A. Wright, vice-president and manager of the Great Bend (Kan.) Water & Electric Company. Mr. Wright comments on the electric range load and the revenue derived therefrom as follows:

"We find that the diversity factor of the electric ranges on our lines is very high. In one instance in addition to our regular lighting load we have nine ranges connected to one 10-kw. transformer which has a 2,200/115 voltage ratio. We have experienced no trouble from the transformer overheating and have received no complaints as to service. In fact, all of the customers using service from this transformer are highly pleased.

"For the year 1918 our cooking rate was $1.50 fixed charge per month, plus 2½ cents per kilowatt-hour. On this rate at the end of the year we had installed a total of twenty-six ranges, all but seven of which were in operation throughout the entire year. Our gross revenue from this source was $863.81 for a total kilowatt-hour consumption of 20,347. The average monthly bill per customer was $3.26, and the average rate per kilowatt-hour was 4.25 cents. Beginning with 1919, the rate per kilowatt-hour was increased to 3 cents, the fixed charge remaining the same. At the close of the year 1919 we had installed a total of thirty-seven ranges, two of which are temporarily out of service. The gross revenue from range operation during 1919 was $1,247.25 for a total kilowatt-hour consumption of 25,564. The average monthly bill per customer was $3.57, and the average rate per kilowatt-hour was 4.85 cents."

Competition in Lighting Develops Business

BY COMPARING illumination intensities in different installations it is often easy to "sell" the idea of improved lighting to customers who are uninterested in calculations. At the recent question-box conference of the New England Section of the National Electric Light Association it was brought out that the foot-candle meter in the hands of the central-station contractor-dealer or manufacturer's representative is stimulating rivalry in illumination in industrial plants and mercantile establishments. The lighting bills of one restaurant in Boston were increased $50 a month by the improved installation authorized by the proprietor when he was shown tests of his competitor's installations averaging 3 to 3.5 ft.-candles against his own average of 1.75 ft.-candles. The Boston Edison Company is taking foot-candle readings in every department of a department store and comparing them with corresponding results in other establishments, and while this survey has not yet been completed, it has already resulted in the addition of a large amount of lighting. Wherever shown, the foot-candle meter has excited interest and proved a clinching argument for better lighting with small development expense to the central station.

At the conference it was brought out that 8,000 300-watt lamps are to be used in a mill in place of 100-watt lamps because of foot-candle comparisons. In another case, where only 0.1 ft.-candle was available in the shop apart from the use of 25-watt lamps here and there near the work, 300-watt lamps on 20-ft. spacing were substituted. Little argument has been required to convince mill drafting departments with the foot-candle meter that intensities of 4 and 5 ft.-candles should give way to 25 ft.-candles. It was emphasized that in industrial plants intensities of 15 to 25 ft.-candles are coming and that close direct lighting is on the wane. The point was also made by H. D. Stokes, Worcester (Mass.) Electric Light Company, that it is unnecessary to lay out an entire mill for improved illumination. If the installation is satisfactory, it will be extended, automatically as it were, throughout the mill; if not, it will be removed.

Traveling Library in Construction Camp

A SCHEDULE of eight hours' work and eight hours' sleep leaves eight hours for idling in most "camp jobs," hours that soon become burdensome if no means of relaxation are provided. To meet this condition the Southern California Edison Company on its big construction job at Kern River Plant No. 3 has provided several interesting entertainment features. One of these is the traveling library, shown in the accompanying illustration. This library, mounted on a Ford touring car, makes regular visits to the camps and circulates books of interest to the men. The work is supervised by the Kern County Circulating Library. In this way 2,500 men have had an opportunity to keep in touch with events in the outside world.

GOOD READING FURNISHED MEN ON KERN RIVER CONSTRUCTION WORK BY SOUTHERN CALIFORNIA EDISON COMPANY

Many other opportunities for enjoyment are furnished. These include baseball games and other athletic contests. Motion pictures, exhibited in the camp dining room, also serve to while away the evening hours.

An Attractive Office Is an Asset to a Utility

AN INCREASING number of central stations are appreciating the advantages of having well-appointed quarters for the transaction of business with the public. The experience of the light and power department of the Fort Wayne & Northern Indiana Traction Company, at Fort Wayne, Ind., as voiced by an officer in the following statement, is of interest:

CENTRAL STATION OFFICE AT FORT WAYNE, IND.

The front part of the office is used for the sale of electrical merchandise and has a rest room for customers. The first counter to the left is for the sale of lamps and appliances. The showcase is filled with attractive appliances, and all the lamps are kept out of sight in drawers. Further back on the left are the cashiers' cages and beyond is the billing department. Behind the information desk, which is in the right foreground, are sections for the use of the superintendent of the light and power department and his assistants. The office in the right rear is occupied by the electrical engineer. The entire room is 150 ft. by 30 ft. in size.

"It has been thoroughly demonstrated to us that the pleasant appearance of this office has made us many new friends, and we have been repeatedly told that people really enjoy coming into these quarters to do business with us."

Continuous Power Supply Necessary for Electric Furnaces*

ONE of the principal factors in the economical production of steel in the electric furnace is low consumption of reliable and cheap power. Actual cost of power is not to be considered at the expense of continuous service, and absolutely reliable continuous supply of power is the first requisite of cheap power. The following observations explain this point. A furnace was operating under an average load of 800 kw.; a breakdown in the power house resulted in the stopping of one generator supplying the furnace, which made it necessary to reduce the furnace load to 500 kw. This condition continued for one hour. During the hour the melting advanced slowly, if at all, and increased the time of the heat and also the power consumption.

Another furnace was connected to the lines of a central station having no reserve equipment; the power failed when the charge in the furnace was melted, but not hot enough to pour into molds. On receiving power the following day the solid mass had to be remelted, an operation requiring double the time and energy necessary to melt the original charge. During this remelting the hearth was cut to such an extent that patches had to be burned in before operations could be resumed. Interruptions of power became so frequent, with results as above, that the furnace had to be abandoned.

The losses that must be sustained under such conditions are measured not only in the cost of the additional power consumed, the labor wasted or the damage to the furnace, but, what is more important, in decrease of the furnace tonnage output, which controls the price of all steel produced.

A furnace load should necessarily be connected to a central station capable of turning out large blocks of energy; otherwise the heavy surges caused by the poor contact and intermittent arcs produce poor voltage regulation unless the furnace load is a small proportion of the total load connected to the power lines. Hence the smaller power companies cannot, and the less progressive will not, equip themselves to handle the new furnace loads without charging excessive rates, for they have to take account of the impossibility of selling their capacity to some other industry in case the furnace is abandoned. Since the electric furnace can compete in production with the other processes, there is no reason to anticipate an installation shutting down as long as the required reliable supply of power is furnished to the furnace.

Smaller Central Stations Must Do Their Part

Another point in power supply is that, owing to fixing of rates by the public service commissions and regulations affecting distribution, the small and unprogressive stations are protected from the invasion of the more progressive central stations. The following will illustrate this point: A power station of limited capacity undertook to supply a medium-sized furnace. The result was irregular service, which limited the furnace output to a very small percentage of its possible capacity. The load factor was low, with resulting large power consumption and excessive charge per kilowatt-hour.

Within a few miles of the plant thus handicapped a power company was operating with a sufficient capacity and reserve to supply this furnace with a steady supply of power at the same rates. If the operators had been able to buy their power from this larger plant, they would have been able to obtain steady power, increase their output and decrease the power consumption, so that their power costs per ton of metal would have been reduced by half and the furnace installation would have been successful instead of a burden to the operator. In the steel-castings trade there appears to be no reason why the electric furnace, which has been developed to a high degree, should not largely supplant other processes. Close co-operation between the furnace operator and the central station can aid in bringing this about quickly, but it will be necessary for the smaller power companies to do their part, as well as the more progressive stations, to help make the electric furnace a permanent success by insuring to it an adequate and continuous supply of power.

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*Abstract from a paper presented by W. G. Berlin, electric furnace operator, Taylor Wharton Iron & Steel Company, before a joint meeting of the American Electrochemical Society and the American Institute of Electrical Engineers.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generation, Transmission and Distribution

Steel-Plant Power Generation from Waste Heat and Coal.—B. H. **Greene.**—The author presents some of the practical problems encountered in the utilization of waste heat from open-hearth furnaces for the generation of power for steel-mill use. In this case the steam derived from waste heat was supplemented by coal-fired boilers used for electric power generation. This particular installation was made for the following purposes: (1) To utilize the waste heat of the open-hearth furnaces; (2) to assist in eliminating power shortage conditions which prevailed in the territory where this plant was located; (3) to have standby electrical service when required; (4) to be able to control peak loads occasioned by plant operation; (5) to govern power-factor conditions properly. The author enters into a detailed discussion of how these ends were attained. He predicts that the installation of waste-heat boilers or open-hearth furnaces will increase with the increased price of coal and the scarcity of the supply. Another factor advantageous to their use is the improvement in open-hearth furnace operation, which can be charged principally to better draft conditions.—Paper presented at meeting of A. I. and S. E. E., January, 1920.

Current Densities in Conductors and Cables.—E. **Soleri.**—A committee having been appointed by the Associazione Elettrotecnica Italiana to revise the regulations for electric installations, the author calls attention to the fact that the current densities prescribed by the various countries are different and that these differences are sometimes important. He examines the regulations published by the electrotechnical societies in America, Austria, England, France, Germany and Switzerland, both for overhead and for underground conductors, and reports the nomination of an Italian committee for studying the regulations to be officially adopted in Italy. In the meantime he advises the adoption of the English regulations for overhead conductors and of the German ones for underground cables.—*Science Abstracts, Section B*, Dec. 30, 1919. (Abstracted from *Elettrotecnica*, Sept. 25, 1919.)

Traction

Economical Use of Energy for Car Purposes.—D. D. **Ewing.**—It is estimated that the total energy used for traction purposes in 1917 was about ten billion kilowatt-hours, which was used for moving cars to the extent of 2,125,000 car-miles. This gives an average energy consumption of 4¾ kw.-hr. per car-mile measured at the power-plant switchboard. At 3½ lb. (1.6 kg.) of coal per kilowatt-hour the total consumption is 17,500,000 tons, or about 3½ per cent of the annual coal production. Of the 4¾ kw.-hr. only about 60 per cent gets to the cars. The author analyzes the losses at the car in order to indicate possible saving where the consumption can be reduced. He considers particularly economy through economical coasting, acceleration and control of stops.—*Electric Railway Journal*, March 27, 1920.

Applying the Automatic Substation.—C. A. **Butcher.**—An illustration of what can be saved by automatic control is furnished by a tabulated summary of a report recently made on an Eastern property operating a double-track line between two cities of approximately 200,000 population each and 80 miles (130 km.) apart. The schedule is essentially one car each way every 40 minutes. Local cars are operated on a schedule speed of 23 miles per hour (37 km.) and limited trains at 30 miles per hour (48 km). While each proposition is a study in itself the writer thinks that automatic operation should be applied to a considerably greater extent than at the present time.—*Electric Railway Journal*, March 27, 1920.

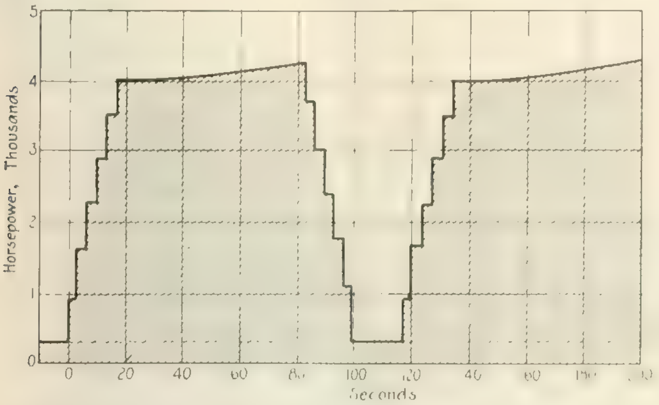
BALANCE SHEET FOR PROPOSED INSTALLATION OF AUTOMATIC CONTROL ON INTERURBAN LINE

Investment required:		
Seven new substation buildings		$20,000
Eleven automatic switching equipments (including oil circuit breakers, lightning arresters, automatic high-tension transfer switching and auxiliaries)		125,400
Freight		575
Installation of switching equipment and moving old rotaries and transformers		16,300
Total		$162,275
Replacing 18.52 miles 500,000-circ.mil copper messenger with 7-16 in. galvanized messenger at $325 per mile		6,030
Taking down and reeling 66.58 miles 500,000-circ.mil copper feeder at $50 per mile		3,330
Extension of transmission line		4,350
Gross investment		$175,985
Credits:		
85.1 miles 500,000-circ.mil copper feeder at 18 cents per pound (scrap value)	$123,000	
Salvage other material	6,000	
Total		129,000
Net investment		$46,985
Annual savings:		
Operators' wages eliminated		$22,330
Power saved		2,860
Coal saved (substation heating)		200
Total		$25,390
Annual charges:		
Inspectors' wages	$4,725	
Fixed charges (except interest) on net investment	4,230	
Total		8,955
Net annual saving		$16,435
Return on investment (including 6 per cent interest)		34.9%
Return on investment (less interest)		28.9%
Total investment would therefore be returned in approximately three and one-half years.		

Installations, Systems and Appliances

High-Power Switch Gear.—Max **Vogelsang.**—An instructive article dealing with the constructional development of high-power oil breakers. A number of photographs and tracings illustrative of German practice are exhibited.—*Elektrotechnische Zeitschrift*, Nov. 20, 1919.

Electric Mill Drives.—J. D. **Wright.**—The purpose of this article is to show how the layout of the mill and method of rolling steel affects the load cycle from which the motor capacity, size of flywheel, type of control, etc., are determined. One of the simplest of the large motor applications is to a continuous mill such as a six-stand continuous sheet-bar or billet mill of which the load cycle is given in the figure. It is seen that the load comes on in several easy steps and remains on for some time. The duty on the motor is not severe. It is said that a total motor capacity of about 80,000 hp. has been applied in this country to this type of rolling mill. Other types of mill layout considered are a three-stand combination rail and structural mill which is served by two tilting tables on the entering side of the mill and the so-called merchant mill. The author gives in considerable detail the information necessary for calculating the proper size of motor required to roll any given product.—Paper presented before meeting of A. I. and S. E. E., January, 1920.



TYPICAL LOAD CYCLE FOR SIX-STAND MORGAN CONTINUOUS-SHEET BAR MILL

Almost Laborless Dipping and Baking Plant.—A description of a plant for dipping, impregnating and baking armatures and field coils designed with particular reference to economizing man power.—*Electric Railway Journal*, Feb. 21, 1920.

Electrically Heated Boilers and Heat Storage.—It is pointed out that where water power is inexpensive it may be practicable to raise steam electrically. Attention is called to tests on two electrically heated boilers in Switzerland, in which it is said that 90 per cent efficiency was obtained. Several makes of boilers equipped for electric heating are described which are mostly of Swiss origin.—London *Engineering*, Feb. 6, 1920.

Electrochemistry and Batteries

Effect of Cold Weather on Electric Vehicles.—Changes of temperature affect electric vehicle batteries. The writer deals in a practical manner with the falling off in mileage capacity per charge in winter time.—*Electric Vehicle*, January, 1920.

Specific Inductivity of Mixtures.—FRITZ BANNEITZ.—Theoretical expressions for the dielectric constant of a mixture have been derived under certain simplifying assumptions. The present author reports upon some experimental investigations on what may be called "artificial mixtures," consisting of thin glass tubes filled with one of the ingredients, placed parallel to each other and surrounded by the other ingredient. The capacity of a condenser with such a composite dielectric was measured at high frequency by a wave-meter method. When the tubes were spaced relatively far apart the obtained results checked well with theory, but for closer spacings considerable deviations were observed.—*Annalen der Physik*, July 4, 1919.

Telegraphy, Telephony and Signals

A New Method for the Reception of Weak Signals at Shore Wave Lengths.—EDWIN H. ARMSTRONG.—The problem dealt with is to construct a receiver for undamped, modulated continuous and damped oscillations which is substantially equally sensitive over a range of wave length from 50 m. to 600.m., which is capable of rapid adjustment from one wave to another, and which does not distort or lose any characteristic note or tone inherent in the transmitter. Three well-known means which might be employed are: (1) Amplification of the low-frequency current after rectification; (2) amplification of the high-frequency current before rectification, and (3) application of the heterodyne principle to increase the efficiency of rectification. The author's solution of the problem, however, consists in reducing the frequency of the incoming signal to some predetermined superaudible frequency which can be readily amplified, passing this current through an amplifier and then detecting or rectifying the amplified current.—*Q. S. T.*, February, 1920.

Localization of High-Resistance Breaks in Submarine Cables.—A. POULSEN.—It is said that the Siemens method of locating breaks in submarine cables, while first proposed in 1876, is still the best method when dealing with high-resistance breaks. The method consists briefly in determining the resistance of the cable up to the break by means of a combined resistance and capacity test as follows: (1) The sum of the resistance of the cable and in the break is measured. (2) The cable is discharged through a galvanometer after having previously been charged from a battery. The theory of this method, with examples of calculations, is given.—London *Electrician*, March 19, 1920.

Dependence of Amplification Constant and Internal Plate Circuit Resistance of Three-Electrode Vacuum Tube Upon Structural Dimensions.—JOHN M. MILLER.—The amplification constant of three-electrode vacuum tubes is mathematically derived in terms of readily measurable physical dimensions of the tube. Curves are plotted enabling the rapid predetermination of tube amplification constant on this basis. The curves are shown to give results agreeing with experiment for a number of types of tubes. The internal resistance of the tube is similarly deduced, and an agreement between theory and experiment is shown. Certain deviations in specific instances are explained.—*Proceedings Institute of Radio Engineers*, February, 1920.

Amplifiers.—MARIUS LATOUR.—In 1905 the author proposed to use a three-electrode mercury-vapor tube for amplification of feeble currents, and a similar apparatus was later employed as a high-frequency generator for heterodyne reception. In an earlier article (*Electrician*, Dec. 1, 1916) the author, in analyzing the behavior of three-electrode thermionic amplifiers, introduced the classical "tube constants," namely, the partial derivatives of the plate current with respect to plate voltage and grid voltage. In the present paper a more complete theory is given, in accordance with a report prepared in 1916 for General Ferrié. The input impedance of the tube is taken into consideration, and regenerative amplifiers and self-oscillating circuits are dealt with.—*Bulletin de la Société Française d'Electriciens*, July, 1919, and *Revue Générale d'Electricité*, Nov. 22, 1919.

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

FREIGHT shipments are improving. Demand for conduit, flexible armored conductor, wire and porcelain fittings is heavy and greatly exceeds present shipments. In the East and Central West much trucking has been done to relieve the situation, but the amounts received either by truck or rail are small in comparison with the demand.

FEW PRICE changes are announced, a 5 per cent advance on metal molding, the same amount on certain large Westinghouse units, and an increase of $8 per 1,000 ft. on flexible armored conductor being the principal ones.

INTERCHANGE of views between Eastern and Far Western delegates is expected to mark the Electrical Supply Jobbers' Association at Del Monte, Cal., this month.

PRACTICALLY all electric ranges which have been held in stock are sold and likewise those which are en route. No more ranges are expected until the fall season except those already on order.

THE MANUFACTURE of flexible armored conductor has been negligible during the past week. Mills have been trucking almost no steel strip, and freight shipments are at a standstill, except for a few cars of finished conductor which have been loosed from the yards.

WITH strikes more or less serious under way in almost every section of the country, the suggestion is made of infusing the employee with the idea of a square deal, after having taken steps to put this idea into practice.

THE DEPARTMENT stores are coming to be regarded more and more as a real factor in the distribution of motor-driven socket devices. Their sales are heavy, especially where demonstrations are held of the devices in operation.

INTERCONNECTION of virtually all the larger systems in central and western Pennsylvania, northern West Virginia and eastern and central Ohio is predicted by A. M. Lynn president of the West Penn system.

A GREAT growth of stock sales to customers of its subsidiary companies is reported by the Standard Gas & Electric Company, stock so held now reaching $8,894,500.

AN EXPENDITURE of $1,750,000 to overcome the seepage from the Cedar Falls (Wash.) reservoir by abandoning the present dam and raising the old dam further up stream is advocated. An annual saving to Seattle of $800,000 for fuel would, it is said, result.

DEVELOPMENT of a training course in electric welding, standardization of processes and other steps to further progress in the welding industry are to be undertaken by the American Welding Society.

J. H. DEPPLER has been elected president of the American Welding Society. Sections of the society for Chicago, Cleveland and Philadelphia are being organized.

UNDEVELOPED water rights held under a state franchise do not come under the protection of the inviolability-of-contract clause of the federal constitution, according to a decision of the United States Supreme Court in a dispute between Ohio power companies over property acquired through eminent domain.

A LOW-PRESSURE steam unit of a turbine-generator rated at 60,000 kw. and built for the Duquesne Light Company has been "turned over" for the first time in the East Pittsburgh shops of the Westinghouse Electric & Manufacturing Company.

THE JOINT convention of the Pacific Coast sections of the American Institute of Electrical Engineers will be held at Portland, Ore., on July 21-24.

OPPOSITION has arisen in Maine to the proposed super-power trunk line program under federal supervision on the ground that it may nullify the Maine policy which prohibits the exportation of electrical energy from within the state.

BOSTON contractor-dealers, members of the Massachusetts State Association, agreed upon percentages of overhead ranging from 46 per cent on contracts from $200 to $450 to 10 per cent on contracts involving $50,000 and over.

ENTERTAINMENT features of the N. E. L. A. convention at Pasadena, Cal., this month are to culminate in a great electrical spectacle, "La Fiesta de Electra," on the evening of May 21.

EXISTING shortage of power has led the Public Service Corporation of New Jersey to plan the construction of a power plant with an ultimate capacity of 200,000 kw. The North Jersey Power Company is to be organized for this purpose with a capital stock of $25,000,000, part of which it is expected will be sold to the consumers of the power.

A HEADQUARTERS building to cost $1,400,000 is to be erected in Washington by the National Academy of Sciences with funds from the Carnegie Corporation.

COMPLETION of the government development at Muscle Shoals, Ala., on which $7,000,000 has already been expended, was advocated by Secretary of War Baker before a Senate committee hearing. Frank S. Washburn, president of the American Cyanamid Company, urged that the project be dropped.

APRIL issues of bonds and stock by electric public utilities show a slight decline in total value as compared with March and bear the highest rate of interest of all the year's issues.

REPRESENTATIVES of the N. E. L. A. outlined their classification of accounts before delegates of the National Association of Railway and Utility Commissions at Chicago.

MULTIPLEX telegraphy and telephony over open-circuit bare wires laid in or on the earth or submerged in water is now possible, according to an announcement made before the National Academy of Sciences at Washington by Major-General George O. Squier of the United States Army Signal Corps.

KANSAS' Court of Industrial Relations is in full operation, although the question of its constitutionality is still before the Supreme Court of the state. The first order of the new body effected a settlement of the relations of electrical employers and employees which is reported to have been satisfactory to both sides.

A REPEAL of the daylight-saving bill by the New York State Legislature will probably be vetoed by Governor Smith. Trenton, N. J., has adopted the daylight-saving plan. Opposition to it in New England has large support, though many cities and towns have put it in force.

HEARINGS on the projected St. Lawrence River deep waterway will be held by the International Joint Waterways Commission, representing the governments of the United States and Canada, from May 7 to June 29, the first hearing to be at North Bay, Ontario, on the former date.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Illinois Commission Asks Cities to Appoint Utility Inspectors

IN AN apparent effort to give the advocates of the home rule of public utilities some measure of satisfaction without sacrificing the advantages of straight commission control, the Public Utilities Commission of Illinois has invited municipalities to appoint local public utility inspectors to operate under the rules of the commission. These inspectors, who would be paid by the cities, would be expected to make frequent tests of public utility service to determine if it is in accord with the standards established by the commission. For the purpose of this inspection the commission divides the cities of the state into four classes based on population. Rules for the inspections in the various classes will be formulated by the commission later.

Twenty-five-Million-Dollar Station to Be Partly Financed by Consumers

TO MEET the existing power shortage in the north New Jersey territory and provide capital required for the construction of a power plant of 200,000 kw. ultimate capacity, the Public Service Corporation of New Jersey is planning the formation of a twenty-five-million-dollar corporation, to be known as the North Jersey Power Company, which will be partly financed by the sale of preferred stock to present and prospective power customers. In discussing the project with a representative of the ELECTRICAL WORLD, John M. O'Toole, assistant to President McCarter of the Public Service Corporation, stated that the project calls for the construction of a power plant on a site in or near Newark, which is the center of the district served by the company. At the outset it is proposed to provide an initial capacity of 100,000 kw., involving a capital expenditure of $12,500,000 within two years from next June.

Commenting on the demand for power and the company's reasons for the proposed plan of financing, Mr. O'Toole said: "At the present time in the north Jersey territory there is a power shortage of 60,000 kw. to 75,000 kw. The existing financial situation makes it impracticable for the Public Service Electric Company to finance an undertaking of this magnitude. For these reasons a plan has been outlined for the formation of the North Jersey Power Company along lines that would, in a sense, bring the electric power users into an association or copartnership with the Public Service Corporation to operate the plant in close co-operation with the Public Service Electric Company. Present power users and those whom the company has been unable to supply because of insufficient capacity are being asked to subscribe to the preferred stock of the proposed company to an amount approximating 50 per cent of what it would cost each individual subscriber to install his own power plant."

Of the authorized capitalization of $25,000,000, it is proposed to issue upon completion of the preliminary details, which will be within the next sixty days, $12,500,000 in 8 per cent cumulative preferred stock to be available for subscription by the industrial power users. Such subscribers will have preferential claims upon the power supply and guarantees of continuity of service. The proposed preferred-stock issue is to be taken in eight installments ending July, 1922, and to be retired within twenty years after July, 1924. Provision is made for a sinking fund for this purpose to be set aside in advance of dividends on common stock, and it is also provided that no bonds or mortgages shall be placed on the plant in excess of 50 per cent of the total outlay proposed. The Public Service Corporation of New Jersey, which owns all of the stock of the Public Service Electric Company, will subscribe for and own all of the common stock of the North Jersey Power Company.

Mr. O'Toole further stated that although definite arrangements have not been completed, it is expected that orders for equipment will be placed by next June and the plant will be operating about eighteen months later. Response to inquiries among power users as to their willingness to participate on the basis proposed has been very gratifying to the Public Service Corporation.

Vice-president P. S. Young stated that he felt very much encouraged at the manner in which the proposition has been received by the manufacturers and other interests requiring power. He feels confident that the plan as outlined will be brought to maturity.

250,000 Kw. to Be Interconnected in Pennsylvania-New Jersey Power System

NEW transmission lines are under construction for the Pennsylvania-New Jersey power system of the General Gas & Electric Company which will establish through interconnection with other systems a combined capacity of nearly 250,000. The three plants of the General Gas & Electric Company which are to be tied together have at present a total installed generator capacity of 79,425 kw., divided as follows: Metropolitan Edison Company (Reading, Pa.), 45,500 kw.; Pennsylvania Utilities Company (Easton, Pa.), 26,925 kw.; New Jersey Power & Light Company (Dover, N. J.), 7,000 kw. These three plants have available for sale at the present time 9,000 kw. of generating capacity, which will be increased to 20,000 kw. by the installation of additional boilers at Reading and Easton and the completion of the transmission line connecting the two plants.

The entire system will be physically connected with the following systems for the exchange of power: York Haven (Pa.) Power Company, 20,000 kw.; Philadelphia & Suburban Electric Company (Pottstown, Pa.), 10,000 kw.; Counties Gas & Electric Company (Norristown, Pa.), 20,000 kw.; Lehigh Navigation Electric System and Lehigh Valley Transit Company, with power plants at Allentown, Hauto and Harwood, Pa., 100,000 kw. While the interconnection will establish a system of nearly 250,000 kw., the present lines will transmit only a part of this. They are, however, sufficient for the purpose and can readily be increased.

When the new lines are completed the system will extend practically from the Susquehanna River eastward through Pennsylvania and New Jersey to the territory covered by the Public Service Corporation of New Jersey and southward as far as Philadelphia. The cities and towns served by the system are of a highly industrial character with a large market for the sale of power.

Pennsylvania, Ohio and West Virginia Interconnection Predicted

INTERCONNECTION of virtually all of the larger systems in central and western Pennsylvania, northern West Virginia and eastern and central Ohio was predicted by A. M. Lynn, president of the West Penn system, in a paper read at a luncheon of the Western Geographical Section of the Pennsylvania Electric Association held in Pittsburgh on April 21. Akron, Canton, Massillon, East Liverpool and Steubenville, Ohio, are now connected through West Penn lines with those of the Duquesne Light Company, which supplies Pittsburgh and Allegheny County.

"Within three years," said Mr. Lynn, "I look to see the Republic Railway & Light Company of Youngstown, Ohio, and Newcastle, Pa., the Penn Public Service Company of Johnstown and the Monongahela Valley Traction Company of West Virginia connected together. I understand that the Penn Public Service Company lines now cross those of the Penn Central Light & Power Company of Altoona, so it appears that within a reasonable time light and power interests from central Pennsylvania to central and northern Ohio and northern West Virginia will be connected. Great advantages will accrue to these utilities and to the public."

How such an arrangement would enhance reliability of service, the various companies coming to the aid of any one of the group which might be in trouble, was outlined by the speaker, who told of receiving a long-distance call from a large central-station company in central Ohio asking if the West Penn could spare 5,000 kw. of capacity. The West Penn being short, the same request was made of the Duquesne Light Company, the idea being that if the Duquesne could spare the power requested it would turn over 5,000 kw. to the West Penn, which in turn would deliver 5,000 kw. to the American Gas & Electric Company at its Windsor (W. Va.) station, and the American Gas & Electric Company, which supplies eastern Ohio, would turn over 5,000 kw. to the company which made the original request.

The technical sessions of the section meeting were devoted to a discussion of power-factor problems. E. C. Stone, Duquesne Light Company, who presided, read a short statement of the problems, together with proposed means of solving them. He said that if the power factor on the Duquesne system could be raised to unity an additional capacity of 30,000 kw. would be available.

W. H. Pratt, in a paper on "Power-Factor and Kilovolt-Ampere Measurements," outlined the principles involved and told of difficulties encountered in designing a simple instrument which would measure power factor correctly. Recording power-factor meters are unsatisfactory, he said, because they are not accurate if the three-phase load is unbalanced. He described a voltmeter-ammeter method of measuring power factor consisting of two independent moving elements which utilize the flat portion of the sinusoidal power-factor curve.

An analysis of the power-factor conditions of the Duquesne Light Company was given by C. L. Rupert. He presented figures which showed the no-load and reactive losses of each type of circuit and each class of service.

C. W. Drake, Westinghouse Electric & Manufacturing Company, in a paper on "Induction and Synchronous Motors for Industrial Applications," told generally of the problems surrounding the installation of motors in industrial plants. Mr. Drake stated that the testing of motors in the plant will help to better the power factor.

A paper on "Power-Factor Correction" was read by Robert Treat, General Electric Company. Comparisons of static and synchronous condensers were made regarding both operation and economy.

Considerable time was devoted in the discussion to the question of billing the customer in such a manner that he would be interested in maintaining a good power factor. The word "penalty" in power-factor clauses of contracts is not desirable, it was agreed, and some simple method is needed to give the consumer a clear idea how the low power factor affects him.

Instruments for measuring power factor were discussed at length, and it was the general thought that the demand method of measuring power factor is better than the integration method.

Townley Urges Engineers to Grasp Opportunities for Leadership

THE general public looks upon an engineer as a man to be employed, and it does not realize that an engineer's training is inherently that of an employer-executive or leader, and for this reason engineers should welcome every opportunity for intelligent leadership, especially during these politically troublesome times. So Calvert Townley, president of the American Institute of Electrical Engineers, told the Milwaukee Society of Engineers last Tuesday at a special meeting held under the auspices of the local section of the institute. Continuing, Mr. Townley spoke of the need for a strong national engineering society and outlined some of the plans which had been suggested for its creation. In this connection it was emphasized that none of the plans contemplated any reduction in the responsibility of local engineering organizations.

Mr. Townley's address was discussed by F.A.Vaughan, consulting engineer of Milwaukee, and Prof. J. C. Pinney, dean of the Engineering College of Marquette University. The latter gave an outline of the extensive activities of Milwaukee engineers in civic problems.

Extension of Rural-Service Lines Gaining in the South

IN A NUMBER of places in the South there is a very noticeable activity in the extension of central-station service into the rural districts. Particular attention, it is reported, is being paid to this class of business by the contractors and jobbers, who persuade six to ten farmers to pay for a new line. As a rule these are 2,200-volt lines and are of inexpensive construction. Owing to the excessive cost of money, it is reported, the Southern utilities, while glad to serve the farmer, have not cared to finance the new rural lines.

Special activity in the extension of lines into the rural districts was noticed in North and South Carolina and in Georgia. Around Memphis and some of the other Southern cities in which the lighting companies are in the hands of receivers increasing service to farmers was not so noticeable.

Expenditure of $1,750,000 Would Save $800,000 Annually

EVER since the disastrous flood caused by seepage from the Cedar Falls (Wash.) reservoir attempts have been made to seal the basin, but the efforts have been unsuccessful. While the first efforts to seal it were made by J. D. Ross, superintendent of the Seattle (municipal) Light and Power Plant, he protested against further attempts of this kind after seeing that the basin could not be made to hold water, and since then the work has been conducted by the water department. Altogether, nearly $400,000 has been spent for sluicing clay into the basin.

Believing that no economical method of sealing can be devised, Mr. Ross purposes abandoning the 110-ft. (33-m.) masonry dam now in existence as an impounder of water and raising the old dam farther up stream so that water in Cedar Lake will be raised to the same level that the temporary spillway of the 110-ft. masonry dam was intended to raise it. This will require an increase in height of only 8 ft. (2.4 m.) at the old dam, which could be made with rockfill from a nearby quarry. An additional 5 ft. (1.5 m.) of water can be stored by installing Tainter gates. This work will cost about $150,000, it is estimated.

In connection with this rehabilitation Mr. Ross proposes cutting an 8,500-ft. (2,550-m.) tunnel from the present tunnel opening at the concrete dam through rock to Cedar Lake itself. The opening of the proposed tunnel would be at such an elevation that 55 ft. (16.5 m.) of water could be drawn down in Cedar Lake, or about 80,000 acre-ft. (98,400,000 cu.m.). This is five times what is now available and would therefore permit a continuous capacity of 18,000 kw. instead of 7,551 kw., the present continuous rating. According to Mr. Ross' figures, based on fifteen years' averages, it would require only 72,000 acre-ft. (88,560,000 cu.m.) to regulate the entire run-off of Cedar River. The tunnel, including headgates, it has been estimated, will cost $1,100,000.

With the transmission and substation labor, machinery and equipment required to complete this development, the total expense would be $1,750,000. However, with this development completed it is anticipated that $800,000 per annum can be saved owing to reduction in fuel-oil consumption at the Seattle steam station, and the investment per kilowatt installed will be reduced from $582.37 to $313.05, even including the abandoned masonry dam and expense of sealing. If the proposed changes are not made, the municipal lighting department will be paying $1,000,000 a year in 1923 for fuel oil alone at the present rate.

Pacific Coast A. I. E. E. Sections to Discuss Transmission

THE Pacific Coast sections of the American Institute of Electrical Engineers will hold a convention at Portland, Ore., in the Multnomah Hotel, July 21 to 24. A tentative program has been arranged as follows:

Wednesday, July 21—Morning address by President Calvert Townley; paper by W. D. Pearslee on "Design and Application of Suspension Insulators." Afternoon, paper by Prof. H. J. Ryan and H. H. Henline on "Unit Voltage Duties in Long Suspension Insulator Strings"; paper by D. M. Jones on "Power-Factor Correction on Distribution Systems."

Thursday, July 22—Morning, paper by R. Beeuwkes on "Electrification of Railroads." Afternoon, paper by Darrat Corbet on "Hogged Fuel, Fuel Oil and Pulverized Coal."

Friday, July 23—Morning, paper by a member of the Pacific Telephone & Telegraph Company on "Bridge Methods for Alternating-Current Measurements"; paper by the chief engineer of the Maryland Pressed Steel Company on "Use of Special Steel in Pressed-Steel Transmission Line Fittings." Afternoon, choice of golf tournament with prize cup offered by J. B. Fisken or trip up Columbia River Highway. Dinner will be served at Crown Point Chalet.

Trips in and around Portland on Saturday will terminate the convention.

Paris to Have 200,000-Kw. Power Station

PLANS have been completed for the construction of a 200,000-kw. power station for Paris, France. This station is intended to replace the small generating plants now operating in the city at a variety of frequencies ranging from 16⅔ to 42 cycles. A site has been chosen on the Seine River close to the city, where the coal supply can be received either by boat or by rail and delivered either direct to crushers or placed in storage.

The main generating equipment consists of seven three-phase, 50-cycle units of 35,000 kw. capacity each at 80 per cent power factor, which feed ten 60,000-volt underground and two 60,000-volt overhead circuits. Turbines will operate at 325 lb. steam pressure with 320 deg. Fahr. superheat. The boiler room will be thoroughly modern in every respect. An additional thermal saving will be effected by using the cooling air from the generators for forced draft.

It is estimated that the plant as designed would have cost $45 per kilowatt of capacity on pre-war conditions. Present cost, it is expected, will be nearly three times that figure. On account of the unfavorable conditions of exchange much of the equipment will be built abroad, although considerable electrical equipment is to be constructed in this country. The design of this plant was discussed by Harold Goodwin, Jr., of the power and mining division of the General Electric Company, at the Washington Section meeting of the American Institute of Electrical Engineers on April 13.

Bare Wire May Supersede Insulated Communication Cables

THE latest researches in uninsulated cable communication conducted by the Signal Corps of the army were revealed by Major-Gen. George O. Squier before the National Academy of Sciences, in session this week in Washington. Multiplex telegraphy and telephony are now possible over open-circuit bare wires laid in or on the earth or submerged in water, according to his report. The expensive, heavy-insulated land and submarine communicating cables will be superseded by a single bare wire submerged in the sea or buried a few inches in the earth, over which a number of telephone or telegraph messages may be sent or received at the same time.

The germ of this plan was noted by Major-General Squier in September, 1910, and discussed by him in April 1912, but it was not until recently that successful tests proved the discovery to be a practical one. Both telegraph and telephone communication was established recently between Fort Washington, Md., and Fort Hunt, Va., distant three-quarters of a mile (1.2 km.), on opposite sides of the Potomac, by the use of a bare No. 12 phosphor-bronze wire laid in the river to connect the stations. The transmitter consisted of an electron tube oscillator which delivered a current of about 270 milliamperes to the line at a frequency of about 600,000 cycles. At the receiving end of the line an electron tube and a six-stage amplifier were used without any ground connection. With this arrangement good tuning was obtained at both ends of the line, and telegraphic and telephonic transmission was secured.

Similar communication was established between two stations at the Signal Corps Laboratory at Camp Alfred Vail, N. J., by using bare No. 16 copper wire buried about 8 in. (20 cm.) in the earth and connecting the stations, about three-quarters of a mile apart. Frequencies as high as 1,000,000 cycles were used. Communication was also carried on by means of a bare wire, one and three-quarter miles (2.8 km.) long, laid on the surface of moist earth. In these land tests a current of about 100 milliamperes was used.

National Organization Conference of Engineering Societies June 3-4

THE joint conference committee of the four founder engineering societies has issued a call to the engineering organizations of the United States for an organizing conference to be held at Washington, D. C., June 3 and 4. It is the purpose of this conference to bring into existence a comprehensive organization which proposes the co-operation of engineering and allied technical associations to further the public welfare wherever technical knowledge and engineering training are involved and to consider matters of common concern to these professions. All engineering organizations whose chief object is the advancement of the knowledge and practice of engineering and the allied technical arts and which are not organized for commercial purposes are expected to send delegates.

A plan of organization has been drawn up by the joint committee based on the following principles:

1. Non-interference with the interrelations with respect to technical matters and the maintenance of the autonomy, functions and operations of individual organizations.
2. Local affiliation of existing groups of engineers in order to facilitate united action in local questions of public welfare and other matters of common interest.
3. National association of engineering organizations by means of National Council composed of representatives widely chosen by local affiliations or organizations and by national organizations, meeting annually and acting through an executive board.
4. Financial support of such association by contributions from all participating organizations on a basis of membership.
5. A form of organization which will permit expansion and development.

Dr. Langmuir Propounds New Conception of Energy and Magnetism

A NEW conception of energy, force, time, space magnetism and all the general properties of matter was propounded at the Tuesday session of the National Academy of Science at Washington by Dr. Irving Langmuir of the General Electric Company.

To the usual conception of matter involving particles, molecules, atoms and electrons, Dr. Langmuir adds a new division which he has named the "quantel," consisting of a positive and a negative part, present everywhere in space, moving in all directions with the velocity of light and capable of passing through matter. Quantels constitute, according to Dr. Langmuir, what has heretofore been known as the "ether of space" and cause all of the phenonema of light, electricity mass and energy.

Managerial Topics Discussed at Arkansas Convention

THE Arkansas Utilities Association met at Hot Springs the first three days of the week in its thirteenth annual convention. Governor Brough at the opening of the convention stated that the two hundred leading utilities in the state had an investment of $150,000,000 and that the tax commission reports showed that the utilities were fairly reporting their investments. J. S. M. Wharton, president of the association, in responding, said that the records showed that the utilities were paying on a basis of assessment double the average of the other industries of the state.

"Lightning Protection" was the subject of a paper by J. L. Buchanan, president of the Wesco Supply Company, St. Louis. O. P. Barnell, Westinghouse Electric & Manufacturing Company, St. Louis, presented a paper on underfeed stokers. P. W. Thomas, mechanical superintendent Arkansas Light & Power Company, Pine Bluff, discussed the three fuels readily available in Arkansas, namely coal, oil and natural gas, with special reference to labor supply, first cost, reliability, economy and overload requirements. The discussion was merged with that of an address on present operating problems by W. G. Schmauder, Texas Power & Light Company, Dallas, the interesting topics being cost of money, open shop and power plant efficiencies.

A. Hardgrave of Dallas represented the National Electric Light Association, and after due consideration it was voted to affiliate with the Southwestern Geographic Section.

The convention voted to meet at Hot Springs next year. The officers elected for next year are: C. J. Griffith, Little Rock, president; J. F. Christy, Jonesboro, first vice-president; J. A. Whitlow, Pine Bluff, second vice-president; Judge R. M. Foster, Helena, third vice-president, and S. E. Dillon, Hot Springs, secretary-treasurer.

Water-Power Bill Conferees Reach Agreement

CONFEREES of the Senate and the House on the water-power bill reached an agreement on Wednesday. No public announcement could be obtained from the conferees at that time relative to the changes agreed upon.

The water-power bill has been in conference since the passage of the bill by the Senate on Jan. 15.

Big Spectacle to Be Staged Last Night of N. E. L. A. Convention

THE culminating entertainment feature of the Pasadena N. E. L. A. convention, "La Fiesta de Electra," will take place Friday night, May 21, at the Hotel Maryland. This crowning event will be given by the Pacific Coast Section.

"Charlie" Murray, the Mack Sennett comedian, will be master of ceremonies. He will be assisted by a number of well-known motion-picture performers. In fact, no pains are being spared to make "La Fiesta de Electra" the most spectacular performance of its kind ever staged.

Tentative plans contemplate a dance in the great ballroom of the Hotel Maryland in conjunction with the acts staged by Mr. Murray.

April Financing the Most Expensive Since Beginning of the Year

APRIL shows only a slight decline as compared with March in the total of bond and stock issues offered by electric public utilities and an even higher rate of interest than has appeared so far this year. An issue of three-year gold notes totaling $500,000 offered by the Syracuse Lighting Company is conspicuous because it bears 6 per cent and yields only 6.99 per cent. One of the largest bond issues to be floated by any public utility this year is a five-year note issue for $10,000,000, offered by the Pacific Gas & Electric Company at 97½ to yield 7.70 per cent. With but two other exceptions—a bond issue of the Buffalo General Electric Company for $2,000,000, offered at 97½ to yield 7.60 per cent, and $200,000 in three-year notes of the Massillon Electric & Gas Company yielding 7.60—the yield in every case is 8 per cent or more. All of the issues have short maturities. The bond and note issues total $22,965,000 and represent nine companies. To this is added $10,000,000 in preferred stock of the Ohio Cities Gas Company, bearing 8 per cent interest and offered at par. The following table gives each issue in detail:

Company	Amount of Issue	Period	Class of Security	Rate of Interest	Per Cent Yield	Offered at
United Light & Railways Co.	$ 2,000,000	Two-year	Gold notes	7	8.34	98
Ohio Cities Gas Co	10,000,000		Preferred stock	8		100
Union Electric Light & Power Co.	2,500,000	Three year	Gold debenture bonds	7	8.1	97.
Syracuse Lighting Co	500,000	Three-year	Gold notes	6	6.99	97.54
Toledo Traction Light & Power Co	3,000,000	Three-year	Debenture bonds	7	8.1	97.25
Massillon Electric & Gas Co	200,000	Three-year	Notes	7	7.6	98.50
Milwaukee Electric Ry. & Lt. Co	2,000,000	Three-year	Gold notes	7	8.1	97[illegible]
Buffalo General Electric Co.	2,000,000	Five year	Debenture bonds	7	7.6	97.50
Oklahoma Gas & Electric Co.	765,500		Gold notes	7	[illegible]	98.72
Pacific Gas & Electric Co.	10,000,000	Five-year	Gold notes	7	7.7	97½
Total	$32,965,500					

Illinois Utilities Say Return Is Not Sufficient to Attract Capital

LEADING public utility operators in the northern part of Illinois told the Public Utility Commission of Illinois at a hearing in Chicago on Thursday of this week that the utilities were not being allowed to earn a sufficient return on their investment to attract capital. It was said to be difficult even to get money at any price to make extensions and betterments which the commission had ordered or which the companies considered necessary. Samuel Insull, president of the Commonwealth Edison Company; B. E. Sunny, president of the Chicago Telephone Company, and Henry A. Blair, president of the Chicago Surface Lines, who appeared on behalf of Chicago utilities, were having trouble in getting necessary capital. The Chicago Association of Commerce appointed a special committee to attend the hearing and a number of municipalities were represented.

Regulation of Utility Labor Receives Attention of Business Men

ONE of the most important questions before the Atlantic City meeting of the United States Chamber of Commerce this week was that of the regulation of public service corporation labor. Up to Thursday morning final action by the chamber had not been taken.

The resolution as first proposed to the Chamber of Commerce came from the Philadelphia Bourse. The wording was probably changed somewhat by the resolution committee before submission to the chamber. The original resolution urged the enactment of federal and state legislation which will declare operating employees of public service corporations to be public servants and as such not free to leave the service simultaneously or proximately so, or at any time except upon due and sufficient notice, and which will also forbid the corporations discontinuing operation by "lockouts" or similar methods. It was held that such legislation should provide for the settlement of all questions concerning wages and working conditions by the representatives of the separate corporations and of the employees of the same, if possible, but that provision should also be made for arbitration (where other methods have failed) before a board upon which the employee, the employer and the public shall be represented. The arbitration should be compulsory and final and provision made for the enforcement of the award or the punishment of either party refusing to accept it.

For the first time the business press of the country has been recognized by the chamber as an integral unit by assigning it a separate session and a place on the general program. James H. McGraw, president McGraw-Hill Company, publishers of ELECTRICAL WORLD, addressed the convention on the function of the business press in relation to production.

Secretary Baker Urges Completion of Muscle Shoals Development

LAST week the Secretary of War appeared before the Senate committee on agriculture to urge the completion of the work on the dam at Muscle Shoals, Ala. The water power should be developed, Secretary Baker declared, even if the nitrate plant should not be operated. He pointed out that the section tributary to Muscle Shoals is particularly in need of the power. Because $7,000,000 has been already expended on the construction of this dam, all of which would be wasted if the project were to be abandoned, Mr. Baker expressed the belief that the only businesslike thing to do is to go ahead with the development. He also urged the operation of the government's nitrate plant.

Frank S. Washburn, president of the American Cyanamid Company, who believes that the government should not attempt the operation of the nitrate plant and should cease work immediately on the dam, made the following statement to the committee:

"It is proposed now to spend $25,000,000 for a 100,000-hp. plant or $250 per horsepower. Let us assume you could use all of it throughout the year and have no losses from idle time. Five per cent on the cost of your power, nothing else, is $12.50 a horsepower. Yet these gentlemen in making their estimates have referred to $1.69 for power in one case and in another case about three times that amount."

Mr. Washburn's estimate of the cost of producing hydro-electric power at Muscle Shoals is as follows:

Administration and labor		$100,000
Maintenance and supply		60,000
Depreciation, obsolescence, insurance and extraordinary repairs:		
Power house, dam and lock		408,900
Equipment		251,500
Contingencies		60,000
Interest, 5 per cent		1,250,000
Steam plant standby:		
Maintenance	$25,000	
Supplies	15,000	
Heat and light	7,500	47,500
Total		$2,177,900
Cost per kilowatt-year		$29.00
Cost per horsepower-year		21.77
Cost per kilowatt-hour		0.0033

Supply Jobbers' Del Monte Convention Plans

PLANS are well shaped up for the Del Monte (Cal.) convention of the Electrical Supply Jobbers' Association, to be held May 12, 13 and 14. Special trains will leave from Eastern points next week.

No program of the association in general has been made available, but it is understood that the Atlantic Division will direct its efforts along these lines: A. M. Little, chairman of this division, will head the discussion on the "Organization Plan of our Electrical Supply Jobbing House." Members will be provided with blueprints showing an organization lay-out. E. W. Rockafellow has been asked to answer the question, "What is going to be the effect on electrical supply jobbers when there is a return to normal times, if that time comes, of the appointment by manufacturers during these abnormal times of many additional distributers?"

Jobbers in the East feel that jobbers in the Central Division and in the Pacific Coast Division do business in a different manner and along different lines from the methods employed in the East. The secretary of the Atlantic Division has invited C. C. Hillis of the Electric Appliance Company, San Francisco, to address the division on the subject of Western methods and F. W. Van Winkle of the Post-Glover Electric Company, Cincinnati, to speak on the way business is done in the Central Division.

Final Action on Uniform Accounting Referred to Committee

AT THE joint conference on uniform classification of utility accounts, held in Chicago April 21 and 22, representatives of the National Electric Light Association and the American Gas Association outlined their classifications of accounts to the representatives of the National Association of Railway and Utility Commissions. The purpose of the conference was to present the views of the two utility associations to the committee appointed by the commissioners' association.

The discussion centered principally on two things—first, the proper method of recording and classifying withdrawals or retirements of units of plant and equipment; second, the proper method of providing through operating expenses for writing off at the time of retirement the book value of the unit retired. On the first question it was agreed by the representatives of the commissioners' association that no benefit results from the requirement now in force in some states that withdrawals be classified with respect to whether installations were made before or after a specified date and that credits for withdrawals of property installed before the specified date be made to one set of accounts and those representing property installed after that date be made to a different set of accounts. It was agreed that both charges for installations and credits for withdrawals made in any given year should be classified and recorded in the same set of detail accounts regardless of date of installation.

With respect to the second question, it was the view of the conferees that provision for retirements of units of plant should be made by charges to operating expenses based on the accounting company's history and experience and other pertinent facts, such charges to be credited to a retirement reserve against which should be charged at the time of retirement the original cost of the units retired less net salvage; and if, because of public policy, obsolescence, inadequacy or other sufficient cause any retirement of an unusual or extraordinary character should become necessary and the loss thereby involved should exceed the balance to the credit of the retirement reserve, such loss, or any portion of it, might, with the consent of the commission having jurisdiction, be charged to a "property abandoned" account to be amortized through future charges to the retirement reserve account.

A sub-committee composed of H. C. Hasbrouck, statistician of the Public Service Commission of the Second District of New York; George C. Mathews, statistician of the Railroad Commission of Wisconsin, and Harry Boggs, accountant of the Public Service Commission of Indiana, was appointed to consider details of the proposed classifications and to report at the earliest practicable date. A set of balance-sheet account titles was worked out and agreed on. All present felt at the conclusion of the two days' conference that much progress had been made.

Hearings on St. Lawrence River Project by International Board

FROM May 7 to June 29 a series of hearings on the projected development of a St. Lawrence River deep waterway from Montreal to Lake Ontario will be held by the International Joint Waterways Commission, representing the governments of the United States and Canada. This scheme provides for an international water route from the Great Lakes through the St. Lawrence River to the sea to accommodate ocean-going vessels. Its projectors wish the United States and Canada to undertake the work jointly. An organization said to embrace fifteen states in the Middle West is promoting the undertaking and it is the object of much favor in the Dominion, but New York State and New York City regard it coldly.

Besides its importance as a transportation project, the scheme has vast significance because of the water power it would make available. There is a total fall in the St. Lawrence River between Lake Ontario and Montreal of about 240 ft. (72 m.).

Representative Nelson of Wisconsin, an ardent advocate of the project, in a recent speech in Congress estimated the cost of a 25-ft. (7.5-m.) channel on the St. Lawrence, exclusive of the additional cost of hydro-electrical development, at $120,000,000. In the Great Lakes drainage basin, he declared, about 1,700,000 hp. could be developed, of which half would belong to the United States.

According to Mr. Nelson, the development of this hydro-electric project would make power so plentiful in New York State that Niagara energy could be released for the benefit of Erie, Pa., and the contiguous territory. A million horsepower, he asserts, could be distributed in an arc extending from Rochester down to Geneva, taking in the whole central area of New York.

The earlier sittings of the international commission are scheduled for the following dates: North Bay, Ont., May 7; Marquette and Sault Ste. Marie, Mich., May 10; Sault Ste. Marie, Ont., May 11; Fort William, Ont., May 13-14; Winnipeg, Man., May 15-16; Grand Forks, N. D., May 18; Regina, Sask., May 20; Calgary, Alta., May 22-24. From there the commission will go to Billings, Mont., holding sittings later in Idaho, Wyoming, Colorado, Nebraska, Iowa, South Dakota, Wisconsin and Ohio, returning to Windsor, Ont., for June 23; London, Ont., June 24; St. Catharines, Ont., June 25; Hamilton, Ont., June 26, and concluding its work at Buffalo, N. Y., June 28 and 29.

Training Course in Welding to Be Developed

DEVELOPMENT of a training course in welding—of which the instructions will be published in circular form—standardization of common welding processes, investigation of welding failures and a determination of their cause, decision on the proper test of welding wire which may be incorporated in specifications, listing and classification of the various processes in which welding is used, analysis of data which will be published on the proper welders to use for various processes and the compilation of a bibliography containing the best papers which have been prepared on welding and the appliances used with it are among the plans outlined for next year by the program committee of the American Welding Society at the annual meeting, April 22.

Establishment of a Philadelphia section of the association was authorized. It was stated that the organization of sections in Chicago and Cleveland was almost complete. The extension of the society into other cities, among which is Detroit, is anticipated soon.

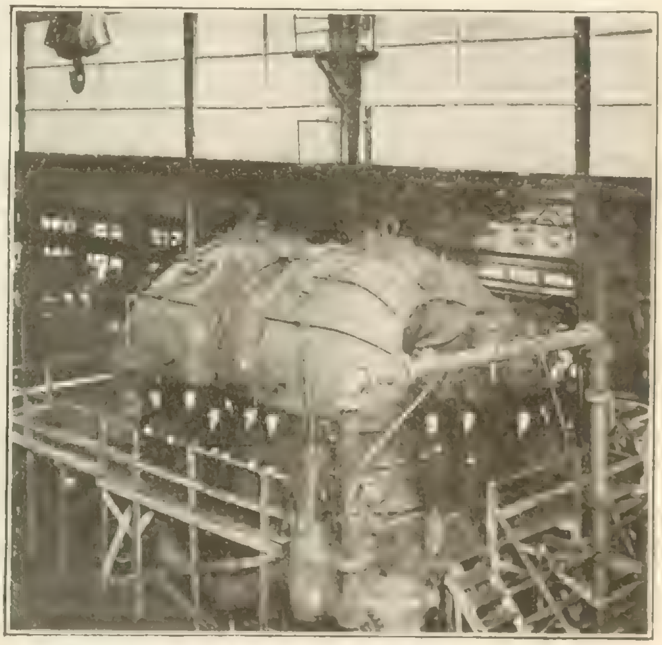
In the election of officers, J. H. Deppler was made president, J. W. Owens vice-president for two years, D. B. Rushmore vice-president for one year. The three-year directors will be W. M. Beard, A. M. Candy, C. J. Holslag, W. J. Jones, C. A. McCune, S. W. Miller, Joan Brogden and P. F. Willis.

A report on the committee for co-operation with the bureau of welding, prepared by H. S. Rawdon but read by Dr. Wittimore, mentioned among other things relative to testing the strength of welds that reports of the Ledebur method of determining the oxygen in iron and steel might be found in the Bureau of Standards library in Technical Paper No. 118 (1919), Scientific Paper No. 350 (1919) and Scientific Paper No. 346 (1919).

In a paper dealing with the speed of arc welding, by William Spraragen, it was stated that a large number of tests showed that with bare wire the electrode should be of a negative polarity except for very thin work; it also showed that a short length of wire is better, and that higher currents than have been commonly used give better results.

Describing the automatic arc-welding machine, H. L. Unland gave figures on speed for definite thicknesses of flat work when working at different current values.

New 60,000-Kw. Unit Turned Over



On April 15 the low-pressure steam unit of a 60,000-kw. turbine-generator for the Duquesne Light Company was officially "turned over" for the first time in the East Pittsburgh shops of the Westinghouse Electric & Manufacturing Company. Among those who were present and who are shown in the photograph are A. W. Thompson, president Philadelphia Company of Pittsburgh, and C. S. Cook, general manager Duquesne Light Company. The members of the party were shown how the turbine is started and how the overspeed governor release prevents it from "running away."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Pennsylvania Engineers Put Duty First.—The annual convention of the Pennsylvania Railroad section of the American Association of Engineers, scheduled for April 17, was postponed on account of the railroad strike, it being felt that the professional engineers employed by the Pennsylvania should be immediately available for any emergency duties that might arise.

Promoting Use of Technical Books.—Among the praiseworthy activities of the American Library Association is that of promoting a larger use of the technical books now in the public libraries and urging employers to install special libraries of technical books in factories and plants for the use of their employees. Edwin A. Goewey, American Library Association, 24 West Thirty-ninth Street, New York, is specially connected with this work.

Examinations for Electrical Draftsmen.—The United States Civil Service Commission announces competitive examinations for electrical draftsmen for the filling of vacancies in the government service. Salaries range from $1,200 to $2,000 a year. Both men and women, if qualified, may enter the examination, applications for which will be received up to July 1, unless enough eligibles are obtained sooner. Apply for form 1312, stating the title of examination desired, to the Civil Service Commission, Washington, D. C., or the secretary of any United States civil service board.

Electricity Supply for Melbourne.—A bill recently passed by the Parliament of Victoria, Australia, and sanctioned by the executive authority, provides for the development of a great electrical plant at the brown-coal mines near Morwell for transmission of energy to the city of Melbourne, 60 miles distant. The first cost of the scheme is placed at £3,000,000. The power plant at Morwell is to contain three turbo-generator sets rated at 25,000 kw. each, with provision for increase of capacity up to 100,000 kw. Transmission is to be at 130,000 volts.

A Westinghouse Record-Breaking Transformer.—The largest single-phase transformer ever built in the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company was recently finished. The transformer is rated at 11,500 kva. and 150,000 volts. It is oil-insulated and water-cooled, has a height of 23 ft. from the base to the tip of the terminal, and when filled with oil it weighs 111,000 lb. To fill the machine 4,700 gal. of oil are needed, and 44 gal. of water a minute are required to cool it. There are 20,400 ft. of wire in the high-tension windings and 17½ tons of iron in the cord. The transformer is one of eleven of the same type built for the Southern California Edison Company.

Electric Motor Installed at Top of Boom.—A Western contracting company has installed a 20-hp. motor on top of a 65-ft. boom which operates the sand and gravel elevator used in unloading barges. When operating at a point where energy cannot be obtained from the shore a gasoline engine drives a 40-hp. motor-generator operating at 1,275 r.p.m., which also furnishes energy for the 15-hp. motor that operates the belt conveyer used to load the elevator buckets. If energy is available, two wires incased in a heavily insulated hose are extended from the source of energy to the switchboard. Both motors are of the Bullock type, compound-wound, 240-volt, direct-current, constant-speed. Eighty yards of aggregate is elevated in an hour when the motors are run on energy from the generator and 65 yards in an hour when they are operated from the shore.

World's High-Head Hydro-Electric Plants.—A tabulation by E. M. Bergstrom printed in a recent issue of the London *Electrician* lists seventeen representative high-pressure turbine installations made in various parts of the world in the last fifteen years. Of these nine have heads of more than 1,000 ft. The Aura plant, in Norway, ranks first in this respect, with a head of 2,350 ft.; the Tata plant, in Bombay, has 1,650 ft.; the Brusio plant, in Switzerland, has 1,350 ft.; the Necaxa (Mexico) plant and the Mexican Light & Power Company extension plant are tied with 1,279 ft.; the Tysse plant, in Norway, has 1,260 ft.; the Loentch (Switzerland) extension has 1,150 ft. and the original Loentch plant 1,075 ft., while the Kinugawa plant, in Japan, has 1,050 ft. The highest head tabulated for a United States plant is 865 ft. in the case of plant No. 1 of the Southern California Edison Company at Kern River. This is exceeded by two plants in Brazil.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Technology Club.—The Technology Club of Philadelphia is scheduled to meet on Wednesday, May 5.

Michigan Section, N. E. L. A.—This section of the National Electric Light Association will hold its annual convention at Ottawa Beach, Mich., Aug. 24-26.

North Central Geographic Division, N. E. L. A.—The annual convention of this newly organized division of the National Electric Light Association is scheduled for June 16 and 17 at Minneapolis, Minn.

Conference Club.—The first meeting of the Conference Club under its new plan of membership providing representation for the entire industry will be held at White Sulphur Springs, W. Va., on June 17, 18 and 19.

A. I. and S. E. E., Philadelphia Section.—At the May meeting of this section of the Iron and Steel Association, to be held tonight, the program, as previously announced, will be devoted to "general ideas and discussions" on electrical applications in the industry. On Saturday, June 5, the annual outing will take place.

Electric Club of Chicago.—This club announces a "May party" for Tuesday, May 18. At this week's meeting Guy Norton, sales manager of the Duplex Lighting Works of the General Electric Company, discussed the functions and relations of the electrical and illuminating engineer, the electrical supply jobber and the electrical contractor and dealer.

A. E. S. Activities.—A Spokane chapter of the American Association of Engineers was organized on April 3 and a Denver chapter on April 6. A charter for a chapter has been granted to St. Augustine, Fla. The Kansas State College chapter has elected Walter E. Dickerson president, and the University of Missouri chapter has conferred that office on J. W. Moody.

Worcester Section, A.I.E.E., Formed.—A section of the American Institute of Electrical Engineers has been formed at Worcester, Mass., the chairman being C. R. Oliver, construction engineer, New England Power Company, and the secretary D. J. Locke, assistant to Prof. A. S. Richey, Worcester Polytechnic Institute. At the first meeting, held last month, about 100 persons attended, the speaker being Prof. C. F. Harding of Purdue University, whose topic was "The Effect of Power Factor and Load Factor on Central Station Rates."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Powers of State Engineer in Determining Water Rights.—In proceedings for the determination of water rights, the Supreme Court of Nevada has declared, the ultimate findings of the State Engineer, though entitled to great respect, do not under the law take from the district court the power to grant relief to an applicant who takes exception to the State Engineer's decree and whose rights the court may find to have been infringed. (187 P. 1004.)

Liability for Accident Caused by Failure of Light.—Where a company contracted merely to furnish electrical energy for power to the operator of a factory it was not liable, according to the finding of the Mississippi Supreme Court, in Mulligan vs. Meridian Light & Railway Company, for the death of a worker in a factory who, when the lights went out owing to a failure of power, fell into a vat of boiling chemicals, the electric company having no duty toward the employee as agent of his employer or otherwise. (83 So. 816.)

Duty of Commissioner to Make Valuation.—The Supreme Court of Colorado, declaring that the Public Utilities Commission of that State is not a court, bound to consider for determination only what is brought before it, but is a legislative agent with certain administrative duties, has announced that where a public utility seeks increased rates the commission should on its own initiative determine the value of the property devoted to the public use. The court holds that the outstanding capitalization of such company can have but little effect on rate decisions in view of the common practice of watering stock. The commission is not confined to technical rules of procedure and as an investigator it should determine the facts. (187 P. 1082.)

Increase of Rate by Public Utilities Commission Without Valuation Declared Erroneous.—In reversing the action of the Public Utilities Commission of Colorado granting increased rates to the Colorado Power Company for energy supplied to the Ohio & Colorado Smelting & Refining Company, the Supreme Court of Colorado laid down these principles: (1) Where a power company made extensions without having obtained the approval of the commission or a certificate of necessity, it cannot demand an increased rate so as to pay a fair compensation on the property used in the extension, for the state is not necessarily an insurer of the productivity of all investments by a public utility company; (2) the sufficiency of the rate prescribed is strongly presumed, and the burden of showing it to be confiscatory is on the complaining company, there being a still stronger presumption of adequacy where the rate is fixed by contract between the company and third persons; (3) where the commission, without determining the value of the property devoted to public use, entered an order authorizing a power company to charge an increased rate for energy furnished to a particular smelter, which increased rate would probably cause the smelter to suspend operation, such order was erroneous, particularly where it appeared that the same power company supplied energy to a competing smelter in the same state at a rate lower than the one fixed in the contract between the smelter and the power company. (187 P. 1082.)

Electric Supply Company's Responsibility for Death from a Sagging Wire.—Several interesting points were decided by the Missouri Supreme Court in a suit brought by the widow of an employee of a laundry against the Kansas City Light & Power Company for damages because of his death, which was caused by electric shock attributed to a primary wire having sagged and come into contact with a secondary wire which energized a defective drop cord feeding a lamp. The question of the company's negligence was held to be one for the jury. The negligence of deceased's employer in not furnishing a properly insulated drop cord did not relieve the company from liability for the accident, the proximate cause of which was its own negligence, even though the fatality might not have taken place had the drop cord been intact. A requested instruction to the jury that the plaintiff could not recover if the deceased knew that the lamp cord was defective or in such condition that he was liable to receive a shock from it was properly refused, as was a further requested instruction that defendant was not liable if it had constructed and maintained wires in the manner required by the electrical department of the city. Testimony from men of long experience in electrical work that they had felt the passage through their own bodies of the voltage normally carried by secondary wires and had seen deaths from higher voltage, and expert testimony as to whether an electric supply company was negligent in permitting a primary wire to sag and touch a secondary wire, were properly admitted, but evidence as to the condition of the wires three years before the accident and two years after the accident was inadmissible in the absence of a showing as to the condition of the wires in the interval. The court also held that a verdict for $10,000 in the case of a widow with three children under seven years whose husband was twenty-nine years old at the time of the fatal accident and earned $22.50 a week was not excessive. (219 S.W. 80.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Donations Not a Proper Charge to Operating Expenses.—Donations made by public utilities for patriotic and other purposes must not be charged against consumers as an operating expense, the Missouri Public Service Commission has held, but are to be understood as the contributions of the stockholders.

Outside Business of Municipal Plant.—When a municipality furnishes service beyond its own limits it becomes a public utility, the Colorado Public Utilities Commission holds, and is subject to the jurisdiction of the commission, and the commission will not refuse to assert authority over rates in such cases on the ground that the municipality has no constitutional or statutory power to supply customers beyond its bounds.

Reasonable Rates to Street Railways.—Where an electric power company furnishes electrical energy under contract to a street-railway company at actual cost plus 25 per cent to cover loss in transmission, and in consideration thereof the railway company supplies and maintains the transmission lines used in serving it, the rate, according to a decision of the Public Service Commission of Pennsylvania in a complaint brought against the Northwestern Electric Service Company, is not unreasonable, because the increased costs of energy and transmission, so far as service to the railway is concerned, are actually reflected in the rate paid by the railway company and do not fall upon any other class of consumers served by respondent.

Relations of Producing and Distributing Companies.—To a petition of the city of Aledo, Ill., against the Illinois Northern Utilities Company, charging inadequate service, that company replied alleging that the poor service was due to the failure of the Edwards River Power Company to supply it with power and asking that the latter company be made a party to the proceedings. The Illinois Public Utilities Commission decided that the producing company is not a necessary party to a complaint against the service of a distributing company. The commission, while ordering the distributing company to improve its service, found that the question whether a public utility has violated its franchise by raising rates or rendering inadequate service is not within its jurisdiction and also that it has no power to issue an order for the enforcement of a court injunction.

H. C. Orton is now general manager of the Interstate Power Company, with headquarters at McGregor, Iowa.

W. H. Burtis, who was general manager of the Interstate Power Company, Decorah, Iowa, has been made general manager of the South Dakota Light & Power Company, Armour, S. D.

D. George McMillan has resigned as superintendent of power with the Singer Manufacturing Company of Elizabeth, N. J., to accept the position of maintenance engineer with the Williams Printing Company of New York City.

Edward F. Flynn, of Stone & Webster, formerly assistant to Henry Howard, who was director of the United States Shipping Board recruiting service during the war, was presented with a loving cup recently by the personnel of that service.

Charles T. Main has recently enlarged the scope of the engineering work of his office to include textile mills and other industrial plants, water-power and steam-power developments and examining and reporting on plants. Col. F. M. Gunby, who has recently been released as head of the engineering branch of the construction division of the United States Army, has returned to take up the work of engineering manager of Mr. Main's organization.

Prof. William H. Freedman, for many years the head of the electrical department of the College of Engineering at the University of Vermont, has resigned to become head of the department of personnel and training of the American Telegraph & Telephone Company. This is a new department of the company. Professor Freedman expects to make his headquarters in New York City. He will not entirely sever his relations with the university, but will give lectures each year.

W. G. Claytor, who has recently been appointed assistant to the general manager of the Roanoke (Va.) Railway & Electric Company and the Lynchburg (Va.) Traction & Light Company, was formerly general superintendent of the lighting and power departments of those companies. Mr. Claytor entered the service of the companies in January, 1907. During the war he served in the United States Army with the commission of captain as electrical engineer for the United States Picric Acid Company, Brunswick, Ga.

George B. Tripp, president of the Central Construction Corporation of Harrisburg, Pa., has resigned to take up the duties of vice-president and general manager of the South Carolina Light, Power & Railways Company at Spartanburg, S. C. The latter company operates hydro-electric steam and gas plants as well as an electric railway system in Spartanburg and suburban territory. Mr. Tripp succeeds F. H. Knox, who was recently elected president of the Columbia (S. C.) Railway, Gas & Electric Company, as was mentioned in these columns in the issue of Feb. 28.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Warren B. Lewis, who took over general supervision of the Taunton (Mass.) municipal lighting plant in 1919, has now turned the plant back to a local manager after making the necessary improvements to increase its efficiency. George F. Seibel has been appointed resident manager in charge of this plant. Mr. Lewis has for more than twenty-five years maintained a consulting engineering office at Providence, R. I.

R. W. Alexander, manager of the stock sales department of the San Joaquin Light & Power Company of Fresno, Cal., returned to that city on May 1, after a ten days' visit in Eastern financial centers. He also accompanied A. Emory Wishon, assistant general manager of the company and president of the Pacific Coast Section of the N. E. L. A., during a speaking tour of the East undertaken by Mr. Wishon to outline his self-interest idea in the financing of needed central-station development. Features of the plan and its co-operative possibilities are outlined on page 997 of this issue. Mr. Alexander is largely responsible for the execution of the company's stock-selling campaigns, outlined on page 959 of the April 24 issue of the ELECTRICAL WORLD.

R. W. ALEXANDER

Frank V. Magalhaes, who has recently been made superintendent of meter and test departments of the New York Edison Company, has been a member of the engineering department in various capacities since 1898, with the exception of leaves of absence to attend Pratt Institute and the Brooklyn Polytechnic Institute. After graduation from the latter institution in 1906 with the degree of electrical engineer, he became foreman of the company and in 1907 was transferred to the meter department as general foreman. In 1910 he became superintendent of the meter department and in 1917 was transferred to a similar position in the test department. His appointment as superintendent of both the meter and test departments is in recognition of the able work he has done.

Obituary

John Graves Phillips, who for a number of years held the position of sales representative in Philadelphia for Harvey Hubbell, Inc., died at his home in Elkins Park, Philadelphia, on March 31.

Henry P. Erwin, treasurer of the Brooklyn Edison Company and for many years prominent in Republican politics of his district, died on April 24 in Brooklyn, N. Y., at the age of forty-two years.

William A. Lincoln, treasurer of the United Electric Light Company, Springfield, Mass., died at Springfield, April 22, aged sixty-two. Mr. Lincoln was president of the Springfield Safe Deposit & Trust Company and was one of the best known bankers in western Massachusetts.

Frank E. Hurlbut, Brooklyn (N. Y.) representative of the Parr Electric Company, New York, died suddenly on April 1. Mr. Hurlbut was electrical inspector for the New York Board of Fire Underwriters for fourteen years in New York and Brooklyn and was widely known among contractors.

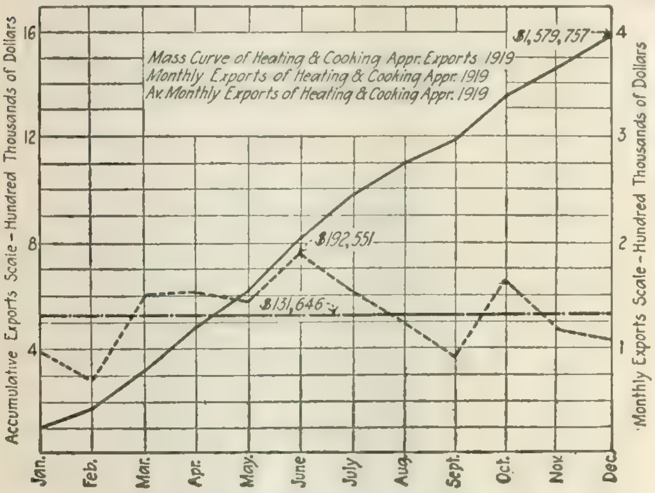
Col. John Bogart, the well-known consulting engineer, who died at his home in New York City, April 25, had been associated with many prominent civil-engineering projects throughout the United States. During the civil war he worked on the fortification at Fort Monroe and other points. Subsequently he held the following positions among many others: Chief engineer of the Park Department of New York for six years, New York State Engineer for four years, constructing engineer of the Washington Bridge, New York; chief engineer of the Rapid Transit Commission, designer of railroad terminals for Buffalo and Toronto. He was employed as an expert on harbor works in South America, especially the harbors of Venezuela. He had also served as consulting engineer for a number of large water-power projects, including developments at Niagara Falls, Keokuk, Iowa, and Chattanooga, Tenn. For the New York Edison Company he also acted in consulting capacity on the building of its large steam stations. Colonel Bogart was eighty-four years old when he died and still maintained his office at 29 Broadway, New York City.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

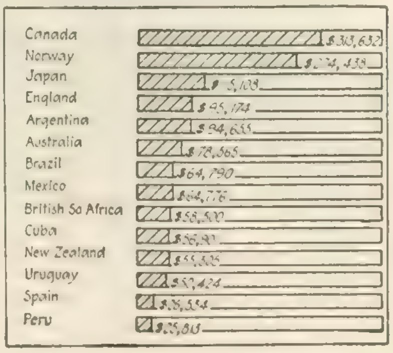
Analysis of 1919 Electric Heating and Cooking Apparatus

THE value of electric heating and cooking apparatus exported from the United States during 1919 ranked twelfth as regards classes of electrical apparatus exported, last year's exports of this product amounting to $1,579,797. The exportation of heating and cooking apparatus was very uniform throughout the year, as is indicated by Fig. 1. The highest monthly value was recorded in June, amounting to $192,551. The average monthly rate of exportation was $131,646.



MONTHLY VARIATIONS OF EXPORTS

Data compiled by the ELECTRICAL WORLD indicate that Canada imported the largest amount of electric heating and cooking apparatus, being followed closely by Norway. These two countries stand in a class by themselves as regards this class of imports, Japan, the third in rank, being over $159,000 behind Norway. Fig. 2 shows the relative value of exports to various countries importing heating and cooking apparatus, the value of which was in excess of $25,000. It is noticeable that with the exception of England not a single European nation involved in the late war imported more than $25,000 worth of this class of electrical apparatus. The market in these countries, however, appeared to be opening up during the latter part of the year, owing mainly to more normal conditions.



ANALYSIS OF EXPORTS BY COUNTRIES

The six progressive American republics of Argentina, Brazil, Mexico, Cuba, Uruguay and Peru absorbed about $358,000 worth of this apparatus, or more than was taken by Canada. The housewives in the larger cities of Argentina and Brazil are especially attracted by these convenient electrical devices for the home, and the native merchants are pushing the trade in every way possible. Australia and New Zealand have a large proportion of people who can afford to live well, and the importation and sale of small household electric apparatus is of considerable proportions in these countries. The total imports of heating and cooking apparatus from the United States by these two island commonwealths was $133,870.

Especially noticeable is the fact that the export of this class of electrical apparatus in large quantities is confined to the countries where the benefits of electricity have become recognized by the inhabitants, or where the people have not been reduced by the ravages of war to the use of the more primitive methods of heating and cooking with wood. The inhabitants of such countries as China and British India, both of which imported large amounts of insulated wire and motors in 1919, have not as yet come to recognize the benefits of electricity as a heating agent, but are still marveling over its more fundamental uses, for illumination and power.

The above figures are based on export statistics issued by the Bureau of Domestic and Foreign Commerce for 1919.

Freight Situation Beginning to Be Unscrambled

RAILWAY transportation conditions have improved during the past week. Several Eastern railroads have lifted their freight embargoes on carload-lot shipments to an extent, but at this writing there is little new nonperishable freight moving. Here and there jobbers and manufacturers report a carload of electrical material received. In most cases, probably, it has been released in the first general unscrambling of cars in the freight yards. Railroad labor has returned rather rapidly in the last few days, and it is expected that by the end of this present week the movement of pent-up cars will be noticeable. It will undoubtedly take two full weeks to accomplish anything like a fair clean-up of the yards, and in the meantime a small amount of new freight will have been moved.

There has been almost no movement of steel strip this week so the output of flexible armored conductor has been negligible. Trucking of this material has been continued, but the movement has not begun to fill the demand. Few jobbers report any stocks of armored conductor, although a few belated cars have been located and moved to unloading points. An advance of $8 per 1,000 ft. has been applied to this material as of date of April 21.

Rigid-conduit production has likewise been negligible and, with the exception of a car found here and there, little has found its way to jobbers' stocks. Steel-mill production is badly curtailed, many furnaces having been blown out for lack of raw materials, coke, etc. The mills have been running as far as they could and finished products have been piled high in warehouses. This end of the electrical trade will probably feel the effects of the strike longest as the volume of steel, finished and semi-finished, waiting for shipment is large, and it will take many weeks to move it. Added to freight congestion is the car shortage and locomotive shortage.

In the New York City district auto-trucking across the rivers and to the piers has been unsatisfactory. So many houses are attempting to move materials by this method that whole days are lost in awaiting turn to board boats or unload at piers, and many trucks have returned to their starting points loaded. Cartage of lamps from the factories in this neighborhood to nearby points has fallen because of blocked traffic. Stocks of lamps are increasing in Harrison and Bloomfield plants, and at the same time supply of raw materials is almost shut off. A break in this raw material situation is expected soon.

New England routes are still open to New York and points south. Schedule materials are being trucked to New York City, the trucks going to Trenton for porcelain before returning to Connecticut mills. Rubber-covered wire and heating appliances continue to be received by jobbers by this method.

The situation is creating a bad collection record for the month. Some manufacturers have required payment on goods held up for weeks. and jobbers who have complied have had little or no return on their money because of their inability to ship and bill. Unless shipments permit jobbers to move some of their short stocks this week, billings for the month of April are going to be much below the average.

Rubber and Wood Parts Hold Up Battery Production

THE demand for starting and lighting storage batteries is so far in excess of the available capacity of leading battery manufacturers that shipments are being delayed because of short supply of raw and semi-finished parts. Battery manufacturers increased their capacity for this year's business to an extent which they thought would be sufficient to handle the demand and are now finding that they undershot the mark by about 30 per cent. Consequently new increases in floor space are well under way in several plants.

Outside of the present transportation upset, there has not been enough rolling stock to handle raw materials into the mills or finished and semi-finished products away from them, and therefore the battery manufacturers have not been getting all the parts they need. Rubber-jar manufacturers have not been able to supply the demand for jars even with old-line rubber manufacturers getting into the jar field. A serious shortage is being felt in the line of wooden parts. Separators are not being turned out in quantities great enough to satisfy the demand, and wooden boxes to hold the finished battery are not so plentiful as they should be. Wood packing materials for shipping are getting scarcer, and increasing costs of packing are being tacked on to final battery costs. Lead for grids and connectors and sealing compounds seem to be sufficiently plentiful to have no detrimental effect on shipping schedules. There is, however, no excess supply of acid tank cars, and there is a possibility of a hold-up here and there through failure of acid to show up on time.

Battery manufacturers are looking for even greater business in the next few years. At the present rate of automobile prduction, and that anticipated up to 1925, output of starting and lighting batteries alone will have to be considerably increased everywhere merely to meet the demand. New companies are entering the manufacturing field almost daily, it seems, but will not be in a position for some time to take big slices of the battery business. Many of them are merely assemblers of parts and depend on the larger companies, which are already well loaded down, for their materials.

The demand for storage batteries for special work is increasing, but is not what the larger manufacturers call attractive business. They are already so heavily booked on starting and lighting batteries, which they are turning out under heavy quantity production, that they are not anxious to turn even part of their capacity over to special work. Special work takes greater engineering skill and often necessitates adding to the personnel, and some manufacturers do not feel they would be justified in thus increasing their forces. Besides, they feel that they have all they can take care of in their present high volume of simply executed orders. Consequently it seems that there might be a place in the industry for manufacturers of storage batteries for special purposes.

Sell Square Deal to Labor to Help Solve Difficulties

ALTHOUGH he had no panacea to offer on the labor problem, Richard H. Rice, manager of the Lynn Works of the General Electric Company, recently stated that he thought a long step forward could be taken toward the solution of many of the difficulties confronting industry if the idea of the square deal were sold to the employee.

In discussing the situation, Mr. Rice says that there are thirty-seven nationalities and fifty different classes of apparatus represented in the manufacturing field with which he is in touch; that the demand for electrical products is so great that orders are being turned away, and that the housing problem today limits the expansion of the company's man-power. The need of both quality and quantity production is paramount. The union spirit, with its tendency toward limiting production and minimizing of interest in work, is unfavorable in its effects, and a tremendous amount of educational effort must be expended in order to counteract such tendencies in many establishments. The complexities of electrical manufacturing are so great that it is obviously an impossibility for soviet methods to be successfully applied to the management of the plant, and in this respect the electrical industry is somewhat at an advantage compared with some of the simpler manufacturing businesses.

Mr. Rice declares positively that the present forty-eight-hour week is insufficient for the production of goods needed by the world and that for some time to come this condition seems likely to obtain. It is estimated that the world's requirements in manufactured articles increases 10 per cent a year, and this means that since 1914 the annual need has risen more than 50 per cent. His company is doing much at Lynn to enrich the off-hours of its employees. Every noon hour from six to eight concerts are given in the shops by volunteer employees, and there are from 200 to 300 of these "entertainers" in the works. Twice a week some of these employees voluntarily interrupt their night's rest to give a concert between midnight and 1 a.m. to the night shifts. Once a week a community night is held, and the factory social organizations include bowling teams, a rifle club, gymnasium for both men and women, boxing and ball clubs. There are classes in reading music at sight, French, English, civil government, an American Institute of Electrical Engineers Lynn section of 800 members, and classes in Americanization. Recently the company took sixty of its foreign-born employees to Salem, where they were sworn in as American citizens and welcomed into the brotherhood of democracy. There are training conferences for foremen, which, Mr. Rice says, are most helpful in improving relations with subordinate employees and in bettering preparation for department headship.

Department Stores Big Factor in Socket Device Sales

IT IS easily noticeable that department stores are taking a bigger part than ever before in the distribution of electrical devices. In following up this matter in New York City, an investigation has brought out the readiness with which the public will buy when it understands the operation of the appliance in question. This is especially true of the motor-drive socket device.

Of the larger socket devices, the department store sells more vacuum cleaners than any other device. This is not unexpected, but the ratio of vacuum cleaner sales to washing machine sales appears to be higher in New York City than in communities in New England, the West and the Middle West. This is undoubtedly because of the small space available in the average New York apartment kitchen for a machine of this size. Then, too, many people who otherwise would have a machine live in hotels.

The dishwasher and the mangle are the least well known of these socket devices. The public has had little acquaintance with them, but the department stores are increasing in number where sales of these machines are carried on.

It is rapidly being realized that, already having the housewife in the store for other purchases, a reasonable amount of sales effort and demonstration will create an interest that will be difficult to down. Only five or six department stores in New York City carry electric dish washers and mangles, although washing machines and vacuum cleaners may be found in a dozen or fifteen of them. They do not necessarily specialize in just one make of machine, but may carry up to four or five makes of vacuum cleaners and a couple of washing machines.

In only two stores have manufacturers placed the operation of their vacuum cleaners and washing machines in charge of their own representatives, and it is interesting to note that in these two cases the sales have far exceeded those of the stores where this policy has not been followed. Extremely large orders have been placed with the factories concerned in order to attempt to provide sufficient stocks for the demand created. It is noticeable even in some large department stores that where there is little effort placed on selling and no demonstrations are made the sales of vacuum cleaners will average only two a day. Compared with an average of 190 a month in one store, the value of demonstrations is obvious. Some few stores also follow up sales in order to insure correct utilization in the home.

Advertising, not only on the part of the individual store but also by the manufacturer, is bringing increased sales, because repeated instances show that prospective customers are coming to the store to inquire after a definite make of machine.

Metal Market Situation

IN THE domestic market copper is developing a little stronger tone. There has been no general dropping off of price either on the part of producers or of the outside market, although some small sales were made at 18.50 cents at refinery. Producers' prices for the present quarter are steady at 19.25 cents and third quarter at 19.75 cents. For this later delivery bids were a quarter cent under this figure. The inquiries in both markets are greater than during the past week, but sales are light.

Export demand is holding up well in face of shipping and exchange conditions, and it is expected that the month's total will show fair figures. Plans are taking form for extending credits to French copper consumers, and under tentative arrangements credits running from 90 to 120 days are proposed.

Reports from Butte, Mont., show less than one-third normal crews of miners at work in copper mines. Last week the works closed entirely as a result of the strike. Copper production in general is at a much lower rate than it was a year or so ago. The heavy buying, both domestic and foreign, of the past six months has reduced any accumulated stocks to such an extent that in some leading quarters it is expected that by midsummer these stocks will be so small that they will have considerable tendency to move prices upward.

Brass mills in New England are running short of raw copper and strike conditions are affecting some of them.

NEW YORK METAL MARKET PRICES

	April 21	April 28
Copper	£ s d	£ s d
London, standard spot	104 10 0	103 0 0
	Cents per Pound	Cents per Pound
Prime Lake	19.00	19.00
Electrolytic	19.25	19.25
Casting	18.37½	18.37½
Wire base	23.00	23.00
Lead, trust price	9.25	9.25
Antimony	10.50	10.25
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Zinc, spot	8.35	8.20
Tin	61.50	61.50
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.50 to 17.00	16.50 to 16.75
Brass, heavy	10.25 to 10.50	10.25 to 10.50
Brass, light	9.00 to 9.50	9.00 to 9.50
Lead, heavy	7.50 to 7.50½	7.25 to 7.50
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

SHIPMENTS are gradually improving and materials are being received slowly but surely in nearly all sections of the country. The amounts received by truck and by rail, however, are slight in comparison with the demand, and although materials were coming in quite satisfactorily up to the time of the railroad tie-up the heavy spring building operations promise to clean out jobbers' stocks entirely and to cause a serious delay to the building program unless much needed material is received. Labor conditions in the building trades in New York and in Atlanta appear much brigter than heretofore. Building materials, non-electrical, are scarce in the East and may cause some work to be delayed. Weather conditions in the South are discouraging as the heavy rains are delaying spring planting. In Chicago heavy demand continues, and it is expected that April sales will be as large as those for March. New England jobbers have been greatly benefited by the inability of manufacturers there to ship their products out of the district. Many back orders have been filled. Labor conditions in the Naugatuck Valley are unsettled. The volume of business done in Boston has been about normal. In the West activity in the building trades will continue for months to come, and although there are some signs of retrenchment in retail lines, volume of business is considered fair.

NEW YORK

Considerable improvement in shipments is noticeable in the metropolitan district, although it is far from satisfactory, and in some instances jobbers are completely out of a large number of stocks and certain manufacturers have been forced to cut their production. This is true of manufacturers of outlet boxes and flexible armored conductor.

Lamps, glassware, porcelain, heating appliances, irons and sockets have been received in quantities by truck. Some freight has been located and unloaded, including a number of shipments of flexible armored conductor, rubber-covered wire, condulets from up-state, miscellaneous material from Schenectady and some schedule material.

Demand for roughing materials, including pipe, wire, etc., has improved, and much business will be transacted during the next four weeks provided that jobbers can get shipments long overdue.

Flexible armored conductor has advanced $8 per 1,000 ft., and metal molding approximately 5 per cent.

Flexible Armored Conductor.—Stocks generally are low or have completely vanished. Shipments are coming in, however, and a number of jobbers have received quantities of from 5,000 ft. to a carload. One jobber has just unloaded 10,000 ft.; another has received one carload, which was due here in March, and others report the receipt of varying quantities. The total amount received is not large but is encouraging. Prices are up about $8 per 1,000 ft. One jobber is now quoting No. 14 double-strip at $120 per 1,000 ft. in quantity, $131 per coil or $150 for less than a coil.

Metal Molding.—Stocks are low and in many instances are completely out. Shipping delays have held up both raw material and the manufactured product. Demand is many times the supply. The National Metal Molding Company has doubled the list price, thus getting away from plus discounts. Some price revisions have been made amounting to approximately a 5 per cent increase.

Glassware.—Demand has increased during the week. Good stocks are on hand and shipments are commencing to come in, two jobbers having received some within the last few days.

Heating Appliances.—Toasters, irons and heaters are coming in better. At the same time, the demand has eased off a little.

Ranges.—Some ranges have come in, but these are cornered by orders and are shipped out as soon as received. With the exception of ranges still to be delivered, there will be few in the market until fall.

Heating Appliances.—As of April 10, discounts on Westinghouse heating appliances in broken packages to dealers decreased five points. The 3-lb. iron went from $6.50 to $8.50, the 8-lb. iron from $8.50 to $9.50, the five-cup percolator from $14.50 to $15, and the turnover toaster from $7.50 to $8.50.

Apparatus.—A 5 per cent increase in price was effective about April 12 on Westinghouse large-size engine-driven generators, frequency changers, rotary convertors, motor-generators, water-cooled and self-cooled transformers.

Lamps.—Stocks are spotty. Few lamps have come in to jobbers' stocks this week and supplies are low. One jobber reports receiving several truck loads of lamps from Massachusetts.

CHICAGO

Regardless of reports of almost complete return to normal, shipping conditions so far as electrical manufacturers and jobbers are concerned are still bad. Almost complete cessation of freight receipts have swept jobbers' shelves bare, and inability to make shipments is piling manufacturers' warehouses full of merchandise which is badly needed throughout the country. Announcement this week of the lifting of the long-continued embargo on express consignments has helped to a certain degree.

Bad as this combination of circumstances seems, it has not tended to decrease the steady flow of orders and inquiries. Indications are that April business will be virtually as large as March.

Collections are subject to three factors, viz., time consumed in securing goods in transit, inability of factories to ship manufactured products and general reluctance of banks to make or renew loans. Collections are materially slower than before. Large interests report current liquidation of bills to be generally under pressure.

Weatherproof Wire.—Constant heavy production has enabled dealers to obtain deliveries on all sizes in from four to six weeks. Changes in copper prices of three weeks ago have put weatherproof wire up to a 28-cent base. Chicago prices are: On No. 6, 30 cents; on No. 8, 31 cents, and on No. 12, 34 cents per pound in lots of 500 lb.

Bare Copper Wire.—Recent slight reductions in the market price of electrolytic copper have been sufficient to change wire prices in effect for the past three weeks. Supply and demand both remain constant with delivery in from six to ten days.

Outdoor Lighting Equipment.—Demand from public utilities and municipalities is strong. Suspension street hoods are a prominent feature. With an 12-in. radial-bowl reflector these are quoted for immediate delivery at $11.65 each, complete.

Pole-Line Equipment.—Conditions remain about the same as for some time past. Heavy demand is felt for material for farm-line transmission.

Fuses.—Current quotations on non-renewable cartridge fuses are as follows: 1 amp. to 30 amp., 25 cents each, subject to 42 per cent discount in standard packages, 23 per cent in fifths and 12 per cent in less than fifths; 35 amp. to 60 amp. are 35 cents each, with the same quantity discounts. Refillable cartridge fuses are, for 1 amp. to 30 amp. in standard package, $23.85 per 100; in fifths, $28.05 per 100; in less than fifths, $47.55 per 100; 35 amp. to 600 amp., in similar quantities, are priced at $47.25, $59.25 and $94.25 per 100.

Buzzers.—Resulting from increased production costs, buzzers have been advanced approximately 10 per cent. Present prices are, in lots of ten, class B, 65 cents each; class C, 60 cents each. Delivery can be made from jobbers' stock.

Circuit Breakers.—New list prices are now in force on the I T E line of circuit breakers made by the Cutter Electrical & Manufacturing Company. The advance on this line is about 10 per cent instead of 50 per cent, as was erroneously reported in these columns on April 3.

BOSTON

No let-up is apparent in the volume of trade, notwithstanding the chaotic condition of deliveries. Collections are holding up well, but jobbers are handicapped in some cases by the insistence of manufacturers upon payments before the receipt of goods in transit. Stocks are very uneven, and steel supplies are very low. Porcelain from outside New England is scarce. Prices are being maintained steadily as a whole, but some weakness is noted in rubber-covered wire. The inability of not a few manufacturers to ship normal consignments out of New England during the period of recovery from the effects of the railroad strike has helped local jobbers wonderfully in filling back orders. Motor-truck shipments continue to give some relief to Boston and other cities distributing electrical supplies, and parcel-post deliveries are working out well in this district for smaller material. Labor conditions are somewhat unsettled, especially in the Naugatuck Valley, where production in brass works has been greatly curtailed by a strike of unskilled workers.

Wire.—Rubber-covered wire quotations show softness this week. One price as low as $11 per 1,000 ft. on a 5,000-ft. lot basis was seen a few days ago, and $11.50 to $12 is being asked in other cases. Stocks are in good shape.

Non-Metallic Flexible Conduit.—Stocks are spotty. One jobber succeeded in filling all his orders and had some loom to sell to competitiors at the end of last week through shipments received from a New England factory which was unable to ship its product West and South. Other inquiries brought report of zero stocks in this material. Prices are firm at $37 per 1,000 ft. for $\frac{7}{32}$-in. and $40 for ¼-in. loom.

Flexible Armored Conductor.—Stocks are being temporarily built up here and there with the aid of motor-truck shipments. Prices are very firm, No. 14 single-strip is quoted $110 per 1,000 ft. and double-strip of this size at about $125.

Sockets.—A plentiful supply still features the market, with steady prices. In case lots, pulls bring 50 cents, keys 28 cents and keyless 26 cents.

Rigid Conduit.—Deliveries are greatly upset. Stocks of ½-in. and ¾-in. pipe are shot to pieces, only dribbling sales being reported. Galvanized pipe, ½-in., brings $99.58 per 1,000 ft. in less than 2,500-ft. lots, and ¾-in., $132.20. Black pipe in these sizes is quoted at $93.98 and $124.60 respectively. One representative jobber had no pipe, either white or black, under 1½-in. size Monday. Quotations on 3-in. galvanized and black conduit were $879.37 and $828.90.

Lamp Cord.—Cotton-covered cord is now in fair supply, No. 18 bringing $30 per 1,000 ft.

Motors.—Deliveries are being extended to from twenty-eight to thirty weeks on motors of 5-hp. to 20-hp. rating. Prices are steady and the demand is extremely active. Manufacturers are making vigorous efforts to increase their production facilities.

Appliances.—Washers are moving freely, although some difficulty is being encountered on shipments from outside New England unless by boat. Cleaners are in heavy demand. Heating devices are reported scarcer in some jobbing circles.

Meters.—Business is holding up vigorously. Gradually manufacturers appear to be getting into a stride which promises fairly good deliveries for some time. Central-station storerooms are not carrying many extra meters, but the present needs of the market are being pretty well handled. Fairly good shipments for immediate needs can be made on the basis of about three to four weeks' delivery.

Lamps.—Regular customers' needs are being met by manufacturers with reasonably good success, but shipments are being held down to clear requirements. A shortage is reported in 40-watt "B" lamps. Miniature and sign lamps are in good supply.

ATLANTA

Jobbers are beginning to feel keenly the effect of the railroad strike in the East, particularly on express shipments, of which only few are coming through. One or two firms report a slight slowing up in the contractor demand because of the local strike, but the outlook for a settlement of the controversy with the carpenters' union, which was scheduled to go out on May 1, is somewhat brighter and a number of jobbers are predicting that the strike will not take place.

Collections from contractor-dealers show some improvement, but payment of accounts by automobile accessory houses and other lines of business which are not wholly of an electrical nature are reported not altogether satisfactory.

Weather conditions throughout the territory are discouraging from an agricultural standpoint, and unless rains cease crops will be curtailed because of late planting.

Fans.—The fan season opened up well, with the prospect that the demand will exhaust local stocks. However, there is a plentiful supply of desk fans on hand at present

Sewing Machines.—Spring has stirred this specialty into activity and stocks are moving briskly. A good supply of machines is in the territory, but slow shipments, on account of difficulty in obtaining proper woodwork, will soon deplete local holdings.

Wire.—The wire outlook is not so bright as heretofore, stocks of No. 12 being practically exhausted, while the popular sizes of weatherproof are hard to obtain in quantity. It is difficult to accumulate any stocks in the face of the strong demand.

Porcelain.—Porcelain stocks show no improvement over last week, although one jobber reports the receipt of a large shipment of knobs, insufficient, however, to afford more than temporary relief. Manufacturers will make no promise of shipment. Prices—Knobs, 500 to 4,000, $3.10 per 100; cleats, 300 to 1,850, $3.20 per 100.

Heating Devices.—Stocks of hollow ware are low and shipments unsatisfactory. There is a sufficient supply of flatirons in the territory.

Line Material.—A fair supply of line material is reported, hardware excepted. One of the largest jobbers reports the receipt of a large shipment of cross-arms, relieving a shortage that has existed for several weeks. Shipments on poles are reported satisfactory. Price, cross-arms, pine, four-pin, 5-ft., less than 1,000 ft., $1.23.

Glassware.—There is a shortage in glassware. Such stocks as are in the territory are reported very spotty and consist mostly of obsolete material. Little hope is held out for improvement in the immediate future.

Vacuum Cleaners.—National and local advertising has greatly stimulated the movement of this device. Stocks at present in fair condition are being rapidly depleted, while best shipments are quoted at three months.

Armored Conductor.—The supply received by one jobber ten days ago was quickly exhausted and the local situation is again acute, there being no stocks of moment in the territory. Only indefinite promises of shipment are being made. Price, 1,000 ft. to 2,500 ft., $11.60 per 100 ft.

Washing Machines.—The demand indicates that this article is growing in popularity and difficulty is being experienced in taking care of the trade. While stocks are in fair shape they will be quickly exhausted unless the embargo on shipments is lifted.

SEATTLE—PORTLAND

In Seattle jobbers and dealers report business during the past week as featured by movement of schedule materials, fractional-size motors and farm-lighting plants and by the decrease in sales of labor-saving devices for the first time in months. Inquiries and actual sales were considerably decreased. Stocks in every line are short, and the outlook for future deliveries is far from promising. While prices on some lines, principally scheduled material, are fluctuating, there has been no material increase. Business building in Seattle and contiguous Puget Sound cities is showing renewed activity, and residence construction is keeping pace with levels heretofore announced, in Seattle especially. Big construction is getting well under way with the erection of several school buildings, a number of apartment houses, moving-picture theatres, hospitals and six business structures, including a two-million-dollar building for the Pacific Telephone Company. However, the full benefit of this construction will not be felt by electrical jobbers and contractors until midsummer and early fall. Additional contracts have been awarded Seattle steel shipyards for tankers, and it is reported that the Portland yards have closed further contracts. Lack of steel is all that is withholding reopening of nearly every yard in this section. The freight embargo has seriously affected business. All promises for shipments are off for the present. Business continues about the same as last week, if anything a little better. Collections are still somewhat slow, but it is felt that this is only temporary and largely due to income and local taxes. The shortage of motors, both new and second-hand, is becoming acute.

Farm-Lighting Plants.—One Seattle firm doing a large business in lighting plants states that for the first time in the history of the industry in the Northwest there is plenty of stock on hand to handle the demand which is very good. A majority of the sales are being made to farmers in western Washington and Oregon, although demand from Puget Sound points is showing increases. Prices are showing a steady trend.

Motors.—Demand for larger sizes is light, although inquiries from lumbering and logging interests contemplating electrification of their industries continue coming in. Demand for fractional sizes far exceeds available stocks; in fact, stocks are next to impossible to obtain, especially in single-phase.

Lamp Cord.—Stocks are low in Seattle and other Puget Sound cities and demand increasingly heavy, deliveries being obtained in from two to four months. Prices recently advanced approximately 10 per cent.

Porcelain Fittings.—Available supply is not sufficient to meet increasing demands. Deliveries are exceedingly hard to obtain. Tubes are particularly scarce. Prices are trending upward. Weatherproof wire shipments average from two to six months in face of brisk demand. Stocks of smaller sizes are especially low, prices fluctuating with the upward trend.

SAN FRANCISCO

Although business is still at high tide, there is a growing feeling that provision should be made for future requirements in a conservative manner. The electrical industry is in general so closely allied to the building trades that the necessary activity in them will stimulate it for months to come, but in other retail lines there are unmistakable signs of retrenchment.

Washers.—There is a lull in the call, caused in part by the usual shortage of one or another make, but principally by the passing of the washers market from a sellers' to a buyers' market. Prices are still averaging $140 cash for a swinging wringer machine, family size.

High-Tension Insulators.—Deliveries are poor, due to manufacturing difficulties. Factories are behind their schedules, and in certain types no deliveries can be made for a year. Demands are normal for this time of the year.

Line Tools.—Business is active in construction tools and stocks are fairly good, with the exception of a general shortage of the smaller tools, such as pliers, "come-along" grips and cable splicers. The small tool situation, however, is improving, and normal stocks are expected within a few months.

Appliances.—Demand remains active, but stocks are low in the heating-device line. Factories are fairly behind, although a noticeable advance in production is being made. Normal stocks cannot be expected until along in the spring of 1921.

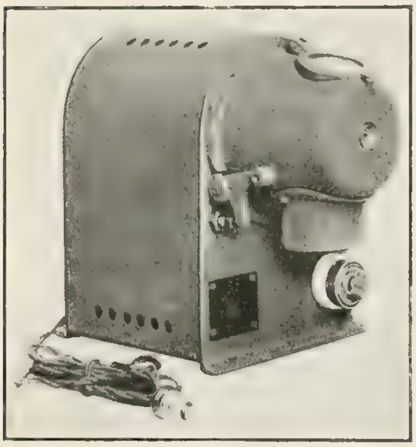
Schedule Material.—Large orders are being placed and deliveries are still fairly good in some lines, but in general factories are from three to four months behind production and no improvement for coast cities is looked for until next year.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Insulated Wire Stripper

The France Manufacturing Company, Cleveland, Ohio, has developed a machine for stripping insulation from stranded wire, single-conductor wire, enamel-insulated wire and duplex cord. Motor-driven knives rotate continuously and are adjustable to any size of wire, says the manufacturer. All moving parts are completely inclosed. The stripper is equipped with either a single phase, 110-volt, 60-cycle motor or a 110-volt direct-current motor. It is said to be especially useful in all stripping work where the volume is large.



ROTATING KNIVES STRIP WIRE

Shade Holder for Plug Clusters

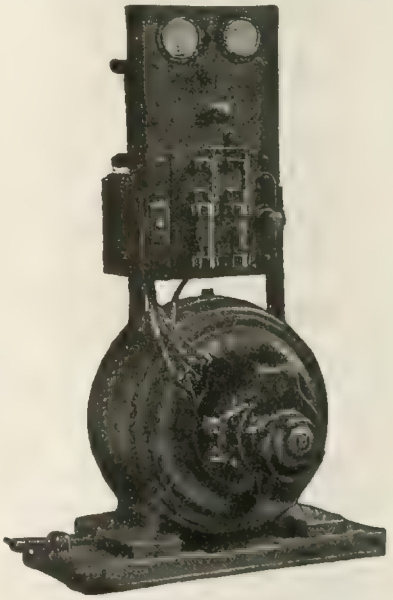
A shade holder for use with its No. 92 two-way plug clusters has been put on the market by the Benjamin Electric Manufacturing Company, Chicago.

Low Reader Ammeter and Voltmeter

The Rawson Electrical Instrument Company, Cambridge, Mass., has just placed on the market an instrument which it has named the "Multimeter." The possible uses to which this can be put, says the manufacturer, cover a wide range of measurements. There are five ranges in micro amperes and milliamperes, four ranges in millivolts and four ranges in volts, covering readings from 1 microampere to 1 amp., 50 microvolts to 100 millivolts and 0.01 volt to 600 volts. With the use of external shunts the current range can be extended to any desired value. All ranges are plainly engraved on the face of the polished condensite panel.

Farm Light and Power Generator and Panel

The Westinghouse Electric & Manufacturing Company has placed on the market a line of electric generators and control panels for use with internal-combustion engines for farm light and power service. These electric generating units are made in standard capacities from ½ kw. to 2 kw. and are adapted for operation with 32-volt battery equipment. The generators are built to be directly connected or belt driven. The belt-driven generators are equipped with sliding bases with adjustment to keep the belt at the proper tension. They are shunt-wound for normal operation, but have an additional series winding which allows the generator to be operated as a compound motor.



NON-AUTOMATIC ELECTRIC GENERATING UNIT FOR FARM-LIGHTING OUTFIT

The control panel is made of sheet steel and is mounted directly on the generator. On the panel are a voltmeter, an ammeter, a rheostat, a line switch, line fuses, a series field (starting) switch, an ignition (stopping) switch and a reverse-current relay.

An automatic stop is supplied with these panels when desired. The stop consists of a clock, mounted on top of the panel, which can be adjusted to cut the engine ignition circuit when the battery has been fully charged. This panel is therefore semi-automatic, since it is only necessary to start the unit manually—the clock mechanism automatically stopping the unit.

Water Heater

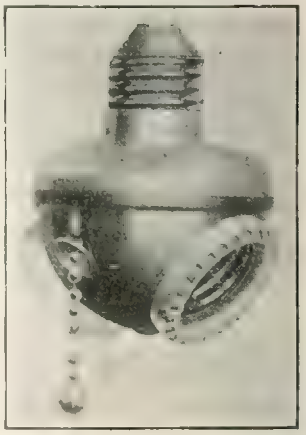
The Electric Heating & Manufacturing Company, Seattle, Wash., has just placed on the market its "Coppersert" electric water heater. It is said to be an improved type of Apfel's "Electric Insert" water heater, possessing the following characteristics: Heating element does not come into contact with either air or water and is therefore not subject to corrosion; it is always surrounded by the body of water being heated; element is inclosed in seamless copper tubing to eliminate corrosion, which, the manufacturer says, affords 50 per cent quicker heat transmission; no changing of pipes is necessary to install; no siphoning of tank is possible, reducing liability of turn-outs; it does not interfere with other methods of heating the water. The heater is made in 600, 1000, 1500 and 2000-watt sizes for alternating or direct current.

Alloy for Bonding Aluminum to Brass and Copper

The Mirete Company of Massachusetts, Inc., Springfield, Mass., has developed a new alloy for bonding aluminum to brass, copper or other metals. The manufacturers say it has a conductivity that approaches 90 per cent that of pure aluminum and that the bond is absolutely permanent. The alloy is called "Mirete" metal and can be used with an ordinary gasoline torch. Its tensile strength as given is as great as that of aluminum itself, with a higher elastic limit. Exhaustive tests show for it oxidation not so great as aluminum or copper and little evidence of electrolysis. It is claimed that with the use of this alloy the resistance loss at points of connection can be overcome either on aluminum or copper wire.

Two-Way Plug with Pull Chain

The Benjamin Electric Manufacturing Company, Chicago, has developed the Benjamin pull plug, the pull-chain mechanism of which controls one of the outlets, which permits the lamp to be turned on and off without interfering with the use of an appliance on the other outlet.



CHAIN CONTROLS ONE OUTLET

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE PERFECTION STORAGE BATTERY COMPANY, Fortieth St. and Rhodes Ave., Chicago, announces the appointment of territorial distributers for its Perfection and Jupiter light and power plants and Perfection storage batteries as follows. State of New Jersey, Edward C Daniels, Rutherford, N. J.; Maryland and Delaware, Perfection Battery Service Station, Inc., 1,417 Maryland Ave., Baltimore; Virginia, North and South Carolina, Farmers' Delight Company, 413 Lyric Building, Richmond, Va.; Tennessee, Georgia and Florida, Southern Machinery Company, 9294 South Forsythe St., Atlanta; Alabama, Dixie Electric Company, Montgomery; Kansas, Nebraska and southern half of Illinois, Perfection Farm Light Company, Kansas City and St. Louis, Mo.; North and South Dakota, Minnesota, Nebraska and Iowa, McMains Sales Company, Des Moines, Iowa, and Omaha, Neb.; New England States, W. T. Richardson & Company, Tremont Building, Boston; New Zealand, Electrical Equipment Company, 122 Customs St. East, Auckland, N. Z.; Commonwealth of Australia, Ramsey, Sharp & Company, Sydney, New South Wales; India, Eastern Electric & Trading Company, Bombay and Karachi; Cuba, Fierros & Rodriguez, Havana; Porto Rico, R. M. Delgado, Ponce.

THE MONROE LAMP COMPANY, 310 West Fourteenth St., New York, N. Y., has increased its capital stock from $100,000 to $250,000.

THE CROUSE-HINDS COMPANY, Syracuse, N. Y., manufacturer of condulets, is planning to build an addition, 70 ft. x 260 ft., to its foundry.

THE MORSE CHAIN COMPANY, Ithaca, N. Y., announces the removal of its offices from Greensboro, N. C., to 401 Commercial Bank Building, Charlotte, N. C. George W. Pritchett the Southeastern manager, has found this change advisable owing to the great increase in the use of Morse silent chains throughout the textile industry, which has had such a phenomenal growth, necessitating the building of new mills and increasing the capacity of all mills in the South.

THE ROLLER-SMITH COMPANY, 233 Broadway, New York City, announces the removal of its Cleveland office from the Williamson Building to the Vickers Building, Sixty-fifth St. and Euclid Ave. J. E. Wood, district manager, will continue in charge of this office.

THE ILLINOIS TESTING LABORATORIES, Inc., electrical engineers, have moved into new and larger quarters at 430 South Green St., Chicago. This change was made necessary on account of increasing business. It is proposed to increase the scope of the work, particularly along the lines of developing new apparatus and doing an increased amount of testing and engineering work.

W. E. THAU, general engineer for the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has been appointed engineer in charge of the marine section of the engineering department. Mr. Thau was graduated from the University of Cincinnati in 1911 and entered the apprenticeship course of the Westinghouse company. Later he become engaged in the steel mill and marine work. He has been in marine engineering work since the company became actively associated with the development of electrical equipment for this type of service.

THE WAYNE OIL TANK & PUMP COMPANY, Fort Wayne, Ind., is bringing out some new oil filters for turbines and engines and a complete oil-burning equipment for use under boilers.

L. H. KLEIN has been appointed general sales manager of the R. D. Nuttall Company, and W. H. Phillips has been appointed manager of equipment.

THE UNIVERSAL ENGINEERING & ELECTRIC COMPANY, 508 McKinley Avenue, N. W., Canton, Ohio, has been organized recently to do an engineering and construction business in northern Ohio.

LANDERS, FRARY & CLARK, New Britain, Conn., at its annual meeting elected the following officers for the coming year: Charles F. Smith, chairman of board of directors; Arthur G. Kimball, president; Frederick A. Searle, Joseph F. Lamb, Frank J. Wachter and Herbert A. Johnson, vice-presidents, the last named in charge of production; Pardon C. Rickey, treasurer; Edward F. Hall, secretary; John W. Abell and D. Niles Sheppard, purchasing agents.

THE BRYAN MARSH DIVISION, National Lamp Works of the General Electric Company, Chicago, announces that it will occupy its new offices at 623-33 South Wabash Avenue, Chicago, after May 1.

JOSEPH G. BROBECK has opened an office at 120 West Thirty-second Street, New York City, for the sale of the Simplex Wire & Cable Company's products. Mr. Brobeck has been connected with the Simplex company in a sales capacity for twenty years, ten of which were spent in Chicago and ten in Boston. His territory comprises New York State, Connecticut and the counties of New Jersey, adjoining New York City.

JOSEPH G. BROBECK

THE NATIONAL CONDUIT & CABLE COMPANY, INC., Hastings-on-Hudson, N. Y., has during the past year made extensive improvements to its mills, having entirely remodeled and enlarged its cable mill. New equipment has been installed throughout, with a greatly enlarged capacity, to meet the ever-increasing demands for cable, etc.

THE ELECTRIC FURNACE CONSTRUCTION COMPANY, Philadelphia, Pa., announces the appointment of agents for "Greaves-Etchells" electric steel furnaces as follows: H. M. Smith, 309 Schofield Building, Cleveland, Ohio; A. S. Lindstrom, 519 California Street, San Francisco, Cal.; McCrum & Gillem, 1011 Empire Building, Birmingham, Ala.; D. P. Morisseau, General Welding & Supply Company, Wainwright Building, St. Louis, Mo.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, has placed contracts for additional factory buildings which will increase its floor space by approximately 15,000 sq.ft.

L. B. STILLWELL & H. S. PUTNAM, consulting engineers, and the L. B. Stillwell Engineering Corporation, constructing engineers, now at 100 Broadway, New York, announce the removal of their offices on May 1 to 143 Liberty Street.

THE ARTHUR JONES ELECTRICAL COMPANY, 2837 South State Street, Chicago, Ill., contemplates erecting a new plant at Calumet Avenue and Twenty-ninth Place to cost about $60,000.

THE DOVER MANUFACTURING COMPANY, Dover, Ohio, manufacturer of electric irons, is planning to erect a three-story addition, 80 ft. by 206 ft.

THE McGILL MANUFACTURING COMPANY, Valparaiso, Ind., manufacturer of lamp guards, pull-chain sockets, etc., has awarded contract for the erection of two buildings on Campbell Street, 104 ft. by 206 ft. and 52 ft. by 78 ft.

THE FAHNESTOCK ELECTRIC COMPANY, Meadow Street, Long Island City, N. Y., has awarded contract for the erection of a two-story reinforced-concrete plant, 50 ft. by 100 ft., at East Avenue and Eighth Street, to cost about $50,000.

THE CLEVELAND ELECTRIC MONORAIL COMPANY, Cleveland, Ohio, is planning to build a plant at Wickliffe, Ohio, for the manufacture of overhead carrying systems.

J. LIVINGSTON & COMPANY, 70 East Forty-fifth Street, New York, N. Y., has filed notice of an increase in capital stock from $450,000 to $600,000.

THE AMERICAN STORAGE BATTERY COMPANY, Cambridge, Mass., is erecting a plant at Fernwood, Pa., where it will manufacture its complete products.

MATHEW H. DEVEY, Trenton, N. J., is organizing a company, to be known as the Devey Manufacturing Company, to establish a plant to manufacture electrical products, including conduits and other specialties.

THE CARTER HAGER ELECTRIC CORPORATION, Buffalo, N. Y., manufacturer of electric specialties, has filed notice of change in name to the Hertel Electric Corporation.

THE AMERICAN LIGHTING COMPANY, 800 Sibley Street, Chicago, manufacturer of Davis flood lamps and allied specialties, has leased a three-story building containing 36,000 sq.ft., at the corner of Polk and Sibley Streets.

THE EDWARD N. RIDDLE COMPANY, Toledo, Ohio, manufacturer of electric lighting fixtures, has acquired a building which will be remodeled for manufacturing purposes.

THE COOPER STORAGE BATTERY COMPANY, Madisonville, Ohio, has awarded a contract for the construction of a two-story addition to its plant, 80 ft. by 100 ft. Plans are also under way for another addition of the same dimensions, on which work will not be started until the one under contract is completed.

THE NATIONAL RADIO COMPANY, San Francisco, Cal., is planning to erect a two-story plant, 95 ft. by 245 ft., on Twentieth Street, near Folsom, for the manufacture of wireless and radio equipment. It will cost about $65,000.

THE STANDARD ELECTRIC WELDING COMPANY, Philadelphia, Pa., has removed its plant from Emerald and Firth Streets to 1939-41 East Sergeant Street.

THE DUPLEX STORAGE BATTERY COMPANY, 637 Edison Avenue, Milwaukee, Wis., is planning to erect a plant in West Allis, to cost with equipment about $50,000.

THE COOK ELECTRIC COMPANY, Jelliff Avenue and Runyon Street, Newark, N. J., is having plans prepared for a one-story plant, 22 ft. by 95 ft.

GRAY & DAVIS, INC., Cambridge, Mass., has received an order from its French representative amounting to more than $700,000. To meet the increasing demand for its systems the company has found it necessary to increase its output to 800 systems per day.

HARVEY HUBBELL, INC., Bridgeport, Conn., contemplates the construction of a building on State Street, near its present works, in addition to the manufacturing building, 90 ft. by 100 ft., for which contract has been awarded.

THE OSGOOD-BRADLEY CAR COMPANY, West Boylston Street, Worcester, Mass., manufacturer of electric cars, etc., is planning to build a three-story addition to its plant, to cost with equipment about $300,000.

WILLIAM A. BERTSCH has been appointed receiver of the South Bend Current Control Company, South Bend, Ind. The company manufactures electric time switches.

THE DUPLEX STORAGE BATTERY COMPANY, now occupying leased quarters at 637 Edison Avenue, Milwaukee, Wis., contemplates erecting a plant of its own in West Allis, to cost with equipment about $50,000.

THE GENERAL ELECTRIC COMPANY has acquired a large block of common shares of stock of the Hurley Machine Company, Chicago.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is arranging to increase its capital from $5,000,000 to $7,500,000.

THE OTIS ELEVATOR COMPANY, New York City at its annual stockholders' meeting voted favorably on the proposition to increase the authorized common stock from $10,000,000 to $15,000,000.

THE GENERAL ELECTRIC COMPANY has acquired the Feuchtwanger chemical plant at Little Ferry, N. J., for use of the Edison Lamp Works. The buildings have a total area of 35,000 sq.ft. and will be used for chemical work in connection with the manufacture of lamps.

AMERICAN DIELECTRICS, LTD., is the name of the new company recently organized by John H. Barker, 95 Liberty Street, New York City, and his brother, Charles A. Barker, formerly chief engineer of the John C. Dolph Company. D. J. Manson will be chief chemist, A. E. Horn associate chemist, and W. F. Eagan, formerly of the research department of the Westinghouse Electric & Manufacturing Company, electrical engineer. Charles A. Barker is chief engineer and John H. Barker is sales manager. American Dielectrics, Ltd., has arranged with the Horn-Holland Company, Long Island City, N. Y., to produce insulating varnishes and compounds under its direction. The latter company has abundant manufacturing and financial capacity, according to J. H. Barker.

THE LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, is building an addition to its factory which will increase its manufacturing floor space by about 70 per cent. The new building will be used to increase the production of alternating-current motors and arc welders.

Supply Jobbers' Notes

THE ROBERTSON-CATARACT ELECTRIC COMPANY, Buffalo, N. Y., has purchased two three-story brick buildings adjoining its store at Huron and Niagara Streets, which it plans to occupy in the near future.

THE WESTERN ELECTRIC COMPANY, INC., has established an office at 233 Harris Avenue, Providence, R. I., in charge of N. I. Allen. The Rhode Island trade will be given special attention from this headquarters.

THE MATTHEWS ELECTRIC SUPPLY COMPANY, Birmingham, Ala., announces that it will establish a branch at 59 Water St., Mobile, Ala., which it expects to have in operation by May 15. The company intends to handle its business in southwest Georgia, Florida, south Alabama, south Mississippi and south Louisiana through the Mobile branch. John W. Black will be in charge of this office.

THE MOHAWK ELECTRICAL SUPPLY COMPANY of Syracuse, N. Y., has added to its sales organization C. S. Buller of the commercial department of the Public Service Company, Newark, N. J. Mr. Buller will confine his efforts to exploiting and selling throughout New York State Edison "Mazda" lamps, "Ivanhoe" reflectors and "Duplexalite" fixtures. As a graduate electrical engineer and with many years of experience in the commercial lighting work Mr. Buller will be in position to co-operate with the general salesmen in the above company and with electrical dealers to recommend and lay out up-to-date lighting installations.

Foreign Trade Notes

THE CANADIAN GENERAL ELECTRIC COMPANY, Ltd., in its annual report for the year ended Dec. 31, 1919, states that the manufacturing situation at the end of the war was far more discouraging than at the commencement of the war, but has since improved to a remarkable extent. For the first six months of the year, owing to the hesitancy of the public in placing orders, conditions were far from encouraging, but as the year progressed new business was offered in an ever-increasing volume. For the second half of the year sales exceeded those of the first half by 115 per cent. During the later months sales exceeded those of any previous period in the history of the company, and for the last three months they have reached an average of over $2,000,000 per month. In the judgment of the directors the demands for the products of the company will continue to increase at least for some years to come, for the reason that the electrical industry has a certain assurance for the future which begets a feeling of confidence and warrants constructive effort. The manufacturing and distributing facilities of the company being overtaxed, new extensions and additions have been authorized and are being carried out, as the future of the company's activities is more assured and promising than at any previous period. A new factory for the manufacture of interior conduit has been completed and is about to start operations. A new factory for electrical fittings and supplies will, when completed, contain about 170,000 sq.ft. of manufacturing floor space.

THE WONHAM, BATES & GOODE TRADING CORPORATION, 17 Battery Place, New York, announces that it has been established jointly by Wonham, Bates & Goode, Inc. of New York, E. Naumburg & Company of New York and M. Samuel & Company, Ltd., of London, for the purpose of enlarging and expanding foreign business, both export and import, carried on for many years by Wonham, Bates & Goode, Inc., at 17 Battery Place, New York. The active management of the company will remain in the hands of the present officers. The new company, through its affiliations, has immediate benefit of many foreign connections and branches in addition to those inherited from the old firm. It will be identified commercially with M. Samuel & Company, Ltd.'s branch houses established for many years in Japan, China, the East Indies, etc. The new corporation will specialize in transmission line equipment.

D. U. E. G. IN SPANISH HANDS?—Reports from Germany are to the effect that control of the Overseas Electric Company, commonly known in the United States as the D. U. E. G., has passed into the hands of a syndicate floated in Spain. It is not known whether the old interests, which were closely allied to the A. E. G. (Allgemeine Electricitäts-Gesellschaft) have sold their holdings to Spanish interests or whether perhaps advantage was taken of the opportunity to finance in money other than marks. The company, which was a powerful factor before the war in German trade in South America, controls electric light plants and street-railway systems in Argentina and Chile. Doubt has been expressed in the United States whether the Allies will permit such a powerful concern to escape from German control while the matter of reparations is still to be settled.

THE TOYO ALUMINUM COMPANY, which had been promoted by combined interests of Japan and America, was established on Dec. 8, 1919, with a capital stock of $5,000,000 for the purpose of manufacturing aluminum by electric process. Water-power rights sufficient to develop 18,000 kw. have been secured, and steps are being taken to obtain further water rights to develop 100,000 kw. The company is said to be the first to attempt the manufacture of aluminum in Japan. Dr. Jokishi Takamine, 120 Broadway, New York, N. Y., is one of the promoters.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An electrical dealer in Spain (No. 32,532) desires to purchase 100 telephones, magnetic, with generators of three and five magnets, with combined hand transmitter and receiver (European style), and also bells for telephones.

A merchant in Spain (No. 32,540) wishes to secure an agency for the sale in that country and Portugal of electric wiring and lighting equipment, motors and generators.

A firm of ironmongers in Scotland (No. 32,545) desires to secure the sole agency for the sale of electrical goods, vacuum cleaners, etc.

Trade Publications

PUMPS.—Centrifugal pumps of the single-stage and multi-stage types for various services are described in a well-illustrated catalog just issued by the De Laval Steam Turbine Company, Trenton, N. J.

FUSES—The Star Fuse Company, 290 Church St., New York, N. Y., has issued a folder listing and illustrating its fuses under its most recent prices.

CONDENSITE.—The Condensite Company of America, Bloomfield, N. J., is circulating a booklet entitled "Condensite" for engineers, designers and purchasers, in which it describes the properties of condensite, shows how it is molded, how to design it and how to specify it.

ELECTRIC GENERATING SETS.—"Ker-O-El" is the title of a booklet published by the Matthews Company, Port Clinton, Ohio, in which it describes and illustrates its new "Ker-o-el" kerosene or gasoline electric generating sets for farm power and lighting systems.

ILLUMINATION.—The Cooper Hewitt Electric Company, 95 River St., Hoboken, N. J., has issued a "Portfolio of Industrial Illumination" containing photographs showing illuminating effects in large industrial plants.

New Incorporations

THE UNITED STATES BATTERY COMPANY of Passaic, N. J., has been incorporated by Joseph J. Flood, Aaron L. Simon and Mortimer R. Simon. The company is capitalized at $200,000 and proposes to manufacture electric batteries.

THE BLAU SERVICE, INC., has been incorporated with a capital stock of $125,000 to manufacture electrical appliances. The incorporators are: Edward Blau and Ellis J. Cook.

THE NEW JERSEY LAMPS WORKS of Newark, N. J. has been incorporated with a capital stock of $125,000 by Ascher Herman and Maurice S. Maurer to manufacture electric lamps.

THE YORK (ALA.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $10,000 by J. B. Ross and others.

THE LITTLE RIVER LIGHT & POWER COMPANY of Mount Carmel, S. C., has been organized with a capital stock of $20,000 to construct an electric light plant. L. L. Hester is president.

THE ALLIED STORAGE BATTERY COMPANY of Montclair, N. J., has been incorporated by F. S. and Beverly Weilbacher and William Von Hollen. The company is capitalized at $50,000 and proposes to manufacture electric storage batteries.

THE CARMICHAEL 8-IN-1 PLUG CORPORATION of New York, N. Y., has been incorporated with a capital stock of $100,000 to manufacture fuse plugs and other electrical specialties. The incorporators are H. and E. Carmichael and S. E. Haupt, 201 East 115th Street, New York City.

THE GREER ELECTRIC CONSTRUCTION COMPANY of New York, N. Y., has been chartered by J. Greer, C. F. Zweifel and P. R. Kuhn, 1343 Lexington Avenue, New York City. The company is capitalized at $50,000 and proposes to manufacture electrical equipment and supplies.

THE MOMAC COMPANY, INC., of Trenton, N. J., has been incorporated with a capital stock of $100,000 to manufacture lighting equipment. The incorporators are Charles E. McCullough, Maurice A. Mackey and Stewart H. O'Donnell.

THE IDEAL ELECTRIC HEATER COMPANY of Pittsburgh, Pa., has been incorporated by W. I. N. Lofland, Mark W. Cole of Dover, Del., and Wilber A. McCoy of Pittsburgh, Pa. The company is capitalized at $100,000 and proposes to manufacture electric heating appliances, etc.

THE CANADIAN LINE MATERIALS, Ltd., of Hamilton, Ont., has been incorporated by Thomas H. Barnard, John L. Counsell, Ralph R. Bruce and others. The company is capitalized at $200,000 and proposes to manufacture electric transmission and electric railroad line materials, etc.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

AUBURN, ME.—The Androscoggin Electric Company of Lewiston is contemplating the erection of a substation on Turner Street in the near future.

SKOWHEGAN, Me.—The Central Maine Power Company has appointed John Calvin Stevens of Portland as consulting architect to design its new power house in Skowhegan.

FARMINGTON, N. H.—The plant of the Cloutman Gas & Electric Company has been taken over by the Twin State Gas & Electric Company. Electricity for operating the local system will be transmitted from the Dover plant of the latter company.

GLOUCESTER, MASS. — Improvements to the street-lighting system are under consideration by the Council.

HOLYOKE, MASS.—The Mayor and Board of Aldermen have approved the bill to be introduced in the State Legislature permitting the city of Holyoke to incur indebtedness in excess of its borrowing limit to an amount not exceeding $2,000,000. This additional amount is asked for extensions to the municipal electric light plant and also for the proposed new plant, recommended by John J. Kirkpatrick, manager, on the old sawmill site, above the Holyoke dam and adjacent to the Boston & Maine Railroad.

WESTFIELD, MASS.—The special committee appointed to investigate the Municipal Electric Light Department has recommended the sale of the municipal plant. The value of the plant is placed at $600,000.

BRIDGEPORT, CONN.—Work has been started on the foundations of the proposed new power station of the United Illuminating Company on East Main Street near Water Street. The plant will be completed by 1921 and will cost about $3,000,000. The plans provide for an ultimate capacity of 100,000 kw., with an initial installation of 30,000 kw., consisting of three 10,000-kw. turbo-generators and six 750-hp. Babcock & Wilcox boilers. Westcott & Mapes of New Haven are engineers.

SOUTH NORWALK, CONN.—Commissioners of the South Norwalk Electric Works is reported to be considering the question of obtaining energy from the Connecticut Light & Power Company with the view of extending the service.

Middle Atlantic States

ALBANY, N. Y.—Bids will be received at the office of Edward S. Walsh, Superintendent of Public Works, Albany, until May 18, for electrical and mason work at the Barge Canal terminal at Greenpoint, Brooklyn, (terminal contract No. 104). Copies of detailed plans or drawings may be obtained at the office of the State Engineer and Surveyor at Albany, N. Y.

ALBION, N. Y.—The Western New York Utilities Company has applied to the Public Service Commission for permission to construct an electric light plant in Barre and also to exercise a franchise in the towns of Barre and Kendall. Surveys for the proposed transmission lines have been made.

BLACK RIVER, N. Y.—The St. Regis Paper Company contemplates the erection of a power house on the Black River, to generate 7,500 hp. The cost is estimated at about $500,000.

BROOKLYN, N. Y.—The New York Telephone Company has awarded contract to the Gillies-Campbell Company, 110 Park Avenue, New York, N. Y., for the construction of a four-story telephone exchange, at Liberty Avenue and Milford Place, to cost $200,000.

NEW YORK, N. Y.—Plans are being prepared by the Board of Trustees of Columbia University for the erection of a new power plant at the Teachers' College, 120th Street near Broadway, to cost $100,000, including equipment.

NEW YORK, N. Y.—Plans have been completed by the New York Edison Company for the erection of a two-story substation on Inwood Avenue, near 170th Street. The cost, including equipment, is estimated at $250,000.

NEW YORK, N. Y.—Contract has been awarded to the Northeastern Construction Company, 101 Park Avenue, for the erection of a transformer station on Irving Place and Fifteenth Street, to cost about $100,000, by the New York Edison Company.

ROCHESTER, N. Y.—The Fred T. Ley Company, Springfield, Mass., has been awarded contract by the Eastman Kodak Company for the construction of a new power plant, to cost, including equipment, $200,000.

ROME, N. Y.—Plans are being prepared by the board of managers, State School for Mental Defectives, for the erection of a central light and power plant, to cost about $120,000.

WATERTOWN, N. Y.—The Beebe Island Utilities Company has awarded contract to J. G. White Engineering Company, 43 Exchange Place, New York, N. Y., for the erection of a hydro-electric plant on Beebe Island, to cost about $1,000,000.

CAMDEN, N. J.—Eavenson & Levering, 217 Atlantic Avenue, have awarded contract to George Kessler, Drexel Building, Philadelphia, Pa., for the erection of its proposed plant, including machine shop, power house, scouring mill, etc., to cost between $500,000 and $600,000.

SOUTH RIVER, N. J.—Bids will be received by the Board of Public Works and the Borough Council until May 10 for design, construction, furnishing and installing machinery and equipment for an addition to the municipal electric generating plant as follows: (1) Construction of building and foundations; (2) furnishing and erection of two 300-hp. boilers; (3) two 500-kw. turbo-generator units; (4) two 500-kw. surface condensers, two air pumps and two circulating pumps; steam piping for two boiler-feed pumps and one water heater; (6) construction of coal trestle and guyed steel or radial brick chimney. Copies of specifications may be obtained at the office of Goss, Bryce & Johnson, engineers, 55 Liberty Street, New York, upon payment of $5. E. B. Hedden is superintendent of public works.

PHILADELPHIA, PA.—Permit has been taken out by the Philadelphia Electric Company for the erection of an addition to its transformer station at Marshall and Noble Streets, to cost about $75,000.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company, is planning to build a generator house at Race and Leadenhall Streets, to cost about $20,000.

HAGERSTOWN, MD.—A committee appointed by the Hagerstown Chamber of Commerce is planning extensions to the street-lighting system. A. K. Coffman is chairman.

CECIL, W. VA.—The Sterling Coal Company plans to rebuild its tipple and power plant, recently destroyed by fire. The loss is estimated at $50,000.

LOGAN, W. VA.—The Guyan Machine Shops are in the market for two 400-kva., 2,200-volt, three-phase, 60-cycle turbo-generators, complete, with water tube boilers, condensers, cooling tower, switchboard, pumps, etc. B. Shell is manager.

WHEELING, W. VA.—Plans have been completed by the city engineer for the installation of an ornamental street-lighting system, for which estimates have been asked.

WHEELING, W. VA.—Extensions and improvements contemplated or under way by the Whitaker-Glessner Company of Wheeling, to be completed in 1920, include the following: At Wheeling mill, new boiler and power house; at Portsmouth (Ohio) works, eighteen-continuous-sheet bar, billet and blast mill, power-house addition, equipment for handling river coal; new warehouse and factory building at Kansas City, Mo., etc. The cost of the entire works is estimated at $1,052,140. Andrew Glass is president

WASHINGTON, D. C.—Bids will be received at the Machinery and Engineering Materials Branch, Treasury Department, Washington, D. C., until May 11, for telephone and telegraph material under circular M. E. 199.

North Central States

DETROIT, MICH. — The Wisconsin Bridge & Iron Company, 1362 Penobscot Building, has been awarded contract by the Clayton-Lambert Company, 1380 Beaubien Street, for the construction of a factory, 210 x 300 ft. and a power house, 42 x 42 ft. Equipment for power plant, it is understood, has not yet been purchased. F. F. Van Tuyl, Union Trust Building, is engineer.

GRAND RAPIDS, MICH.—Plans are being prepared for the construction of a tire plant at Fuller Avenue and Grand Trunk Railway, to cost $400,000, by the Grand Rapids Tire & Rubber Company, 315 Kelsey Building. The plant will be equipped for electrical operation. H. H. Swan is factory manager.

HILLSDALE, MICH.—Bids will be received by the Board of Public Works, City Hall, Hillsdale, until May 21, for furnishing the following equipment: One 1,000-kw steam turbo-generator with condenser; one 400-hp. water tube boiler with stokers; one 1,500-gal. per minute motor-driven centrifugal pumping unit. Specifications may be obtained upon application to the Board of Public Works.

MENOMINEE, MICH.—The Hoskins-Morainville Paper Company has awarded general contract for a paper mill, consisting of main building, boiler house, power plant and 200-ft. concrete stack, to H. J. Selmer of Green Bay, Wis. The cost of proposed plant with equipment is estimated at $875,000.

PONTIAC, MICH.—Bids will be received by the city of Pontiac until May 17 for the construction of a filtration plant, to cost about $500,000. The plans provide for electrically driven pumps. C. W. Hubbell, 2348 Penobscot Building, Detroit, Mich., is engineer.

CLEVELAND, OHIO.—Contract has been awarded by the Jordan Motor Company, 1070 East 152d Street, for the erection of a factory and power house to be erected on East 152d Street, near St. Clair Avenue, to cost about $300,000. New equipment, including two 250-hp. boilers, with coal-handling apparatus, stokers, bunkers, etc., it is understood, is to be purchased. Paul Jones is secretary and treasurer.

DAYTON, OHIO.—Extensions are contemplated by the Dayton Power & Light Company, involving an expenditure of $1,500,000 The work will include doubling the capacity of the Miller's Ford station and extending the service in several new sections of the city.

LISBON, OHIO.—Plans are being made by the Ohio Gas & Electric Company to extend its transmission lines on Canton road and also to Willow Grove Park. A line to Elkton and other adjoining districts is also under consideration

WARREN, OHIO—The General Fire Extinguisher Company will erect a foundry, to cost about $350,000, to be equipped with electrically driven machinery. The H. M Lane Company, 701 Owen Building, Detroit, Mich., is engineer.

WORTHINGTON, OHIO.—The installation of an electric street-lighting system is under consideration.

ASHLAND, KY.—The capital stock of the Boyd County Electric Company has been increased to $220,000.

PRAISE, KY.—Plans are under consideration by the Kanawha-Elkhorn Collieries Company of Praise for the installation of electrical equipment at its local plant, including generators, etc. R. C. Simpson is general manager. The main offices of the company are at 217 Ellicott Square, Buffalo, N. Y.

ANDERSON, IND.—Extensions and improvements to the municipal electric light plant, to cost about $316,000, are under consideration

BARGERSVILLE, IND.—Contract has been awarded to N. E. White of Moran for the installation of an electric light plant in Bargersville.

COLUMBIA CITY, IND.—Plans are being considered for extension of the municipal electric lighting service to the town of Larwell, a distance of 8 miles.

HOBART, IND.—The State Board of Tax Commissioners has authorized the issue of $50,000 in bonds for improvements to the municipal electric light and power plant.

MOUNT VERNON, IND.—The city of Mount Vernon has applied to the Indiana Public Service Commission for permission to purchase the Mount Vernon Light & Power Company.

MUNCIE, IND.—Extensions and improvements to the municipal electric plant, to cost about $200,000, are under consideration by the City Council.

RICHMOND, IND. — The City Council contemplates extensions and improvements to the municipal electric power plant, to cost about $200,000.

LINCOLN, ILL.—The Lincoln Water & Light Company contemplates the installation of a new turbo-generator to cost about $6,000.

BUTTERNUT, WIS.—W. J. Schultz, owner of the local electric light plant, contemplates reconstruction of the plant, including installation of machinery to increase the output by 150 hp.

GALESVILLE, WIS.—Preparations are being made by the Davis Mill & Electric Company for changing its system from direct to alternating current. Contracts, it is understood, are now being placed for equipment and machinery. The company supplies electricity to the municipality and local industries.

MILWAUKEE, WIS.—Contract has been awarded by the Department of Public Works, to W. F. Cummings Company, 330 South Paulina Street, Chicago, Ill., for the installation of a street-lighting system, to cost about $320,000.

MILWAUKEE, WIS.—The park board has accepted the plan of the Municipal Bureau of Illumination for lighting Washington Park with electricity, replacing naphtha lamps now in use. The plans provide for 160 lamps.

ORFORDVILLE, WIS.—The Southern Wisconsin Power Company of Madison, it is reported, will erect a high-tension transmission line from Jonesville to Orfordville.

RICE LAKE, WIS.—At an election held recently the proposal to take over the local electric lighting system of the Wisconsin-Minnesota Light & Power Company at the expiration of the present contract was carried.

ST. PAUL, MINN.—Montgomery, Ward & Company of Chicago, Ill., it is reported, will soon award contracts for the construction of a merchandise building, ten stories, 340 ft. x 220 ft., and an administration building, three stories, 85 ft. x 80 ft., at St. Paul. Separate contract will be awarded later for construction of a 12,000-kw. power plant. The total cost of the project is estimated at about $4,000,000

VIRGINIA, MINN.—Contract has been awarded by the Water and Light Commission for the installation of two 775-hp. boilers and stoker in the municipial light plant.

BURLINGTON, IOWA.—Contract for electric wiring of the Showers' Brothers furniture store, now under construction, has been awarded to the Home Electric Company of this city. Contract for the electric power system has not yet been awarded.

KANSAS CITY, MO.—Plans have been completed and an ordinance has been sent to the City Council for a new street-lighting system in Fiftieth Street, from Brooklyn to Prospect Avenue. Single 400-cp. tungsten lamps will be used.

KANSAS CITY, MO.—Negotiations are under way by the Kansas City Power & Light Company for the purchase of the distributing system of the North Kansas City Light, Heat & Power Company, which is valued at about $150,000. The latter company buys its energy from the Kansas City company.

GRAFTON, NEB. — The installation of two 25-hp. oil engines, directly connected to 15-kw., 125-volt direct-current generators, and one 2,000 gal. tank and pumping equipment in the municipal plant is contemplated.

Southern States

EAST DURHAM, N. C.—The Crystal Hosiery Mill Company is equipping its mill for electrical operation. Electricity will be supplied by the Cumberland Railway & Power Company.

COLUMBIA, S. C.—Contract has been awarded to J. T. Dabbs by the Home Light & Power Company for the construction of an addition to its plant, to cost $40,000.

COLUMBIA, S. C.—Extensions and improvements to the street-lighting system, to cost about $20,000, are under consideration W. H. Harth is electrician.

MOUNT CARMEL, S. C.—The Little River Light & Power Company, recently incorporated, is considering the erection of a dam and power house to develop 475 hp., to cost about $20,000, and also a 2-mile electric transmission line, to cost about $5,000. L. L. Hester is president

SWANSEA, S. C.—Steps have been taken to organize a company to establish an electric plant to supply the town with electricity.

ELBERTON, GA.—The Elberton Oil Mills is contemplating the construction of a power plant. J. T. Dennis, Jr., is manager.

LULA, GA.—Plans are under consideration by T. C. Miller & Son to use electricity to operate its plant next year. The company generates its own power. H. C. Miller is manager.

PEARSON, GA.—Bonds to the amount of $30,000 have been voted for the installation of a lighting and waterworks system.

APALACHICOLA, FLA.—The construction of a municipal light plant is under consideration.

BRONSON, FLA.—The establishment of an electric light plant for municipal service is under consideration by the Bronson Manufacturing Company. I. P. Kimble is manager.

TAMPA, FLA.—Extensions to the electric lighting system are under consideration by the City Council.

NASHVILLE, TENN. — The Mohrlite Company of America, recently incorporated, contemplates the construction of a new plant, to cost about $300,000. W. M. Dixon of the Mohrlite Company of Urbana, Ohio, will be in charge of the Nashville plant.

BIRMINGHAM, ALA.—Surveys, it is understood, are being made by the Alabama Power Company for the erection of a transmission line from Auburn to Tuskegee; an extension of this line will provide service for Notasulga and other smaller municipalities.

BIRMINGHAM, ALA.—Horace M. Lane, 2320 Dime Bank Building, Detroit, Mich., is preparing plans for the proposed freight and car shop to be constructed for the Tennessee Coal, Iron and Railroad Company, at a cost of $2,500,000

MONROE, ALA.—The municipal electric light and power plant, destroyed by fire on March 23 and rebuilt, is reported to have been burned a second time.

PICKENS, MISS.—The Town Council is considering issuing $10,000 in bonds for extensions to the electric light system.

HEBER SPRINGS, ARK.—The plant of the Heber Springs Light & Power Company, it is reported, was recently destroyed by fire, causing a loss of about $10,000. The plant is to be rebuilt at once.

LAVERNE, OKLA.—Plans are being prepared by the City Council for the construction of a new power plant, 30 ft. x 80 ft., to be used for municipal service. Arrangements are also being made for the installation of a local distributing system. Claude H. Arbuthnot, engineer, is in charge.

CORPUS CHRISTI, TEX.—Plans have been completed by the Corpus Christi Railway & Electric Light Company for the rehabilitation of its property, to cost about $125,000. A new thirty-year franchise has been granted the company by the City Commission.

DALLAS, TEX. — Extensive improvements are contemplated by the Nunn Electric Company to its property.

HOUSTON, TEX.—Contract has been awarded by the Mack Manufacturing Company to Thomas Tellepsen for the erection of a foundry, to be equipped with a 3-ton electric furnace, etc.

MARSHALL, TEX. — The Texas & Pacific Railway Company is changing the motive power of its local roundhouse and machine shop from steam to electricity. Additional equipment will be required. The works will not be completed for six months

PHARR, TEX.—The electric light and power plant of the Pharr Mill & Elevator Company has been purchased by the Pharr Ice & Power Company. This company now furnishes electric and power service to San Juan and Swallow and contemplates the extending of its lines to other adjoining towns

CONNELL, WASH.—The City Council is considering a proposal to issue $12,000 in bonds for the purpose of erecting a transmission line from Connell to Colotus, a distance of 15 miles.

HOQUIAM, WASH. — Grays Harbor Lumber Company is planning the construction of a sawmill to have a daily capacity of 1,400,000 ft. A new power house is to be erected to supply power to all of the company's industries.

SEATTLE, WASH.—The City Council has approved an ordinance which provides for extensions and improvements to the municipal electric light and power plant, to cost about $50,000.

TACOMA, WASH.—Petitions, it is understood, are being circulated requesting the City Council to install an ornamental lighting system on K Street, to cost about $13,000.

TACOMA, WASH.—Ira S. Davidson, City Commissioner, is reported to be planning the development of electric light and power in Pierce County, for which project bonds were voted last year.

YAKIMA, WASH.—Improvements to the local system, to cost about $30,000, are under consideration by the Pacific Power & Light Company.

KLAMATH FALLS, ORE. — W. B. Parker of the Klamath Development Company has purchased the property of the Keno Power Company, including the Klamath River power plant.

VICTORVILLE, CAL. — The Mohave River Irrigation District has voted to issue $5,000,000 in bonds to purchase and complete the Little Bear dam of the Arrowhead Reservoir & Power Company of San Bernardino. The plans provide for power development and distributing system to serve 27,000 acres. F. E. Trask, Central Building, Los Angeles, is engineer

VISALIA, CAL.—The Southern California Edison Company of Los Angeles, has petitioned the State Railroad Commission for permission to take over and operate the system of the Mount Whitney Power & Electric Company, which operates in Tulare, Kern and Kings Counties.

LAYTON, UTAH.—The installation of a street-lighting system is under consideration by local business men.

SALT LAKE CITY, UTAH.—Petitions have been filed and have been referred to the city engineer for estimates on an ornamental street-lighting system for State Street, Broadway and Fourth South Street.

Canada

CALGARY, ALTA.—Tenders addressed to the City Commissioners, will be received at the office of J. M. Miller, city clerk, until May 14, for three 200-kva., 12,000-volt to 2,300-volt transformers. Specifications may be obtained at the office of the city electrical engineer.

EDMONTON, ALTA.—Tenders, it is reported, will soon be asked by the Hayward Lumber Company, 11904 Seventy-third Street, for the erection of a factory to cost $30,000, dry kiln to cost $10,000, and a power house to cost $12,000. E. W. Moorehouse, 11153 Sixty-fourth Street, is architect.

EDMONTON, ALTA.—A by-law to appropriate $500,000 for extensions to the city telephone system will be submitted to ratepayers. J. E. Lowry is superintendent of the city telephone department.

STOCKTON, MAN.—The sum of $150,000 has been appropriated for the construction of a dam at Stockton on which work will begin at an early date. The proposed transmission line will be erected along the Souris branch, east, until met by the line now being constructed from Portage to Carman and west as far as Souris.

WINNIPEG, MAN.—Contract has been awarded by the City Council for the construction of an extension to the power house at Point du Bois to Thomas Kelly & Sons, at $198,334.

WINNIPEG, MAN.—Tenders addressed to the chairman committee on fire, water, light and power will be received at the office of C. J. Brown, city clerk, until May 3, for furnishing and delivering cast-iron pipe and specials, cast-iron pipe transformer, rails and accessories for extension to the power house at Point du Bois Specifications may be obtained at the office of the city light and power department, 54 King Street.

Directory of Electrical Associations

Printed in the First Issue of Each Month

Alabama Light and Traction Association. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

American Association of Engineers. Secretary, C. E. Drayer, Nepecnauk Bldg., 63 East Adams St., Chicago, Ill. Annual meeting, St. Louis, Mo., May 10 and 11.

American Electric Railway Association. Secretary, E. B. Burritt, 8 West 40th St., New York City.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, Bethlehem, Pa.

American Institute of Consulting Engineers, Inc. Secretary, F. A. Molitor, 35 Nassau St., New York City.

American Institute of Electrical Engineers. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country. Annual convention, White Sulphur Springs, W. Va., June 29-July 2.

American Physical Society. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

American Society for Testing Materials. Secretary-treasurer, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting, Asbury Park, N. J., June 22-25.

American Welding Society. Secretary, H. C. Forbes, 29 W. 39th St., New York City.

Arkansas Utilities Association. Secretary, W. J. Tharp. Little Rock, Ark.

Associated Manufacturers of Electrical Supplies. General secretary, C. E. Dustin, 30 East 42d St., New York City.

Association of Edison Illuminating Companies. Secretary, Preston S. Millar, Electrical Testing Laboratories, New York City.

Association of Iron and Steel Electrical Engineers. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

Association of Municipal Electrical Utilities of Ontario. Secretary, S. R. A. Clement, 190 University Ave., Toronto.

Association of Railway Electrical Engineers. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago, Ill. Annual meeting, Chicago, Ill., Oct. 28-31.

British Columbia Association of Electrical Contractors and Dealers. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C. Annual meeting, Vancouver, B. C., Oct. 19.

Canadian Electrical Association, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St., East, Toronto, Ont.

Colorado Electric Light, Power and Railway Association. Secretary-treasurer, F. O. Safford, Denver Gas & Electric Co., Denver, Col. Annual convention, Glenwood Springs, Col., September.

Conference Club. Secretary, Sullivan W. Jones, 19 West 44th St., New York City. Annual meeting, White Sulphur Springs, W. Va.

Commercial Section, N. E. L. A. Secretary, R. H. Tillman, Baltimore, Md.

Eastern New York Section, N. E. L. A. Secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

Electric Hoist Manufacturers' Association. Secretary-Treasurer, E. Donald Tolles, 52 Broadway, New York City.

Electric Furnace Association. Secreretary, Dr. C. G. Schluederberg, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Electrical Manufacturers' Club. Secretary, F. L. Bishop, Hartford Faience Co., Hartford, Conn.

Electrical Safety Council. Secretary, Dana Pierce, 25 City Hall Place, New York City.

Electrical Supply Jobbers' Association. General secretary, Franklin Overbaugh, 411 South Clinton St., Chicago, Ill., Annual meeting, Del Monte, Cal., May 12-14.

Electrical Supply Jobbers' Association, Atlantic Division. Secretary, E. Donald Tolles, 52 Broadway, New York City.

Electrical Supply Jobbers' Association, Pacific Coast Division. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

Electrical Trade Association of Canada. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Canada.

Electric Power Club. Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill. Annual convention, Chattanooga, Tenn., May 5-8.

Electric Vehicle Section, N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York City.

Empire State Gas and Electrical Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York City.

Florida Engineering Society. Secretary, J. R. Benton, Gainesville, Fla.

Illinois State Electric Association. Secretary-treasurer, R. V. Prather, Springfield, Ill.

Illuminating Engineering Society. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

Indiana Electric Light Association. Secretary, Thomas Donohue, Lafayette, Ind.

Industrial Electric Heating Association. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

Institute of Radio Engineers. Secretary, Alfred N. Goldsmith, College City of New York, New York.

International Association of Municipal Electricians. Secretary, C. R. George, Houston, Tex.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria Street, Westminster, London, S. W., England.

Iowa Section, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

Jovian Order. Jupiter (president), Arthur J. Binz, Houston, Tex.

Kansas Public Service Association. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

Michigan Section, N. E. L. A. Secretary, Herbert Silvester, Ann Arbor, Mich. Annual convention, Ottawa Beach, Mich., Aug. 24-26.

Mississippi Electric Association, affiliated with the N. E. L. A. Secretary, E. S. Myers, Vicksburg, Miss.

Missouri Association of Public Utilities. Secretary-treasurer, F. D. Beardslee, 315 N. 12th St., St. Louis, Mo. Annual convention, Jefferson City, Mo., June 3-5.

National Association of Electrical Contractors and Dealers. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin. Annual convention, Baltimore, Md., Oct. 6.

National Council of Lighting Fixture Manufacturers. Secretary, C. W. Hoffrichter, 8410 Lake Ave., Cleveland, Ohio.

National Association of Electrical Inspectors. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

National Electric Light Association. Executive assistant to president, M. H. Aylesworth, 29 West 39th St., New York City. Annual convention, Pasadena, Cal., May 18-21.

National Electrical Credit Association. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

National Fire Protection Association. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

Nebraska Section, N. E. L. A. Secretary-treasurer, B. H. Conlee, Nebraska Gas & Electric Co., Beatrice, Neb.

New England Electrical Credit Association. Secretary, Alton F. Tupper, 15 State St., Boston, Mass.

New England Section, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass. Annual convention, Kineo, Me., Sept. 14-16.

New Mexico Electrical Association Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

New York Electrical Credit Association. Secretary, E. Donald Tolles, 52 Broadway, New York City.

New York Electrical Society. Secretary, George H. Guy, 29 West 39th St., New York City.

North Central Geographic Division, N. E. L. A. Secretary, M. Barnett, St. Paul, Minn. Annual convention, Minneapolis, June 16 and 17.

Northwest Electric Light and Power Association, affiliated with N. E. L. A Secretary, L. A. Lewis, Washington Water Power Co., Spokane, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 13-16.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

Oklahoma Utilities Association. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City.

Pacific Coast Section, N. E. L. A. Secretary, A. H. Halloran, Rialto Bldg., San Francisco, Cal Annual meeting, Hotel Del Monte, Del Monte, Cal., May 17, 18.

Pennsylvania Electric Association, State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

Public Service Association of Virginia. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

Public Utilities Association of West Virginia. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

Radio Club of America. Secretary, T. J. Styles, 1112 S. Curtis Ave., Richmond Hill, Queens Borough, N. Y.

Rocky Mountain Association of Municipal Electricians. President, Lawrence Stone, Denver, Col.

Society for Electrical Development, Inc. General manager, J. M. Wakeman, 29 West 39th St., New York City.

Society for the Promotion of Engineering Education. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa. Annual Meeting, Ann Arbor, Mich., June 29-July 2.

Southeastern Section, N. E. L. A. Secretary-treasurer, Charles A. Collier, Georgia Railway & Power Co., Atlanta, Ga.

Southern California Electrical Contractors and Dealers' Association. Secretary-treasurer, J. E. Wilson, 125 Consolidated Realty Building, Los Angeles, Cal.

Southwestern Electrical and Gas Association. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex. Annual convention, Galveston, Tex., May 13, 14 and 15

Southwestern Society of Engineers. Secretary, C. E. Barglebaugh, 721 First National Bank Building, El Paso, Tex.

Technical and Hydroelectric Section, N. E. L. A. Secretary, W. C. Anderson, 29 West 39th St., New York City.

Toronto Electrical Contractors' Association. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

Tri-State Water and Light Association. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual convention, Atlanta, Ga., May 19-21.

Vermont Electrical Association. Secretary-treasurer, A. B. Marsden, Rutland, Vermont.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

Western Society of Engineers, Electrical Section. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

Wisconsin Electrical Association. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis.

Record of Electrical Patents

Notes on United States Patents

(Issued April 13, 1920)

1,336,414. **Telegraphy**; John H. Bell, South Orange, N. J. App. filed Aug. 14, 1918. Prevents wandering-zero effects in conductors having high electrostatic capacity characteristics.

1,336,416. **Regulator for Electric Generators**; Henry E. Borger, Newark, N. J. App. filed May 8, 1918. Cam-type regulator for automobile generator avoids use of batteries.

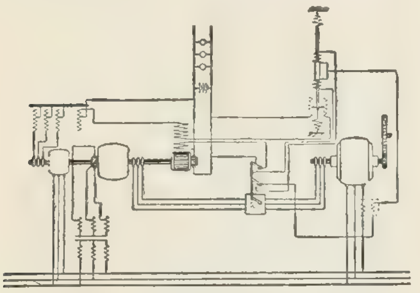
1,336,424. **Testing Device**; Maxwell W. Davis, West Haven, Conn. App. filed April 14, 1919. Portable flashlight tester.

1,336,431. **Combination Socket and Adapter**; William Halter, Cleveland, Ohio. App. filed March 9, 1918. Receives interchangeably either threaded base of a lamp, a threaded plug or a rectangular or non-circular push plug.

1,336,437. **Electric - Cable - Connecting Means**; John M. Kiefer, Jr., Newark, N. J. App. filed June 21, 1918. Used with ignition generator.

1,336,475. **Electrical Connector**; George A. Mead, Mansfield, Ohio. App. filed Jan. 5, 1918. Bond with proper proportioning of parts attached to the rail by use of heating flame of 4,000 deg. Fahr. temperature and upward.

1,336,488. **Control System**; William M. Scott, Tredyffrin Township, Chester County, Pa. App. filed Nov. 4, 1914. For rotary converter.



No. 1,336,566. Speed-Control System for Induction Motors

1,336,497. **Receiver Mounting for Submarine Signals**; Edward C. Wood, Somerville, Mass. App. filed May 18, 1918. Microphone mounted, so that undesirable lateral vibrations are largely eliminated, and microphone vibrations amplified.

1,336,502. **Rail Bond**; William P. Bovard, Mansfield, Ohio. App. filed Nov. 2, 1917. Ferrous terminal member interlocked with body member by the compression of varying degrees of intensity to give high efficiency.

1,336,503. **Catenary Suspension System for Electric Railways**; John R. Brown and Glenn H. Bolus, Mansfield, Ohio. App. filed Sept. 12, 1917. Insures high-speed service without hard spots and without danger of falling wire by having trolley suspended from messenger every few feet by continuous auxiliary messenger zigzagging from trolley to messenger and attached by trolley clips and by Crosby clips.

1,336,504. **Curve Pull-Off Hanger**; John R. Brown, Mansfield, Ohio. App. filed Oct. 18, 1917. For suspending wires around curves without subjecting the wires to twisting strains.

1,336,506. **Battery Cell and Vent Means Therefor**; Campbell C. Carpenter and Roy J. Ellis, Niagara Falls, N. Y. App. filed April 6, 1916. Minimizes escape of electrolyte and permits escape of gases.

1,336,519. **Electrically Operated Vibratory Motor**; Charles J. Henschel, Brooklyn, N. Y. App. filed Feb. 28, 1919. Armature mounted upon a pivot vibrates by attraction and release of an electromagnet.

1,336,520. **Protecting Means for Dynamo-Electric Machines**; John H. Hertner, Lakewood, Ohio. App. filed June 5, 1918. Prevents injury to shunt-field coils when run on an open circuit.

1,336,544. **Electric Generator Attachment for Windmills**; Vernon L. Sullivan, El Paso, Tex. App. filed Feb. 12, 1919. Runs small electric motors, electric lighting, etc., and stores energy in battery.

1,336,559. **Electric Internal Tube Heater**; Herbert Gutzwiller, Schonenwerd, Switzerland. App. filed Aug. 7, 1918. Heater with independent heating elements capable of being moved outward radially by means of a spreading-out device.

1,336,561. **System of Motor Control**; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Oct. 7, 1915. Control of alternating-current compensated, commutator-type motors.

1,336,562. **System of Control**; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 27, 1916. Regenerative operation for vehicles.

1,336,564. **Mechanical Rectifier and Means for Improving the Operation of the Same**; Oliver S. Jennings, Wilkinsburg, Pa. App. filed March 2, 1917. Mechanical rectifier, both self-starting and self-synchronizing.

1,336,566. **Speed-Control System for Induction Motors**; Benjamin G. Lamme and Wilfred Sykes, Pittsburgh, Pa. App. filed May 2, 1918. Flexible and economical operation of large-size induction motors substantially free from surging and allied harmful phenomena.

1,336,587. **Incandescent Electric Lamp Holder**; Pierre M. R. Salles, Cauderan, France. App. filed Feb. 18, 1918. Combined wire-gripping and terminal piston-holding member consists of a sleeve having contracted open ends.

1,336,603. **Electrode Adapter**; Ralph Baker, Wilkinsburg, Pa. App. filed Nov. 16, 1918. Carbon electrode of large diameter used with an electrode holder having an electrode receiving opening of small diameter.

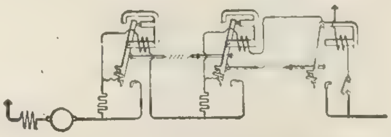
1,336,607. **Electric Lamp Socket**; Reuben B. Benjamin, Chicago, Ill. App. filed Jan. 29, 1915. For use with feeder consisting of an inner insulated conductor and an outer bare grounded conductor.

1,336,608. **Electrical Connecting Device**; Reuben B. Benjamin, Chicago, Ill. App. filed Sept. 13, 1918. Screws into an Edison lamp-receiving socket and receives a lamp plug of Edi-Swan type.

1,336,611. **Electrical Measuring Instrument**; William M. Bradshaw and Walter G. Mylius, Wilkinsburg, Pa. App. filed July 12, 1915. Records periodic demands for power.

1,336,615. **Toll Trunk Circuit**; Ormond F. Cassaday, Chicago, Ill. App. filed Dec. 6, 1915. Trunking incoming toll calls by a local operator direct instead of having toll operator extend connection to a local operator.

1,336,619. **Electric System**; John L. Creveling, Tucson, Ariz. App. filed Oct. 7, 1916. Field strength of spark-producing dynamo at times to be great and at other times weaker for speed regulation.



No. 1,337,040. Motor-Control System

1,336,728. **Ripener for Mother Starter**; Niels Christensen, Lima, Ohio. App. filed Oct. 5, 1918. Even temperature by resistances makes it possible for preparation of a pure lactic ferment culture to be kept indefinitely.

1,336,736. **Incandescent Lamp Socket**; Witter W. O. Fenety, Fredericton, N. B., Can. App. filed March 9, 1918. Molded from single piece of porcelain.

1,336,764. **Electrical Apparatus**; William I. Thomson, Newark, N. J. App. filed Feb. 16, 1917. Permits rapid charging of storage battery without injury to accompanying devices.

1,336,765. **Process of Recovering Cobalt**; Marvin J. Udy, Kokomo, Ind. App. filed Aug. 14, 1919. Oxidizing roast to produce soluble sulphates, which are brought into solution and converted into basic form, the basic material being used to replenish a metal-depositing slightly acid electrolytic bath operating with an insoluble anode.

1,336,795. **Automobile Signal**; Joseph Svaigel, Detroit, Mich. App. filed June 13, 1919. Electrically operated tubular signal arm carried by a cross head.

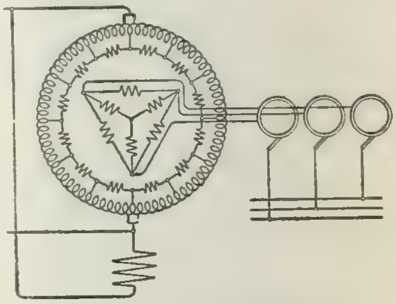
1,336,801. **Electrical Connector**; Clifford R. Wassell, Chicago, Ill. App. filed May 4, 1916. Two separable elements enable circuit changes to be made.

1,336,807. **Electric Furnace**; Leone Almagia, Cornigliano Ligure, Italy. App. filed Sept. 23, 1918. Controls heat distribution and gives instantaneous automatic regulation of short-circuit points.

1,336,820. **Electric Furnace**; Edwin L. Crosby, Highland Park, Mich. App. filed May 3, 1918. Inclosed refractory cylinder type.

1,336,833. **Radio-telegraphy**; Leonard F. Fuller, San Francisco, Cal. App. filed May 21, 1917. Arc radio transmitter including a Poulsen type generator.

1,336,850. **Connector for Electrical Conductors**; Hosea F. Maxim, Norfolk, Va. App. filed March 19, 1913. Spring clip comprises two parts, one to be attached to carbon terminal, and a spring lever which grips a wire firmly in body part.



No. 1,337,071. Transforming and Converting Apparatus

1,336,859. **Telephone Cord**; Anthony Reihing, East Toledo, Ohio. App. filed Oct. 15, 1919. Prevents twisting and breaking of cord.

1,336,889. **Selective Signaling and Train-Stop System**; James R. Coker, Knoxville, Tenn. App. filed Sept. 25, 1915. Double-acting selector mechanism functions either as a telephone signal alone or as a combined telephone signal and train-stop mechanism.

1,336,894. **Electrical Transformer**; Sebastian Ziani de Ferranti, Baslow, Eng. App. filed Feb. 1, 1916. Winding held against seatings by resilient members so that no reversal of thrust takes place on occurrence of an excessive current.

1,336,918. **Rheostat**; Antonio Papini, Philadelphia, Pa. App. filed Aug. 28, 1919. Regulates current from zero to the maximum available.

1,336,919. **Current-Regulating Plug and Socket**; Antonio Papini, Philadelphia, Pa. App. filed Oct. 13, 1919. For medical batteries or other devices.

1,336,928. **Method and Apparatus for Aligning Work on V-Blocks and the Like for Magnetic Chucks**; Frank L. Simmons, Woonsocket, R. I. App. filed May 10, 1919. Apparatus for aligning work upon magnetizable V-blocks or parallel bars.

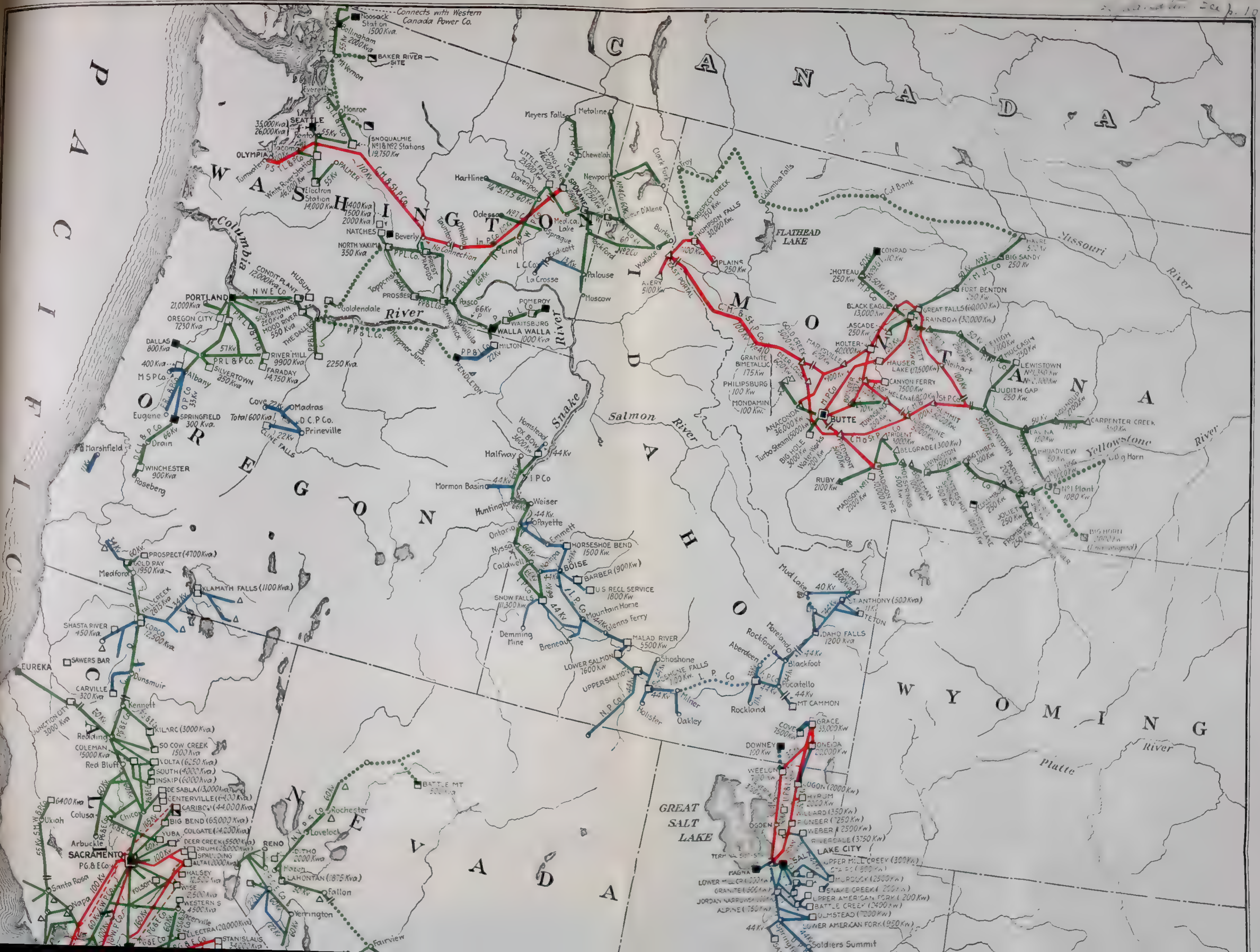
1,336,929. **Telephone-Receiver Holder**; Charles F. Simpson, Oakland, Cal. App. filed Sept. 10, 1919. U-shaped shoulder member with receiver resting against ear.

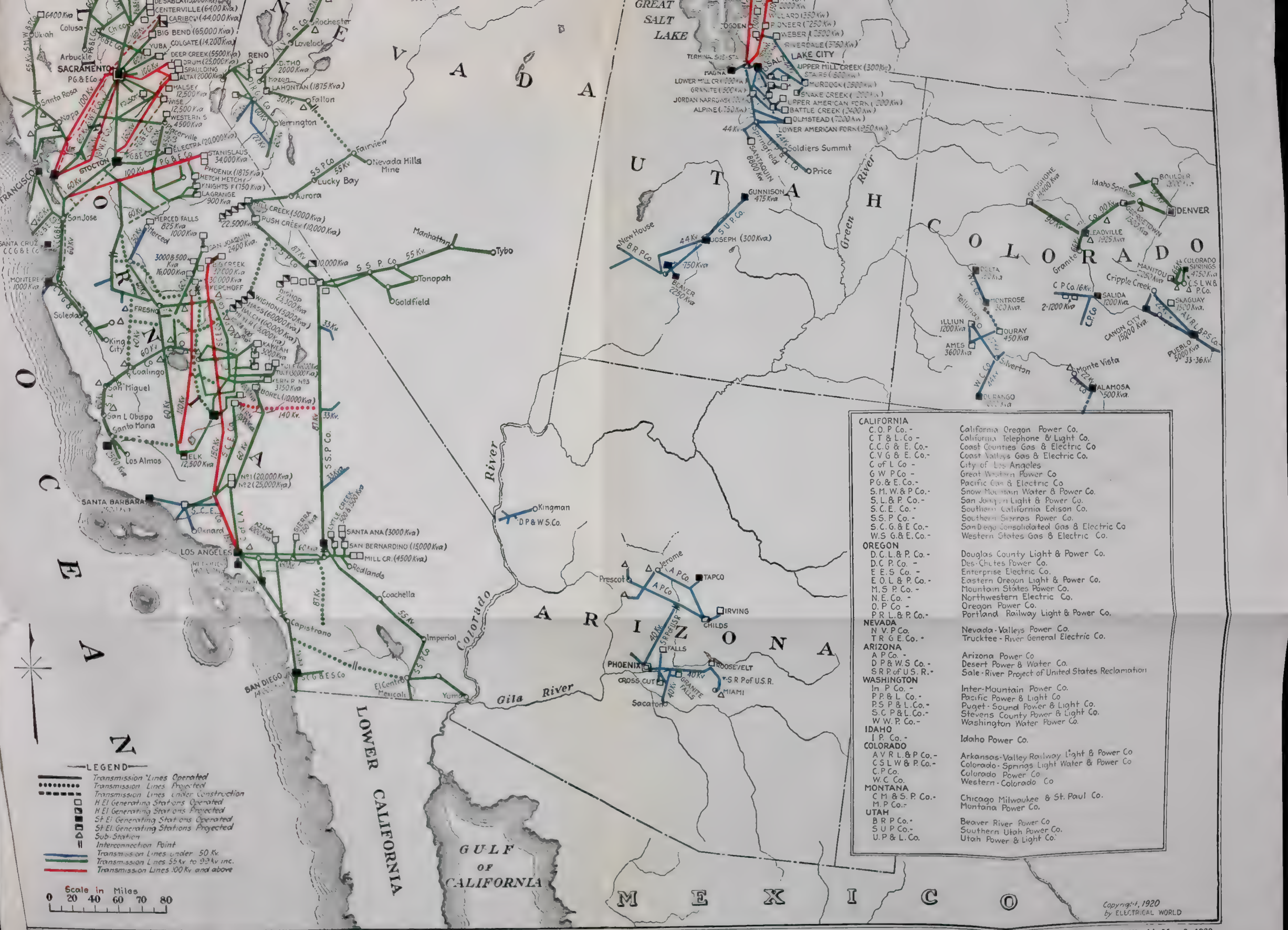
1,337,040. **Motor-Control System**; Eugene R. Carichoff, Schenectady, N. Y. App. filed May 6, 1918. Circuits controlled by electromagnetic switches which operate automatically in succession.

1,337,071. **Electricity. Transforming and Converting Apparatus**; Henry M. Hobart, Schenectady, N. Y. App. filed Sept. 21, 1916. Electrical apparatus for receiving high-pressure polyphase current from a supply system and delivering relatively low-pressure direct current to a distribution system.

Trunk Line and Interconnected Electric Transmission Systems of the Western States

[illegible] See p. 1071.





CALIFORNIA	
C. O. P Co. -	California Oregon Power Co.
C T & L. Co -	California Telephone & Light Co.
C.C.G & E. Co.-	Coast Counties Gas & Electric Co
C.V G & E. Co.-	Coast Valleys Gas & Electric Co.
C of L Co -	City of Los Angeles
G W P Co -	Great Western Power Co
P G. & E. Co.-	Pacific Gas & Electric Co
S. M. W. & P Co.-	Snow Mountain Water & Power Co.
S. L. & P. Co.-	San Joaquin Light & Power Co.
S. C. E. Co. -	Southern California Edison Co.
S.S. P Co. -	Southern Sierras Power Co.
S. C. G. & E Co.-	San Diego Consolidated Gas & Electric Co
W.S G.& E. Co.-	Western States Gas & Electric Co.
OREGON	
D. C. L. & P. Co. -	Douglas County Light & Power Co.
D.C P. Co. -	Des-Chutes Power Co.
E E.S Co. -	Enterprise Electric Co.
E O. L & P. Co. -	Eastern Oregon Light & Power Co.
M. S P. Co. -	Mountain States Power Co.
N. E. Co. -	Northwestern Electric Co.
O. P Co -	Oregon Power Co.
P R L. & P. Co.-	Portland Railway Light & Power Co.
NEVADA	
N V. P Co.	Nevada-Valleys Power Co.
T R G E. Co. -	Trucktee-River General Electric Co.
ARIZONA	
A P Co. -	Arizona Power Co
D P & W. S Co. -	Desert Power & Water Co.
S R P. of U S. R.-	Sale-River Project of United States Reclamation
WASHINGTON	
In P Co. -	Inter-Mountain Power Co.
P P. & L Co. -	Pacific Power & Light Co
P. S P & L. Co.-	Puget-Sound Power & Light Co.
S. C P & L. Co.-	Stevens County Power & Light Co.
W W. P. Co.-	Washington Water Power Co.
IDAHO	
I P. Co. -	Idaho Power Co.
COLORADO	
A V R L. & P Co.-	Arkansas-Valley Railway Light & Power Co
C S L W & P. Co.-	Colorado-Springs Light Water & Power Co
C. P Co.	Colorado Power Co
W. C Co.	Western-Colorado Co
MONTANA	
C M & S. P. Co.-	Chicago Milwaukee & St. Paul Co.
M. P Co.-	Montana Power Co.
UTAH	
B R P Co.-	Beaver River Power Co
S U P Co.-	Southern Utah Power Co.
U. P & L. Co.	Utah Power & Light Co.

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Supplement to Electrical World, May 8, 1920

The Empire West of the Rockies

Yosemite Falls, 2,600 feet high, in Yosemite Valley, Cal.

ELECTRICITY has played a very important part in the growth of the states west of the Rocky Mountains. Hydro-electric plants supply almost all of the energy, which is transmitted over great distances at high voltages. Steam plants, where they exist, are mostly of the oil-burning type for reserve supply.

Although Portland, Ore., was the pioneer in electric transmission on the Pacific Coast, those who attend the convention of the N. E. L. A. at Pasadena will be on historic ground. The first hydro-electric station in California was a single-phase plant erected on San Antonio Creek near Pomona in 1891. This was followed shortly afterward by the three-phase plant in Mill Creek Canyon near Riverside in 1893. Further north a hydro-electric plant was erected near Folsom in 1894, from which three-phase energy was transmitted into the city of Sacramento. Since then the development of hydro-electric energy in California has been nothing short of phenomenal.

Some of the largest hydro-electric systems in the world now operate in California, notably those of the Southern California Edison Company, the Pacific Gas & Electric Company and the Great Western Power Company, with outputs aggregating 1,000,000,000 kw.-hr., [illegible] kw.-hr. and 450,000,000 kw.-hr. respectively. Other great systems along the Coast are those of the Portland Railway, Light & Power Company with an aggregate output of 270,000,000 kw.-hr., and the Puget Sound Power & Light Company and the Washington Water Power Company, in the State of Washington, with outputs of 450,000,000 kw.-hr. and 241,000,000 kw.-hr. respectively. Further to the east are the great system of the Montana Power Company, supplying about 90 per cent of all of the electrical needs within Montana, and the Utah Power & Light Company system, supplying 461,000,000 kw.-hr.

Russell H. Ballard

A Californian by adoption, an ardent advocate of the electrical future of the West and an executive with a remarkable organizing faculty and ability to make friends

TWENTY-SEVEN of the thirty years Russell H. Ballard has devoted to the electrical industry have been spent in the Middle and Far West. For four years following 1890 he was a member of the Chicago office of the Thomson-Houston Electric Company. When that company was merged with the General Electric Company in 1894 he was transferred to Schenectady. During the next three years he was assigned to various branches of the company throughout the East and became intimately acquainted with the financial problems of the industry, acquiring an accurate knowledge of electrical operation and commercial policies. In 1897 an opportunity was offered to enter the accounting department of the West Side Lighting Company of Los Angeles, and with that company and its successors he has since been associated, with the exception of four years as office manager of the Butte (Mont.) Electric & Power Company. Mr. Ballard's thorough knowledge of the commercial side of the industry was properly coupled with his organizing ability when he returned to the Edison Electric Company in Los Angeles in 1904 as auditor.

With untiring energy and diligence he faced the complicated and perplexing financial and operating problems during a time when errors in judgment made serious inroads in company revenue. His determination, enthusiasm and forward thinking and his keen appreciation of public policy won rapid advancement to the position of assistant general manager of the Southern California Edison Company, and in 1917 to the vice-presidency and assistant general managership when that company and the Pacific Light & Power Corporation were consolidated. He is at present vice-president and general manager of the company. For a number of years Mr. Ballard has devoted considerable time to the problems of the industry on the Pacific Coast. He was the first president of the Pacific Coast Section of the National Electric Light Association and a leading figure in the organization of the California Co-operative League.

His election to be vice-president of the N. E. L. A. in 1915 was a recognition of his activity in all of this work. As president of the N. E. L. A. during the past year he has devoted his time unsparingly to the new departmentized organization and has not only attended and taken part in conventions of geographical sections but made extensive speaking tours in the execution of his plan to establish throughout the country territorial organizations for handling the local problems of central-station companies. In this he has met with the same success that has attended his efforts on the Pacific Coast.

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician
Published by McGraw-Hill Company, Inc.

W. H. ONKEN, Jr., Editor D. H. BRAYMER, Managing Editor
S.B.WILLIAMS, M'n'g Editor A M PERRY, Engineering Editor J.C MARTIN, Western Editor ROBERT SIBLEY, Pacific Coast Editor H S KNOWLTON, New England Editor
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Volume 75 New York, Saturday, May 8, 1920 *Number* 19

The Larger Aspects of Power Transmission

FOR the last decade we have preached, in season and out of season, the need for interconnection of power plants, thus welding together scattered systems into a coherent unit. In this week's issue we give our readers in a series of maps and articles some idea of what has been wrought to this important end. Looking at the situation thus in detail, the accomplishment has been of startling magnitude. Beginning with the northeastern portion of the country, there is an interconnected group of power transmission lines reaching from Long Island Sound to Lake Champlain and covering southern Vermont, substantially all of Massachusetts, southern New Hampshire, eastern Connecticut and Rhode Island. To the west these lines are interlinked with the Hudson Power Company, stretching far up the Mohawk Valley. The filling of one short gap would interlink the network again with the Niagara system and the Canadian lines beyond the border. Pennsylvania shows two groups of power systems, one centering about Pittsburgh, the other on the Susquehanna, reaching south to Baltimore. The New England group is not yet fully united with that in the Middle States. Beyond these, however, in the busy states of the Middle West, there are a series of important networks, especially in the states of Indiana, Illinois and Wisconsin, with an independent group of no small extent in Michigan. The ramifications of the distribution line in this great industrial territory are most complicated and far-reaching.

Interconnection in South and West

To the southward through the Piedmont country and beyond to the Alabama line and northward into Tennessee, on the other side of the Appalachians, runs a great industrial network with many branches and many power stations. It reaches from Goldsboro, N. C., on the east to Nashville, Tenn., on the west, as the lines cover more than 700 miles (1,120 km.). It is not yet linked with the important system in northern Alabama, reaching from Sheffield on the north to Opelika on the south. West of the Mississippi lies a great unspanned stretch of farming country not rich in hydraulic resources. Not until one reaches the Rockies does the scene change. Colorado, one of the earliest fields of power transmission, presents a group of isolated plants, Utah another group, for the main part united, centering about Salt Lake City. To the north, in the busy mining country of Montana, ramifies the great system of the Montana Power Company with its heavy industrial loads and splendid railway electrification. So remarkable are the hydraulic resources here that the network is operated without steam reserve. It reaches westward into Idaho and needs but a very short span to connect it with the Washington power group, which ends only on tidewater in Puget Sound. Southern Idaho has a system of its own along the Snake River as yet unconnected with the eastern group or the Utah system. Eastern Oregon is covered independently, although soon to be linked with the Washington system, and then to the southward begins that prodigious series of developments in California with which our readers are familiar, at one extremity stretching across the border into southern Oregon and at the other ending only at the Mexican border. Yet these vast systems of high-voltage transmission lines, interconnected with many ramifications from end to end, built up of the work of many companies, utilize hardly more than one-fifth of the available water power along the Cascades and Sierras.

The Greater Things Yet to Come

Surely all this constitutes a prodigious feat in utilizing the forces of nature. None the less there is another side to the story of which we must speak in looking forward to the future. These interconnections of allied systems, great as is their usefulness in assuring somehow continuity of supply, are upon the whole and in the main not fundamental but auxiliary. They do not yet touch the biggest things in the electric transmission of power. The exchange of energy between independent watersheds, the seasonal interchange of great blocks of power, the winning of a combined diversity and load factor—to accomplish these great results requires far more than linking together the extremities of existing lines. It implies treating the whole area of distribution as a fundamental unit with trunk lines to insure the full balancing of the load, such trunk lines as have been over and over again suggested but never yet built. They must sometimes cover hundreds of miles, with capacity reckoned by the hundred thousand horsepower, to take full advantage of the varying needs and varying water supplies. They must link regions of different storage facilities, as they would in California, or of different periods of effective rainfall, as between the Rockies and Puget Sound, or bind together hydro-electric plants and those built at the mouths of coal mines, as they might well do along the eastern coast. Today the gains from interconnection, great as they are, are chiefly local gains. Take, for example, the far-flung Southern system, reaching from the Mississippi Valley to the coast, in theory 700 miles of united transmission line, in practice only a small amount of power interchanged between end and end.

Even California, far to the front in power development when one considers the number of plants and intricate networks, presents two natural independent distributions very loosely linked. A full regard for the conservation of water demands that the whole hydraulic resources of the Cascades and Sierras be so tied together as to make the most of the combined storage facilities of nature and art. It is not necessary or desirable that the nearly threescore plants which contribute to the colossal total should all be in simultaneous operation. They need to be run as conjoint requirements of storage and of irrigation demand. In the long run not a few of them may be evolved into automatic or semi-automatic stations brought into play when they can best serve the interests of the whole. And so the story goes elsewhere in the country. The Snake River plants, the Montana system and the Washington system are close enough together and to the Utah group to link into unity the watersheds of the Pacific Coast and the Rockies. Along the Atlantic seaboard the trunk-line project already outlined gives play to the imagination, affording a vision of New York City, Niagara and the Pennsylvania coal mines tied into an invincible triangle. By Niagara we do not mean the driblet of power now accorded, but something like the full resources of the great cataract.

All these things to be achieved are not to be reckoned with in years, but in decades or generations. As year by year we come more and more to realize the grim limitations of the stored fuel with which we have played spendthrift, things which now seem the unsubstantial phantoms of a dream must become realities. The loss year by year of the power raised skyward by the sun to run unused into a thankless sea is the only irrevocable loss which civilization knows. It is high time that this loss were converted into gain.

Commissioner Edgerton's Views on Public Utility Financing

MEN supposedly of light and leading are frequently lured into print to discourse with an air of finality on politics, the contentions of capital and labor, the relations between utilities and the people and other public questions. Too often, however, the expectant reader, seeking guidance amid partisan noise and confusion, learns from their outgivings nothing more than that honesty is the best policy, that there are two sides to everything, that friendliness makes friends, that extremes in any direction should be avoided, or that rights and duties are reciprocal. When pressed for advice men in authority are prone to emulate the katydid of Oliver Wendell Holmes and say undisputed things in such a solemn way that they pass momentarily for chunks of original wisdom, though when examined they take on the triteness of bewhiskered platitudes.

From such exhortations and counsels of perfection it is pleasant to turn to the concrete suggestions made elsewhere in this issue by the chairman of the California Railroad Commission concerning the proper financial regulation of public service companies. Mr. Edgerton wastes no space on generalities that age has deprived of power even to glitter, but, laying down the axiom that public utility securities are necessarily of the conservative and not the speculative type, makes four proposals for establishing a proper relationship between securities, rates and profits in order to attract needed capital and promote its successful use.

He advocates in the first place that the present intricate method of basing rates on plant valuation be abolished and that instead rates be placed at a figure sufficient to pay dividends and interest on outstanding capitalization sanctioned by the commission; second, that, to prevent constant fluctuation in rates, the companies be permitted to accumulate a cash reserve when earnings are high to tide them over periods of temporary decrease in revenue; third, that the companies and their customers shall share increases in earnings due to efficient management, thus providing the incentive for the exercise of executive ability that is lacking when profits are absolutely fixed, and, fourth, that there be financial co-operation between utilities of the same kind, even to the extent of indorsing one another's securities and consulting one another as to the amount of the obligations and the time of their issue.

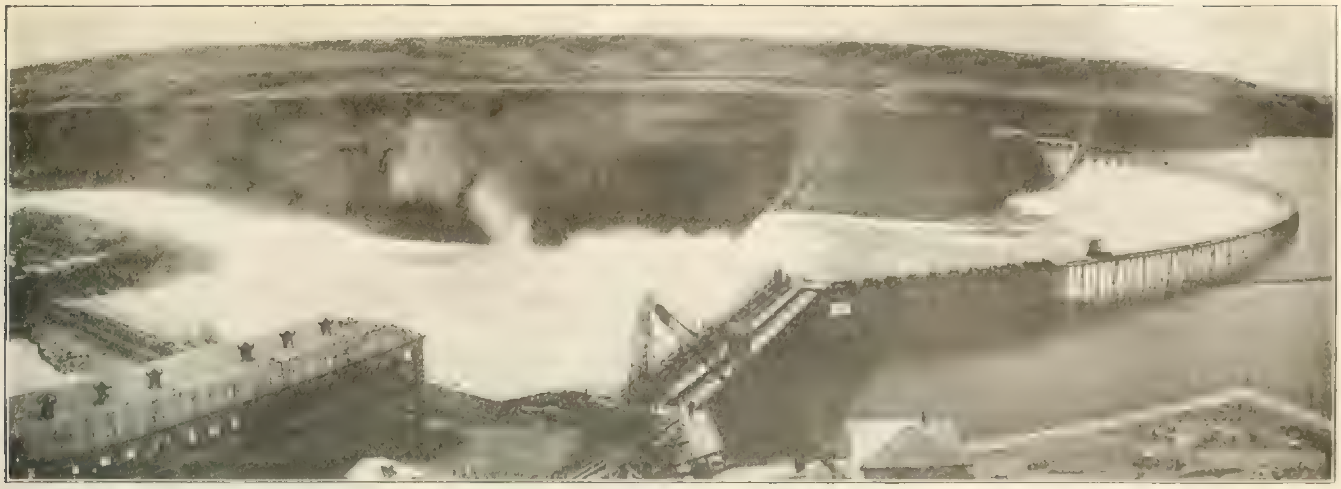
Capitalization and Rates

Mr. Edgerton's first and most important proposal runs directly counter to existing practice. In fact, among the court decisions summarized in last week's ELECTRICAL WORLD was one by the Colorado Supreme Court, which, in passing on a case that had been before the Public Service Commission of the State, expressed the opinion that outstanding capitalization should have little influence on rates in view of the common practice of watering stocks. Mr. Edgerton's answer to this obvious objection is that where overcapitalization exists it would have to be reduced in accordance with the decision of the commission and that the companies could have the option of agreeing to such a reduction or continuing under the present rate-making system. We presume that in arriving at the proper capitalization for any company a valuation of its physical property would be made and thus there would not, after all, be an elimination of that laborious process; but if the public mind could be made confident that all water had been squeezed out of the stocks and bonds, the method of rate fixing favored by the commissioner would have a great point in its favor.

Mr. Edgerton's second proposal, for a cash reserve, seems a wise one in view of the impossibility of insuring a revenue that will not fluctuate from unforeseen and unescapable causes. His third contention, for a division of managerial profits, is along the line of universal practice in other businesses than those of public convenience and necessity; for in what manufacturing or mercantile establishment are all the gains from careful management or executive ability handed over to the customers? Nothing, indeed, is surer than that care and skill which bring no reward will sooner or later cease to be exercised to their utmost.

Co-operation in Finance

There remains Mr. Edgerton's fourth proposition—for financial co-operation among utilities. This is primarily a question for the companies themselves to determine, and to their thoughtful consideration it may be commended. Such co-ordination as he suggests has, among large-company combinations, the novel aspect, from the popular point of view at least, of being clearly in and not against the public interest. Indeed, the commissioner's whole plan as outlined in his article foreshadows invitingly an era of harmony and mutual satisfaction, when utilities will be content with their profits and customers with their bills—an era of understanding, of fair dealing on both sides and of public control in just the right degree by men conspicuously fit.



POND ABOVE THOMPSON FALLS DAM THAT DEVELOPS 30,000 KW.

What Interconnection Has Done for Montana

The Montana Power Company, with Thirteen Hydro-Electric Plants and No Steam Reserve, Assures Continuity of Service to Mines, Smelters, Refining Plants and Railroads at Lowest Average Price in the Country

ELECTRIC service can be pointed to as the agent that has made Niagara Falls the great electrometallurgical and electrochemical center and as the very lifeblood of comfortable existence in California, but few persons probably realize how vital a factor it has been in Montana in fostering the native industries and making it possible for them to be carried on more economically than would be possible otherwise.

Prior to 1912 electric service was furnished by several independent companies not co-ordinated, but since that time the Montana Power Company has consolidated and unified the systems by tying together the generating plants and operating them as a whole rather than as separate entities. Unlike many systems that have been formed out of several old ones, the Montana system has been laid out with future development in view, the transmission network being arranged to take care of almost any industries that may develop and to permit ready connection with new hydro-electric plants that may be constructed. Not only have provisions been made for assuring almost absolute continuity of service, but energy is supplied at the lowest average rate per kilowatt-hour offered by any company doing a similar business. The company claims as well the highest energy consumptions per capita. The system is also peculiar in that it operates without any steam reserve.

In the application of electricity to extensive mining operation Montana has easily assumed first rank, and the energy obtained from distant water power is being conducted to remote places, difficult of access, where it performs an infinite variety of work in a most economical and efficient manner. So satisfactory have been the results that electricity has practically superseded steam power and is now driving enormous hoists, compressors, pumps and other mechanical appliances used in the gigantic mining, reduction and refining operations at Butte, Anaconda and Great Falls.

In the electrification of railroads Montana has secured first place. Starting with the electrification of the Butte, Anaconda & Pacific Railway, with its 90 miles (144 km.) of track, the Montana Power Company next electrified the Chicago, Milwaukee & St. Paul Railway, which has 450 miles (724 km.) of its electrified track in Montana.

Even coal mines, which would be expected to be able to develop power as cheaply as it could be done, are served extensively with electricity from this system. Not a single flour mill—and there are many in this great wheat region—is operating on any power but what is furnished by the Montana company. While electric service has made industry in Montana, it in turn has been made available at the attractive rates offered because the demand has been in large blocks and not in small, widely scattered units.

IMPORTANCE AND NATURE OF INDUSTRIAL LOADS

Based on their connected loads (see Table I) the industries which take chief rank are, first, smelters, including electrolytic and electrometallurgical processes, and, second, electrified railroads. Mines, irrigation and pumping of all kinds, cement works and rock crushers, mine mills, railroad shops and flour mills also provide very important loads. While copper is the principal metal mined, market prices are making it attractive to devote considerable attention to silver, zinc and ferromanganese. In fact, the increased activity in connection with these materials has appreciably offset the slump in the copper business. The copper and zinc mines in the Butte district use electricity almost exclusively, while the smelters of the Anaconda Copper Mining Company and American Smelting & Refining Company employ it entirely.

To give some idea of the nature of some of the most important loads, nine have been listed in Table II, with their average and maximum demands for one day. It

TABLE I—DIVISION OF CONNECTED LOAD
IN 1919

		Horsepower
Commercial arc and incandescent lighting		25,470
Domestic heat applications and electrical appliances (principally electric ranges)		13,306
Commercial power		266,657
Smelters	95,419	
Electrified railroads (motor-generators)	71,005	
Mines	69,223	
Irrigation and pumping	7,532	
Cement works and rock crushers	4,256	
Mine mills	2,844	
Railroad shops	2,697	
Flour mills	2,685	
Miscellaneous		10,477
Total		315,910

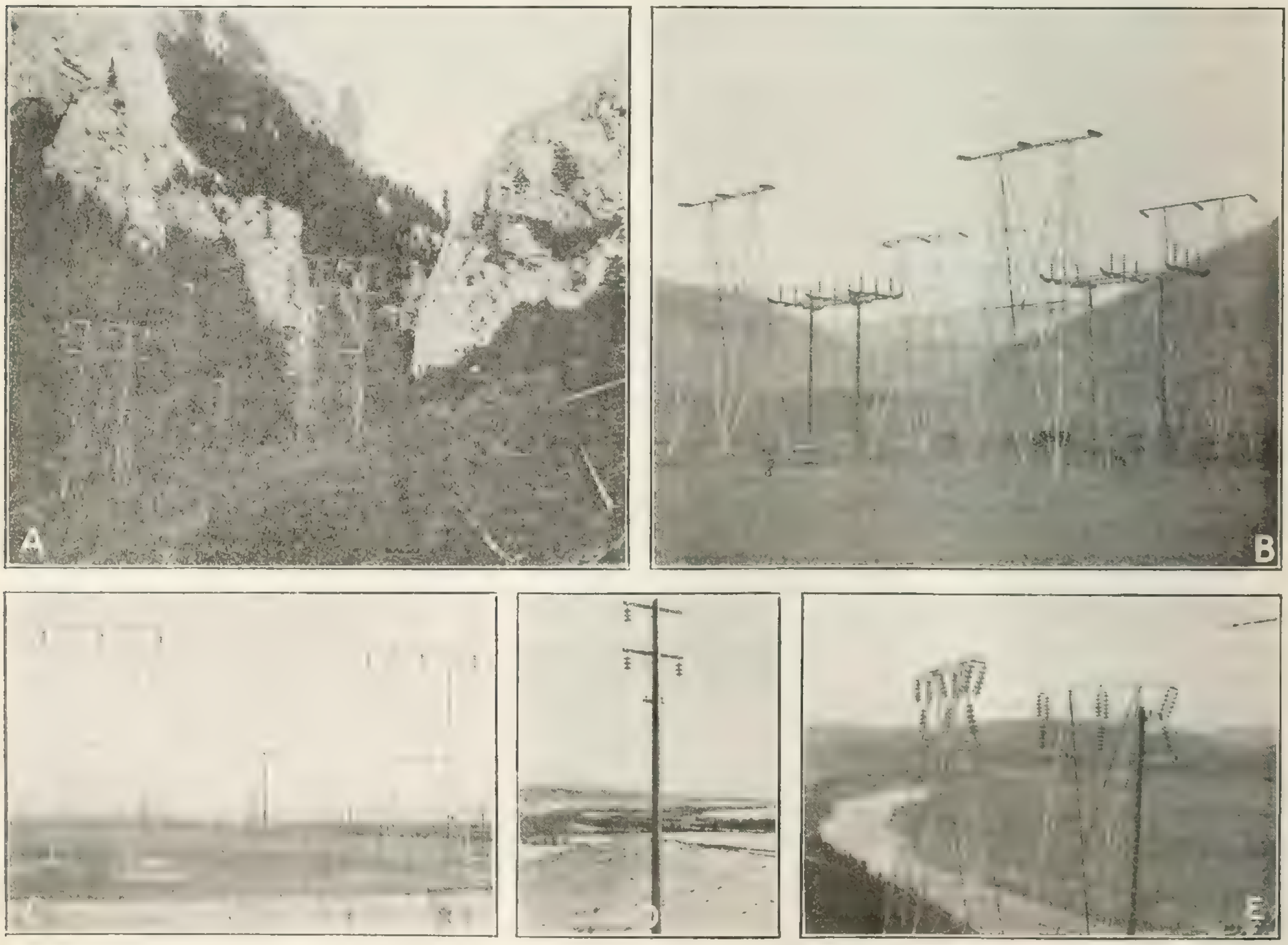
TABLE II—NATURE OF PRINCIPAL LOADS
(System load factor 93 per cent, March 13, 1920)

Industry	Load (Kw.) Average	Load (Kw.) Max.	Load Factor Per Cent
Great Falls zinc plant	31,083	31,500	99
Butte mining load	30,250	35,000	86
Anaconda copper smelter	17,458	19,400	90
C., M. & St. Paul electrification:			
Rocky Mountain division	9,450	16,000	59
Missoula division	9,000	14,000	64
Electrolytic copper	4,530	5,200	87
Ferromanganese *	5,950	7,900	75
Butte miscellaneous power and lighting	6,312	8,000	79
Butte, Anaconda & Pacific electrification	1,458 1,316	4,400 5,000	33 27
Coeur d'Alene Mines	5,100	6,200	82

* Only two furnaces working; five eventually will give still better load factor.

is interesting to note the very high load factors of the zinc plant, copper smelter and electrolytic copper plant, ranging from 99 to 87. Mining ranks closely as a business with high load factor, while the load factor from railroad electrification ranges from 39 per cent for the Butte, Anaconda & Pacific Railway to 60 per cent for the Chicago, Milwaukee & St. Paul. Miscellaneous power and lighting gives a load factor of 79 per cent. While the load factor of the ferromanganese furnaces is only 75 per cent at present, it will be considerably higher when more furnaces are working to give a greater diversity factor. The load factor of the Montana Power system on the day to which the foregoing figures refer was 93 per cent.

Some persons may contend that the copper mines could operate without electric service from a large system like the Montana Power Company's. They have done so and they could still do so, but not at the power cost which electric service from this system makes possible. Power cost would not be so important to some industries, but copper mining, smelting and electrolytic refining require considerable energy per ton of output and the price of power is an important factor. By reason of the low energy rate available to all, the mines can afford to work up closer to the rock facings than they would otherwise do and hence are able to remove copper that would otherwise be left in the mines. The gold dredges, particularly, are benefited by electric service, not only because no individual could generate electricity so cheaply as the public service company but



TYPICAL TRANSMISSION LINES IN MONTANA

A—Great Falls-Butte transmission line in Beaver Canyon. B—Outdoor switching on 100,000-volt line. C—Double-tower 100,000-volt line near East Helena. D—Typical 50,000-volt line on wood poles. E—Great Falls-Butte line crossing the Missouri River.

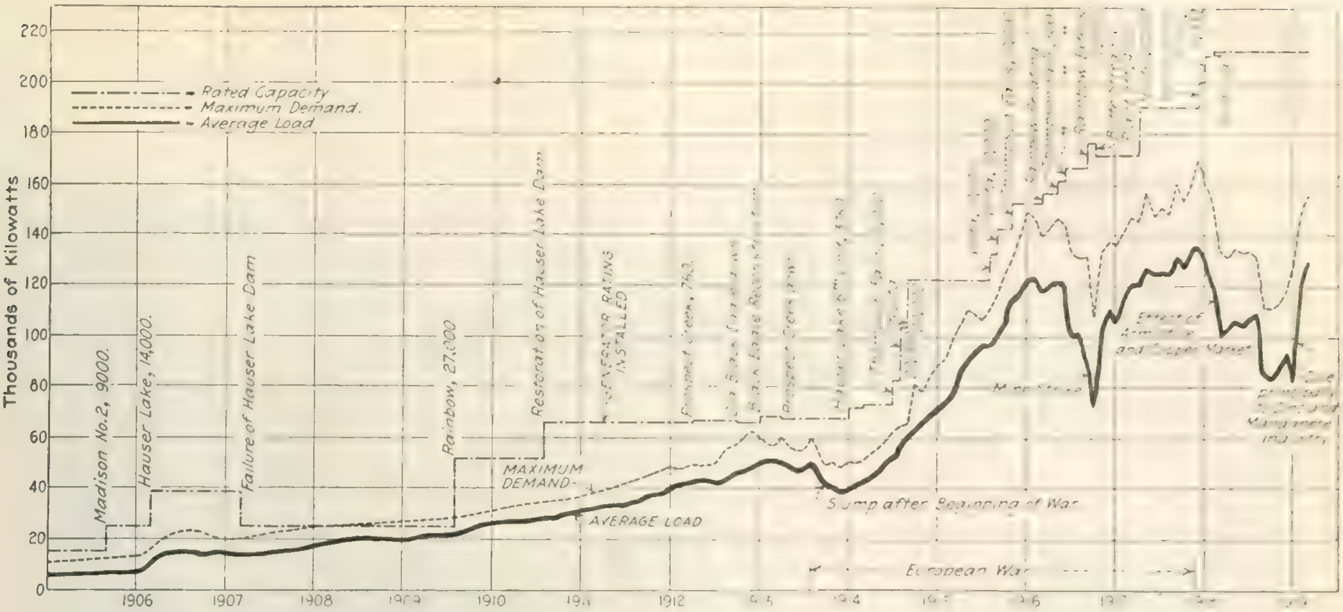


FIG. 1—SUPERIMPOSED MONTHLY PEAK AND AVERAGE LOADS AND STATION CAPACITY (1905 TO DATE)

It will be noted that this average load curve is almost a historical picture of industrial development. The effect of the war, the strike and the zinc and manganese industry are very evident.

because the handling necessary to place coal on the dredges adds to the unit cost.

The value of electric service to industries in Montana is well illustrated by the following example: A large coal-mining concern at Roundup equipped itself with a modern turbo-generator station. After running the plant for a considerable time and keeping accurate records of the costs it decided to salvage the plant and buy energy from the Montana Power Company. Since then it has greatly increased its production per dollar spent for power. This coal mine is not the only one which has found it more economical to give up an isolated plant. Every coal mine in Montana, except one group which cannot be reached economically by a transmission line, is using central-station energy.

As a result of electrification both the Butte, Anaconda & Pacific Railway and the Chicago, Milwaukee & St. Paul are saving money per ton-mile transported, hauling larger loads per train, saving in locomotive maintenance, reducing delays, increasing schedule speed, and thereby getting along with less rolling stock than would be the case with steam locomotives. Aside from these advantages, they have been able to dispense with water tanks and coal docks and have got rid of the trouble they used to meet in braking. The train hands are better satisfied, freight is not so easily stalled, passengers are pleased, and numerous other advantages accrue. With the great increase in the price of coal the advantages of electrification over steam operation have multiplied.

RELATIVE POSITIONS AND FEATURES OF HYDRO-ELECTRIC STATIONS

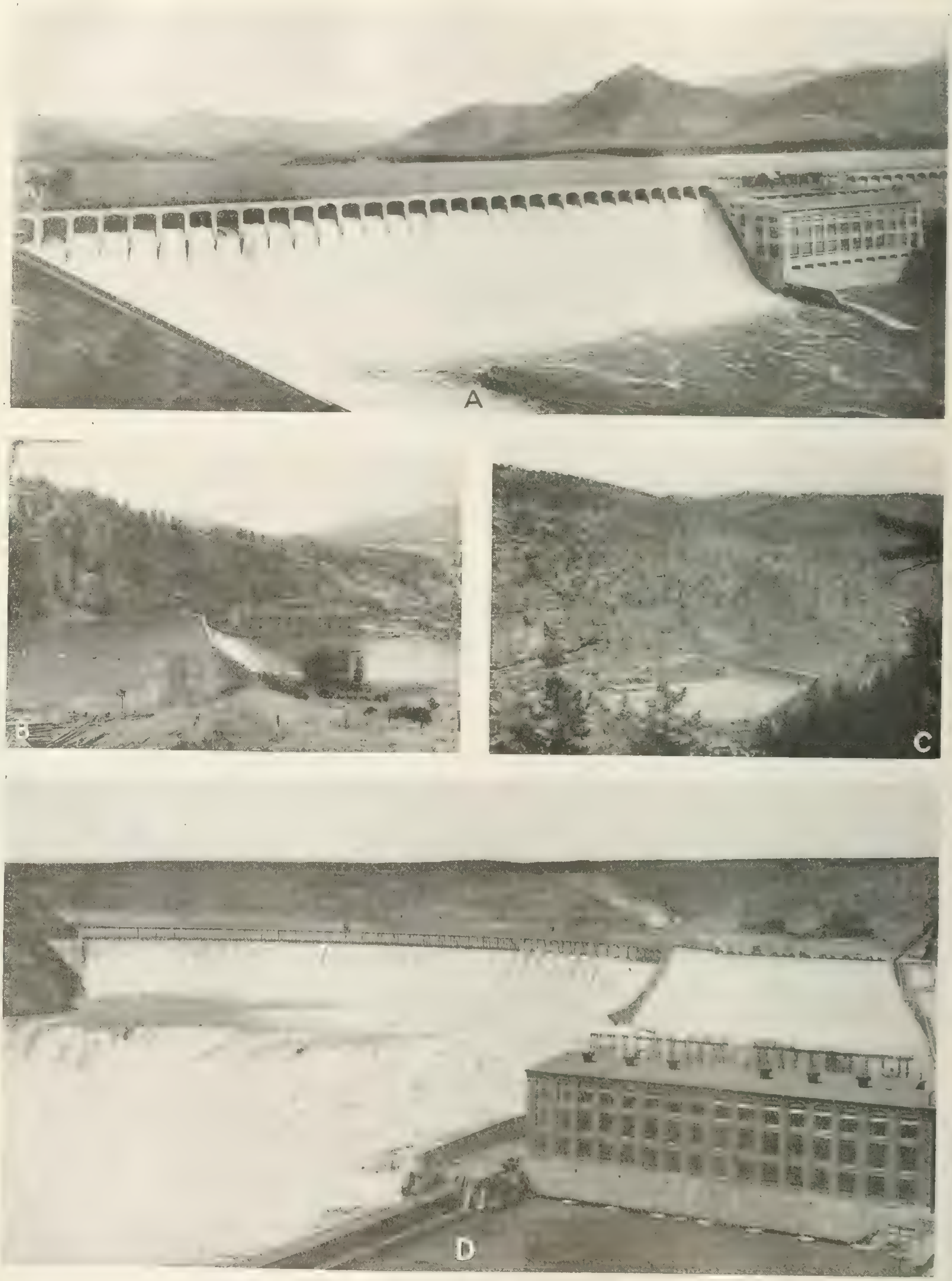
To serve these industries the Montana Power Company is operating thirteen hydro-electric plants with a combined rating of 212,340 kw., distributed as shown in Table III (see map on page 1056). Some of the plants can operate at full load all year; others have considerable reserve for daily peak loads. Thompson Falls, on the Clark Fork of the Columbia River, is over on

TABLE III—OPERATING DATA REGARDING HYDRO-ELECTRIC PLANTS FOR YEAR 1919

Name of Plant	Year Completed*	Rating Kw.	Average Head, Ft.	Storage, Acre-Ft.	Dam		Average Water Flow (Sec.-Ft.)		Kw. per Sec.-Ft	Load Factor	
					Height, Ft.	Length, Ft.	Available	Used		1919	Theoretical with System Fully Loaded
Great Falls....	1916	60,000	150	3,000	72	1,250	4,487	3,147	9.00	48	56
Holter	1918	40,000	103	73,000	100	1,350	3,622	1,534	6.70	19	41
Rainbow......	1910 & 1916	35,000	111	1,000	36	1,145	4,487	3,221	6.40	53	80
Thompson Falls	1916	30,000	56	4,200	35	1,000	15,809	5,458	....	45	
Hauser Lake	1911 & 1914	18,000	65	46,000	65	720	3,430	2,432	3.66	56	66
Madison No. 2..	1906	10,000	108	36,000††	44	183	1,651	944	6.70	63	100
Canyon Ferry	1891 & 1901	7,500	34	40,000	40	490	3,431	2,194	2.13	35	61
Black Eagle	1913	3,000	43	.	18	745	....	852	2.50	56	100
Big Hole....	1898	3,000	60	†		...		.		10*	
Madison No. 1..	1901 & 1907	2,000	55			.	.		3.35	6**	100
Livingston.....	1906 & 1908	1,500	24	None	.					59	
Billings No. 1..	1907	1,080	17	None						76	
Lewiston No. 1..	1906	450	62	...			176	66		64	

* Big Hole did not operate during February, March, April, May and September
** Madison No. 1 operated only 544 hours during year.
† Sufficient for daily variations in load.
†† Does not include 325,000 acre-ft. in Hebgen Reservoir just above plant.

Four of the Thirteen Developed Water Powers in Montana



A—Holter, the newest and second largest plant, with a storage of 73,000 acre-ft., provided by a dam 100 ft. high by 1,356 ft. long. B—Canyon Ferry, the oldest plant, having a storage of 40,000 acre-ft. C—Hauser Lake, an 18,000-kw. plant with 46,000 acre-ft. storage. D—Great Falls development, 60,000 kw., the largest on the Montana system.

the western edge of Montana, but in a very convenient position to serve the western end of the Missoula division of the Chicago, Milwaukee & St. Paul Railway and the Cœur d'Alene mining district in northern Idaho. The Livingston and Billings plants are on the Yellowstone River, Lewiston on Big Spring Creek, a tributary of the Missouri. Big Hole is on the river of the same name, Madison Nos. 1 and 2 are on the Madison River, which empties into the Missouri, discharging water through Canyon Ferry, Hauser Lake, Holter, Black Eagle, Rainbow Falls and Great Falls. Thus the last eight plants all benefit from Hebgen reservoir, on the Madison River, just above Madison No. 1, with its storage of 325,000 acre-ft. (399,750,000 cu.m.) and utilize the same water except for what may drain into the river between plants. These plants serve the bulk of the industrial load around Butte, Anaconda and Great Falls. Although Big Hole, Livingston, Billings and Lewiston can contribute their share through the interconnections provided, they are principally to serve loads on the outskirts of the Montana power system.

Great Falls station, which has the highest rating, 60,000 kw., and highest head, 150 ft. (45 m.), of all the plants on the system, is one of the modern installations, having been completed in 1916 (See Table III). While it has only 3,000 acre-ft. (3,690,000 cu.m.) of storage immediately available, it is below all other plants on the Missouri River and hence can utilize all water passing through them as well as take advantage of their storage, which amounts to 524,000 acre-ft. (536,000,000 cu.m.), including the Hebgen reservoir. Of course it takes time for the water from upstream reservoirs to reach it (about two days from Holter and seven days from Hebgen), but the storage at Canyon Ferry, Hauser Lake and Holter is great enough—169,000 acre-ft. (207,000,000 cu.m.)—to carry the maximum rating of this plant until water from Hebgen reservoir reaches it. Usually peak loads are taken first by the three plants above, and when the water reaches Great Falls the load is shifted or shared with this and other plants in its vicinity, namely Black Eagle and Rainbow. Great Falls has six vertical single-runner wheels driving 10,000-kw., 6,600-volt generators, from which the voltage is stepped up to 100,000 volts.

HOLTER—THE NEWEST PLANT.

Holter, the newest station of the system (completed in July 1, 1918), is next in rating (40,000 kw. to 50,000 kw., depending on operating conditions) and has the largest individual storage, 73,000 acre-ft. (89,700,000 cu.m.), with the exception of the Hebgen reservoir. It also has the highest and longest dam, its height being 110 ft. (33 m.) and its length 1,350 ft. (411 m.). Simplicity is the principal feature of the plant. It is built on the downstream face of the dam, thereby reducing substructure expense and simplifying the penstocks. Four vertical single-runner waterwheels drive 12,500-kw., 6,600-volt generators. Whereas double buses and the corresponding complement of switching were used in some of the earlier plants, Holter employs single high-tension and low-tension buses. Each generator is connected through an oil switch and disconnecting switches with a step-up transformer. Any generator may also be connected with a 6,600-volt bus to feed through some other transformer if necessary. The high-tension bus makes it possible for any transformer to feed through any outgoing line. The switching positions are normally such that each generator and its transformers feed one line. Both of the buses contain sectionalizing switches, and a tie containing an air-break start switch is provided between the two principal out-going lines, making the system still more flexible. This is the first plant on the system to use three-phase transformers, the units being rated at 12,000 kw. to 16,000 kw. The transformers are on the same level as the generators, the 6,600-volt switches are on the mezzanine floor, the 100,000-volt switches are on the next floor,

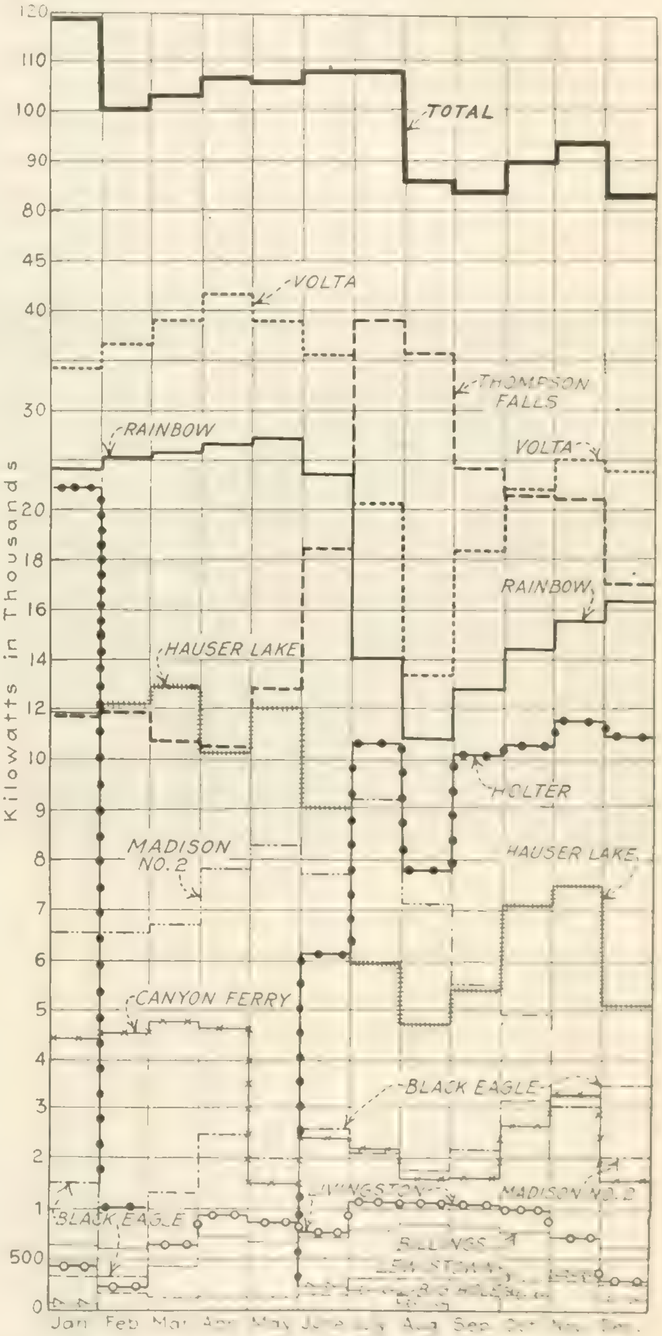


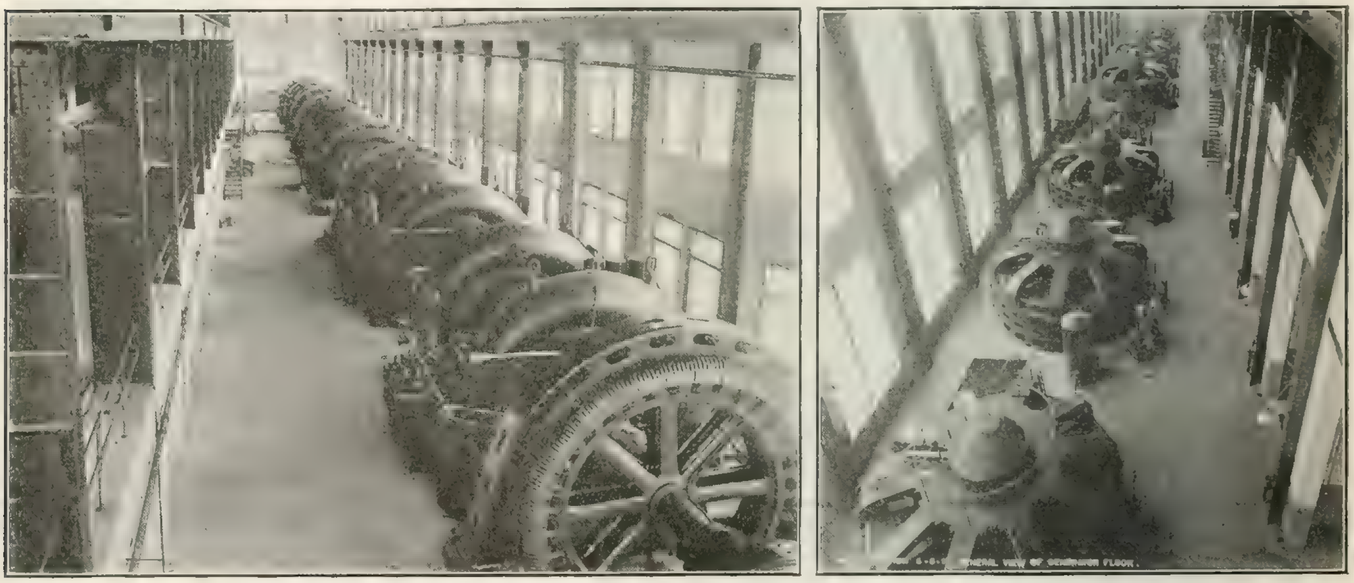
FIG. 2 AVERAGE MONTHLY OUTPUT (KW.) OF STATIONS AND TOTAL FOR 1919

Volta, the Great Falls station, delivered the greatest amount of power during the first half of the year and less the second half, although the output increased toward the end of the year. Rainbow Falls was operated in a similar manner. Thompson Falls' output was weak the first half, strong during the middle of the year, but declined again toward the end. Hauser Lake was strong the first half but weak the last half. Canyon Ferry's output was strongest the first four months, and weak the remainder of the year, owing to replacing waterwheels. Madison No. 2 was strong the first half, increasing to the middle of the year, then declining. Black Eagle was weak the first part, but gradually increased the last half. The load on Billings was relatively uniform, whereas power was on and off at Big Hole. Holter was strongest the first month, then was off five months and fairly strong the rest of the year.

and the 100-kv. bus is on the second mezzanine. On the roof are lightning arresters, air-break disconnecting switches and line-tie switches.

Aside from its features of design, the plant is novel in that it lies between the centers of industrial load and has enough storage and generator capacity to carry any peak loads that may fall on any section of the system. With Canyon Ferry and Hauser Lake just above, it has 169,000 acre-ft. (207,000,000 cu.m.) of water immediately available, which would enable it to carry full load for a remarkably long time (see Table III).

This plant cost about $4,000,000, divided as shown in the accompanying circle diagrams (Figs. 5, 6 and 7). This cost refers to prices before 1918, when the plant was started. Two years and four months were required to complete the plant. If the cost of the transmission lines and reservoir and their share of the expense to develop a market are included, the cost per kilowatt installed would be nearer what a company just starting business would have to figure on under the same conditions.



OLD AND NEW PRACTICE OF THE MONTANA COMPANY IN THE GENERATOR ROOM

Rainbow Falls is third in rating (35,000 kw.). It contains six horizontal 4,200-kw., 6,600-volt waterwheel-driven generators and two 5,000-kw. units. This represents the older practice of the company—from 1910 to 1916.

Thompson Falls is the fourth largest plant (30,000 kw.) and contains six vertical 5,000-kw., 6,600-volt waterwheel-driven generators. It is on the Clark Fork of the Columbia River and has the largest average river flow—15,809 cu.ft. (442 cu.m.) per second—available. The plant is not connected with the rest of the Montana system except through the Chicago, Milwaukee & St. Paul Railway 110,000-volt bus, through which line some energy is being transferred to supplement the other stations in the system.

The remaining plants were built before 1914.

By referring to Table III it will be noted that four of the plants listed have large storage reservoirs, and these are all on the Missouri River and its tributary the Madison River. The total storage represented on this river system is 199,000 acre-ft. (244,000,000 cu.m.) at the various power plants and 325,000 acre-ft. (399,000,000 cu.m.) more at the Hebgen reservoir, making a total of 524,000 acre-ft. (536,000,000 cu.m.). One acre-foot (1,230 cu.m.) of water will produce a flow of 1 sec.-ft. (0.028 cu.m. per second) for twelve hours. This storage is sufficient, therefore, to increase the flow of the Missouri River at Great Falls by 2,000 sec.-ft. (56 cu.m. per second) for a period of 132 days, or nearly four and one-half months.

Before these storage reservoirs were built the minimum flow of the Missouri River at Great Falls was about 2,200 sec.-ft. (61 cu.m. per second). With the storage reservoirs in operation the minimum has been increased to virtually 4,500 sec.-ft. (126 cu.m. per second). At the various plants on the Missouri and Madison Rivers above Great Falls the amount of available storage is somewhat less, but the natural flow of the rivers also is somewhat less, so that approximately the same ratio holds as regards the increased flow made available by storage. In other words, the minimum flow of the river, and hence the continuous power available, has been practically doubled by the construction of the Hebgen reservoir and the several storage reservoirs at the various plants on the Madison and Missouri Rivers.

The amount of river regulation made possible is perhaps the most noteworthy feature of the Montana Power Company's system, doubling as it does the power which otherwise would have been available and doing away entirely with the necessity of any steam auxiliary power.

The great advantage of having the principal plants of the system on the same river is very apparent on account of the fact that each unit of storage is not only available for the plant at which the storage pond is formed but also for all the plants down river from the plant in question. Thus, as the system of rivers increased in natural flow from source to mouth, so with the series of plants developed on the system, the available storage increases also in approximately the same proportion.

With a system of this kind the plants are connected in series on the hydraulic end and in parallel on the electrical end. This means that in order to use the available water with the greatest economy loads are adjusted on the several plants on the system in such a way that the load on each plant is just sufficient to use a quantity of water which, passed on to each of the succeeding

TABLE IV—DATA REGARDING PRINCIPAL MONTANA TRANSMISSION LINES*

Route	Size of Wire	No. of Circuits	Miles
100,000-Volt Lines:			
Great Falls (g) to Rainbow (g) and Zino Plant	4/0	1	4
Great Falls (g) to Morel (r) and Anaconda via Holter (r)	4/0	1	143
Branch to Gold Creek (r)	2 0	1	15
Grieat Falls (g) to Two Dot (r) and Harlowton (j)	115,000	1	114
Ranbow (g) to Great Falls—Morel line	ciro.mil	1	4
Rainbow (g) to Butte (j) via East Helena (j)	1/0	2	125
Butte (j) to Anaconda	1/0	1	23
Holter (g) to East Helena (j)	115,000 circ mil	1	31
East Helena (j) to Josephine (r) via Townsend (j)	115,000 circ.mil	1	55
Madison Nos. 1 and 2 (g) to Butte (j) via Piedmont (r) and Janney (r)	1 0	1	62
Thompson Falls (g) to East Portal (r) and Coeur d'Alene	7 No. 9 & 2 0	2	23
65,000-Volt Lines:			
Hauser Lake (g) and Canyon Ferry (g) to Butte (j) via Boulder (j)	105,000 circ.mil	2	68
Boulder (j) to Townsend (j)	4	1	36
Butte to Deer Lodge	4	1	16
50,000-Volt Lines:			
Rainbow (g) to Conrad	3 & 3 No. 9 G. I	1	94
Rainbow (g) to Havre	.	1	104
Rainbow (g) to Harlowtown (j) via Lewiston (g)	3	1	168
Harlowton (j) to Carpenter Creek, via Lavina (j)	1	1	.
Billings (g) to Lavina (j)	1	1	...
Billings (g) to Livingston (g) via Park City (j)	3	1	112
Park City (j) to Bridges	3	1	..
Livingston (g) to Madison No. 2 via Hot Springs (j)	3	1	73
Madison Nos. 1 and 2 (g) to Three Forks (j)	3	1	29
Madison Nos. 1 and 2 (g) to Twin Bridges	4	1	49
Thompson Falls (g) to Plains	3	1	.

* (g) Means generating station. (j) Junction. (r) Railroad substation

plants below on the river, will produce in the aggregate the total amount of power required from the system. If the natural flow at any time is greater than that required by the power demand on the system, it is stored and saved until such time as the power demand calls for water in excess of the natural flow. At times when the system is fully loaded considerable care is exercised by the load dispatcher in the manipulation of the rivers so that every second-foot is fully utilized and no water at any plant spilled over the dam.

A time interval of about seven days is required for water released from storage at the Hebgen dam to reach the furthermost plant of the system at Great Falls. If an unlooked-for increase in load occurs, this is taken care of immediately by the necessary draft of water from the local reservoirs at each plant. At the same time, however, the required additional amount of water is released from the Hebgen dam, and during the following week as this increased flow reaches the various plants in succession the amount of water which was temporarily taken from the local reservoirs is replaced so that the head at each plant is maintained at nearly its maximum point. Although this continual adjustment and manipulation of the rivers requires some little skill, yet it has been found by experience that very little difficulty is encountered in making the necessary adjustments for the maximum efficiency of operation of the system as a whole.

TABLE V—GENERAL STATISTICS

	1919	1918
Generator rating (kw.)	212,340	200,855
Maximum load (kw.)	152,800	162,900
Average load (kw.)	98,858	126,498
Energy generated (kw.-hr.)	863,960,624	1,106,663,860
Load factor (yearly)	65	74
Load factor (average monthly)	77	82
Connected load (hp.)	315,909	304,541
Loss in transmission and distribution	17	14
Consumption (kw.-hr.)	720,681,439	951,901,714
Number customers served*	44,505	
Area of territory, miles	260x300	
Miles of transmission line	1,922	
Miles of power wire	6,031	
Miles of distribution wire	4,113	....

* Excluding large mines, smelters, refineries and railroads.

The tying together of the plants electrically and the possibility of perfectly free interchange of power without the usual prejudice or bias which exists where interconnection is made between different companies makes it possible to utilize to the greatest extent possible all such plants as naturally would be unable to maintain a continuous or reliable supply of power. Some of the older and smaller plants of the system, such as those at Big Hole, Livingston and Billings, are subject to extremely low water during certain periods of the year, so that their output is reduced to less than 25 per cent of their rated capacity. Such plants if operated singly would be of virtually no value whatever in carrying a commercial load. Tied in with the rest of the system, however, they can be operated all the year round so as to use all water available, and the kilowatt-hours they furnish are just as valuable as if they were furnished 365 days in the year. Practically speaking, their interconnection electrically with the other and larger plants is equivalent to supplying them with their share of the storage which is available at the other plants.

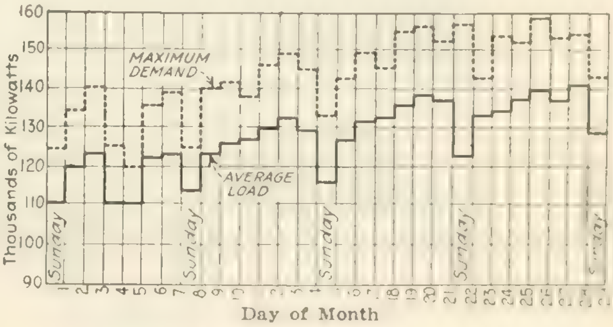


FIG. 3—AVERAGE AND MAXIMUM DEMANDS BY DAYS FOR FEBRUARY, 1920

Note the high load factor, marked decreases on Sunday, non-uniformity of weekly load but general increase.

To sum the matter up, it can be said that the series hydraulic connection and the parallel electrical connection of the plants in Montana, together with the storage which has been made available, have made the effective capacity of the system as a whole at least twice what it would be if the various units of the system were separate and independent.

With the present system as a nucleus, the Montana Power Company is now very advantageously situated as regards the development of additional water-power sites. In the case of a single water-power development built to carry a certain load, the plant must be developed for the anticipated load factor of the load in question, regardless of the natural advantages or disadvantages of the site. With a system such as that of the Montana Power Company to tie into, a new development can be made to operate at any load factor that may be considered desirable; for example, a high-head plant involving the use of a long pipe line, where the pipe line represents the larger percentage of the investment, would naturally be developed to operate at a high load factor so that the pipe line would be operated at its full capacity continuously and the greatest number of kilowatt-hours during the year obtained from a given investment. On the other hand, a low-head or medium-head plant, in which the head is developed by means of a dam and short penstocks, would naturally be developed for a comparatively low load factor so that the storage made available by the dam could be utilized to carry peak loads and the ad-

Some Undeveloped Water Powers in Montana

A—Mystic Lake, which will probably be used to furnish 26,000 acre-ft. of storage for an 1,100-ft. head development of 10,000 kw. B—The falls below the lake, which will furnish part of the head. C and D—Three falls in Snake River which would furnish a natural head for a 22,500-kw. development. E—Site on the Madison River where 13,500 kw. can be developed. F—Point on Missouri River below Great Falls where dam can be built to impound water for 28,500-kw. development; a 60-ft. dam 1,000 ft. long would be required for such a rating.

ditional investment required for this peak load capacity would be only that represented by additional generators and waterwheels.

One thing that has to be taken into consideration in utilizing the reservoirs is the time required for the water released to reach stations downstream. For instance, the Hebgen reservoir is 300 miles (480 km.) above Rainbow, so it requires seven days for water to travel between the two places. Likewise, Holter is five days (water travel) from Hebgen. However, the storage immediately available above this plant, Hauser Lake and Canyon Ferry, is sufficient to carry full load on each plant until water from the Hebgen reservoir reaches them. Hence peak loads can be thrown onto these three plants simultaneously.

As indicated by the map, page 1056, and Table VI, the generating stations are so located and the transmission system so laid out that the centers of industrial load—Butte, Anaconda, Helena and Great Falls—have several sources of energy as well as several channels through which to receive it.

For instance, Anaconda can receive energy over the Great Falls-Anaconda line, the two Rainbow-Anaconda lines or the two lines from Hauser Lake and Canyon Ferry to Butte. Butte, in turn, can be served from the same lines. Some help may also be received in the Butte and Anaconda districts from Big Hole and Madison Nos. 1 and 2. Helena district is fed from Holter, Canyon Ferry, Rainbow Falls and indirectly from Great Falls. Great Falls district is immediately in the vicinity of Rainbow Falls, Great Falls and Black Eagle and may also be fed from Holter as well as other plants connected to the system. Holter, being situated between the big load centers, can transmit energy to them very economically when the nearby plants become overloaded and, besides, is well equipped to take peak loads, as mentioned before. The value of interconnection has been particularly appreciated in the Butte-Anaconda district, where, owing to the several sources of energy and the various lines over which it can be transmitted and the fact that they run over different routes and are not likely to be affected by disturbances simultaneously, there is practically no opportunity for any load center to be without energy. In fact, the mines, which have to consider reliability of service more than any other users, perhaps, have not because of past experience deemed it necessary to have any standby generating equipment.

CONTINUITY OF SERVICE ASSURED BY NETWORK

Because the many transmission lines mentioned tap a 100,000-volt bus line along the Chicago, Milwaukee & St. Paul Railway at seven points, the Montana Power Company is able to give the railroad absolutely reliable service. Several of these tie-in points can be fed from more than one transmission line. For instance, Two Dot can receive energy from Great Falls directly or Rainbow and other plants indirectly; Josephine can be fed from East Helena, which is a junction point for several main transmission lines; Piedmont and Janney tap a main line between Madison Nos. 1 and 2 and Butte and hence can receive energy from two directions and several stations; Morel is fed directly by Great Falls and Holter over one line and may be connected with other plants over this and another line; Gold Creek also taps a main line that can be fed from two directions; East Portal receives energy over duplicate lines from Thompson Falls. The 100,000-volt bus line affords still another channel for transfer of energy.

During the war the policy of the Montana Power Company was to postpone all except absolutely necessary construction (Holter, as mentioned before, was built during the war). No large construction work was done during 1919 either. The principal addition was a line from Harlowton to Roundup and Carpenter Creek coal district and a tie line from this line to Billings.

As may be observed from Fig. 1, showing the monthly peak loads, average loads and station capacity, there was a slight slump in business immediately after the beginning of the war and another severe decline in business in the last half of 1917, due to a mine strike. The signing of the armistice and the simultaneous drop in the copper market had a very marked effect, but the load is now increasing at a greater rate than before.

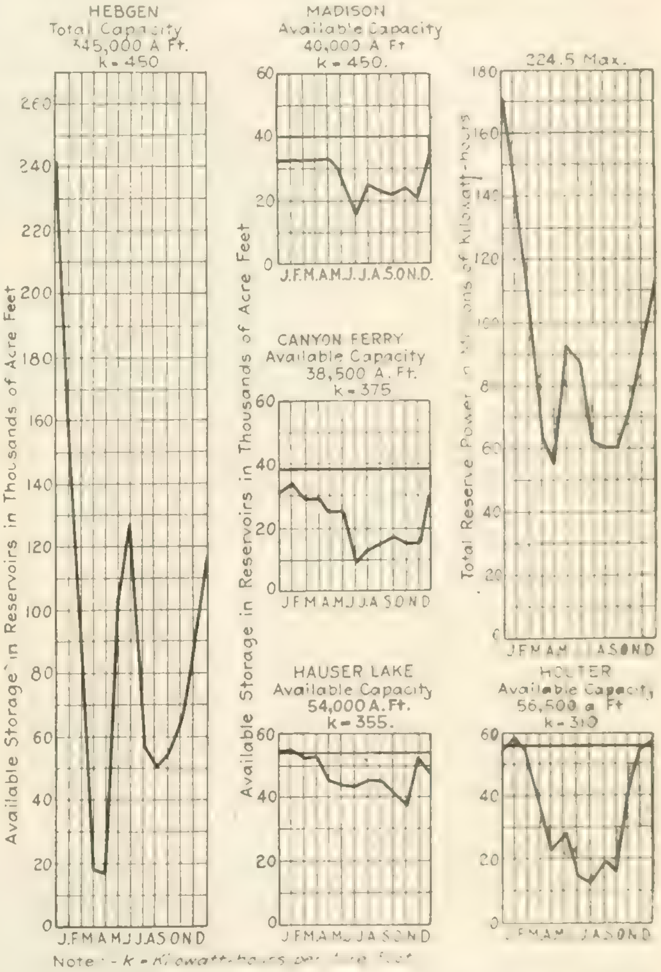
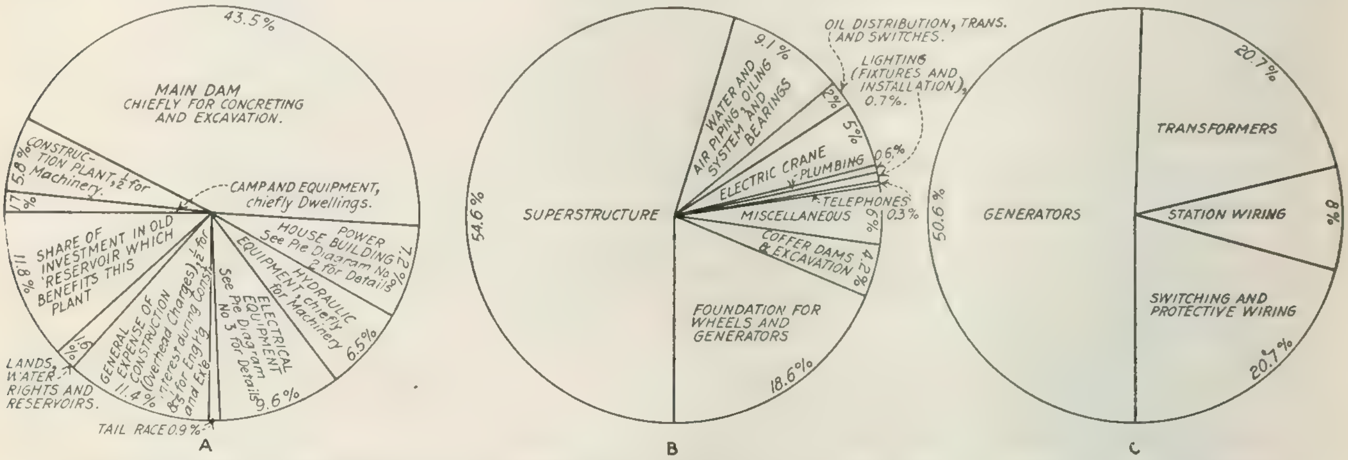


FIG. 4—AMOUNTS OF STORAGE AVAILABLE IN HEBGEN, MADISON, CANYON FERRY, HAUSER LAKE AND HOLTER RESERVOIRS AT DIFFERENT PERIODS OF 1919, THE DRIEST YEAR IN A CONSIDERABLE PERIOD, WITH TOTAL EQUIVALENT ENERGY IN RESERVE

The loads are now about what they were in 1918, the average and maximum demands for February, 1920, being shown in Fig. 3. As will be noted, the load factor is very high. There is no uniformity in the weekly load curves except for the Sunday decline and the general increase in load. Copper and zinc mines and reduction plants have increased operations, silver mining has revived, and ferromanganese has shown special activity. Besides the natural rate of growth in established Montana industries, the development of new industries which will use large amounts of electrical energy, such as electric steel and brass production, is looked for. Owing to the high cost of harvesting natural ice there has been quite a boom in artificial ice production by electricity. Several opportunities to electrify railroads still remain. The Northern Pacific and the Great Northern provide the most favorable opportunities and are now considering electrification, while the Chicago, Burlington & Quincy and the Oregon Short Line also operate the state.



FIGS. 5, 6 AND 7—DISTRIBUTION OF INVESTMENT IN THE MONTANA POWER COMPANY'S LATEST PLANT, HOLTER

A—Major classification of 40,000-kw. plant. B—Itemization of investment in power house. C—Electrical equipment.

It is probable that the existing system will be able to handle the normal increase in load for one or two years to come. The system is designed for about 70 per cent load factor, and, as the present load has a load factor somewhat higher than this, there is considerable peak-load capacity available, which is particularly desirable for railroad electrification.

UNDEVELOPED WATER-POWER SITES

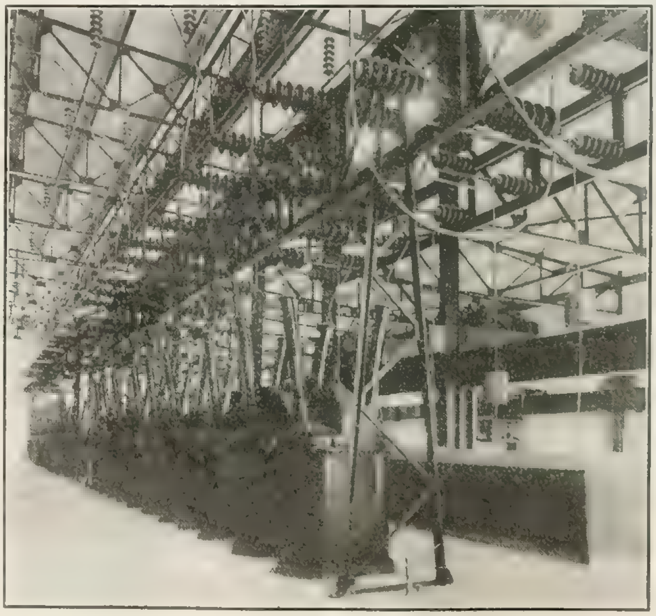
The company has several desirable water-power sites in its territory that remain to be developed, namely, Great Falls C (28,500 kw.), Sheep Creek (28,500 kw.), Snake River (22,500 kw.), Madison No. 3 (13,500 kw.), Mystic Lake (10,000 kw.), on Rosebud Creek, a tributary of the Yellowstone River, and Black Eagle (10,000 kw.). Great Falls C would probably be developed for a 70-ft. (2.1-m.) head and would require a dam 60 ft. (18 m.) high by 1,000 ft. (300 m.) long. Sheep Creek would probably operate on a similar head and have a similar length of dam, but it would not have to be higher than 45 ft. (13.5 m.).

Mystic Lake, with an 1,100-ft. (330-m.) natural head available and 26,000 acre-ft. (32,000,000 cu.m.) of storage, is the most promising site in the eastern part of the State and will in all probability be the next to be developed. A 15-ft. (4.5-m.) dam and about 2 miles (3.2 km.) of penstock will be required. Black Eagle will probably be developed for a 42-ft. (12.6-m.) head by utilizing a 24-ft. (7.2-m) dam about 750 ft. (225 m.) long already built, impounding about 700 acre-ft. (860,000 cu.m.). After developing Mystic Lake, the Montana Power Company will next consider the sites around Great Falls, namely, Black Eagle, Great Falls C and Sheep Creek. Most of these power sites are shown on page 1048 and on the map, page 1056.

As in the past, the policy will be followed of so laying out future transmission lines that service shall be available to almost any industry that may be established in the State, that as many towns as possible may be reached, the most reliable service provided and development of water-power sites facilitated.

For example, if the Great Northern electrifies, a line might be built along the right-of-way from Havre at the east end to the state line on the west and fed at Havre, Cut Bank, Whitefish and Troy. Havre could be served from all existing plants through the present line to Havre, after being reinforced. Cut Bank and Whitefish could be served by lines from Thompson Falls. Mystic Lake would in all likelihood be connected with the Bozeman-Billings line, reinforcing that system, which runs along the Northern Pacific Railway. The transmission lines from Thompson Falls to the Cœur d'Alene mining district run very close to lines of the Washington Water Power Company, but there is no immediate need of interconnection. All of these interconnections will depend on conditions making them economically possible not only as to investment but as to operating expense. In general it costs about 15 cents per kilowatt-year per mile to transmit energy, which is a rough basis on which it is possible to make a rough determination as to whether it is better to utilize local energy or transmit it from a distance.

The foregoing information has been obtained with the courteous co-operation of John D. Ryan, president of the Montana Power Company; F. M. Kerr, vice-president and general manager; H. H. Cochrane, chief engineer, and others.



SWITCHING EQUIPMENT IN THE MOST MODERN STATION, HOLTER

Giving Service in Agricultural Districts

Sparsely Settled Communities That Would Ordinarily Be Considered Uneconomical to Serve Are Being Fed by the Washington Water Power Company, Which Also Serves Two Other Systems and an Electrified Railroad

LONG LAKE DAM AND 46,700-KW. PLANT OF WASHINGTON WATER POWER COMPANY AT LOWER END OF LONG LAKE. THIS IS THE NEWEST AND LARGEST OF ITS FOUR STATIONS

INCREASED economy, production, convenience and comfort made possible by electric service are evident everywhere, but these benefits are particularly marked where the large cities are widely separated and the towns sparsely settled and far from sources of fuel. This is particularly true in that section of the State of Washington east of the Big Bend in the Columbia River which is served by the Washington Water Power Company. There industry, as usually understood in most parts of the country, is not so predominant as agricultural pursuits, which are naturally spread over greater expanses of territory and are therefore more dependent on electric service from a large interconnected system because the carrying charges on fuel make its price almost prohibitive. In that section electricity has been made available at a moderate price through an abundant natural resource—water power—and water storage and interconnection of various plants make it possible to give a more reliable and economical service than could be furnished by individual plants. Furthermore, the service can be rendered without any steam reserve, which would add considerably to the cost of service.

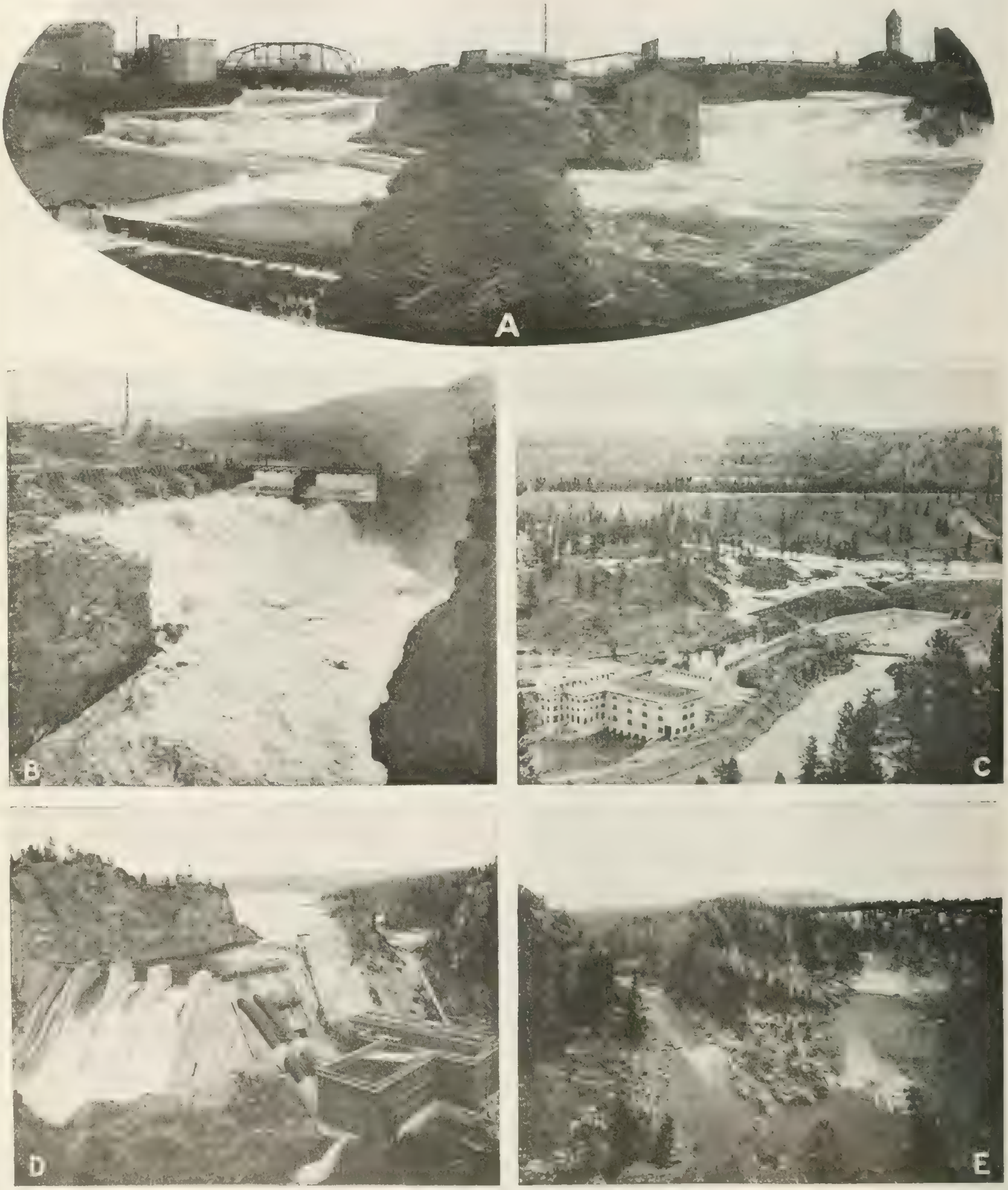
DEVELOPMENT OF THE SYSTEM

As shown by the map on page 1056 the lines of the Washington Water Power Company now cover a territory about 100 miles (160 km.) in both directions, east and west, and a like distance north and south, but this system started from a nucleus centered in Spokane and grew by gradually extending lines to markets in the neighborhood which would justify the investment and losses in transmission lines. The initial hydro-electric station was situated at Spokane on the Spokane River (see Table I and Fig. 1). As the load further increased another hydro-electric plant was erected upstream in 1906 near Lake Cœur d'Alene, with its enormous storage area of 45 sq. miles (116 sq. km.). Because of slack flow in the river at certain periods of the year it was necessary to build a steam reserve plant at Spokane in 1907 to supplement the existing hydro-electric plants, but more especially to supply energy during the interval before the development of more water power. Meanwhile the transmission system had been extended and the benefits of electric service had become so generally recognized that it was necessary to provide additional generating capacity at Little Falls on the Spokane River. Finally Long Lake development, with its wonderful storage of 62,000 acre-ft. (76,260,000 cu.m.), exceeded only by Lake Cœur d'Alene, was completed in 1915. Since all the hydro-electric plants were interconnected and had sufficient storage to regulate the river flow, it was possible after Long Lake was placed in operation to shut down and dismantle the old steam plant at Spokane, which had formerly been required only to compensate for slack flow anyway. This plant was not used much after 1910 and not at all after January, 1912.

FACTORS WHICH HAD TO BE CONSIDERED IN EXTENDING LINES

Simultaneously with the development of new water-power sites came the extension of transmission lines, first to nearby towns such as Medical Lake, southwest of Spokane; subsequently to the Cœur d'Alene lead and silver mining district in northern Idaho; north of Post Falls to the lumber district; the Palouse territory to the south, with similar agricultural pursuits, and the Big Bend country, a rich fruit-growing and wheat-raising district to the southwest of Spokane. These sections now rank in about the preceding order as far as load centers are concerned. In extending lines to each of these sections consideration had to be given to the immediate or likely revenue which could be obtained and the possibility of its paying a reasonable return on the expense of rendering the service. Sometimes a definite enough load could be seen to justify the extension; at other times sufficient revenue to warrant the extension had to be assured by the concern or community which desired service. In some instances where the transmission company could not afford to extend a line the communities or concerns desiring power wanted it sufficiently to build a line up to the Washington Water Power Company's system. In still other cases farmers who desired service and could not be served otherwise have banded together, guaranteed a satisfactory yearly revenue and have also financed part of the line. Furthermore, the farmers agree to use power for a long enough period to make the revenue at least equal the investment in the extension. Of course, after

Hydro-Electric Plants in Eastern Washington



A—Undeveloped power about 2,050 ft. above Spokane plant which is soon to be utilized. B—Control works of Post Falls plant. C—Forebay, spillway and power house of Little Falls plant. D—Largest and newest plant at Long Lake during flood stage. E—Bend in Spokane River below Long Lake at site of Long Lake plant before construction.

they have once tasted the benefits of electric service there is not much likelihood of their discontinuing it. Much of the farm and municipal pumping load is served on the flat-rate basis, but other loads are connected on the maximum-demand and energy-charge basis.

Where the power company sees an opportunity to serve several communities it finances its own trunk lines and requires the small communities only to contribute to the financing of the laterals necessary to serve them in the manner previously described. Sometimes these trunk lines have to be built of steel wire with long spans to avoid a non-paying investment. As the loads develop, however, and the trunk lines are extended they may be converted from second-rate or third-rate construction to first class or second class to reduce the transmission losses and make them more suitable as trunk lines. Some of the lines are steel or copper-clad steel; others, of the first-class trunk-line type, are of aluminum or copper. Rural service is given only from 13,000-volt lines or lines operating at a lower voltage because the expense of stepping down the voltage from the 60,000-volt and 22,000-volt lines is too great to justify serving small loads from them. Where sufficient small loads develop along 60,000-volt or 22,000-volt lines that are now traversing sparsely settled territory it is possible that relatively large step-down substations may be provided at some points to feed lower-voltage bus lines from which these communities may be served. However, such a departure from present practice can come only if the total load which can be served from each bus line will warrant the expense.

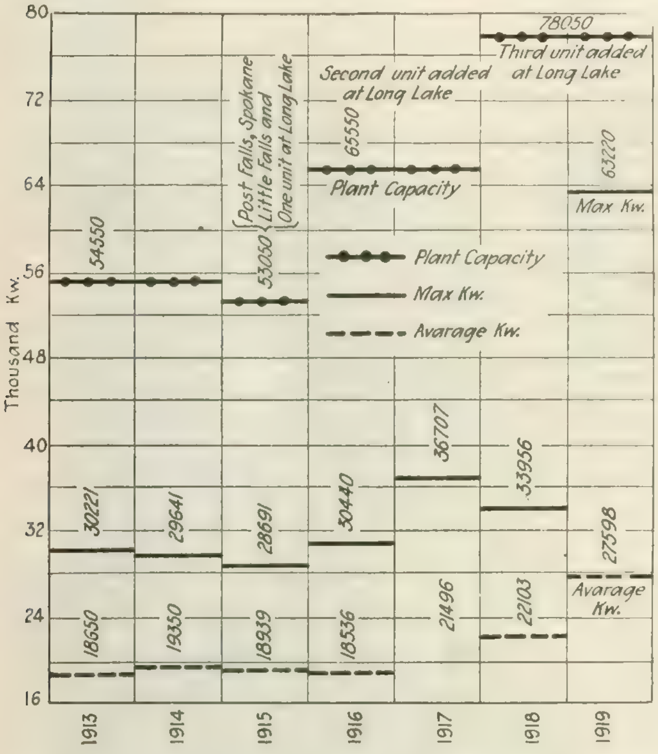


FIG. 1—PEAK LOAD, AVERAGE LOAD AND GENERATING CAPACITY OF WASHINGTON WATER POWER COMPANY FOR PAST SEVERAL YEARS

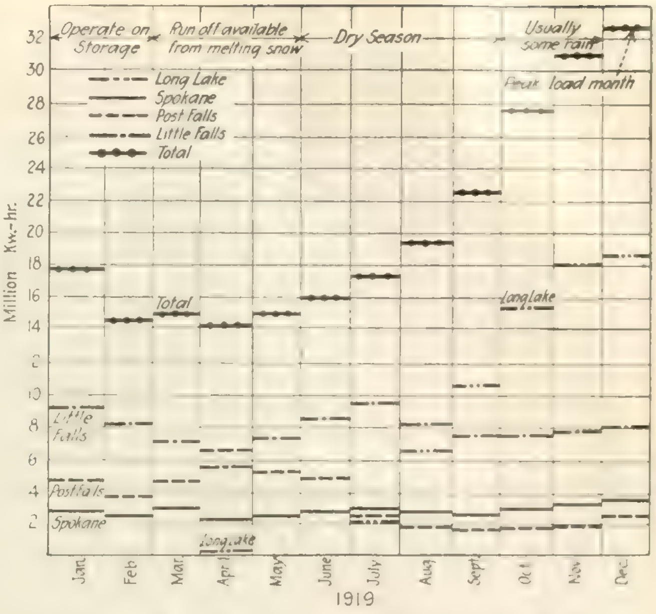


FIG. 2—AVERAGE MONTHLY LOADS FOR 1919 AND DISTRIBUTION OF LOAD BETWEEN PLANTS

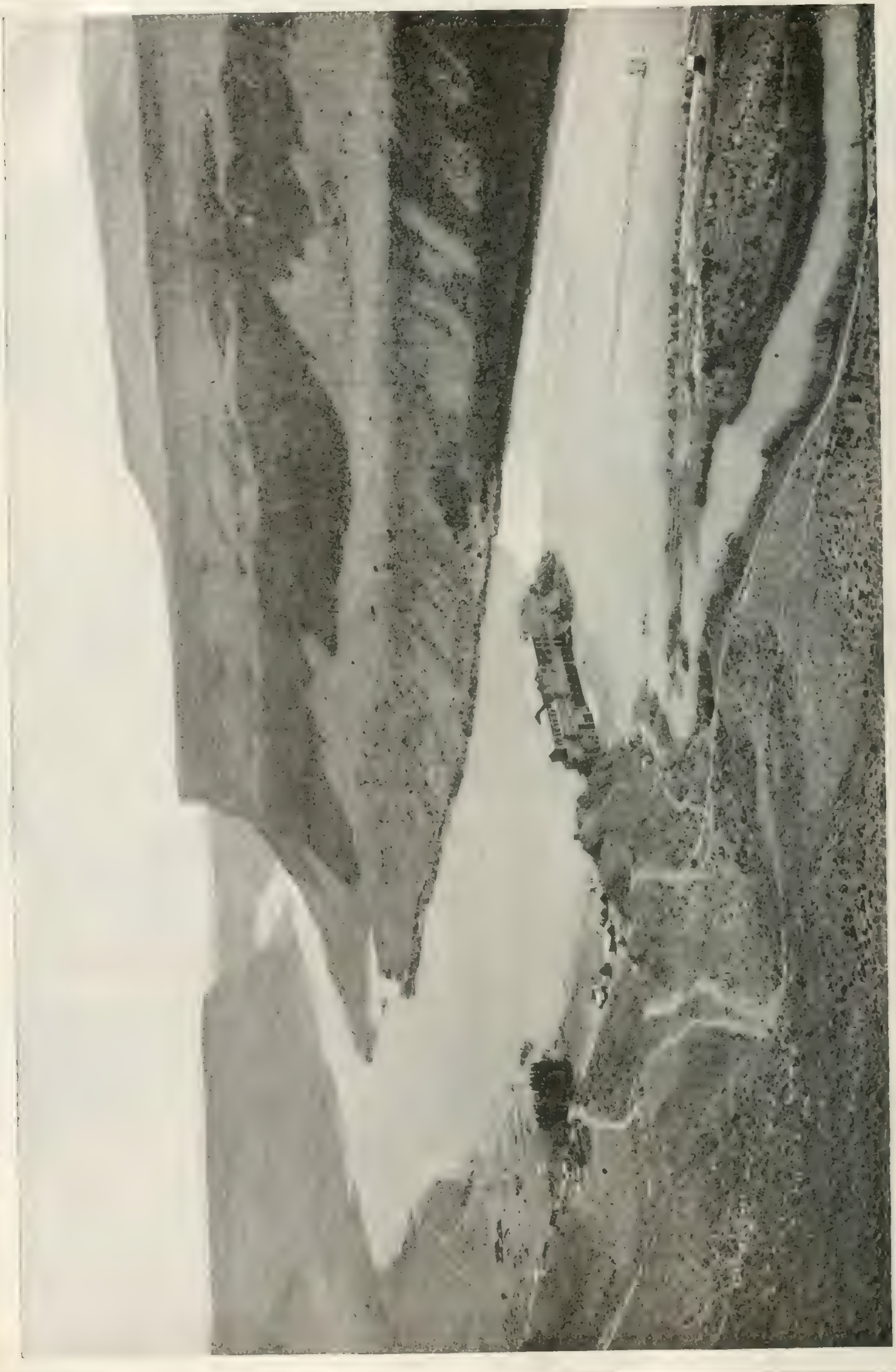
The yearly average load for Little Falls was 10,725 kw.; for Long Lake, 8,110 kw.; for Post Falls, 4,840 kw., and for Spokane, 3,925 kw.

Still further benefits from electric service are resulting from interconnection in the larger sense—that is between systems—since through these lines energy can be transferred from one company when it has a surplus of power to another during its peak-load period. So far the system interconnections which have been made are only for transferring energy one way, but nevertheless the tie lines may be used later for the purpose of exchange which will benefit the companies at both ends. For example, the Washington Water Power Company is now delivering energy from its Long Lake plant to the Pacific Power & Light Company at Lind (see map)

TABLE I—ENGINEERING AND OPERATING CHARACTERISTICS OF THE HYDRO-ELECTRIC PLANTS FOR 1919

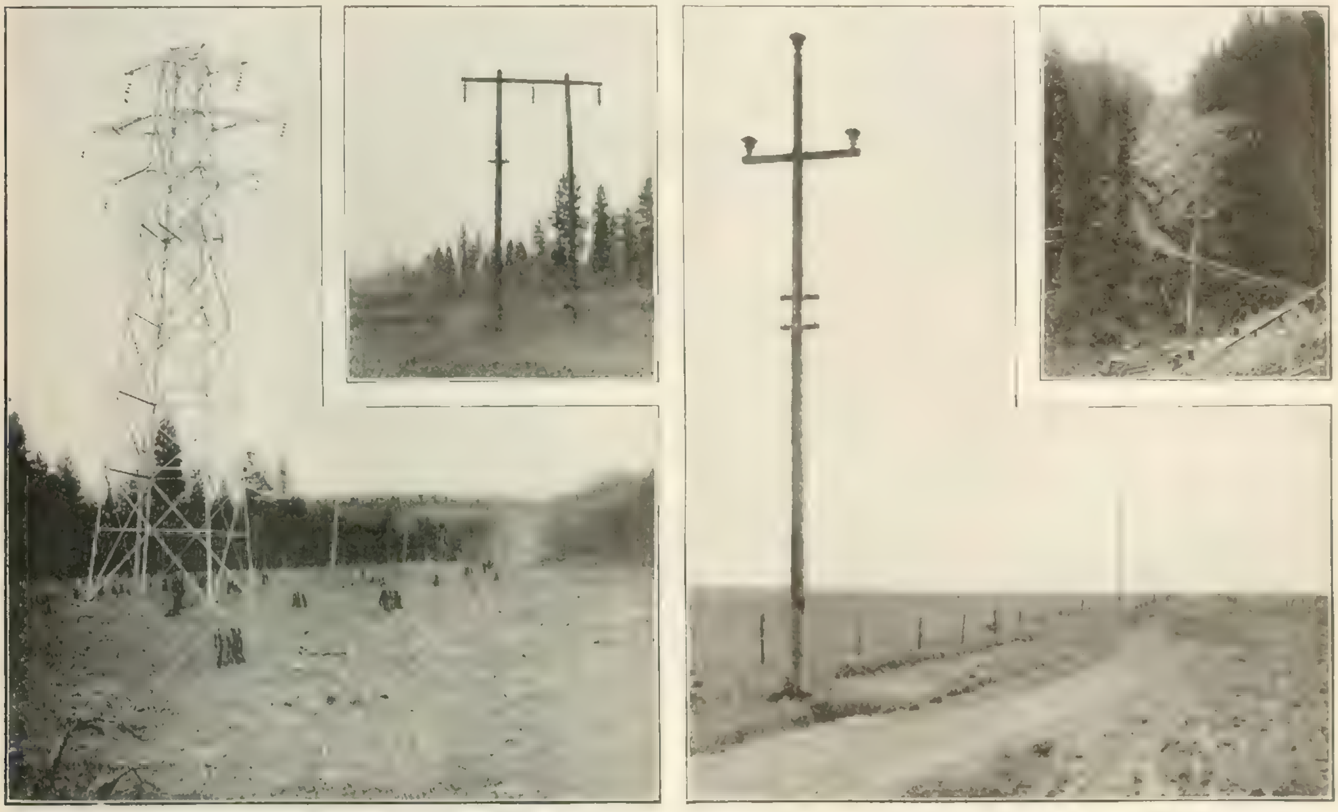
Position on Stream	Name of Plant and Location	Year Completed	Rating (Kw.)	Average Head (Ft.)	Storage (Acre-Ft.)	Dam Height Ft.	Dam Length (Ft.)	Water Flow Sec.-Ft. Max.	Water Flow Sec.-Ft. Min.	Water Flow Sec.-Ft. Average	Kw. Per Sec.-Feet	Load[9] Factor, Per Cent. Yearly
(5)	Long Lake on Long Lake....	1915	46,700	168	62,000[3]	248	251 + 102	50,000	2,065	3,250	12.0	37.4
(4)	Little Falls, Spokane River..	1910	22,800	73[1]	1,740[4]	64	600	50,000	2,065	3,250[7]	5.0	45.8
(1)	Post Falls, Spokane River..	1906	1,250	50–56[1]	161,150[5]	52 64[8] 45[8]	431 180 78	40,000	840	1,735[7]	3.5	42.4
(2)	Spokane, Spokane River.....		8,800	75[2]	158,400[6]	19–26	360 + 90	40,000	1,300	2,500	4.0	61.9

[1] At low water.
[2] Can be increased to 144 ft. by taking water 2,000 ft. further upstream.
[3] At 15-ft. draw-down.
[4] At 10-ft. draw-down.
[5] Water storage in Lake Coeur d'Alene, 158,400 acre-ft.; forebay, 2,750 acre-ft.
[6] Water storage in Lake Coeur d'Alene, immediate storage sufficient only for daily variation in loads.
[7] For four months in summer.
[8] Three channels with the power plant at the middle one.
[9] With full load on each unit.



Swan Falls Development of Idaho Power Company on Snake River, Having Rating of 9,900 Kw.

over the Intermountain Power Company line, and through this line and the Chicago, Milwaukee & St. Paul bus line is delivering energy to the Puget Sound Traction, Railway & Light Company on the extreme western side of the State. Reciprocally, if either of these companies overdevelops its system, it can return energy to the Washington Water Power Company. This has not been nor is it now essential because the Washington Water Power Company has been overdeveloped since the beginning of the European war and has had more energy than it could sell in its own territory. However, its business is fast growing and the time may come when its load will exceed what it can furnish from its existing plants. Then exchange of energy will be valuable. As a result of such exchange each of the interconnected companies can get along with less reserve generating equipment.



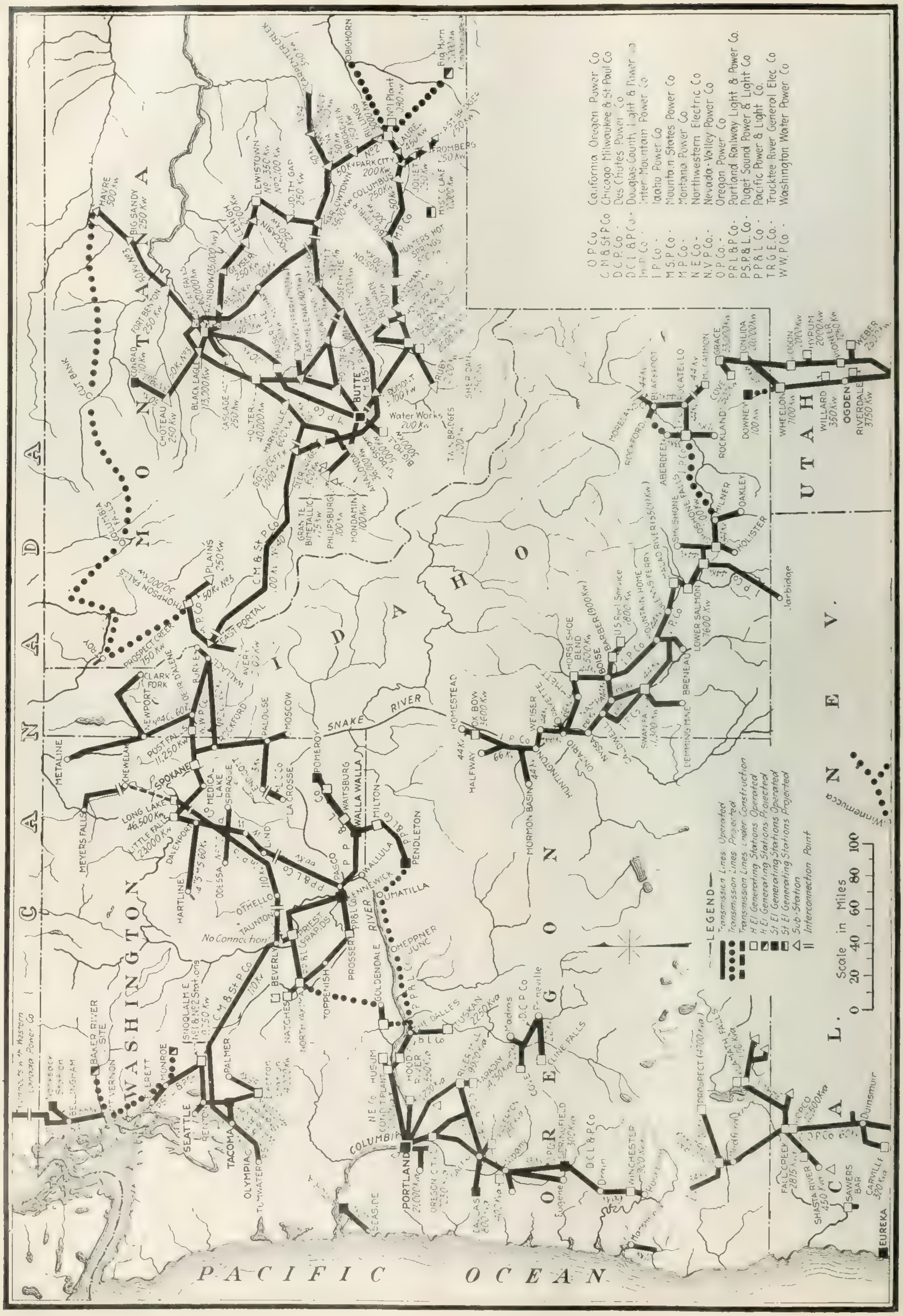
SOME MAJOR TRUNK LINES AND CIRCUITS TO LOAD CENTERS IN EASTERN WASHINGTON

On left, double-circuit 60,000-volt line connecting Little Falls and Long Lake with Spokane, the hub of the Washington Water Power System. In insert on left, single-circuit 110,000-volt line of Intermountain Power Company from Long Lake to Lind and Taunton, feeding the Pacific Power & Light Company, Chicago, Milwaukee & St. Paul Railway, and through the latter the Puget Sound Traction, Light & Power Company. On right, wood-pole 60,000-volt line feeding Big Bend country. In insert on right, Cœur d'Alene 60,000-volt transmission line of Washington Water Power Company in Fourth of July Canyon.

HOW WATER IS UTILIZED TO BEST ADVANTAGE

The interconnection of plants that exists within the Washington Water Power Company's system enables it to give the most reliable type of service and at the same time to utilize the flow in the Spokane River and the storage in Lake Cœur d'Alene and Long Lake to the best advantage. In general during low-water season it is the practice so to operate the plants that all water is utilized. Post Falls plant, which is farthest upstream on the Spokane River of all of the four plants and consequently nearest Lake Cœur d'Alene, is operated at a uniform load which will maintain the minimum flow required in the Spokane River. This flow is sufficient to operate the plant at Spokane at near its normal generator rating. Long Lake plant, which is the next plant downstream and immediately at the outlet from Long Lake, in turn carries just sufficient load to maintain a flow at Little Falls to operate this plant at a rating that will carry the remaining load. This is the reason why the oldest plant on the system is operated at a higher load factor than the other three plants, contrary to the practice which would be followed if the stations were all steam plants. If the water discharged from Lake Cœur d'Alene raises the water at Long Lake so that there is a chance of its being spilled over the dam, then the load is redistributed and all the water is utilized. Because of the fact that it is desired to keep as much water in storage at Lake Cœur d'Alene as possible during low-water seasons, peak loads are taken by Long Lake or Little Falls. The draw-down on Long Lake during such periods is regained during light loads by collecting water from upstream. Since operation of the plants to secure the maximum use of water does not always give the best power factor and voltage regulation if uncompensated, the idle generators in each plant are used during low water for power-factor correction.

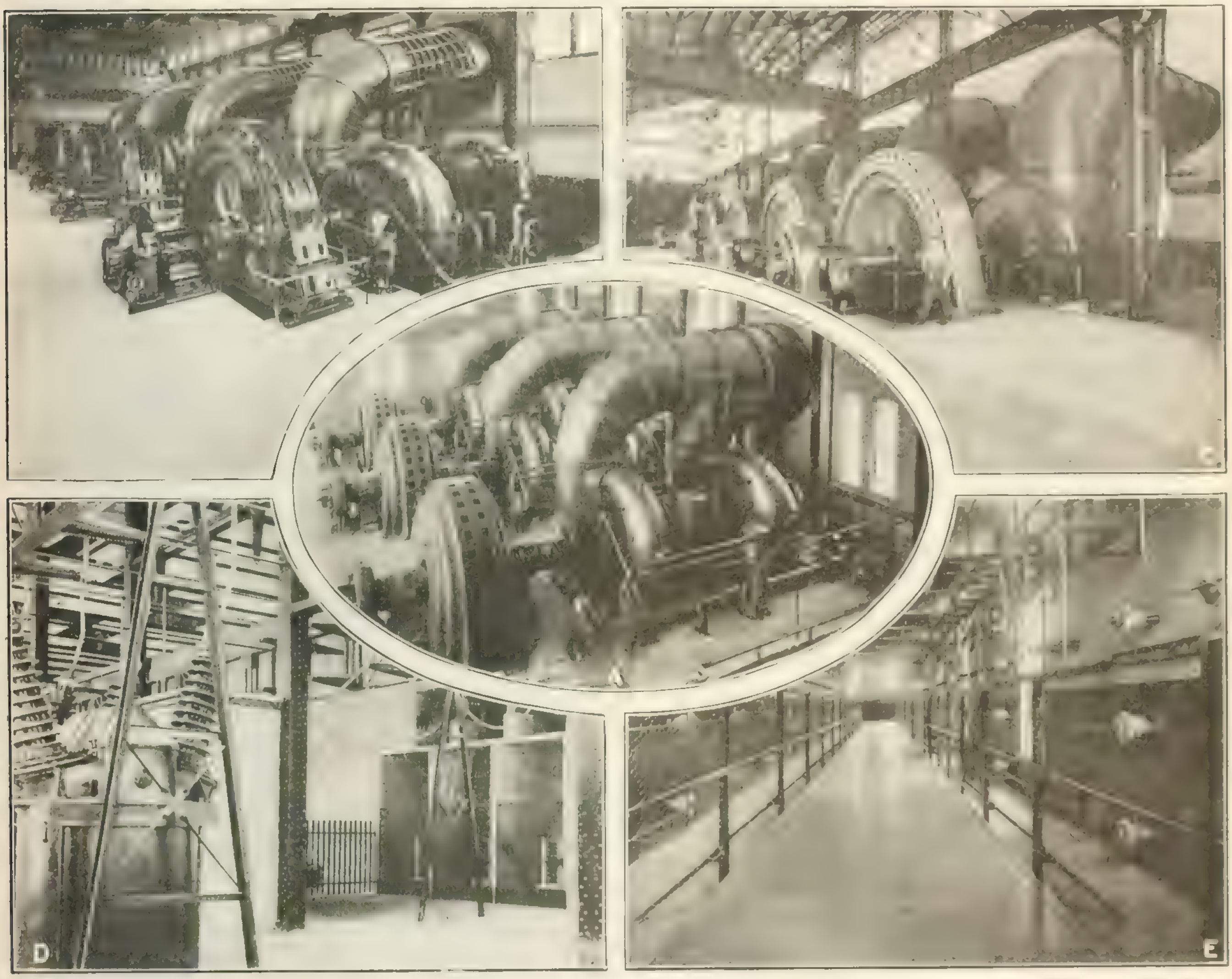
During flood season the plants are operated to insure the best voltage regulation and power factor and the least transmision loss regardless of whether the water is utilized to the best extent or not. At such times water is usually running over the spillways at each plant. During October and November enough rain usually falls to regain most of the storage "let go" during the summer, and thus ample water is available for the annual peak load, which occurs in December. From March to June run-off from melting snow is expected so that water can be stored for the dry season. The system load factor is


C. O. P. Co. - California Oregon Power Co.
C. M. & St. P. Co. - Chicago Milwaukee & St. Paul Co.
D. C. P. Co. - Des Chutes Power Co.
D. C. L. & P. Co. - Douglas County Light & Power Co.
Im. P. Co. - Inter Mountain Power Co.
I. P. Co. - Idaho Power Co.
M. S. P. Co. - Mountain States Power Co.
M. P. Co. - Montana Power Co.
N. E. Co. - Northwestern Electric Co.
N. V. P. Co. - Nevada-Valley Power Co.
O. P. Co. - Oregon Power Co.
P. R. L. & P. Co. - Portland Railway Light & Power Co.
P. S. P. & L. Co. - Puget Sound Power & Light Co.
P. P. & L. Co. - Pacific Power & Light Co.
T. R. G. E. Co. - Trucktee River General Elec. Co.
W. W. P. Co. - Washington Water Power Co.
LEGEND
Transmission Lines Operated
Transmission Lines Projected
Transmission Lines under Construction
H. El. Generating Stations Operated
H. El. Generating Stations Projected
St. El. Generating Stations Operated
St. El. Generating Stations Projected
Sub-Station
Interconnection Point
Scale in Miles
0 20 40 60 80 100
CANADA
MONTANA
WASHINGTON
IDAHO
OREGON
NEV.
UTAH
CAL.
PACIFIC OCEAN
SNAKE RIVER
COLUMBIA RIVER

FROM EASTERN MONTANA TO THE PACIFIC TRANSMISSION LINES OF THE GREAT NORTHWEST EXTEND ALMOST WITHOUT A BREAK increasing, and as this tendency increases it will be necessary to draw down on Long Lake during the dry season to a greater extent than at present.

VALUE OF STORAGE

The full benefits of storage in Lake Cœur d'Alene have not been utilized so far, as it was unnecessary to conserve all the water during the last few years since the construction of Long Lake station has provided an excess of power capacity up to the present time.


EQUIPMENT OF SOME OF THE WASHINGTON WATER POWER COMPANY'S HYDRO-ELECTRIC PLANTS

A—Three 13,900-kva. blower-cooled generators at the Long Lake station driven by double-runner waterwheels. B—Four similar but lower-head waterwheel-driven generators at Little Falls. C—Five double-runner waterwheel-driven generators at Post Falls. D—110,000-volt switch room at Long Lake with reactor compartments in background. E—Half of 60,000-volt bus room at next to newest station of the Washington Water Power Company at Little Falls.

Storage is highly desirable on practically all Western rivers which have their source in the mountains as they are subject to wide variation in flow in successive months and years.

FEATURES OF HYDRO-ELECTRIC PLANTS

The three latest hydro-electric plants have been described quite fully in former issues of the ELECTRICAL WORLD.* Some of the general features brought up to date are given in Table I and outlined below.

Post Falls plant, which is 10 miles (16 km.) below Lake Cœur d'Alene, is built across the middle of three channels at this point and the other channels are dammed. The south channel has six sliding gates with an ingenious traveling gate hoister. The north channel contains the principal control works, comprising seven Tainter gate sluiceways, one log sluice and a 110-ft. (33-m.) main sluiceway fitted with two bear-trap dams. During the spring, when high water prevails in the Tainter gates, bear traps and sluiceways are kept open.

Little Falls, the next plant to be completed, has a cyclopean concrete dam with two hand-operated relief gates of the inverse Tainter type which provide for low-water discharge. The spillway is 604 ft. (180 m.) long. The penstocks are closed by motor-operated headgates bearing on rollers. Four 5,500-kva. generators driven by horizontal twin-runner waterwheels are provided.

The Long Lake development, the most modern of the four plants, has a dam which is unique in at least two particulars. The water spills over the dam itself, making it one of the highest spillway dams in existence. At times of flood about 19 ft. (5.7 m.) of water flows over the crest. Six vertical-lift waste gates are mounted on the crest of the spillway to hold the low-water level at the same level as during high water. The total length of spillway through the gates is 150 ft. (45 m.).

Three generators driven by 22,500-hp. waterwheels, the largest in existence when the plant was completed, are installed, the third unit being placed in operation last year. While the generators were rated at only 13,900 kva. each, tests proved they would exceed this rating so that with the forced-air ventilation provided they would carry 17,400 kw. maximum at 90 per cent power factor. The waterwheels are designed to just carry this load easily. Instead of having the oil pumps driven from the shaft, as is done at the Little Falls plant, they are driven by motors. The open-tank oil system is employed.

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*May 23 and 30, 1908; June 22, 1912; May 29, 1915.

The buses and switching equipment are laid out in such a way that, while each generator and its corresponding transformer ordinarily operate as a unit, they can be operated in a number of other ways if the occasion demands it. To permit this flexibility of operation a single sectionalized low-tension bus is provided that can be formed into a loop bus by a cable running from one end of it to the other. Between each two sections of the bus is a 10 per cent reactor that can be inserted or cut out of circuit as desired. While each generator normally feeds into its corresponding transformer through an oil switch, it can be connected with its section of the low-tension bus and thence with any other transformer. This required three low-tension switches per generator installed. These are of the H-6 type.

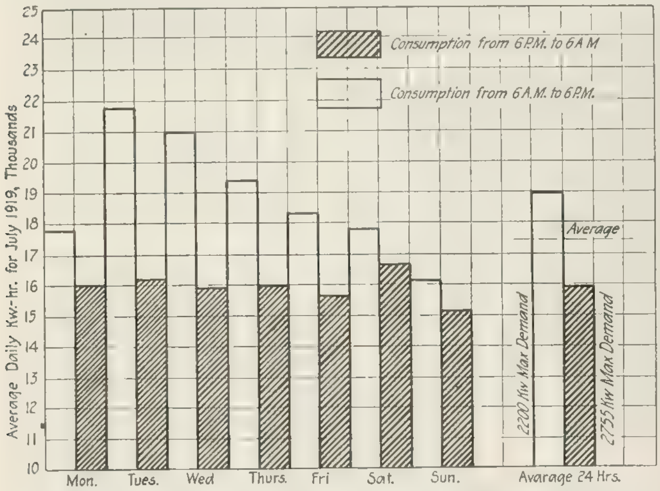

FIG. 3—EFFECT OF RANGE AND WATER HEATER LOAD ON RESIDENTIAL LOAD IN SPOKANE (JULY, 1919)

Additional flexibility is provided by a loop-type high-tension bus with four oil switches per transformer. Through these any transformer may be connected with its own feeder or with any other feeder. Both 60,000-volt and 110,000-volt lines are supplied, and type K-15 and type K-36 oil switches are used respectively.

Reverse-power relays are used on the generators and transformers, selective relays between the generators and transformers, and inverse-time-limit relays on the outgoing lines. While the generator neutrals are not grounded now, they will be eventually and balanced protection will be provided.

The low-tension bus and switch layout is very interesting because it enables almost any desirable connection, permitting convenient placing of any apparatus that may be required and ready access to it. Two vertical tiers of bus compartments are placed parallel to each other with an aisle between and the oil switches overhead. In addition to the advantages mentioned, this obviates having switches and buses on different floors and gives a firm foundation for the switches.

TABLE II—AVAILABLE STORAGE IN RESERVOIRS

	Acre-Ft.	Sec.-Ft. Available
Coeur d'Alene	151,250	445 for 120 days.
Post Falls	2,750	Sufficient for daily load variations.
Long Lake	62,000	260 for 120 days.
Little Falls	1,740	1,000 for 20 hours.
Spokane	...	Enough for daily load fluctuations.

The transformers, which are connected delta-delta for 60,000 volts and delta-star for 110,000 volts, are installed in fireproof compartments at one end of the wheel room, with the high-tension buses overhead and the low-tension buses behind them on the wall. Over them on a mezzanine floor are the low-tension buses and switches within sight of the control board. In another section of the bus and switch house running parallel to the low-tension room are the high-tension oil switches, disconnecting switches, bus-sectionalizing reactors and low-tension current transformers. The high-tension buses, which consist of iron pipe, are run overhead between the ceiling trusses, which are designed to give sufficient ground clearance. High-tension leads to the buses and switches come from uptakes in the floor below. On the floor above are the lightning arresters, choke coils, high-tension current transformers and line "disconnects." The horn gaps, lightning-arrester "disconnects" and terminal tower for the outgoing lines installed are on the roof.

MAGNITUDE AND NATURE OF LOADS

As mentioned before, the principal load centers are at Spokane, in the Cœur d'Alene district, and in the big Bend and Palouse districts respectively. Waste power is sold to the Pacific Power & Light Company, which has a maximum demand of about 6,000 kw. An additional 15,000 hp. is transmitted over the Intermountain Power Company's 110,000-volt line to the Chicago, Milwaukee & St. Paul Railroad electrification at Taunton. All power that the railroad does not use is transmitted over its bus line to the Puget Sound Traction, Light & Power Company. Commercial power in Spokane and suburbs amounts to about 40,000 connected horsepower. The electric range load on this system, which far excels the range load on any other system, is 20,000 kw. (connected). It is worthy of attention that 17½ per cent of the rural consumers have electric kitchens—*i.e.*, electric ranges and water heaters—and that there is a service connection for every four persons. Irrigation and municipal pumping together constitute 8,000 hp., although irrigation is not so prevalent in this territory as

TABLE III—GENERAL STATISTICS REGARDING WASHINGTON WATER POWER COMPANY

	1919	1918
Generator rating (kw.)	78,050	78,050
Maximum load (kw.)	63,220	33,956
Average load (kw.)	27,598	22,103
Energy generated (kw.-hr.)	241,761,350*	193,628,500
Yearly load factor (per cent)	43.6	65.09
Average monthly load factor (per cent)	78 0	70 60
Connected motor load (hp.)	62,400	58,200
Consumption (kw.-hr.)	187,395,293	148,458,721
Miles of transmission:		
60,000-volt	654	630
22,000-volt	32	32
Miles of distribution	700†	650†

* At present rate the energy generated for 1920 will be between 350,000,000 kw.-hr. and 400,000,000 kw.-hr.

† Approximate.

in some other parts of the West. About 4,000 kw. is supplied to the Washington Water Power Company's street railway, and connected loads in flour mills, railroad shops, meat-packing houses and lumber mills are about 3,000, 2,000, 1,500 and 1,000 kw. respectively.

PAST BUSINESS AND FUTURE OUTLOOK

Unlike many territories, eastern Washington was hard hit during the war because it had practically no war industries, men migrated to other sections and business in general was curtailed. As a result the electric service business suffered. Immediately after the armistice, however, electric service picked up, and it has increased rapidly ever since except for slight setbacks due to curtailment of mining in the Cœur d'Alene district owing to market prices and labor conditions. The future outlook is quite promising, and in addition to the natural growth in business it is expected that new loads will develop. For instance, some magnesite mines have been started north of Spokane, and the load may be particularly attractive if the operator converts this mineral to magnesium electrolytically. Pulp and paper industries are developing, and more activity can be expected because of the abundance of wood available and the composition wood products that can be marketed. Flour-mill loads are developing rapidly, and, since this section ranks as a great wheat-growing country, they promise to be still more attractive. In the territory Armour has built a meat-packing plant which is the only one of his plants driven entirely by central-station power, and a meat-packing center is expected to develop around it. Lumber-finishing mills are already being served, but until some use is found for the scrap lumber from sawmills which will prevent its being burned the opportunities for increasing service to such mills are rather slight.

UNDEVELOPED WATER POWERS IN VICINITY

As loads increase it will be feasible to develop other water powers in which Washington abounds, but at present most of the undeveloped sites do not have a sufficient market to justify their development. Among the water powers available are those at Priest Rapids and Kettle Falls, on the Columbia River; Z Canyon, on the Pend Oreille River; Salmon River, Clearwater River, Clark Fork of the Columbia River, Kootenai River, Priest River, other sites on the Spokane River, and possibly Lake Chelan if some of the engineering obstacles now apparent can be removed. Development of any of these sites will benefit all companies now operating in this territory if system interconnection is still further developed.

SHOSHONE FALLS DEVELOPMENT OF IDAHO POWER COMPANY ON SNAKE RIVER. STATION AT LEFT, OPERATED UNDER HEAD OF 210 FT.

The information for this engineering study was kindly contributed by members of the Washington Water Power Company, of which D. L. Huntington is president, W. E. Coman is vice-president and general manager and V. H. Greisser is chief engineer.

Water Powers That Provide Energy for Western Washington

Interior of 46,000-kw. Station on White River at Dieringer

A—Snoqualmie Falls furnishes a 286-ft. head for about 20,000 kw. in generators underground on each side of the falls; in summer very little water goes over the falls.

B—Flume connecting Puyallup River with Electron plant; Mount Rainier, the source of the Puyallup and White Rivers, can be seen in the background of this illustration.

C—Electron, which is connected with bus at White River station, operates on head of 865 ft.

D—T-wheel room of White River station, the largest and most modern hydro-electric plant of the Puget Sound Company.

Hydro-Electric Service West of Cascades

Although Competing with Municipal Plants, the Puget Sound Power & Light Company Has Been Able to Maintain a Firm Foothold by Reason of the High Degree of Service Reliability Assured

THAT portion of Washington west of the Cascade Range is as unlike the eastern part of the State in climate, topography, commercial activity, and hence electrical development, as day is from night. The rainfall is much heavier, there are no wide expanses of level land for agricultural development, the proximity to the ocean gives to the cities more of the trading character, and industry is more predominant. This section is provided with electric service almost entirely by the Puget Sound Power & Light Company, which has two distinct transmission systems, one extending northeast and southeast from Bellingham, the other taking in the territory on Puget Sound including Everett, Seattle, Tacoma and Olympia.

The company has an unusually diversified load such as results from serving prosperous seaport cities which do not have any single dominating industry that takes a large amount of power. For example, in Bellingham there are salmon canneries, cement mills, can factories, lumber and shingle mills, interurban lines, and rural light and power, with prospects of considerable mining load some day. Everett is essentially a manufacturing city producing lumber and its products. The principal load as far as magnitude is concerned, however, is that derived from the paper mills. Tacoma, which is at the head of ocean navigation on Puget Sound, offers excellent wharfage facilities for railway and steamship terminals, and these apply electricity in various ways. The chief industry is lumber, with flour milling ranking next. A large smelter, a shipbuilding yard and a street railway system are served with electricity, and energy is sold in bulk to the municipal plant in this city.

Seattle, the largest load center in western Washington, is the leading port on Puget Sound and has an enormous import as well as export trade. The largest single load in this territory is electric traction (about 20,000 kw.), the remainder being made up of (1) iron and steel-working shops, (2) coal mines, (3) lumber, box and paper mills, (4) office buildings, department stores, hotels and clubs, (5) flour milling, (6) shipbuilding, (7) can making and canning, (8) dock operations, (9) brick, tile and clay, (10) oxygen production, and (11) entertainment places, ranking about in the order of the groups named. The magnitudes of a few of these loads are given in the accompanying table with the average yearly load factors. Load factors, however, are no indication of the value of the loads to this company nor to a good many others, since the diversity factor is very high. Recently a large load (10,000 kw.) in the form of a contract with the Intermountain Power Company to serve the Chicago, Milwaukee & St. Paul electrified road has been acquired.

HYDRO-ELECTRIC PLANTS IN SEATTLE DISTRICT

Because of the greater magnitude and importance of the load in the southern district, the principal generating plants have been developed in connection with this district. There are three hydro-electric plants. The oldest, rated at 11,000 kw., is at Snoqualmie Falls; the next newest is at Electron and is rated at 14,000 kw., and the most modern is at Dieringer, on the White River, with a rating of 46,000 kw. A second plant was built at Snoqualmie Falls in 1910 with a rating of 8,750 kw. Some of the characteristics of these plants are given in Table II. It may be noted that Electron has the highest head—865 ft. (263 m.) and develops the most power per second-foot (46.5 kw.), whereas White River has the largest storage—56,000 acre-ft. (68,880,000 cu.m.). Snoqualmie Falls has the highest river flow, however, and operates at the best yearly load factor and also most economically. Impulse wheels are used in both the Electron and Snoqualmie Falls plants, whereas center-flow, end-discharge Francis wheels are employed at White River.

Connected with the southern system are also two steam[*] plants with a combined rating of 26,500 kw., the principal one, situated at Georgetown, having a rating of 23,000 kw. This plant is used chiefly to compensate for deficiencies in water flow and must stand ready to take an emergency load any time.

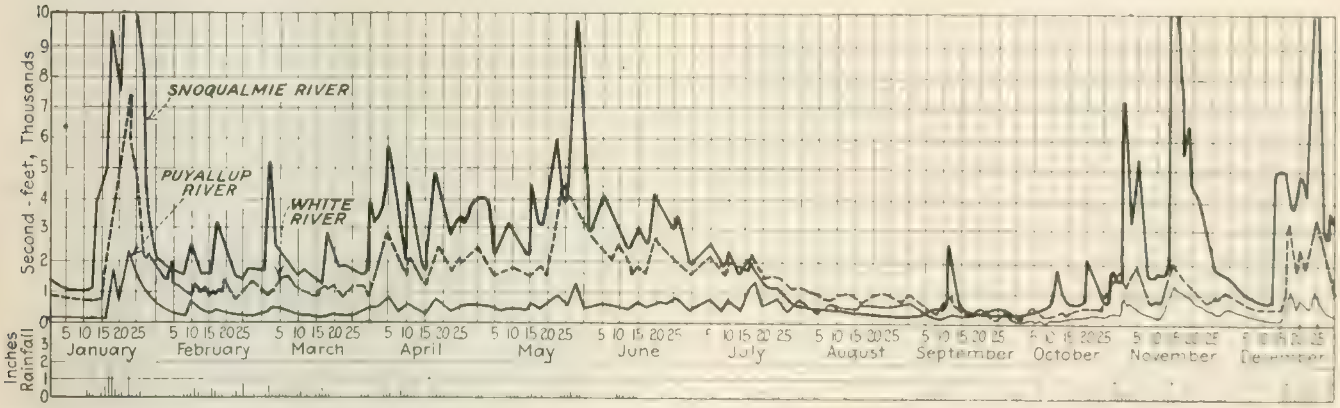

FIG. 1—VARIATIONS IN FLOW OF SNOQUALMIE, WHITE AND PUYALLUP RIVERS, WHICH FEED THE PRINCIPAL HYDRO-ELECTRIC STATIONS OF THE PUGET SOUND POWER & LIGHT COMPANY, FOR YEAR 1919

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[*] The Puget Sound company was a pioneer in the burning of powdered coal and is still conducting extensive investigations in connection with its use in steam-heating plants. However, the company has not utilized coal in this form in its generating stations and will not do so until it feels that the experimental stage has been passed. Results of experience with powdered coal have been published in the ELECTRICAL WORLD.

Additional power is received over the Intermountain Power Company's connection with the Chicago, Milwaukee & St. Paul Railroad and the Long Lake development of the Washington Water Power Company when the railroad does not utilize all the power for which it has contracted. In the northern district is an 1,800-kw. hydro-electric plant on the Nooksack River. Power is also obtained across the Canadian border from the Western Power Company of Canada.

HOW LINES ARE LAID OUT TO ASSURE RELIABLE SERVICE

The method of serving the territory under consideration is best indicated by the transmission map on page 1056. As shown, a 55-kv. line runs from the Nooksack plant to Bellingham, which also receives energy from the Western Power Company of Canada on the north. A line running south to Burlington and branching to Mount Vernon and Contrete serves towns to the southeast. Lines operating at 11,000 volts run south from Mount Vernon, but a gap now exists between their southern extremities and the southern system.

TABLE I—NATURE AND MAGNITUDE OF PRINCIPAL LOADS IN SEATTLE DISTRICT, SHOWING DIVERSITY

Load	Demand Kw.	Load Factor (per Cent)
Pacific Coast Steel Company	2,250	40
Washington Iron Works	700	28
Pacific Construction & Engineering Works	250	33
Seattle Machine Works	150	30
Puget Sound Machinery Company	200	24
Olympic Steel Works (off peak)	273	30
Steel furnaces (peak)	350	70
Hofeus Steel & Equipment Company	110	24
Vulcan Manufacturing Company	250	23
Pacific Car & Foundry Company	1,000	30
Coal mines (twenty)	4,800	50
Canal Lumber Company	1,000	21
Wood-box factories	1,500	20
Everett Pulp & Paper Company	1,092	65
Northern Pulp & Paper Company	600	40
Office buildings, department stores, hotels and clubs	2,500	14–52
Theatres and places of entertainment	800	10–40
Fisher Flouring Mills Company	2,250	60
Hammond Milling Company	550	50
Ballard Shipbuilding Company	50	20
Elliott Bay Shipbuilding Company	125	22
S. F. Duthie Shipbuilding Company	1,300	32
American Can Company	180	29
*National Fruit Canning Company	30	11⅓
*Fruit canneries	600	20
*San Juan Fish & Packing Company	225	44
Seattle Can Company	125	25
O. & W. R. R. & N. C. dock	50	20
Pacific Coast Steamship Company	70	32
Grand Trunk dock	30	15
Colman dock	50	19
East Waterway dock and warehouse	100	21
Todd dry docks	790	19
Denny Renton Clay & Coal Company	515	10
Seattle Brick & Tile Company	25	19
Seattle Oxygen Company	180	90
Air Reduction Company	125	50
Linde Air Products Company	225	74
Washington Burdette Oxygen Company	175	55

*Works three months of year.

TABLE II—CHARACTERISTICS OF PRINCIPAL HYDRO-ELECTRIC STATIONS OF PUGET SOUND POWER & LIGHT COMPANY.

Name and Location of Plant	Snoqualmie Falls		White River	Electron
Year completed	No. 1–1898	No. 2–1910	1911	1903
Rating	11,000	8,750	46,000	14,000
Average head, ft	225		440	865
Storage, acre-ft	350		56,000	88
Value of storage (kw.-days per acre-feet)	7.16*		13.6†	23.4*
Height of dam	20		Diversion dam only	Diversion dam only
Length of dam	217			
Water flow (sec.-ft.) max.	26,880		11,566	3,200
Water flow (sec.-ft.) min.	350		300	120
Water flow (sec.-ft.) average	3,000		2,450	600
Kw. per sec.-ft.‡	14.2		27	46.5
Yearly load factor, per cent	67.1		45.1	49.3
Ranks as regards operating cost:				
(a) Per kw. installed	1		3	2
(b) Per kw.-hr	1		3	2

*Storage for daily fluctuations in load only.
†As measured at intake of storage reservoir and used within 15 days. Evaporation and seepage in three months' time is 17 per cent.
‡Mean water level and at full-load efficiency.

The southern system is laid out so that the load centers are amply assured of reliable service from all or any of the three hydro-electric plants—Snoqualmie Falls, White River and Electron—more than one circuit running to each city. Seattle is particularly well provided with service facilities. For example, it may receive energy over two lines from Snoqualmie or White River and over another pair of circuits from the latter plant as well. White River in turn is reinforced by having Electron connected with its buses by two direct lines and one loop line to the east of White River, so that the two plants operate practically as one generating station. Additional flexibility in service is afforded by having a tie line between two of the transmission lines to Seattle. By this means if anything happens to either the load can be transferred to the other.

Not only is Seattle provided with four paths of energy and a local steam plant but these lines are so connected with substations that there is no likelihood of service being interrupted. One pair of transmission circuits goes to one receiving substation and the other pair to another receiving substation. Each circuit is kept isolated from its mate by sectionalized buses, which may be closed, however, in case of need. The remaining substations have two buses which are separately energized from the two main receiving stations but may be connected if necessary. Ordinarily

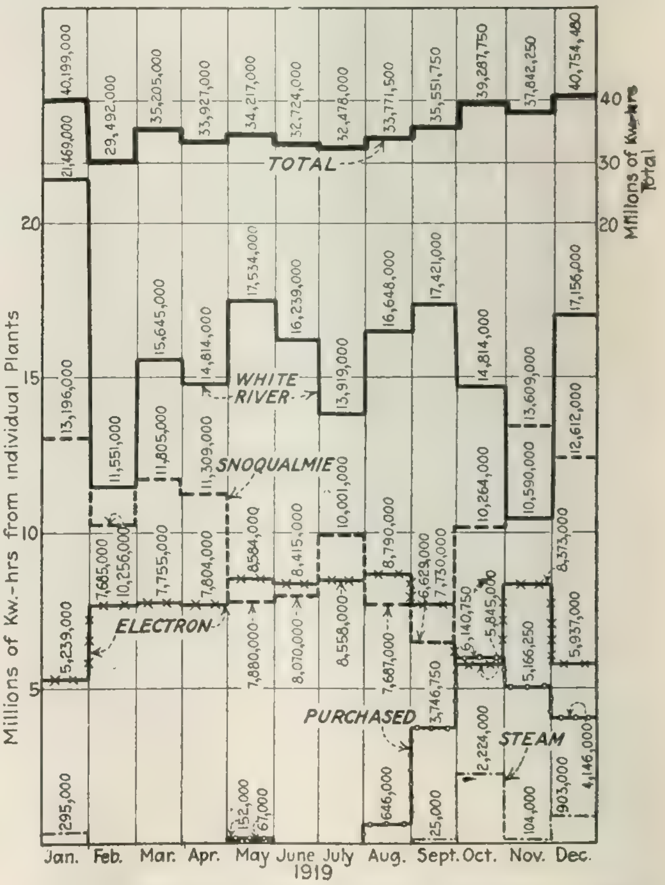


FIG. 2—DIVISION OF YEARLY OUTPUT BETWEEN PLANTS OF PUGET SOUND COMPANY

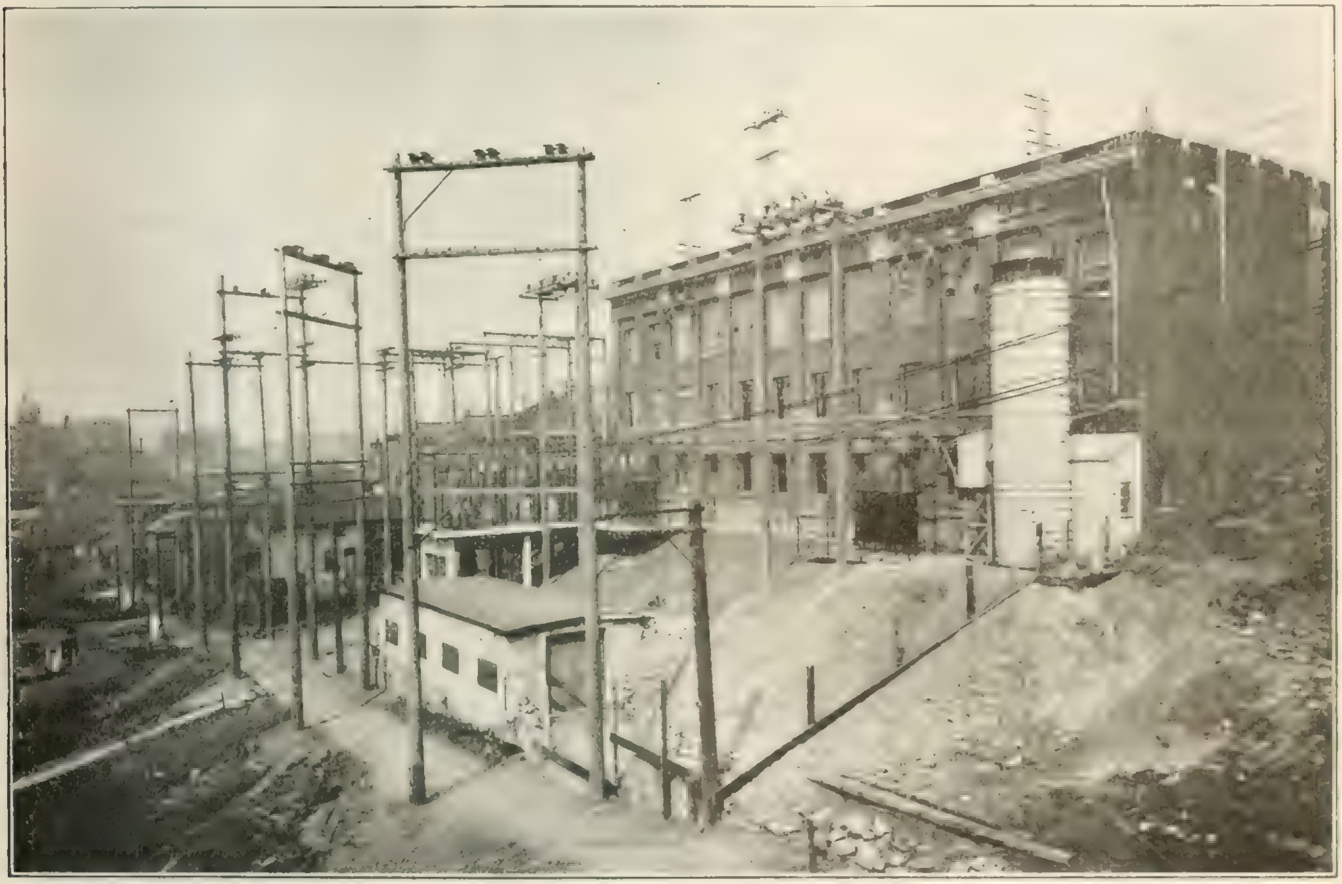
the high-tension feeders are kept isolated and the system is paralleled only on the low-tension side. Tie feeders are provided between all the substations and kept alive at one end to permit interconnecting when necessary.

Reliability of service is still further assured by relays. In the outgoing feeders at generating stations there are overload relays, and in all incoming feeders there are reverse-power relays. The overload relays in the lines from White River to Seattle are set for ten seconds definite time, while those in lines to Tacoma are set for three seconds. The overload relays at Electron are set for five seconds and those at Snoqualmie for eight seconds. Thus Seattle service will be the last to be interrupted, Electron letting go first, Snoqualmie second and White River, the largest plant, last.

Reliable service to both Tacoma and Everett is assured by duplicate transmission lines which are isolated at the receiving ends but arranged so either can energize any bus. The coal mines are served by a line running from Electron to Palmer which is tapped at Buckley by another transmission line from White River. A very effective line-inspection system has been in use for some time, and it also reduces the likelihood of interruption to service.

POSSIBLE INTERCONNECTIONS OF FUTURE

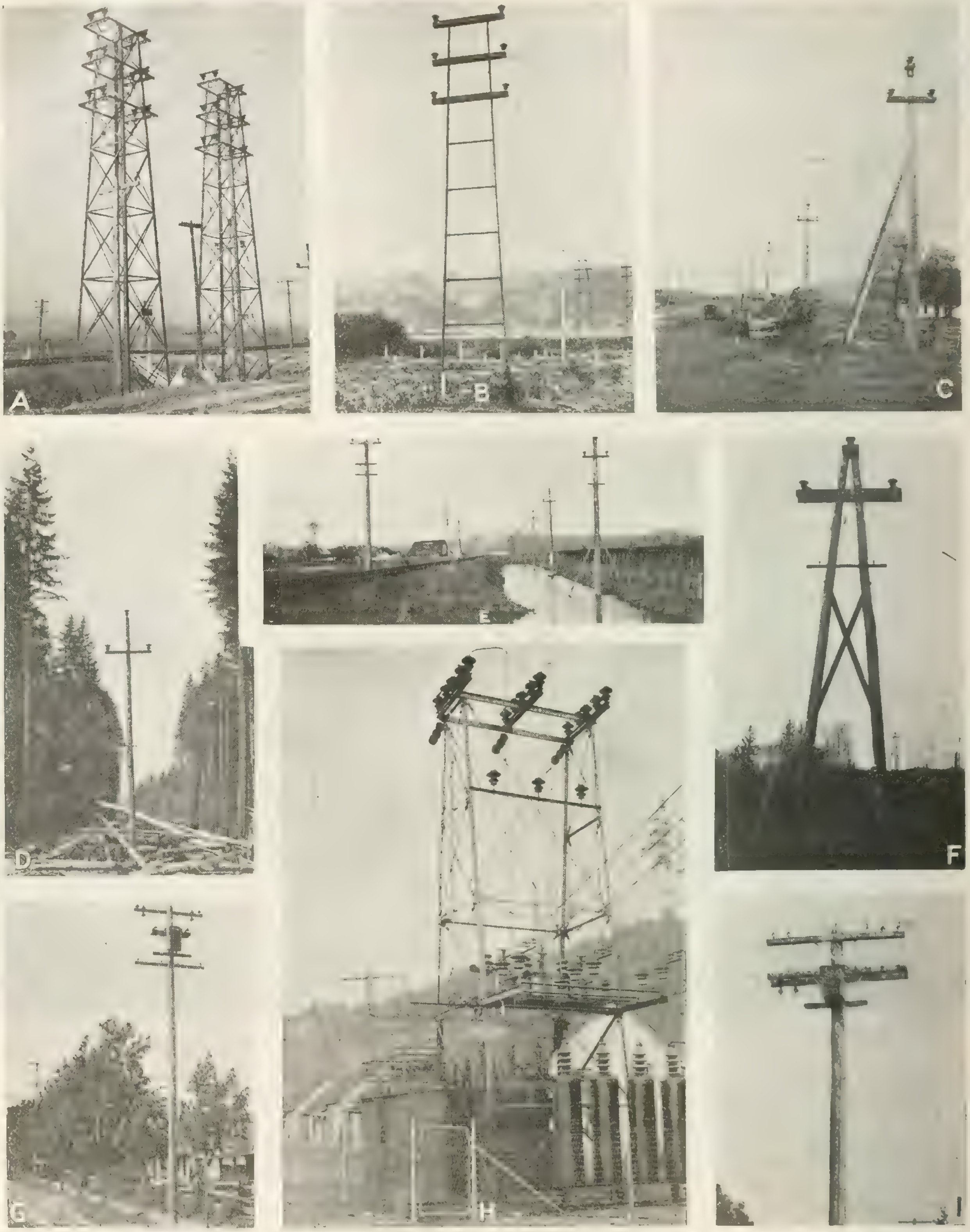
As can be seen from studying the maps, it will be possible to close some gaps and make loop circuits if enough benefits will be gained thereby. In some territories, especially in Seattle proper and between Everett and Mount Vernon, it is possible that as the 13,000-volt lines are extended they may tie together the northern and southern systems, although this capacity would not be sufficient to permit great exchanges of energy. A more effective tie would be afforded by running a 110,000-volt line between Mount Vernon in the northern system and Snoqualmie Falls in the southern system, but this will become feasible and economical only as the financial necessity which now faces all public utilities—the need of higher rates—is relieved and markets for energy are developed in the Bellingham districts great enough to make advantageous its connection with the southern district. Until then it is not likely that the water-power rights which the company now owns on the Baker River will be developed. This site has a possibility of 30,000 kw. to 45,000 kw. that may later be supplemented by another development of about 30,000 kw. Unless sufficient revenue can be earned to pay a more attractive return on the investment required, this development as well as others will doubtless have to wait. When the Baker River site is developed it will in all probability be connected with the 110,000-volt trunk line previously mentioned, the route now considered being indicated on the map. To the east of the Baker River site is the Skagit River development which is now under construction by the city of Seattle.



JEFFERSON SUBSTATION OF PUGET SOUND COMPANY, SHOWING INCOMING 55-KV. AND OUTGOING 13-KV. LINES

In the southern district to the east of the proposed trunk line, at Index, on the Skykomish River, is another water-power site that can develop 10,000 kw. to 20,000 kw. Natural head can be utilized and the plant could be connected with the 110,000-volt trunk line. Farther south, on the upper White River above Buckley, is still another water-power site which can develop about 60,000 kw. by running a penstock several miles upstream. This plant could be connected with the present White River plant.

Types of Transmission Line Construction Used by Puget Sound Company



A—Steel-tower lines at railroad crossing carrying four 55-kv. circuits from White River Station.

B—Flexible steel towers carrying White River lines.

C—Wood-pole lines from Electron to White River.

D—Line to Everett run through timbered tracts where excessive prices asked for cutting trees prohibited as wide right-of-way as would be desirable.

E—Two wood-pole 55-kv. lines along interurban line feeding Seattle.

F—Another 55-kv. line to Everett showing construction employed for 600 to 1,200-ft. spans in rough country and at river crossings.

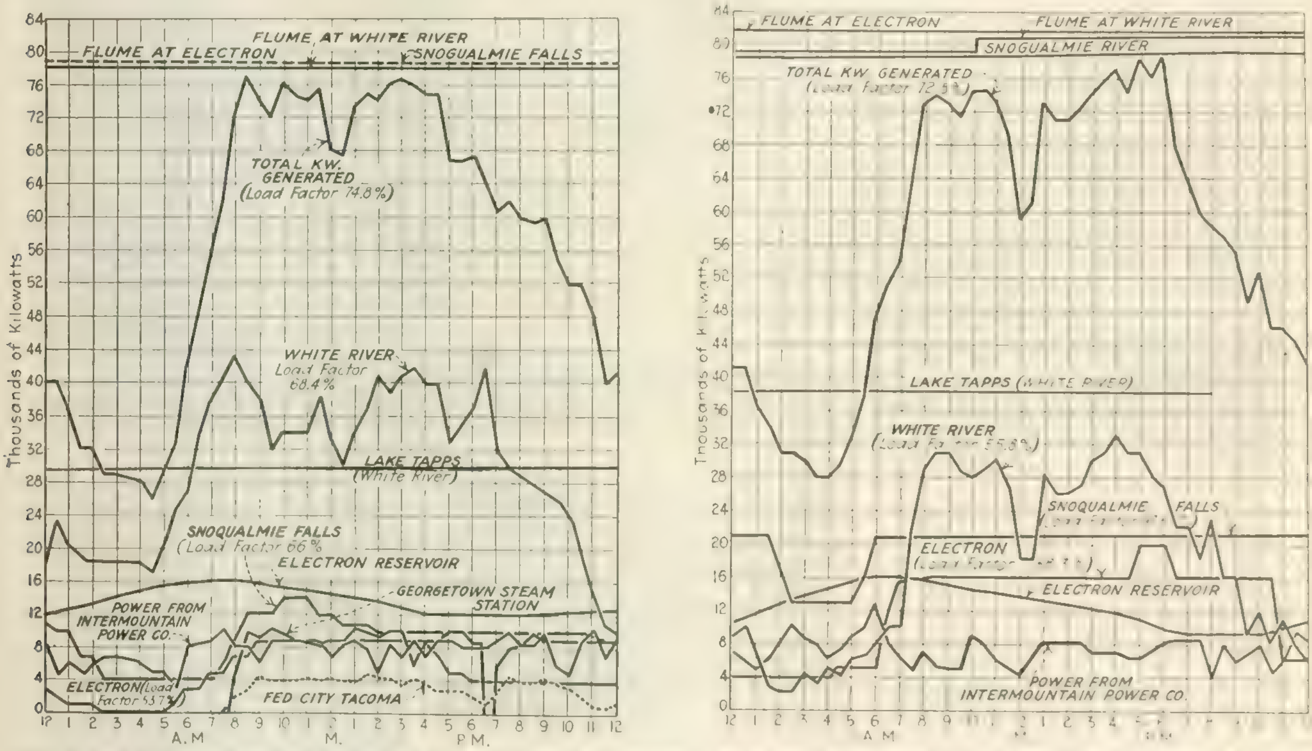
G—Single-phase 13,800-volt line on top crossarm feeds 13,800/230-115-volt transformer which is connected with three-wire crossarm below.

H—Steel tower substation serving coal mine. This substation is typical of those feeding the larger coal mines in western Washington.

I—A single-phase 6,600-volt line on the left side of crossarm feeds 6,600/230-115-volt transformer that is connected with three-wire secondary on right.

Just south of Olympia around Tenino is the northern terminal of a transmission line belonging to a company that connects with Vancouver. Vancouver in turn is connected with Portland, and from that system there is only a short gap to the lines of the Pacific Gas & Electric Company with its ramifications, interconnections and possible future connections. It is looking too far into the future, though, to think of the gaps mentioned being closed, because the benefits which would accrue would be negligible under present conditions, distances between generating centers being too great. Such interconnections could permit only small interchanges of energy, and the annual charges on lines large enough to permit large power interchanges would make the energy cost more than it could be purchased for locally.

Men on the Pacific Coast do believe, however, that it will be feasible some day to have a coastal trunk line into which all generating stations can feed and from which energy can be taken in bulk for distribution. The problems connected with this plan are not so much technical as financial, since a main question is how the charges for line usage, rates for energy, etc., can be equitably fixed.



FIGS. 3 AND 4—PUGET SOUND COMPANY PLANT LOADS FOR TYPICAL LOW AND HIGH FLOW DAYS (OCT. 10 AND NOV. 17, 1919)

HOW LOAD IS DIVIDED BETWEEN STATIONS

The operation of water-power plants with relation to each other is a problem that is handled differently in different territories, but stream-flow conditions exist in this country that may be interesting and the fundamental principles involved in operation can be applied anywhere. The three principal plants—Snoqualmie Falls, White River and Electron—take water from three streams quite different in characteristics.

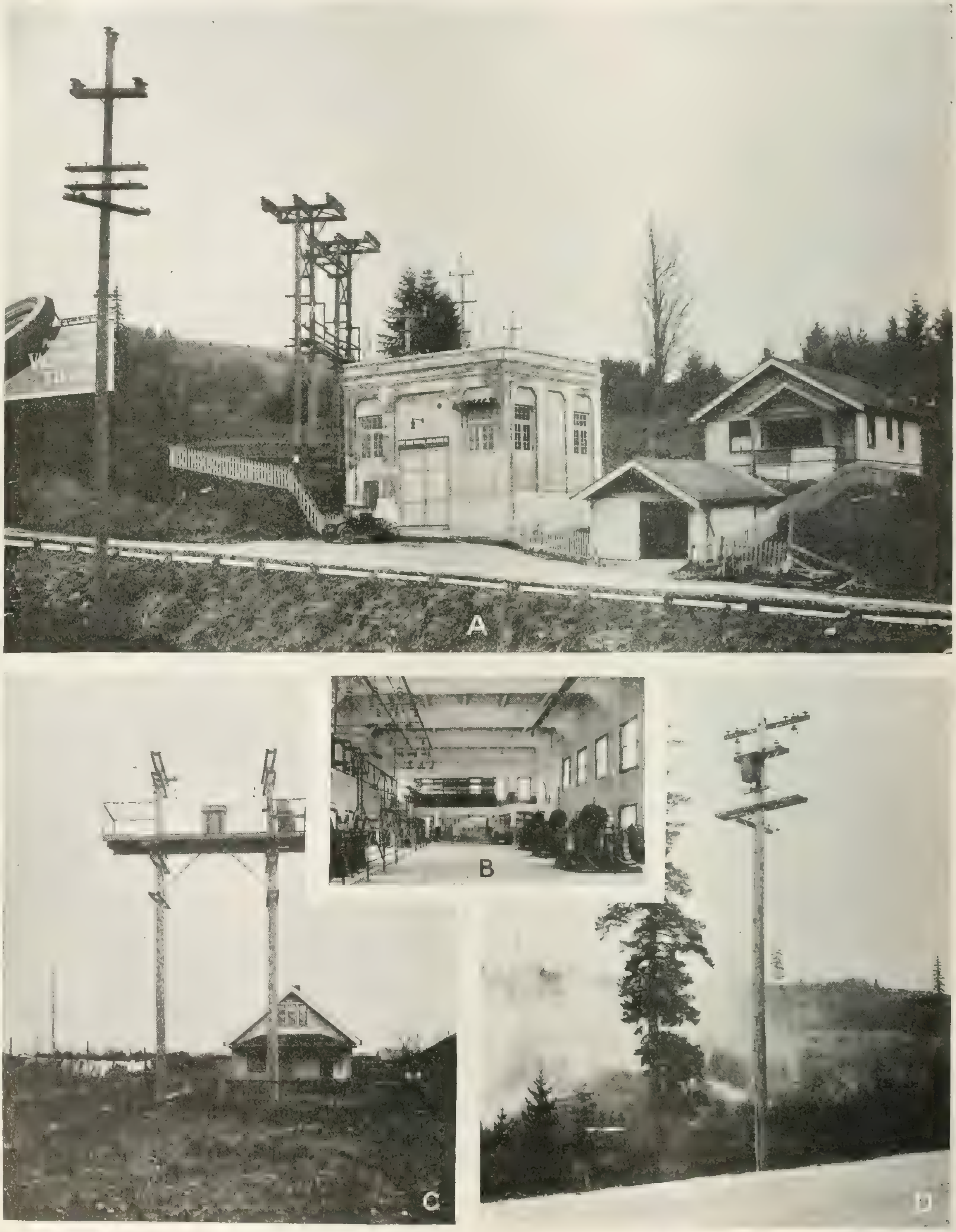
The Snoqualmie River, which feeds Snoqualmie Falls, is a clear-water stream which receives its water from melting snows and rains and none from melting glaciers. It has a very large drainage area covered with heavy timber that regulates the run-off to a great extent. The dry season ordinarily occurs during August, September and October, and the rains are heaviest in winter. On the other hand, Puyallup River, which feeds Electron, rises on the western side of Mount Rainier—14,526 ft. (4,420 m.) high—and receives its water principally from melting glaciers. Of course, it also receives some water from melting snow and rains. As a result the greatest amount of water is discharged through this river when the temperature on the slopes of Mount Rainier is high enough to melt the glaciers. The flow subsides when the glaciers quit melting, but by this time Snoqualmie River begins to benefit from rains.

White River tributaries rise on the north side of Mount Rainier, but at a lower level than Puyallup River. As a result White River has characteristics between those of Snoqualmie River and Puyallup River, receiving water from melting snow, rain and melting glaciers. The rains build up the flow during the winter when snow and glaciers are not melting. As spring progresses the snow melts, and when the warm summer weather occurs the glaciers melt. Thus, except for a short period, usually during October, the river flow is relatively high. The flow in each river is given for the year 1919 in Fig. 1.

To show how the plants utilize these stream characteristics to the best advantage, the division of total load between plants is given for the year 1919 (Fig. 2) and also for typical high-water and low-water days (Figs. 3 and 4). In studying these curves reference should be made to Table II, which gives the average heads, water flow and storage at each plant.

The storage at the White River plant is equivalent to 18,000,000 kw.-hr., while that at Snoqualmie and Electron is only 60,000 kw.-hr., just enough for daily fluctuations in load. For this reason White River storage is allowed to accumulate as much water as possible during the wet season, and Snoqualmie and Electron are used to carry their maximum loads. Of course,

Distribution Features in Rural Sections Fed by Puget Sound Power & Light Company



A—Bothell substation transforms 1,500 kva. from 55,000 volts to 13,800 volts, feeding small towns and rural sections within 15 miles radius; shows cottage and garage for district agent.

B—Main operating floor of Jefferson substation.

C—Pole-top 13,800/2,300-volt transformers and automatic voltage regulator. The structure is designed for three ultimate units of 100 kva.

D—13,800/130-volt transformation for scattered rural distribution.

TABLE III—VOLTAGE OF PRINCIPAL LINES OF PUGET SOUND POWER & LIGHT COMPANY, WITH SIZES OF CONDUCTORS

	Voltage	Size of Conductor
Nooksack (g)—Bellingham (g)	55	No. 2 copper equivalent
Western Canada Power Company—Bellingham (g)	55	No. 2 copper equivalent
Bellingham (g)—Mount Vernon via Burlington (j)	55	No. 1 copper equivalent
Burlington (j)—concrete	55	No. 1 copper equivalent
Mount Vernon—La Conner	13	
Mount Vernon—Stanwood	13	
Snoqualmie Nos. 1 and 2 (g)—Everett	55	No. 4 copper
Snoqualmie Nos. 1 and 2 (g)—Everett via McAleer Lake	55	No. 4 copper
Loop around Seattle	13	
Snoqualmie (g)—Renton (j)	55	Two 4/0 aluminum
Renton (j)—Seattle	55	Two 4/0 aluminum equiv.
Electron (j)—White River (g)	55	Two 4/0 copper
White R (g)—Renton (j)	55	Two 4/0 copper equiv.
White River (g)—Buckley (j)	55	No. 4 copper
Electron (g)—Buckley (j)	55	No. 4 copper
Buckley (j) to Palmer	55	
White River (g) to Tacoma Smelter and Olympia	55	2/0 aluminum No. 4 copper
White River (g) to Tacoma	55	2/0 aluminum
White River (g) to Seattle	55	Two 4/0 copper
Tap to Tacoma	55	Two No. 1 copper, No 1/0 copper
Tie between Renton Junction—White River—Seattle; White River-Renton	55	4/0 copper equivalent
Georgetown (g) connected with one of White River-Seattle lines	..	

(g) Indicates generating station; (j) indicates junction point.

as much of the water that cannot be stored as possible is used to generate power at White River during high-flow season because it is the largest plant. Electron can develop the most power per second-foot, however. During low water Snoqualmie and Electron are operated to utilize as much water as possible, White River is operated to carry a fairly uniform load, and the fluctuations in total load are carried by the steam plant at Georgetown. It is usually necessary to start drawing down White River storage (Lake Tapps) in the last part of August or the first part of September. If there are prospects of a prolonged dry season, less water is drawn off and the steam plant is operated at a heavier load. Fortunately, as pointed out before, the low-flow period in Puyallup River occurs later than in the other two rivers, so that the Electron plant can help to make up any deficiency in the dry season. Power from the Intermountain Power Company cannot be depended on for help during low water because of the fact that the Puget Sound Company receives only surplus power.

The division of load for typical low-flow and high-flow days is better shown by Figs. 3 and 4. On the dry day, it may be noted, Electron and Snoqualmie were loaded for as much as they would carry, the reservoirs being drawn down during the day and allowed to fill up at night. However, White River had to carry the base load and Georgetown steam station had to help. The situation was made more serious than usual by the fact that the Tacoma municipal plant required emergency service on this day. On the high-flow day Electron and Snoqualmie were able to carry larger loads and White River could be operated at less load to allow its reservoir to store water. The idle generator capacity at White River can be used to correct for power factor during the high-flow season.

TABLE IV—GENERAL STATISTICS REGARDING PUGET SOUND POWER & LIGHT COMPANY

	1919	1918
Generator rating	119,500	109,500
Maximum load	101,400	99,200
Average load	51,500	48,700
Energy generated (kw.-hr.)	447,576,000	423,092,000
*Load factor (yearly)	50.75	49.1
Average (monthly), per cent	63.6	63.8
Connected motor load	100.200	86,300
Loss in transmission, transformation and distribution	96,638,000	87,129,000
Consumption (kw.-hr.)	358,000,000	338,200,000
Miles of transmission	....	....
55,000 volts	566	566
13,000 volts	181	160

*Supplied power to Tacoma for short periods, thus increasing maximum demand and reducing load factor.

PROSPECTS OF FUTURE DEVELOPMENT

The prospects are that the central-station load in western Washington will become still more diversified because, as was pointed out before, Seattle handles an enormous amount of import and export trade which will either directly or indirectly affect electric service development. Besides, as manufacturers find that their markets in the Far West and in foreign places easily reached from the Pacific Coast ports justify locating factories in the Far West the territory around Seattle is quite certain to become an industrial center, its excellent ports and transcontinental railroad facilities and its delightful climate conducing to its being worked at a high efficiency the year round.

TRAIN ON THE CHICAGO, MILWAUKEE & ST. PAUL RAILWAY'S OTHELLO-TACOMA ELECTRIFIED DIVISION, FORMALLY OPENED FOR SERVICE MARCH 5, 1920.

Already large parts of the wool, cotton, silk, rubber and flax that are brought into Seattle are being converted into finished products in the city's mills, and more textile plants are likely to be established there because the humidity is almost ideal for textile manufacture. A great many automobiles are used on the Coast, and the demand for rubber tires has warranted their manufacture in the West. Automobile assembling plants with their electric japanning ovens are also being located there. Steel shipbuilding, which was stimulated by the war, is continuing.

Lumbering has always been a predominant industry in the Northwest, and as the supplies of timber elsewhere in the world become depleted, which is fast occurring, this industry will increase in importance. Timber will not become exhausted if proper protection from fire is given to second growth and if it is made financially possible to hold cut-over timber lands until the second growth is ready for cutting. While the logging industry has not been served extensively by central stations so far, because of the fact that "hogged" fuel can be used by logging companies to generate power more economically, the operation of lumber, shingle and lath mills is quite generally performed by electric service from central stations. Paper making, which is also dependent on a supply of wood for some grades, is an important and growing industry.

Much of the level land in western Washington is already used for dairy purposes, and as timber land is logged off more grazing space will be available for cattle. At present large milk-condensing and canning plants, which are electrically operated, are situated at Auburn, Kent, Stanwood, Mount Vernon, Ferndale, Lyndon and Everson. Since these have developed in the last six years, it can be imagined what the size of this industry will be in the next few years with the facilities for cattle grazing increased.

At left, Olympian Express, the first train to be propelled over Cascade Range under electric power. The division is served by the Puget Sound Power & Light Company and Washington Water Power Company through lines of the Intermountain Company.

At right, train being hauled across Rocky Mountain division of C., M. & St. P. R.R. by electric locomotive of a different type served by Montana Power Company. In center, one of the substations feeding the C., M. & St. P. R.R. electrification.

ELECTRIC LOCOMOTIVES ON TWO DIVISIONS OF C., M. & ST. P. R.R. OPERATED FROM CENTRAL-STATION TRANSMISSION LINES

COAL MINES USE CENTRAL-STATION ENERGY

In the northwestern section of the State are enormous deposits of limestone, clay, talc and magnetite. Portland cement is already made in large quantities near the Baker River site. Brick and tile are being manufactured by the aid of electricity, and some magnetite mines have been opened. When some means of economically making aluminum out of clay is developed there should be an attractive electrolytic load for the transmission company. Practically all of the coal mines in western Washington are electrically operated now. The operators have shut down their isolated plants because it was not unusual to have two or three breakdowns a week lasting as long as six hours each. Now they secure reliable, uninterrupted service from the Puget Sound company over lines which are fed from two plants.

Fish canning is an important industry, but the load is light and lasts only three months of the year. Flour mills are fast developing, and electricity is being used at ship terminals for unloading and loading vessels, transporting material in trucks and similar purposes.

ELECTRIFICATION OF RAILROADS

The contract to supply the Chicago, Milwaukee & St. Paul Railway with part of the energy for the Othello-Tacoma electrification constitutes quite a large load (10,000 kw. maximum demand). As more electric locomotives are placed in operation the energy required will increase. Several other railroads enter Seattle, and as these electrify their mountain divisions it is quite likely that they will have to call on the Puget Sound Power & Light Company for energy west of the Cascades, because it appears hardly wise to depend absolutely on transmission lines from the East over the high, windswept territory.

Information for this article was kindly contributed by engineers of the Puget Sound Power & Light Company, Seattle, of which A. W. Leonard is president, W. H. McGrath vice-president, G. E. Quinan chief engineer, John Harisberger general superintendent, S. C. Lindsay electrical engineer, M. T. Crawford superintendent of transmission and distribution, and H. J. Gille sales manager.

THE *cost of steam power is steadily increasing. Power can be developed at far less cost by water. Energy developed by hydraulic plants and converted into electricity can be distributed cheaply and over wide areas. Applications of electricity are multiplying. Demand for electricity, for industrial purposes through motors, for electrochemical use and for domestic convenience is growing with great rapidity. Beyond this, there is the unquestionable fact that trunk lines of railways are certain to depend in the not distant future on electric locomotives wherever energy can be obtained at a reasonable price.*—PRESIDENT DODGE *of the International Paper Company.*

Public Utility Financing

Plan for Basing Rates on Issues of Bonds and Stock—Need for Cash Reserve—Increases in Earnings Should Be Divided Between Company and Public—Financial Co-operation Among Utilities Urged

By EDWIN O. EDGERTON
President California Railroad Commission

THE biggest single problem before the public utilities today is financing; that is to say, obtaining money at reasonable rates sufficient adequately to meet the constantly growing demands of the public for service. Particularly as to the electric power companies the demands for money for development have become so great that, looked at from the standpoint of the consumer, if there are any unnecessary obstacles in the way of financing they should be swept away and every effort should be made to encourage investment in public utilities.

Unless our public utilities are expanded and developed industry and agriculture will be restricted. Practically all utilities are today in a condition where they must make the greatest proportionate development in their histories, else they will fall far short of meeting demands for service. Money is not coming freely to the utilities, and the reasons for this should be examined with an open mind to arrive at the truth in order that necessary steps shall be taken to remedy what may become a very bad condition. That the utilities can be put in a position to finance economically and in the real interest of consumers is my confident belief, and I will make certain definite suggestions in hope that they may lead to real and prompt results.

The result to be attained is that the investors shall have tangible and substantial assurance of the security of investment, continuity and certainty of earning, plus the possibility of increased earning through efficiency and economy of management, while the consumer shall have assurance of sufficiency of service through ample financing at a minimum of cost and further shall have a simple and understandable method of determining whether his own contribution is fair.

TWO CLASSES OF INVESTMENT

Money for investment may be divided broadly into two classes—speculative money and conservative money. Speculative money may be described as money invested on a basis of considerable chance being taken as to security; hence possible ultimate earnings must be very large to justify the taking of such chances. Conservative money may be described as money invested on a basis of practical certainty both of security and return on the investment. This results in the minimum of earnings being required.

Speculative money is not available for public utility investment because regulation and other causes prevent the possibility of large returns; that is to say, large as compared with private enterprises. To obtain conservative money in large amounts the investor therefore must have reasonable assurance that his dollar will remain intact and that it will while invested steadily yield the return expected.

Neither the public utility company nor the regulating body can give any absolute guarantee either as to security of investment or certainty of return, but with intelligent regulation and honest and competent management of the company, in my judgment, the investor in a public utility property can have greater assurance than in any other investment short of governmental guarantee or the purchase of governmental securities.

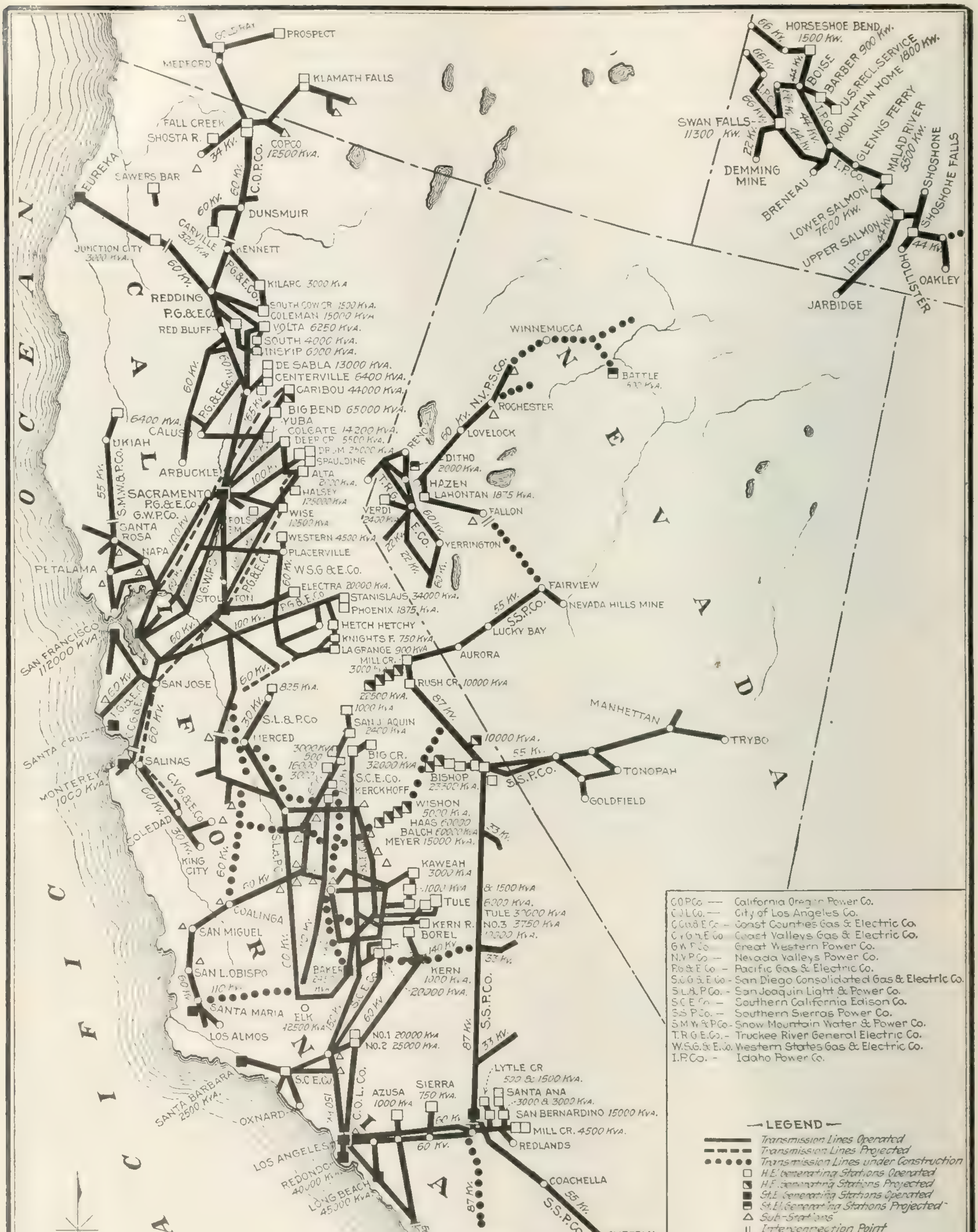
For reasons which appear perfectly logical the history of regulation shows a marked disinclination on the part of regulating authorities to recognize stocks or bonds as a basis for determining revenue or rate fixing. Before the advent of the state public utility commissions, which have control of the issuance of stocks and bonds, city councils and local authorities fixed rates but had no control of bonds or stocks. On the advent of the state regulating authorities it was found impossible at once to make over or revamp the outstanding capitalization of the utilities, and, being unwilling to assume any responsibility for the sometimes unduly large outstanding issues of securities, the regulating bodies immediately took a position of standing on physical valuation as a rate base and insisted at all times—and in a large measure they today insist—that the proper basis for considering the contribution the public must make for service is physical value of plant.

This has given rise to a constant discussion of physical valuation in rate proceedings and to the feeling on the part of investors that, notwithstanding the fact that the regulating body authorizes an issue of securities, nevertheless the purchaser must take such securities with a definite understanding that the regulating body assumes not even a moral obligation to provide dividends or bond interest. In other words, notwithstanding the substantial control of the revenues of the company by the regulating body, the investor is made to realize that it will on the one hand authorize issuance of securities dependent wholly for bond interest and dividends on revenues, while on the other hand it announces in advance that it will not recognize this capitalization as imposing upon it any necessity for adjusting rates in order to care for it.

BASING RATES ON REQUIRED DIVIDENDS AND INTEREST

My first suggestion is that utility commissions establish and recognize a sound issue of securities and thereafter fix rates based on the bond interest and dividend requirements of these securities. Consumers would clearly understand that rates must be such as will enable the company to pay dividends and bond interest regularly; the utility management would have at hand a ready means of measuring its revenue needs, and the investor would have every reasonable assurance that when he purchased securities the regulating authority would, in so far as the business made it practicable, authorize rates which would maintain his investment intact and produce a regular return.

This, it seems to me, would make rate fixing, as far as the total of revenue to be produced is concerned, almost automatic, and instead of the long-drawn-out



DISTANCE BETWEEN POINTS OF ENERGY GENERATION AND UTILIZATION IN CALIFORNIA HAVE CALLED FOR LONG, HIGH-VOLTAGE TRUNK LINES controversies which now occur in rate proceedings, wherein all the intricate and complicated questions of depreciation, various methods of valuation and so forth are discussed over and over again, we should have a comparatively simple problem. The total amount of revenue necessary to meet operating expenses, depreciation, bond interest and dividend requirements could readily be ascertained and rates adjusted accordingly.

It is my observation that it is very much in the public interest that money be obtained by our great public utilities at the lowest possible rates, and it follows for the reasons already given that the public is positively benefited the greater the assurance to the investor of security and return.

Benefit of a Cash Reserve

It would be humanly impossible to fix rates with such nicety as to keep net revenue at an exact figure. Experience has shown that conditions sometimes change suddenly, so that instead of attempting instantly to meet a change in net revenue by an adjustment of rates, thus constantly changing rates and creating a very unsatisfactory condition, it would be better to so provide that cash should be available to pay dividends and interest notwithstanding fluctuations in net revenue.

I therefore suggest that there be set up a cash reserve, probably under the control of the regulating commission, this reserve to be set aside out of rates in the periods when operating expenses are comparatively low and net earnings high and to be held for the purpose of insuring the payment of interest and dividends. The result would be that when operating expenses mounted it would not be necessary to increase rates unless the increased cost continued for long periods, because the reserve could be drawn upon safely to carry the company's fixed charges, and as operating expenses decreased the reserve would build up again, thus acting as a visible and effective storage reservoir of money to keep the stream of bond interest and dividends running.

Division of Increased Earnings

As it is in the interest of both the consumers and the company that service be produced at the minimum of cost consistent with good service, sufficient inducement should be given to the managements of public utilities to operate as economically and efficiently as possible. For this purpose I suggest that regulating bodies lay down the rule (sanctioned by statutory enactment in California) that increased net earnings caused by increased efficiency and economy of management over a predetermined standard be shared in fair proportion between the company and the public. This would answer the criticism of present regulation that it holds out no real incentive for initiative.

Of course, there are companies whose outstanding issues of stocks and bonds are such that no regulating body would recognize the sum in total or agree to fix rates that would at all times care for interest and dividends. Moreover, it must be recognized that in no event short of bankruptcy and sale on foreclosure can owners of stocks and bonds be compelled to surrender them. So I advocate that the suggestions heretofore made be embodied in a plan and that the companies be offered the option of adopting this plan, meeting all of its requirements and of course enjoying its benefits, or continuing in the old way. I believe the plan could legitimately be made sufficiently attractive to be a substantial inducement to the owners and creditors of an overcapitalized company to come in under its provisions and voluntarily reduce the par of their holding to obtain fewer but sound securities.

Can one not at this point say with confidence that the suggestions above made involve problems and interests common to all of the utilities, or at least common to each class of utilities? Yet, strangely enough, there has been an utter lack of conference, co-operation or joint thought or action among the utilities on the question of finance. In practically every other activity we find the companies in a given class contributing experience, study and frequently money, for the good of the industry as a whole, but when dealing with finance they draw apart from one another and maintain complete aloofness.

Need for Financial Co-operation Among Companies

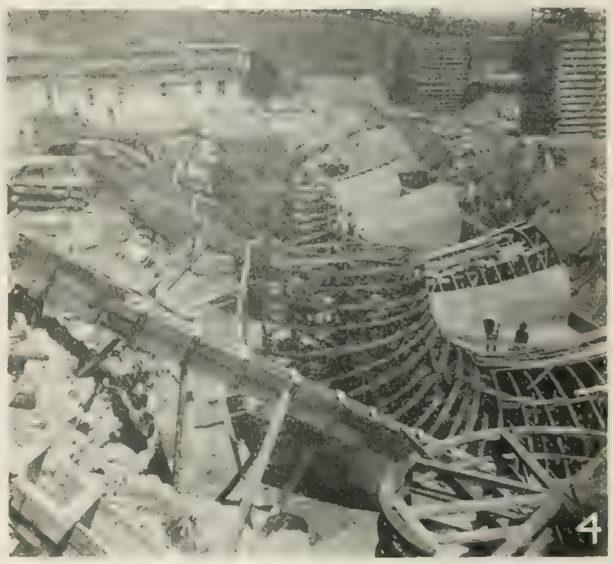
The approach of the utility to a regulating commission for consideration of its financial needs is usually unsatisfactory. The statement frequently will be made that more revenue is necessary in order that money shall be obtained for development, but when the utility's representatives are requested to substantiate this statement the showing is seldom adequate. The regulating body is usually told that which all will admit, to wit, that utilities cannot finance unless they have adequate revenues; but when it comes to a showing that the granting of added revenues will have certain definite results in the marketing of definite securities, the regulating body is usually left to rely upon the mere assertion of the utility's representatives.

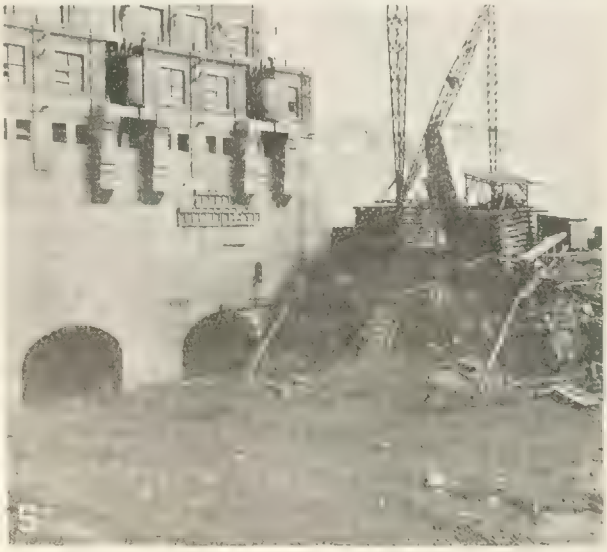
Surely such factors in the marketing of securities as the condition of the investing mind, the available money and the requirements to obtain money are capable of some assembling into reasonable and logical rules or principles. It would seem not impossible that by getting together in conference the financial representatives of the utilities could discuss the problem of raising large sums of money for the whole industry in a given state; that the existing financial condition of the various companies involved could be frankly discussed with a view to bringing those which were not sound up to a proper basis. Such matters as the proportion of outstanding bonds to total assets could be considered and some general rule agreed upon toward which all should work. The question of the time when issues of securities of any class should be brought out, in consideration of the ability of the market to absorb such securities, could also be reviewed. It seems reasonable to suppose that by conference and co-operation reasonable plans could be laid for the amounts and the times when each or all of the companies should make offerings to the public with mutual advantage.

I have in mind co-operation among the utilities, going even to the point where the financial experts of all could consider a given proposed issue by one of the companies and having perfected the proposal could then publicly indorse the issue as sound from the standpoint of all the utilities.

In considering public utility financing for the present and future, old methods must be discarded when they cause waste and loss, and all those who have an important part in these transactions must undertake the huge job ahead with the fixed determination that no obstacle of tradition or conservatism shall be allowed to interfere with the full sweep of a proper program.

Features of 90,000-Hp. Hydro-Electric Station on Wateree River





No. 1—Downstream view of Wateree dam and power station.

No. 2—Interior view of Wateree power station showing five 14,000-kva. generators.

No. 3—Power house substructure showing wheel chamber forms in course of construction

No. 4—Power house substructure showing draft tube forms in course of construction.

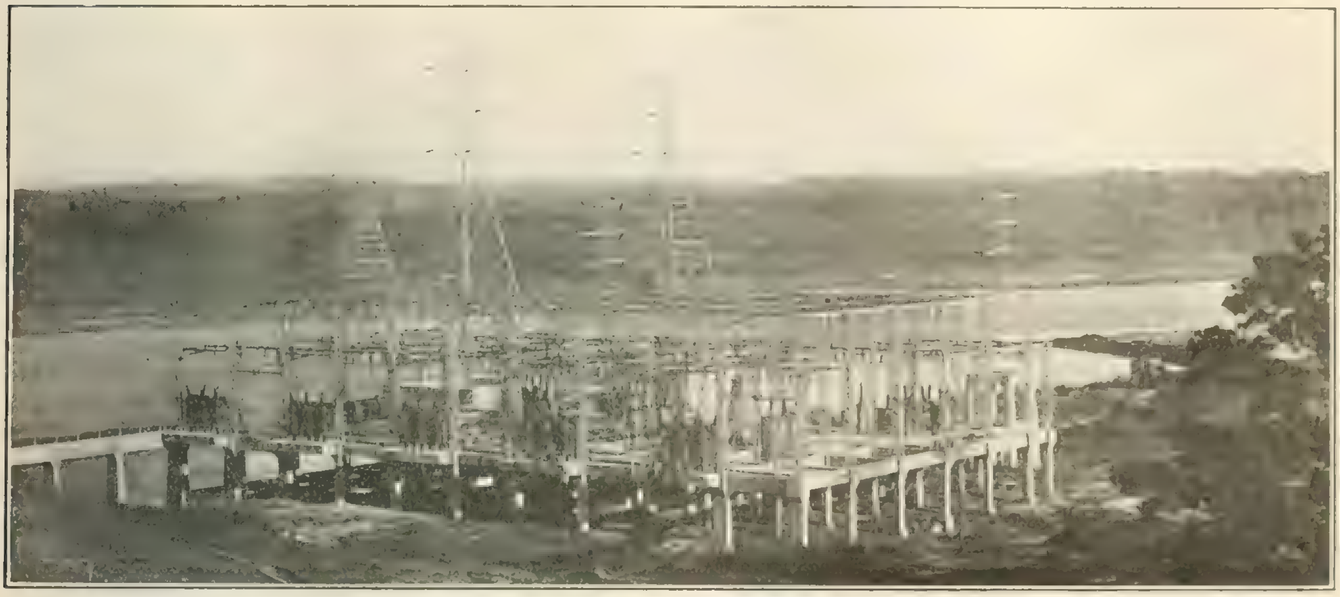
No. 5—View of east end of power house showing transformer platforms on downstream wall.

No. 6—View along upstream face of rack structure to turbines.

The Southern Power Company's Largest Station

On Wateree River Above Camden, S. C., the Southern Power Company Has Built a 90,000-Hp. Generating Station and Outdoor Switching Station—The Designs of Both Provide for Operation Under Extreme Conditions of Sudden Floods of Large Magnitude

By W. S. LEE[1] and RICHARD PFAEHLER[2]



OUTDOOR SWITCHING STATION SUPPORTED ON CONCRETE SUBSTRUCTURE SO THAT TRANSFORMERS ARE MOUNTED ABOVE HIGH-WATER LEVEL

THE LARGEST of the eight hydro-electric stations of the Southern Power Company, having a combined rating of 244,400 kva., is situated on the Wateree River, 8 miles (12.8 km.) above Camden, S. C. This stream, which is known as the Catawba River above the mouth of Wateree Creek, has a drainage area of 5,010 square miles (127,750 hectares) at the station. By the construction of a masonry spillway, masonry bulkhead and earth-fill extension on the west side of the river, a reservoir has been created which covers an area of 11,500 acres (4,600 hectares) when full. The Wateree plant was started on Oct. 7, 1919, and the first water was flowing over the spillway on Dec. 22, 1919.

It is generally known that the Catawba River is subject to sudden floods of large magnitude. The most severe high water of record occurred on July 18, 1916, when, according to the estimates, the Wateree River carried 425,000 cu.ft. (12,300 cu.m.) per second. At that time, which was four months before construction work was commenced, the river rose 35 ft. (10.6 m.) above the normal water level at the spillway site. Considering these extreme conditions, the power-house floor was built at elevation 189.0, which is 49 ft. (14.9 m.) above the mean tailwater level, and the bottom of the basement openings at elevation 179.3, or 2.3 ft. (0.7 m.) above the recorded extreme high-water level. The basement openings, large enough for the passage of the ventilating air for the generators, are provided with pivoted steel sash covered with wire-mesh glass.

The ogee spillway of 1,450 ft. (442 m.) length and 74 ft. (22.5 m.) average height across the river bed is of the gravity type and built of concrete masonry. It is designed for a height of water of 18 ft. (5.4 m.) above the crest line and for an uplift at the base, decreasing in a parabolic function from full hydrostatic pressure at the heel to zero at the toe. The effect of silt pressure due to sedimentation of the reservoir to 28 ft. (6 m.) below the spillway crest is also considered. The top of the power-house bulkhead is 30 ft. (9 m.) above the spillway crest level, and assuming that the high water should reach this height, it is estimated that the discharge over the spillway would exceed the record flood of July 18, 1916, by more than 100 per cent. Considering this extreme case, which is never likely to happen, the analysis shows that the factor of safety against sliding at the base of the spillway is still above unity, disregarding any backwater effect against the downstream face of the structure.

POWER-HOUSE CONSTRUCTION

The power-house substructure forming the downstream extension of the bulkhead is built of concrete masonry. It is strengthened by reinforcing steel around the five wheel chambers which are formed in the concrete, and in the design of the structure a high-water level is used which is 30 ft. (9 m.) above the spillway crest. The draft tubes are also formed in the concrete, and only the upper portion is lined with plate steel so as to prevent wearing of the concrete surfaces due to high velocities of the water when the turbines are operated at full load.

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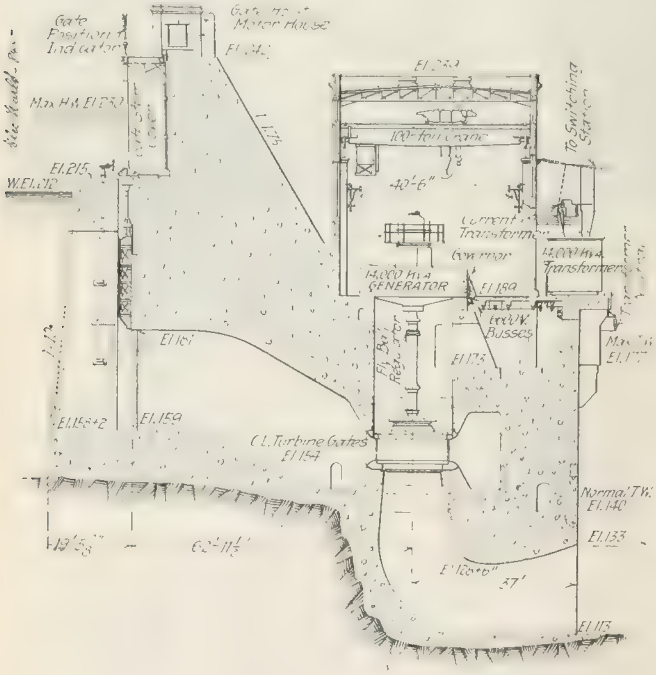
[1] Vice-president and chief engineer Southern Power Company.
[2] Hydraulic engineer.

Under extreme high-water conditions the resultant forces transmitted through the substructure will be very large, and a rich concrete mixture is therefore used around the draft tubes so as to keep the internal stresses within safe limits. The entire power-house bulkhead and substructure is built on excellent bedrock. The generator-floor system is built of reinforced concrete designed to carry a load of 800 lb. per sq.ft. (3,904 kg. per sq.m.) between the generators and of 650 lb. per sq.ft. (3,172 kg. per sq.m.) elsewhere.

TRANSFORMERS ON OUTSIDE WALL OF STATION

Following the usual practice of carrying the low-tension buses to the transformers in the high-tension switching yard, a considerable quantity of copper is required to cover the distance between the power house and the outdoor station. To cut down the length of low-tension wiring to a minimum in this large plant, the five three-phase transformers, of 14,000-kva. capacity each, are placed on reinforced-concrete platforms supported by pilasters, which are cast together with the downstream wall of the power-house substructure. Embedded in these platforms are the transformer rails, which extend into the interior of the power house. By means of sheave blocks and cable affording suitable connection of the transformer carriage with the 100-ton power-house crane each transformer may be rolled into the interior of the station for further handling. The weight of each transformer filled with oil is 107,500 lb. (48,375 kg.).



SECTIONS THROUGH BULKHEAD AND POWER HOUSE OF WATEREE STATION

The power-house superstructure is built of red brick which incases the structural steel frame supporting the roof trusses and the runways for the 100-ton electric crane. The windowsills and lintels are of concrete, and the roofing is a Barrett specification roof laid on cement tile.

Each turbine intake has one 12-ft. x 22-ft. (3.6-m. x 6.7-m.) and one 18-ft. x 22 ft. (5.4-m. x 6.7-m.) entrance opening, giving a wetted area of 660 sq.ft. (60.7 sq.m.). Since the bottom of each opening is 53 ft. (16.1 m.) below the spillway crest level, considerable water pressure will be exerted against the rack surface, assuming that the racks are entirely clogged up. To decrease the unsupported length of the horizontal steel beams to which the rack bars are attached, 18-in. (4.6-cm.) thick reinforced-concrete baffle piers are built between the masonry piers extending from the upstream face of the bulkhead. These baffle piers have a height of 45 ft. (13.7 m.) and are well anchored to the masonry base at the bottom and to the 12-ft. (3.6-m.) high masonry block on top. To prevent deformation, horizontal struts and relief trusses are used between the piers. The main object of the relief trusses is, however, to reduce the amount of shear reinforcement in the baffle piers. It will be noticed that the rack structure contains very little steel which will be exposed to the action of the air, and in addition, the baffle piers will tend to prevent the formation of eddies between the racks and the headgate openings.

VERTICAL SHAFT TURBINES

The five turbines installed in the power house are of the Francis vertical-shaft, single-runner, concrete-spiral-casing type, operating at a speed of 100 r.p.m. The range in head on these waterwheels is between 55 ft. and 75 ft. (16.7 m. and 22.8 m.), and within these limits the rating of each unit is as follows:

	Minimum	Normal	Rated	Maximum
Head in feet	55	63	68	75
Normal horsepower	11,700	14,200	15,800	18,000
Maximum horsepower	13,000	15,750	17,500	20,000

The individual governor system is interconnected, and the rotary oil pumps, pressure tanks and receiving tanks are installed in the power-house basement. Each governor is adjusted to close the turbine gates in three seconds, and the guaranteed speed regulations, based on a flywheel effect of 9,000,000 lb.-ft. (1,340,000 kg.-m.) squared and any head from 68 ft. to 75 ft. (20.7 m. to 22.8 m.) are:

For Sudden Load Changes (in Hp.) Of	Load Increase Speed Drop, in Per Cent	Load Decrease Speed Rise, in Per Cent
17,500	..	35
12,000	28	23
6,000	12	11
2,000	4	3.5
500	1	1

Five 6,600-volt, 60-cycle, three-phase vertical-shaft Allis-Chalmers generators are directly connected with their respective turbines. Each unit is designed for a normal output of 14,000 kva., and when operating continuously at the rated load and 80 per cent power factor the increase in temperature is guaranteed not to exceed 40 deg. C. in any part of the alternator. A Kingsbury thrust bearing is provided on top of each generator. The individual exciters placed above the thrust bearings have a normal rating of 140 kw. at 250 volts and 100 r.p.m.

A central automatic oiling, filtering and cooling system, capable of furnishing continuously 20 gal. (7.5 l.) of oil per minute for each generator, is installed in the plant.

The tailrace is 2,700 ft. (822 m.) long and is designed for a flow of water of 11,000 cu.ft. (308 cu.m.) per second. In this distance the river has a fall of 3.5 ft. (1.05 m.), and deducting an estimated loss of head of 0.8 ft. (0.24 m.) in the tailrace due to friction, a net gain in head of 2.7 ft. (0.81 m.) is obtained by extending the tailrace beyond the shoals immediately below the spillway. The outdoor switching station is connected with the power house by a reinforced-concrete footbridge, in which the conduits containing the electric control circuits for the high-tension oil circuit breakers are embedded. Along the river edge a low retaining wall going down to bedrock is built. The first row of columns supporting the reinforced-concrete deck is anchored into this retaining wall, and the bases for all the other columns rest upon disintegrated rock or clay foundations. The top of the reinforced-concrete slabs, upon which the electric switching apparatus is placed, is level with the generator floor. The structural steelwork built to carry the high-tension wiring and the disconnecting switches is galvanized throughout.

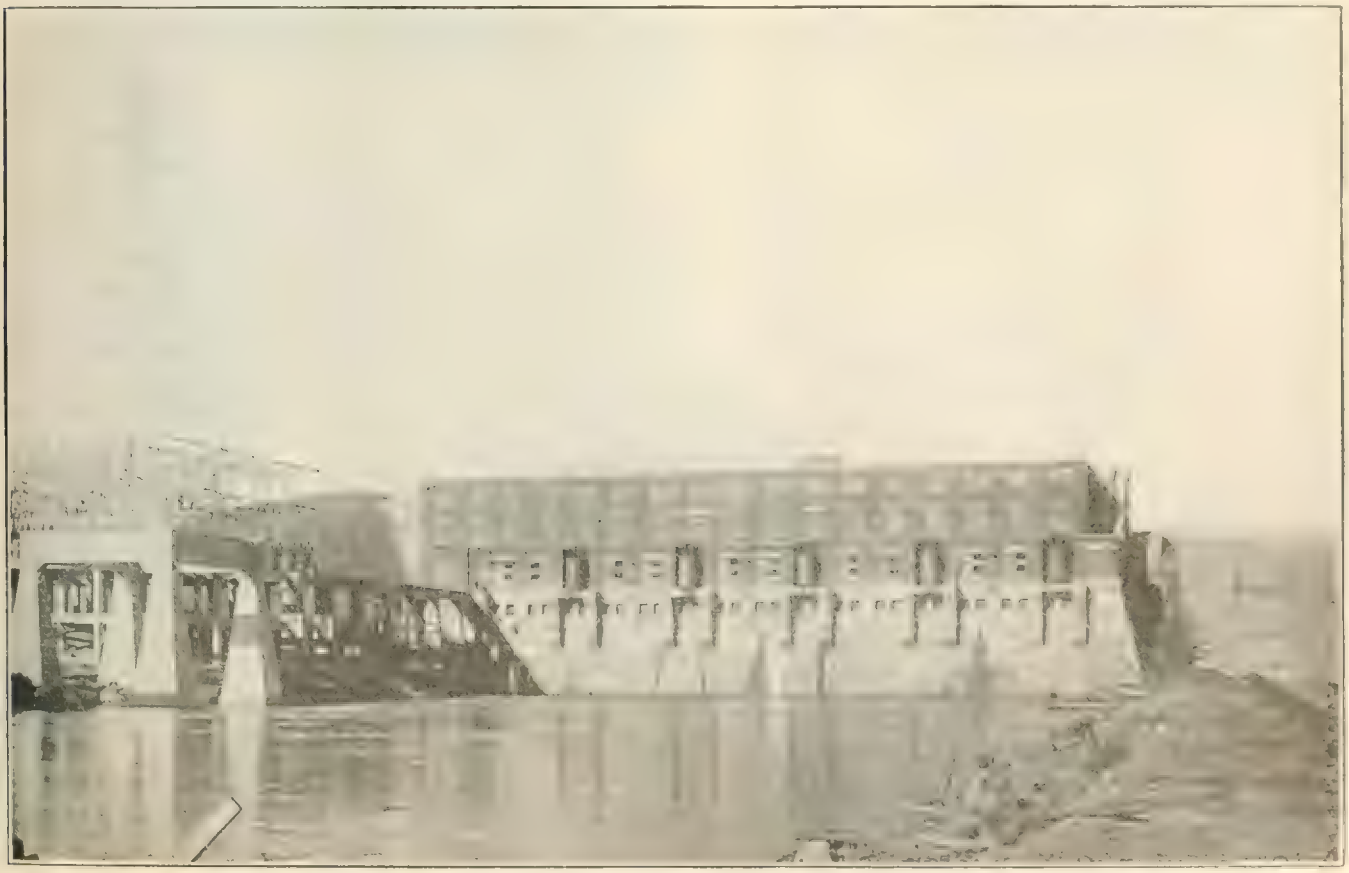
The high-tension lines crossing the Wateree River immediately below the spillway are carried by galvanized steel towers 123 ft. (37.4 m.) high, and on the west side, next to the outdoor switching station, the concrete bases supporting the towers have an average height of 42 ft. (12.8 m.) above the original ground line. The clear span between a pair of river crossing towers is 1,750 ft. (533 m.). The details of the complete Bridgewater project and the Wateree development were executed under the direction of W. S. Lee, vice-president and chief engineer of the Southern Power Company. On the Bridgewater work Albert S. Crane of the J. G. White Engineering Corporation was retained as consulting engineer in connection with the design and construction of the earth dams and masonry structures. F. H. Cothran was the resident engineer. On the Wateree work C. O. Lenz of New York City was retained as consulting engineer. C. I. Burkholder, general manager of the Southern Power Company, laid out the electrical features, and A. C. Lee was the resident engineer.

Supplements to This Issue of the "Electrical World"

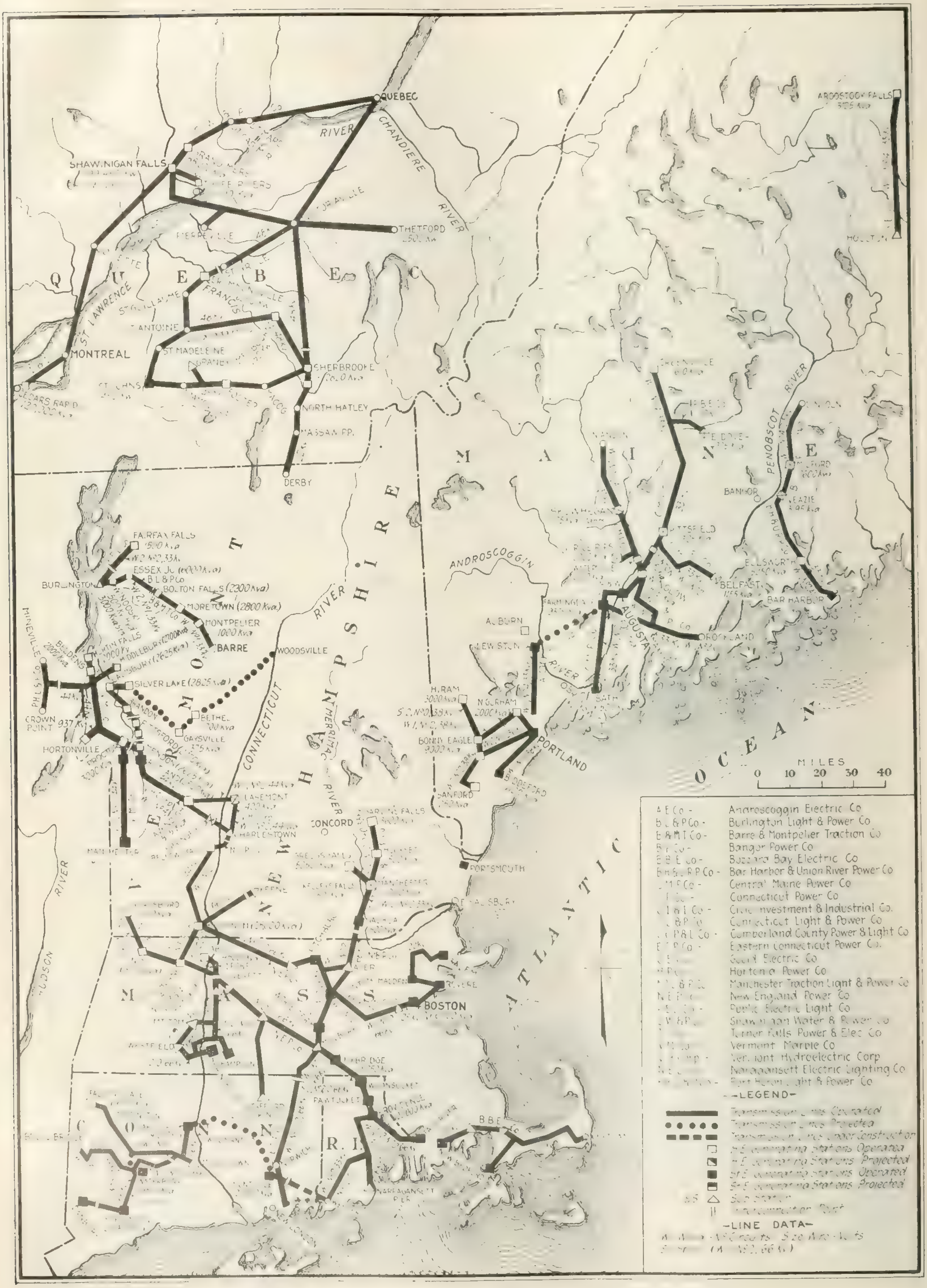
ACCOMPANYING this issue of the ELECTRICAL WORLD are two insert supplements, one a map of the transmission lines of the Western States and the other a chart giving the characteristics of generating, substation and transmission-line equipment of central-station companies operating at 44,000 volts and above.

The map supplements the information which is presented in the articles describing the operating and engineering features of the transmission systems in Montana, Washington and Oregon elsewhere in this number. In order clearly to indicate the trunk lines of the transmission systems of the Western States, they have been printed in colors to show their respective voltage ranges according to the following scheme: Blue, lines under 50,000 volts; green, lines of 50,000 volts to 99,000 volts inclusive; red, lines of 100,000 volts and over. page 1008a.

The chart supplements the section transmission maps and will be found useful as a guide to the design and construction of transmission lines in different parts of the United States operated at different voltages. It covers turbines, generators, step-up and step-down transformers, construction and operating features of transmission lines, and lightning protection, and brings up to date information contained in a chart formerly published in the ELECTRICAL WORLD.



DOWNSTREAM VIEW OF 90,000-HP. WATEREE STATION OF SOUTHERN POWER COMPANY



TRUNK LINES THAT LINK UP THE POWER RESOURCES OF NEW ENGLAND

Interconnection in New England

Movement Shows Steady Development During the Past Five Years, with Resulting Economic and Operating Advantages and Conservation of Fuel, Material and Capital

Interconnected Lines Between Five of the Six States

IN NEW ENGLAND the importance of fuel saving came to the front even before the United States entered the world war. The success of interconnections between adjoining systems of electrical supply led to a comprehensive development which is still in process and which will undoubtedly remain a permanent feature of public utility operation. The benefits of this policy are so great in peace that there is small chance of a reversion to the old days of electrical insularity.

As the accompanying map of the New England transmission systems shows, all states with the exception of Maine are now interconnected. Even in the Pine Tree State local systems are beginning to establish intertransmission lines. The exportation of energy from Maine is at present prohibited, but as time passes it is to be expected that public sentiment will change and permit the exportation of surplus hydro-electric energy at least. The benefits of interconnection elsewhere in New England are so great that it is unlikely that Maine will long be contented to suffer the economic disadvantages of the existing restrictive policy.

There are now so many interconnections in New England that space allows mention of only a few of the later arrangements for interchange of energy and some of the prospects of the immediate future. Last January service was inaugurated over the Boston Edison-New England Power transmission tie line, which interconnects the largest central-station company in New England with the largest hydro-electric power distributer, putting points remote in Vermont, southern New Hampshire, Connecticut and western Massachusetts in electrical touch with the largest tidewater steam plant in these states, and indirectly connecting the Providence and Fall River companies with Boston. This interconnection has been utilized to great advantage in assisting the New England company to handle its day load, while at night hydro-electric energy has been delivered to the Boston company to supplement the existing facilities of the latter and to save fuel.

The recent extension of the New England Power Company's transmission system into Nashua, N. H., and the previous interconnection of the Nashua central-station system with that of the Manchester Traction, Light & Power Company have brought about a tying together of plants in the Merrimack, Deerfield and Connecticut River valleys. The Montville steam plant of the Eastern Connecticut Power Company has lately been interconnected with the New England system through a new line to Millbury, Mass., the operating headquarters of the latter. The new Stevenson hydro-electric plant of the Connecticut Light & Power Company has been tied into the mid-state systems of the latter and of the Hartford Electric Light Company and the Connecticut Power Company. The Fall River Electric Light Company, in Massachusetts, is connected by a recently completed transmission line with the Narragansett Electric Lighting Company's steam plant at Providence, R. I., and through the Rhode Island Power Transmission Company and affiliated New England Power system with the Turners Falls Power & Electric Company's system. Through an outdoor switching station at Leverett, near Amherst, Mass., the New England and Turners Falls systems are interconnected, and this makes it convenient for the Turners Falls Company to deliver energy into the New England system at Leverett, the Fall River company taking energy from the New England and Providence lines in its own district and purchasing from the Turners Falls company through the above interconnections. The central stations at Worcester, Springfield and other central New England points continue to work effectively with the New England and Turners Falls companies respectively, on the interconnection basis.

In Vermont the development of the Vermont Hydro-Electric Corporation's system through interconnection and consolidation of various properties in the southern part of the State and in western New Hampshire is a recent instance of progress. Through this system, which maintains headquarters at Rutland, interconnection is maintained with the Hortonia Power Company and the Vermont Marble Company's hydro-electric plants in the Green Mountain district. Farther north the Burlington Light & Power Company is interconnected with the Barre & Montpelier Traction Company, and a recent tie-in has been effected with the plant of the Public Electric Light Company at Fairfax Falls.

There are many important interconnections operating in New England over lines carrying energy at below 33,000 volts, the approximate minimum shown on the accompanying map. The noted Salem-Malden-Revere line is now interconnected with the Boston Edison system, and a fair degree of electrical continuity exists in western Vermont. The general tendency is toward the establishment of interchange relations along lines of substantial energy-carrying capacity. Present practice avoids mere frontier contacts of systems which can be co-ordinated to advantage.

IMPORTANT INTERCONNECTIONS PLANNED

In the near future an important interconnection will be built from the Hartford-Connecticut Power territory southeastward to tie in the Eastern Connecticut Power Company and its connected New England Power lines with western and central Connecticut. A line is under construction from Mystic, Conn., to the Montville station, and when this is completed the Narragansett plant at Providence, R. I., will be interconnected with the central and western Connecticut systems, and Boston as well. In Maine the construction of a transmission line between the Central Maine Power Company's system at Gardiner and the Androscoggin Electric Company's plants in the Lewiston-Auburn district will accomplish important operating improvements. It seems reasonable to expect in due time complete interconnection from Bangor, Me., through the Central Maine system and Androscoggin system to that of the Cumberland County Power & Light Company at Portland. The removal of power export prohibition in Maine would clear the way for electrical continuity from northeastern to southwestern New England. In the near future it is planned to connect the western and eastern groups of lines operated by the Hortonia Power Company, in central Vermont. The Boston Edison system is now working southward to Quincy and beyond.

Interconnection with industrial plants has developed gradually in New England during the past decade. Many of the customers of the New England Power Company are equipped to deliver energy reciprocally to the hydro-electric system's lines, and a notable connection exists between the Cumberland County Power & Light Company of Portland, Me., and the system of the S. J. Warren Company. In the latter case the supply of energy to the central-station company by the Warren interests is largely by courtesy, but at times of service interruption and low water on the Cumberland system it has been most helpful.

Many further opportunities exist in New England for the development of interconnections. Aside from the Maine companies, several systems serving southwest Connecticut from tidewater steam plants on Long Island Sound have yet to cultivate interconnection to mutual advantage, and in northern New Hampshire a good deal remains to be done. The achievements already attained form in many cases a satisfactory groundwork for the larger trunk-line plans advocated nationally. The rapid growth of interconnection in Massachusetts is shown in an accompanying curve, which sets forth the total interchange of energy from year to year by Massachusetts central stations from 1913 to 1919, inclusive.

INTERCONNECTION CONSERVING FUEL IN MASSACHUSETTS

Interconnection between the electric supply systems of Massachusetts is silently effecting fuel economies little appreciated by the general public. The existing high prices of coal, the probability of their continuance for some time and the economic importance of saving fuel for the country overemphasize the value of intercompany lines as never before in times of peace. On three representative interconnected groups of electrical supply in the Bay State it is safe to say that at least 1,250 tons of coal per month are being saved in this way, representing on a conservative basis a saving of not far from $300 per day. Taking the State as a whole and bearing in mind that at present hydro-electric plants are running with wide-open gates, it may be estimated that the electrical utilities are saving at least 250 tons of coal a day as a result of the interconnection policy, and perhaps much more. It would not be unreasonable to assume that $750,000 worth of coal is now being saved annually by Massachusetts interconnections, and the direct bearing this has upon the holding down of rates from radical advances is evident.

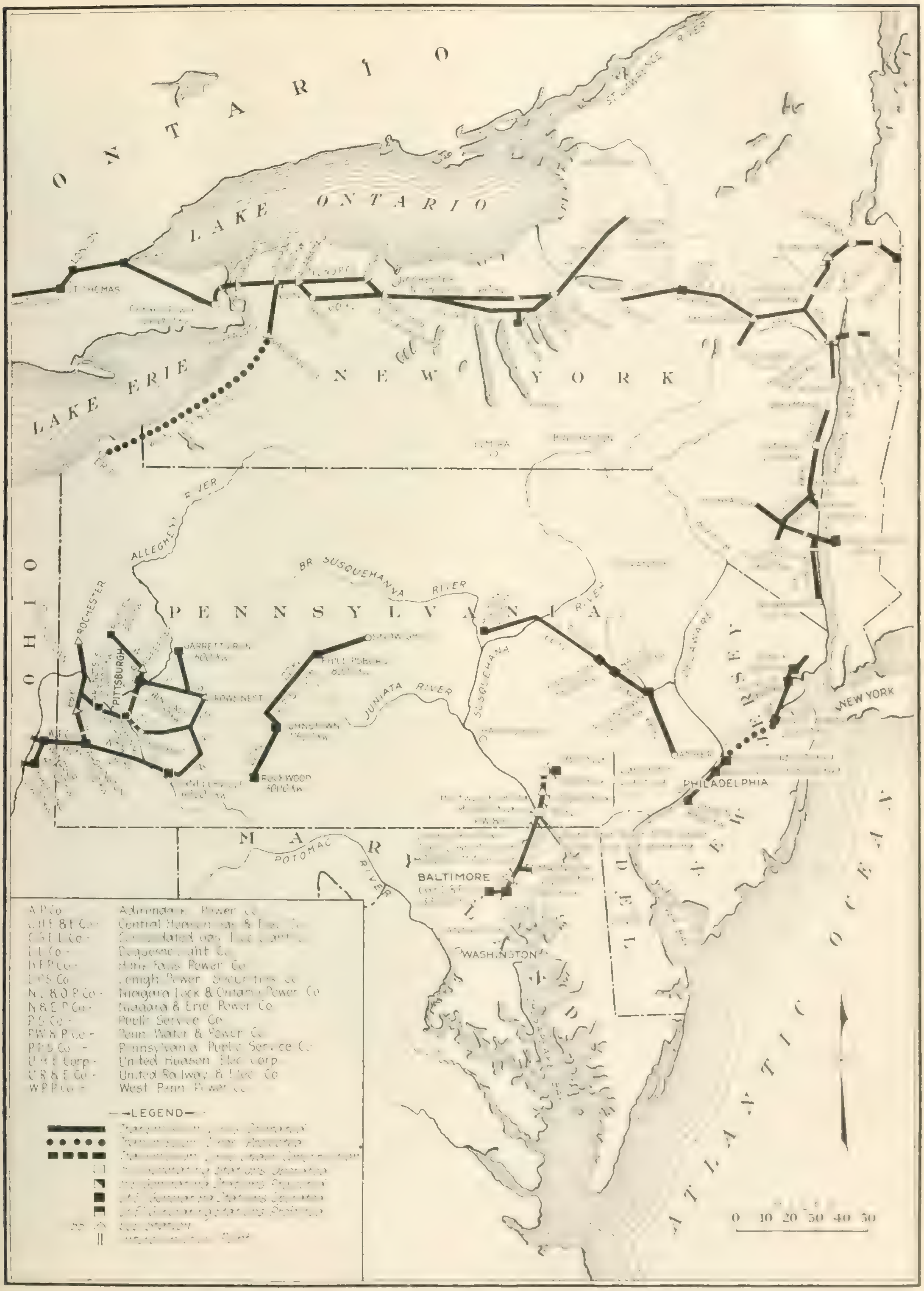
In the ELECTRICAL WORLD of May 17, 1919, page 1014, data were presented upon the interchange of energy among various Massachusetts stations, and it was estimated that in 1917 and 1918 the Salem-Malden-Revere tie line had saved the connected companies at least 8,550 tons of coal. In 1919 this line was operated even more advantageously. During the fiscal year the Salem company delivered 17,454,000 kw.-hr. to the Eastern Massachusetts Electric Company, owner and operator of the line, and purchased no energy therefrom. The energy was produced at the Salem tidewater station with a differential of at least 1.5 lb. (0.67 kg.) per kilowatt-hour in favor of Salem. The Malden and Revere companies purchased 15,853,193 kw.-hr. from the Eastern Massachusetts company, the Revere station not being operated during the year and the Malden station being run to produce but 4,052,100 kw.-hr.

This output at Malden required about 3.8 lb. (1.7 kg.) of coal per kilowatt-hour, while the Salem plant produced at 1.92 lb. (0.86 kg.). The energy purchased at Malden and Revere therefore represents a saving of about 10,600 tons for 1919 alone, making a total estimated saving of about 20,000 tons by this line in the

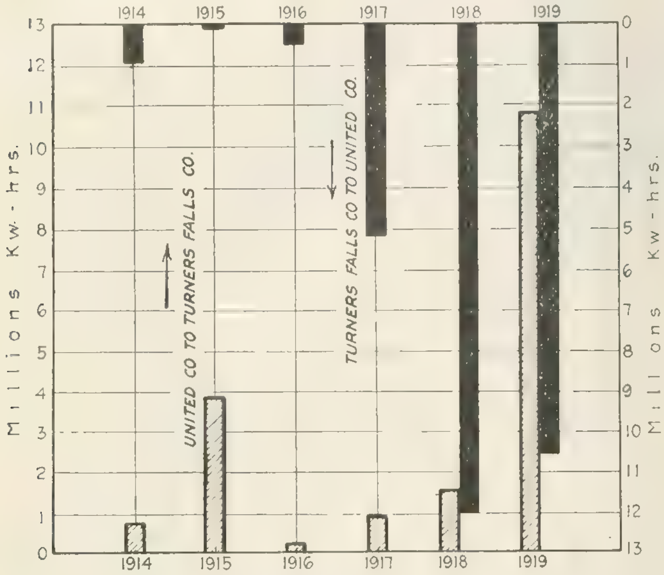
DETAILS OF TRUNK LINE SYSTEMS OF NEW ENGLAND AND EASTERN SEABOARD STATES

Companies	Territory Served	Service Wholesale or Distributed	Miles High-Tension Line and Voltage Mi.	Kv.	No.	Poles	High Tension Substations No.	Rating, Kva.
Androscoggin Electric Company	S. Me.	D	21	33	4	Wood	3	900
Bangor Railway & Elec. Inst'sts	E. Me.	D	66 25	33 50	4 3	Wood	9	16,725
Barre & Montpelier Traction Company	N. Vt.	D	22	33	1	Wood	2	3,750
Boston Edison Company	E. Mass.	DW	20	66	0		1	15,000
Burlington Light & Power Company	N. W. Vt.	D	36	33	1	Wood	1	3,000
Central Maine Power Company	Cent. Mass.	D	322	33	2	Wood	25	17,133
Connecticut Light and Power Company	S. W. Ct.	D	14	66		Wood Steel	4	42,875
Connecticut Power Company	W. Cent. Ct.	DW	70	66	1	Wood Steel	5	28,000
Cumberland County Power & Light Company	S. W. Me.	D	105	38	2	Wood	6	32,200
Eastern Connecticut Power Company	E. Ct.	DW	47	66	2 0	Wood		
Gould Electric Company	N. E. Me.	D	45	33	4	Wood	6	2,500
Hortonia Power Company	Cent. Vt.	DW	50	44	4	Wood		
Manchester Traction Light & Power Company	S. N. H.	D	40	33	2	Wood	6	24,340
Narragansett Electric Lighting Company	S. Ct. & P. I.	DW	83	33	0	Wood	8	8,375
New England Power Company	Cent. New Eng.	W	30 243	44 66	2 2 0	Wood Steel	16	154,200
Public Electric Light Company	N. Vt.	D	19	33	2	Wood		
Turner Falls Power Company	W. Cent. Mass.	W	100	66	0	Steel	5	139,550
Vermont Hydroelectric Corporation	S. Cent. Vt.	D	70	44	2,4	Wood	5	10,000
Vermont Marble Company	W. Cent. Vt.	D	70	44	3		7	4,725
Adirondack Electric Power Corporation	E. N. Y.	DW	33 60	3,0 1.0		Steel	17	50,000
Duquesne Light Company	W. Pa. Pittsburgh	D		66		Wood Steel	160	210,000*
Niagara, Lockport & Ontario Power Company	N. N. Y.	W		33 60	Misc.‡ Misc.	Steel	5	39,000
Pennsylvania Water & Power Company	S. E. Pa.	W	80 80	70 70	150,000 Cu† 300,000 Al	Wood	2	92,500
Public Service Electric Company	N. J.	DW	925 925	26.4 13.2	500,000 Al 350,000 Cu	Wood Steel	93	226,803*
Southern Canada Power Company	S. Ontario	DW	236			Wood Steel	21	13,800
West Penn Power Company	W. Pa.	DW	805 26	 132		Steel	131	184,270*

*Includes all substations. †Cu, copper. Al, Aluminum. ‡Misc., miscellaneous sizes.


ONTARIO
LAKE ONTARIO
LAKE ERIE
ST. LAWRENCE RIVER
ST. THOMAS
NEW YORK
PENNSYLVANIA
OHIO
MARYLAND
NEW JERSEY
DEL.
ATLANTIC OCEAN
ALLEGHENY RIVER
BR. SUSQUEHANNA RIVER
SUSQUEHANNA
JUNIATA RIVER
DELAWARE
POTOMAC RIVER
ROCHESTER
PITTSBURGH
JOHNSTOWN
ROCKWOOD
BALTIMORE
WASHINGTON
PHILADELPHIA
NEW YORK
A.P.Co. - Adirondack Power Co.
C.H.E.& E.Co. - Central Hudson Gas & Elec. Co.
C.G.E.L.Co. - Consolidated Gas, Elec. Light
D.L.Co. - Duquesne Light Co.
H.F.P.Co. - Hone Falls Power Co.
L.P.S.Co. - Lehigh Power Securities Co.
N.L.& O.P.Co. - Niagara Lock & Ontario Power Co.
N.& E.P.Co. - Niagara & Erie Power Co.
P.S.Co. - Public Service Co.
P.W.& P.Co. - Penn Water & Power Co.
P.P.S.Co. - Pennsylvania Public Service Co.
U.H.E.Corp. - United Hudson Elec. Corp.
U.R.& E.Co. - United Railway & Elec. Co.
W.P.P.Co. - West Penn Power Co.
LEGEND
0 10 20 30 40 50

TRANSMISSION SYSTEMS WHICH SERVE LARGE EASTERN SEABOARD INDUSTRIAL CENTERS last three years. This interconnection cost about $550,000 and will probably pay for itself within five years if not sooner. It functions as an interconnection between steam plants of different economy, and as yet derives merely nominal benefit from the interconnection between the New England Power and Boston Edison systems, through which the largest central-station steam plant and the largest hydro-electric system in the New England States are being co-ordinated. The Boston Edison system is connected with the Revere system, but thus far only a small amount of energy has been transmitted over the line in comparison with the service received from the Salem station. During the recent coal shortage at Salem this interconnection proved of much value.



INTERCHANGE OF ENERGY BETWEEN UNITED ELECTRIC LIGHT COMPANY AND TURNERS FALLS POWER & ELECTRIC COMPANY

An interconnection of no small worth exists between the United Electric Light Company, Springfield, Mass., and the Turners Falls Power & Electric Company. The former operates a mixed steam and hydro-electric system in which the steam-plant service predominates, and the latter operates a hydro-electric system with a recently completed steam auxiliary. In the six years ended June 30, 1919, the Turners Falls company sold to the United company 29,325,100 kw.-hr. and purchased from the latter 17,295,250 kw.-hr. The difference, 12,029,850 kw-hr., would have had to be made up by the United company had no interconnection existed, and, at the rate of 2.5 lb. (1.13 kg.) per kilowatt-hour, would have increased the fuel consumption of the United system by about 26,800 tons. It would not be far wrong to estimate a saving of from $150,000 to $200,000 in the six years by this interconnection. At times of low water the Springfield company supplies energy to the Turners Falls system, while under such conditions as at present the hydro-electric supply is utilized to great advantage and the amount of steam-plant operation required at Springfield is greatly decreased. Weather and load conditions cause great irregularities in the total energy interchange from year to year, as the accompanying diagram indicates.

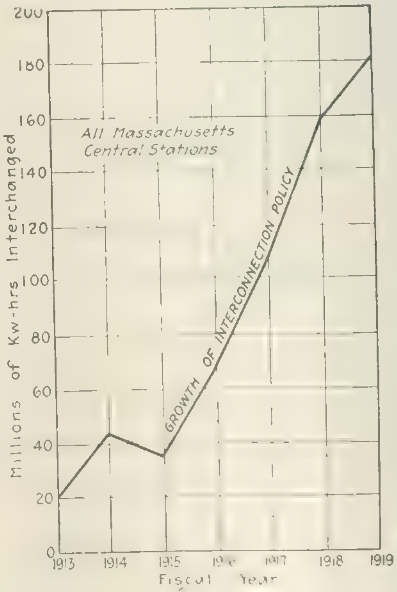
Between the New England Power Company and the Worcester Electric Light Company the total interchange of energy in the past seven years has been 67,113,384 kw.-hr. In this case there is a balance of 4,714,544 kw.-hr. in favor of the New England Power Company, the interchange having approximated a "fifty-fifty" operation, speaking roughly. The New England company sold the Worcester company 35,915,464 kw.-hr. between 1913 and 1919, and the latter sold the former 31,196,920 kw.-hr. On the basis of 2.5 lb. of coal per kilowatt-hour, the interconnection saved the Worcester company 5,260 tons of coal from 1913 to 1919. The operating advantages of the interconnection have enabled each company to handle its business with a relatively smaller investment in generating plant than would have been the case otherwise.

The table printed here gives the total interchange of energy between Massachusetts central-station systems (including hydro-electric companies) for the past seven years. It is noteworthy that the grand total interchange has reached 616,014,614 kw.-hr.

INTERCHANGE OF ENERGY BETWEEN MASSACHUSETTS CENTRAL STATIONS, 1913 TO 1919

Year	Kw.-hr. Interchanged
1913	20,046,708
1914	43,764,942
1915	36,711,926
1916	67,209,934
1917	109,085,946
1918	158,917,094
1919	180,278,064
Total	616,014,611

The number of interchange arrangements in effect, counting those of each pair of companies as one, varied from nine to seventeen during this period. It is of at least speculative interest to note that if each kilowatt-hour interchanged accomplished a saving of 1 lb. of coal, the total saving in fuel for the above period would be 275,000 tons, and that if a 1.5-lb. differential is allowed, the saving would be 412,000 tons. It should not be overlooked that in many of these interconnections very substantial gains in plant economy result immediately; for wherever hydro-electric energy does away with the need of generating by steam the gain is of the order of 1.5 lb. to 3 lb., and where a large steam plant is interconnected with a smaller one or with a group, it is frequently possible to realize gains of 1 lb. or 2 lb. It seems reasonable to believe that since 1912 interconnection in Massachusetts alone has saved more than a third of a million tons of coal and quite possibly half a million, looking at the facts with the utmost conservatism and omitting all reference to the supply of small plants from large centralized stations owned by interests which have absorbed the smaller installations.



INTERCHANGE OF ENERGY FROM 1913 TO 1919 BY MASSACHUSETTS CENTRAL STATIONS

Practice in the making of interconnection contracts varies widely. Some of the best operating results in

New England have been attained through agreements scarcely more than oral in character; and, on the other hand, contracts have been prepared and worked under during the past few years which have illustrated new and complex terminology and which have fitted conditions so intricate that few but specialists appreciate their structure and applications. Where the resale of energy is involved, with prorating of plant equipment to meet certain changes in load conditions, allocating to different corporations legal titles to apparatus and line segments, the agreements tend toward complexity. Comparatively little publicity has thus far accomplished the drafting of such contracts, and the work may in a sense be looked upon as in process of evolution. At present practice exhibits these two tendencies toward simplicity and toward complication, and it is perhaps too soon to say which school, if either, will predominate. At this writing not enough New England contracts of representative character are available to permit conclusions as to the best forms, and it will be necessary to leave the task of analyzing agreements of this class to a more favorable opportunity.

Since contractual relations vary widely, it follows that the prices of blocks of energy interchanged exhibit broad differences. A few instances may be cited from 1919 data. During the fiscal year the New England Power Company sold the Worcester Electric Light Company 2,623,200 kw.-hr. at an average price of $0.0035 (yield $9,181). It purchased from the Worcester Company 16,300,100 kw.-hr. at a unit price of $0.0102 (yield to Worcester company, $166,441). The arrangement was undoubtedly advantageous because of the ability of the Worcester company to absorb secondary power when available, and had the capacity not been available at the steam plant of the Worcester company, the New England company would have had to have made up its output elsewhere, and presumably at greater cost. It is quite inappropriate to judge the profitableness of any interconnection arrangement between two parties by comparing the unit prices of energy transferred in reverse directions.

The interchange of nearly equal blocks of energy in a given period of interconnection by no means results in nearly equal unit prices. Thus, the Turners Falls company sold the United company of Springfield 10,537,600 kw.-hr. in 1919 at an average unit price of $0.00679. From the United it received 10,846,100 kw.-hr. at $0.0084 per unit. The price at which one company can afford to sell energy to another is by no means necessarily the price at which it can afford to buy energy. The advantage for the time being may lie with the seller, or the class of power available may alter the conditions. Of the total energy delivered at its system buses in 1919—viz., 273,551,482 kw.-hr.—the New England Power Company purchased 158,307,730 kw.-hr. at an average price of $0.0062, and it sold to gas and electric companies 102,094,532 kw.-hr. at an average price of $0.0113.

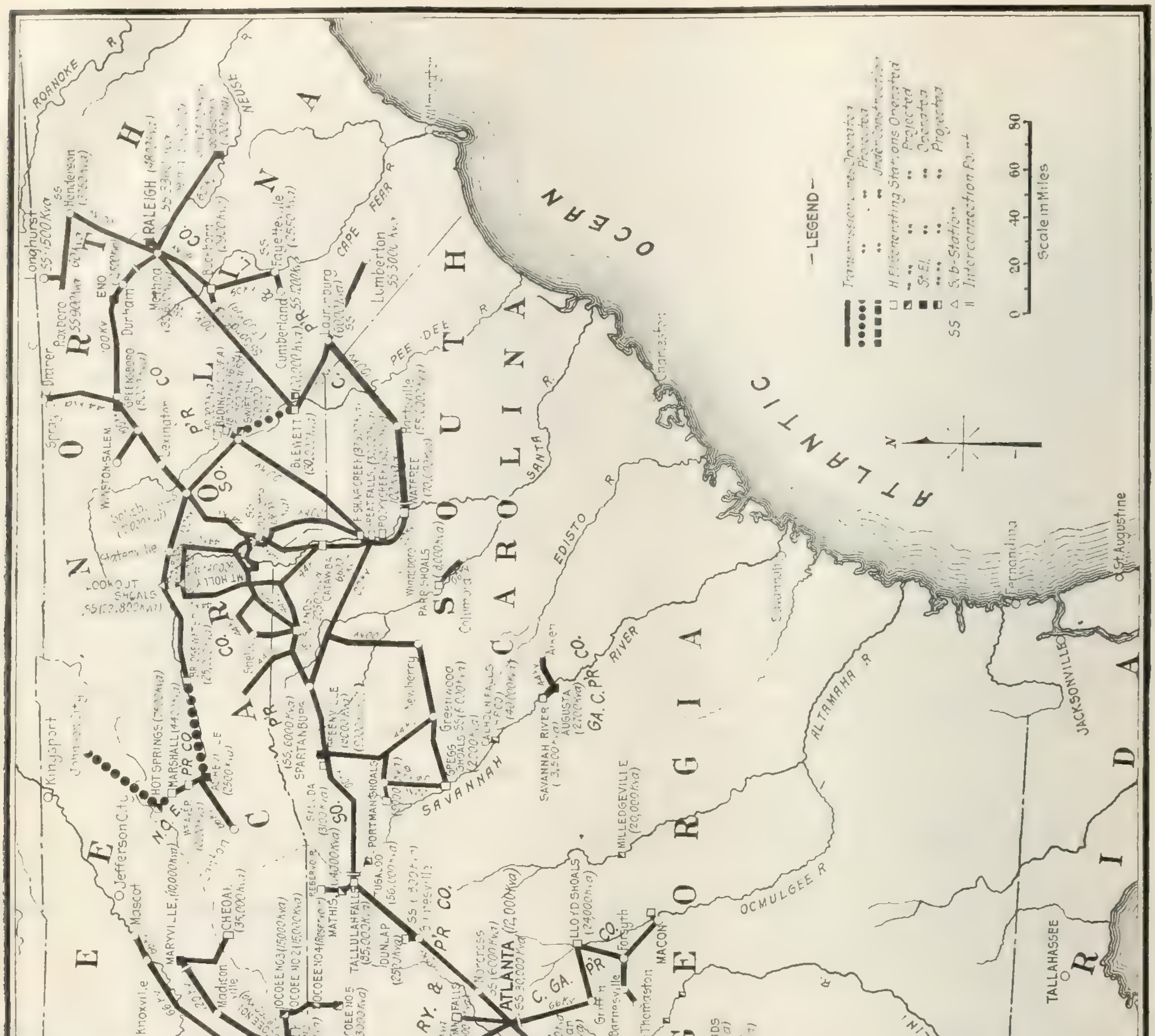
Linking Three Southern Watersheds

Twelve Electric Power Companies in the South Operate 7,114 Miles of Transmission Line—Seven of These Companies Are Now Interconnected and Have a Combined Capacity of 553,500 Kw. in Hydro-Electric Plants on Three Different Watersheds

SEVEN Southern operating companies having 553,500 kw. in hydro-electric plants and 186,050 kw. in steam stations—a total of 749,550 kw. in generating capacity—are now interconnected in one great transmission network extending from Henderson, N. C., in the northeast to Columbus, Ga., in the south, Sheffield, Ala., in the west and Nashville, Tenn., in the northwest. The companies whose transmission lines are thus tied together are the Southern Power Company, Alabama Power Company, Tennessee Power Company, Georgia Railway & Power Company, Columbus Power Company, Central Georgia Power Company and the Carolina Power & Light Company. The layout of this system, locations of generating stations, points of interconnection and proposed new developments are shown on the accompanying map. In the operation of these hydro-electric systems a maximum use has been made possible in thus tying together the powers of the various streams. A glance at the map shows that there are three distinct watersheds—first, in the eastern section, flowing directly into the Atlantic Ocean; second, in the southern section, flowing into the Gulf of Mexico, and, third, in the northern section, flowing by way of Tennessee and Cumberland Rivers into the Mississippi. The rainfall on different rivers, and at times at different points on the same river, varies in such a way that high or low water may severely affect a group of plants on one stream and not so seriously interfere with operation of those on another. The interchange of power, therefore, is particularly desirable and materially lowers the amount of standby steam equipment required.

Of the 4,719.4 miles (7,590 km.) of transmission lines which make up this system 1,659.6 miles (2,670 km.), a little more than 35 per cent, are steel-tower lines, the transmission voltages carried ranging from 44 kv. to 110 kv. Substations for transmission and distribution, excluding those for individual consumers, number 327 and have a combined capacity of 1,079,435 kva. in transformers. In 1919 the total output of the seven companies named was 1,821,821,089 kw.-hr., which was distributed in the following manner: For industrial power, 87 per cent; for residential and commercial lighting, 5.5 per cent, and for electric railways, 7.5 per cent. The rapid development of the South into a manufacturing section embracing such industries as textile mills, fertilizer works, cement plants, aluminum production, coal and iron mining and steel mills has given the power companies an excellent market for electrical energy which is reflected in the proportion of the total output, *i.e.*, 87 per cent, sold for industrial purposes.

In the accompanying tabulation data are given on twelve operating companies in the South. As already mentioned, seven of these are now interconnected. Four others, the Virginia Power Company, Appalachian Power Company, Parr Shoals Power Company and



HOW TRANSMISSION SYSTEM OF SOUTH LINKS TOGETHER THE DIFFERENT WATERSHEDS

Augusta-Aiken Railway & Electric Company, could easily be tied into the same great system. The Texas Power & Light Company, not so geographically situated as to become a part of this transmission system, operates six steam stations through interconnection of 1,334 miles (2,140 km.) of transmission line.

The principal features of the twelve systems, including the extensions and developments which have been made, are outlined in the following paragraphs referring to each company:

Southern Power Company.—Besides being the pioneer transmission company in the South, the Southern Power Company operates the most extensive system. In the States of North and South Carolina 2,050 miles (3,290 km.) of transmission line have been built, with eight hydro-electric and four steam stations. The ratings of the eight hydro-electric stations are as follows: Great Falls, S. C., 30,000 kva; Rock Creek, S. C., 30,000 kva.; Fishing Creek, S. C., 37,500 kva.; Wateree, S. C., 70,000 kva.; Catawba, S. C., 6,600 kva.; Ninety-nine Islands, N. C., 22,500 kva.; Lookout Shoals, N. C., 22,800 kva., and Bridgewater, N. C., 25,000 kva. The aggregate capacity of these plants is 244,400 kva. The Great Falls, Rocky Creek, Catawba and Ninety-nine Islands stations were placed in operation prior to 1915, while the plant at Lookout Shoals was completed and operation started in 1915, the one at Fishing Creek in 1916 and those at Bridgewater and Wateree in 1919. Steam plants of 8,000 kva. each are operated at Greenville, S. C., Greensboro, N. C., and Mount Holly, N. C., and one of 12,500 kva. is at Eno, N. C. The total rating of the steam plants is 36,500 kva. and the combined rating of hydro-electric and steam stations, 280,900 kva. The increase in load for 1919 was 33,900 kw. and the total output for the year was 585,596,925 kw.-hr., of which 80 per cent was used by textile mills, 10 per cent by miscellaneous industries and 10 per cent by lighting and railways. Of the 2,050 miles of transmission line 780 miles (1,256 km.) are steel-tower lines of 44,000 and 100,000 volts. There are 201 substations connected to the lines with a total rating in transformers of 443,500 kw. In addition, the above company controls the Southern Public Utilities Company, which operates plants on the Savannah and Seneca Rivers with steam plants at various points. The lines of the Southern Power Company tie in with the lines of the Georgia Railway & Power Company at Tallulah Falls, Ga.

PRINCIPAL FEATURES OF TWELVE SOUTHERN TRANSMISSION SYSTEMS.

Company	Capacity of Generators			Substations		Miles of Transmission Line	Yearly Output (Kw.-hr.)	Character of Load per cent.		
	Hydro. Kw.	Steam (KW)	Total (kW)	No.	Total Kva of Transformers			Residential and Commercial	Industrial	Electric Railway
Southern Power Company*	244,400	36,500	280,900	201	443,500	2,050	585,596,925	10.	80	10
Alabama Power Company*	69,500	70,500	140,000	9	274,100	1,051	347,993,284		92.8	7.2
Tennessee Power Company	85,500	36,000	121,500	25	113,500	544.2	422,272,590			
Georgia Railway & Power Company	84,700	21,500	106,200	31	135,425	352.	262,834,541			
Texas Power & Light Company	......	60,000	65,000	105	77,338	1,334.	217,775,493	18.3	61.3	20.4
Virginian Power Company	......	49,000	49,000	73	54,875	347.3	69,658,650		85.5	14.5
Appalachian Power Company	22,900	21,500	44,400	10	78,250	630.	124,095,511	3.	96	1.
Carolina Power & Light Company*	32,900	10,050	42,950	49	69,910	236.	55,620,870	11.	87.	2
Columbus Power Company	18,500	9,000	27,500	3	11,750	144.7	82,965,820	3.	94.7	2.3
Parr Shoals Power Company*	20,500	5,500	26,000	2	21,000	58.	52,642,090	8	83	9.
Central Georgia Power Company	18,000	3,000	21,000	9	31,350	231.5	63,518,965	9.4	82.6	8.
Augusta-Aiken Railway & Electric Company*	14,575	2,750	17,325	4	12,000	36.	40,000,000		85	15
Total, all companies	611,475	329,800	941,775	521	1,322,998	7,114.7	2,324,992,739	8.2	84.2	7.6

*Ratings of generating stations and substations given in kva.

Carolina Power & Light Company.—In eastern North Carolina the Carolina Power & Light Company operates 236 miles (379 km.) of transmission line from a hydro-electric plant of 2,900 kva. at Buckhorn Falls on the Cape Fear River, and steam plants of 4,800 kva. at Raleigh, 1,500 kva. at Gallsboro and 3,750 kva. at Henderson. This company also controls the Yadkin River Power Company, which has a hydro-electric plant of 30,000 kva. at Blewett Falls on the Yadkin River. Connected to the transmission system of the Carolina Power & Light Company are forty-nine substations having an aggregate rating of 69,910 kva. in transformers. The combined output of the two systems in 1919 was 55,620,870 kw.-hr. This system is tied in with the Southern Power Company at Durham, N. C.

Tennessee Power Company.—In Tennessee this company operates 544 miles (875 km.) of transmission line served by two hydro-electric stations on the Ocoee River; one of 18,750 kw. operated under a 110-ft. (33-m.) head and one of 15,000 kw. under a 255-ft. (76-m.) head, and also plants of 9,750 kw. under a 110-ft. head at Great Falls and 42,000 kw. under a 34-ft. (10-m.) head on the Tennessee River at Hales Bar. Four steam stations having a total rating of 36,000 kw. are operated at Parksville, Nashville, Knoxville and Chattanooga. The combined capacity of the hydro-electric and steam plants is 121,500 kw. The hydro-electric plant on the Tennessee River at Hales Bar is operated by the Chattanooga & Tennessee Power Company, which sells practically its entire output to the Tennessee Power Company. Of the total output of all stations in 1919—422,272,590 kw.-hr.—236,459,200 kw.-hr. was generated at the Hales Bar station. There are 339.12 miles (545 km.) of steel-tower lines in operation at voltages of 44,000, 66,000 and 120,000, and 179.26 miles (288 km.) of 66,000 volt line on wood poles. Connected to this system are twenty-five substations totaling 113,500 kva. in transformers. This company's lines are interconnected with the Georgia Railway & Power Company at the Georgia-Tennessee State line.

Georgia Railway & Power Company.—The system of this company covers northern Georgia and consists of 352 miles (566 km.) of transmission line with hydro-electric plants of 72,000 kw. at Tallulah Falls, 10,500 kw. at Morgan Falls, 2,200 kw. at Dunlap, and two steam stations in Atlanta totaling 21,500 kw. Additional development of the water power this year will add 16,500 kw. to the hydro-electric stations and make the combined hydro and steam generating capacity of the system 122,700 kw. This company estimates its undeveloped water-power resources at 274,000 kw. In 1919 the total current used on this system (generated and purchased) was 262,834,541 kw.-hr. There are 198.6 miles (319 km.) of 110,000-volt transmission line on steel towers. Wood-pole lines are operated as follows: 61.8 miles (99 km.) at 66,000 volts, 9 miles (14 km.) at 38,000 volts, 63.7 miles (101 km.) at 22,000 volts and 19.78 miles (31 km.)

at 11,000 volts. There are twenty-one substations connected to the system having a total rated capacity of 135,425 kva. in transformers.

This company's transmission lines connect with the Central Georgia Power Company at Atlanta, the Tennessee Power Company at the Tennessee-Georgia State line, the Southern Power Company at Tallulah Falls, the Columbus Power Company at Newnan. A connection is also proposed with the Alabama Power Company at Lindale.

Central Georgia Power Company.—Returning to Georgia, the Central Georgia Power Company operates 231 miles (371 km.) of transmission line with one hydro-electric plant of 18,000 kw. from a 103 ft. (30-m.) head on the Ocmulgee River and two steam stations of 1,500 kw. each. The total output of the stations in 1919 was 63,518,965 kw.-hr., distributed as follows: Residential, 9.4 per cent; industrial, 82.6 per cent, and electric railways, 8 per cent. Transmission voltage throughout the system is 66,000 volts, and there are 97.5 miles (156 km.) of steel-tower and 36.5 miles (58 km.) of wood-pole lines in operation. Connected to the transmission system are nine substations having a total rated capacity of 31,350 kw. in transformers. At Atlanta the transmission lines of this company are tied in with those of the Georgia Railway & Power Company.

Columbus Power Company.—This company serves a large cotton mill load in and around the city of Columbus, Ga. It operates 144 miles (231 km.) of transmission line from three hydro-electric plants on the Chattahoochee River—one of 1,000 kw. from a 10-ft. (3-m.) head, one of 6,500 kw. from a 40-ft. (12-m.) head, and one of 11,000 kw. from a 70-ft. (21-m.) head—with a steam station of 9,000 kw. at Columbus. The combined hydro-electric and steam capacity of the system is 27,500 kw. The total output of the stations in 1919 was 82,965,820 kw.-hr., distributed as follows: Residential, 3 per cent; industrial, 94.7 per cent, and electric railways, 2.3 per cent. Sixty miles (96 km.) of the transmission line is on steel towers, 66,000 volts and 84.7 miles (135 km.) is on wood poles, 11,000 volts. There are three substations connected to the system, having an aggregate of 11,750 kw. in transformers. The transmission lines of this company are tied in with those of the Georgia Railway & Power Company at Newnan, Ga.

Parr Shoals Power Company.—This company sells its output to the Columbia (S. C.) Railway, Gas & Electric Company. It operates 58 miles (93 km.) of transmission line and a 35-ft. (10.5-m.) head hydro-electric plant of 15,500 kva. at Parr Shoals, S. C. In 1919 the total output was 52,642,090 kw.-hr., distributed as follows: Residential, 8 per cent; industrial, 83 per cent, and electric railways, 9 per cent. There are 44 miles (70 km.) of steel-tower and 14 miles (22.5 km.) of wood-pole transmission lines operated at 66,000 and 13,200 volts. Two substations having a total rating in transformers of 21,000 kva. are connected to the system.

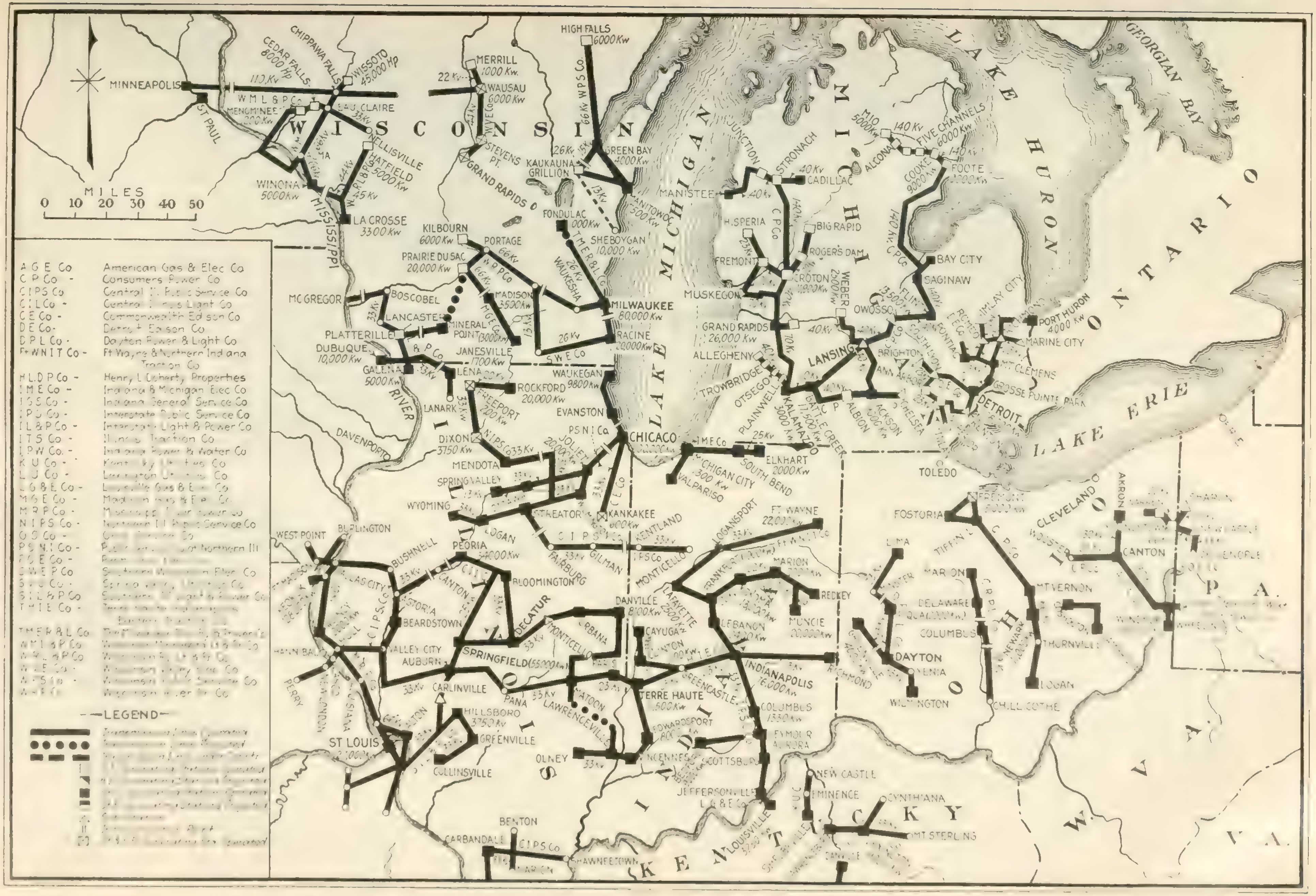
Appalachian Power Company.—In the southern section of West Virginia and across the border into Virginia this company operates 630 miles of transmission line served by two hydro-electric plants, one of 16,000 kw. from a 50-ft. (15-m.) head and the other of 6,900 kw. from a 38-ft. (11-m.) head, and steam stations of 2,000 kw. at Clinchfield, 4,500 kw. at Roanoke and 15,000 kw. at Glenlyn. The combined capacity of the hydro-electric and steam stations is 44,400 kw., which will be increased to 64,400 kw. by the addition of a 20,000-kw. unit now being installed at the Glenlyn station. In 1919 the total output was 124,095,511 kw.-hr., distributed as follows: Residential and commercial, 3 per cent; industrial, 96 per cent; electric railways, 1 per cent. All transmission lines are on wood poles and are operated at 88,000 and 13,000 volts. There are ten large substations having a total rating of 78,250 kva. in transformers. This company has an arrangement with the Norfolk & Western Railroad for an interchange of power through a frequency changer up to a maximum load of 7,000 kw. It sells energy to the Rodford (Va.) Water Power Company and the Roanoke Railway & Electric Company.

Virginian Power Company.—In the coal fields of Central West Virginia this company operates 347 miles (558 km.) of transmission line from a steam station of 49,000 kw. at Cabin Creek Junction, W. Va. The total output for 1919 was 69,658,650 kw.-hr., distributed as follows: Industrial, 85.5 per cent, and electric railways, 14.5 per cent. There are 253.52 miles (408 km.) of steel-tower and 102.22 miles (164 km.) of wood-pole transmission line in operation. This company expects to construct during 1920 42 miles (67.5 km.) of 44,000-volt and 38 miles (61 km.) of 66,000-volt steel-tower lines. It will also install eleven new substations, which will make a total of eighty-four substations having an aggregate capacity of 54,875 kw. in transformers.

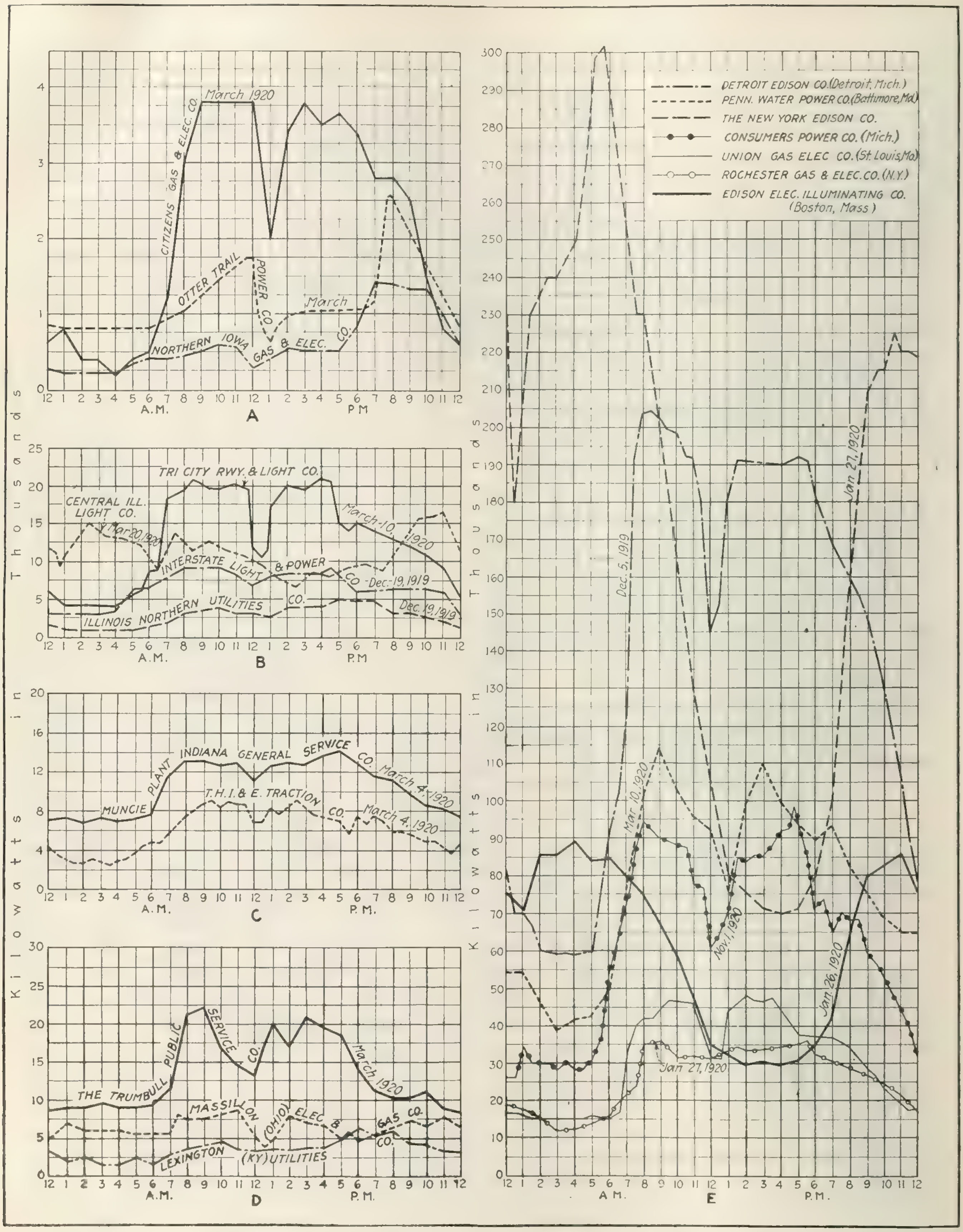
The Augusta-Aiken Railway & Electric Company.—In and around Augusta, Ga., this company operates 28 miles (45 km.) of transmission line and two hydro-electric stations, one of 13,500 kva. from a 30-ft. (10-m.) head at Stevens Creek and one of 1,475 kw. (direct current) from a 27-ft. (8-m.) head on a canal in Augusta. It also has a reserve steam plant of 2,750 kw. In 1919 the total output was 40,000,000 kw.-hr., distributed as follows: Residential and industrial, 85 per cent; electric railways, 15 per cent. There are 8 miles (2.4 m.) of steel-tower and 20 miles (6 m.) of wood-pole transmission lines operated at 44,000 volts. Four substations having a total rating of 12,000 kva. in transformers are connected to the system.

Alabama Power Company.—During the past eight years an extensive transmission network has been built which covers the greater portion of the central and northern sections of the State of Alabama. This system includes 1,051 miles (1,690 km.) of high-tension lines served by two hydro-electric plants, one of 67,500 kva. from a 68-ft. (20-m.) head at Lock 12 on the Coosa River and another of 2,000 kva. from a 26-ft. (7.8-m.) head at Jackson Shoals. Two large steam stations are also operated, one at Warrior of 58,000 kva. and the other at Gadsden of 12,500 kva. The combined capacity of hydro-electric and steam stations is 140,000 kva. In 1919 the total output of the stations was 347,993,284 kw.-hr., of which 92.8 per cent was sold for industrial purposes and 7.2 per cent used by electric railways. This company has 185 miles of steel-tower and 484 miles of wood-pole transmission lines operated at 110,000 and 44,000 volts. There are nine substations connected to the transmission system having a total rating of 274,100 kva. in transformers. An interconnection of this company's lines is proposed with those of the Georgia Railway & Power Company at Lindale, Ga.

Southwestern Power & Light Company.—In the Southwest this company controls a group of properties which operate together 1,334 miles (2,140 km.) of transmission lines from four stations of the Texas



A SECTION SERVED BY EXTENSIVE NETWORKS OPERATED AT MODERATE VOLTAGES



SOME CHARACTERISTIC DAILY LOAD CURVES OF MIDDLE WEST AND EASTERN CENTRAL STATIONS

A—The Otter Trail Power Company of Fergus Falls, Minn., has long-distance transmission lines, but very little power load as yet developed. Two Iowa systems of dissimilar load characteristics which are on opposite sides of the Iowa Falls Electric Company's lines.

B—The Central Illinois Light Company supplies a large proportion of its output to steel mills.

C—The difference between these two curves is probably due to the fact that the Terre Haute (Ind.) Company supplies an appreciable amount of railway service, while the Muncie company is essentially a power and light property.

D—Two of the smaller Ohio companies which have differently shaped load curves, although the principal customers of both are in the iron and steel industry; and the Lexington Utilities, which shows a type of load which large companies having load curves similar to those of the Union Gas & Electric Company are seeking to serve.

E—A comparison of a number of the larger systems, showing conditions of load during the past winter.

Power & Light Company of 23,000 kw., one station of the Fort Worth (Tex.) Power & Light Company of 25,000 kw., and one station of the Dallas (Tex.) Power & Light Company of 17,000 kw. All of these are steam stations and their total capacity is 65,000 kw. In 1919 the combined output was 217,775,493 kw.-hr., distributed as follows: Residential, 8.1 per cent; industrial, 61.3 per cent; electric railways, 20.4 per cent; commercial, 10.2 per cent. The increase in load in 1917 was 18.4 per cent. This company operates 211.62 miles (340 kw.) of steel-tower transmission line at 60,000 volts. There are 105 substations connected to the system having a total rated capacity of 77.338 kva. in transformers.

Interchange of Energy in Middle West

Interconnection Shown to Be a Financial Help—Rates at Which Energy Is Exchanged Between Steam and Hydro-Electric Plants Vary

THROUGH the co-operation of the central-station companies concerned, the accompanying maps of Middle Western States have been prepared to show the extent and the possibilities of interconnection in that territory. In this instance interconnection is taken to mean not only the physical connection between different transmission systems but also the consolidation of many small properties into one system and the interchange of energy between central stations and their large customers. Both the 25-cycle and the 60-cycle light and power systems are shown, as are also the 25-cycle traction systems which dispose of a large portion of their service for light and power purposes. Essentially traction systems with 25-cycle transmission, such as those of the Ohio Electric Railway Company and the Union Traction Company of Indiana, and a number of branch lines, have been omitted to reduce the detail. For further data regarding the details of operating voltage, plant capacity, etc., reference may be had to the table. In addition to these transmission maps and table, typical daily load curves are presented showing a comparison of operating conditions for a number of systems of both eastern and western companies.

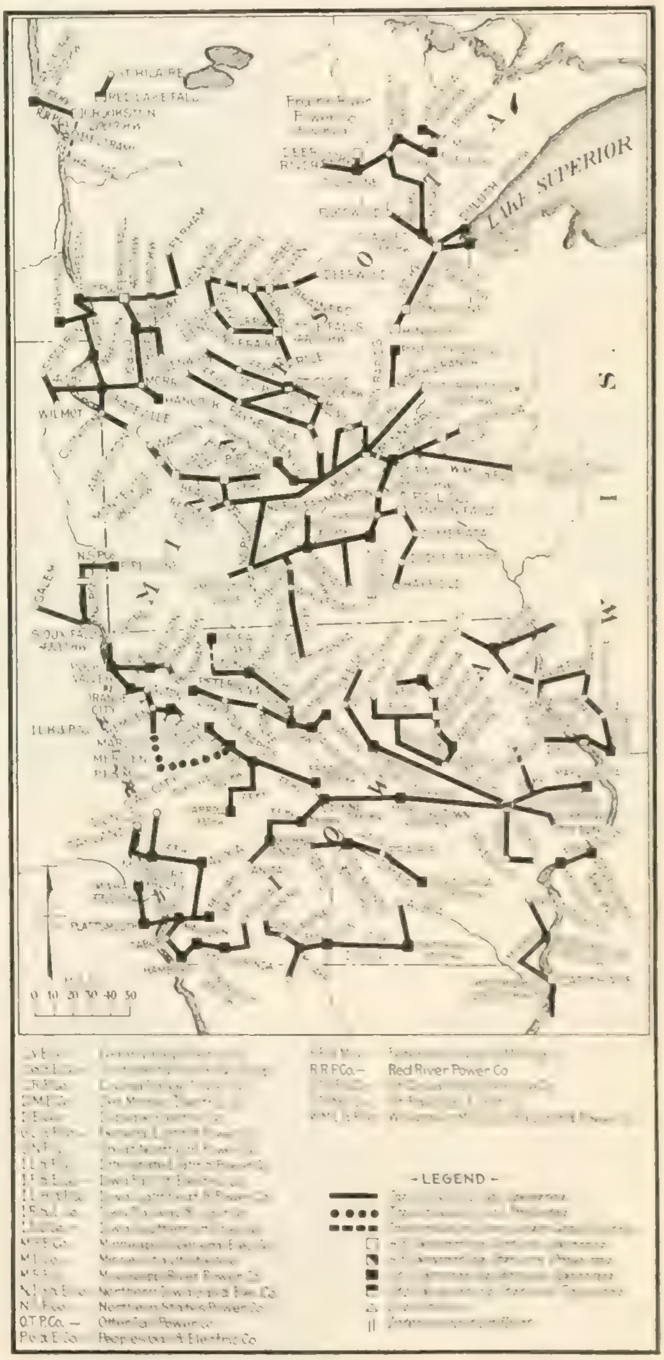
It seems to be the aim of the utilities in this section to shut down small or uneconomical plants whenever the cost of operating such power stations is materially greater than the increased cost of operating larger stations at the increased load. Through these savings and those which have been made possible by improved load factor and greater diversity factor industries have been supplied with energy at a lower rate than would otherwise have been possible. Interconnection has proved one of the most successful methods employed by the utilities to fight the rising cost of service to all their customers. Industrial consumers have also profited by the additional capacity and improved reliability of the service made available for their needs.

EXPENDITURES OF INTERCONNECTED CENTRAL STATIONS WILL BE REDUCED

The public-policy advantages of interconnection have been found to carry weight with financial men when the companies need funds. Increasing expenditures are being made for transmission lines and plants. However, managers of interconnected central stations say that their combined power-plant expenditures per kilowatt of customer's demand will be less than if they had continued to operate independently.

A demand and energy rate is used by practically all Middle Western companies in purchasing or exchanging energy, but the details vary widely. A guaranteed demand and minimum load factor is quite common, but some companies go one step further and contract for a specified demand during stipulated peak and off-peak periods. Provision is generally made so that the demand can be changed on proper notice.

Interchange agreements have been made to require both companies to stand ready to serve each other in case of need up to an agreed-upon maximum demand. When energy is interchanged the rates charged by the two companies are not always on the same basis. For instance, some water-power companies pay more for


LAKE SUPERIOR
WILMOT
N.S.P.Co.
0 10 20 30 40 50
R.R.P.Co. — Red River Power Co
N.S.P.Co. — Northern States Power Co
O.T.P.Co. — Otter Tail Power Co
- LEGEND -

DIVERSIFIED AGRICULTURAL AND INDUSTRIAL REQUIREMENTS SERVED BY WELL-DISTRIBUTED GENERATING STATIONS energy they buy from steam electric plants than the steam generating companies pay for the hydro-electric energy they purchase in exchange.

All the advantageous interconnections have not yet been made, and while many proposed lines are shown on the accompanying maps, they do not by any means include all of the possible connections which are in the minds of central-station men in the Middle West territory. Nearly every central-station executive is giving the matter of interconnection serious thought from one angle or another, and it seems that there is no company large enough or small enough to ignore its possibilities entirely. The development of high-voltage trunk systems, while not carried to the extent of other sections of the country, is gradually unifying the power resources.

WATER POWER IN FINLAND. — *A recent estimate of water power in Finland which within a reasonably near future will be available at the shaft of the turbine places it at 900,000 hp. There is at least 2,000,000 hp. more undeveloped but too remote to be brought into use for a long period to come.*

DETAILS OF THE INTRICATE NETWORK THAT SERVES THE POWER REQUIREMENTS OF THE MIDDLE WEST

Company	Total Miles of Line in System	Principal Power Stations Location	Rating	Energy Distributed or Wholesale
ILLINOIS				
Commonwealth Edison Co		Chicago	600,000	D. & W.
Pub. Serv. Co. of No. Ill.....	600	Waukegan	9,800	D. & W.
		Joliet	20,000	
		Oak Park	2,000	
		Blue Is.	48,500	
Ill. Northern Utility Co.....	500	Freeport	1,000	D. & W.
		Dixon	4,000	
		Sterling	1,500	
Cent. Ill..................				D. & W.
Pub. Serv. Co.............	1,000	Kincaid	6,000	D. & W.
		Mattoon	2,000	
Ill. Traction System........	600	Venice	10,000	D. & W.
		Riverton	10,000	
		Peoria	6,000	
		Danville	8,100	
Cent. Ill. Light Co		Peoria	30,000	W. & D.
So. Ill. Lt. & Pr. Co........		Collinsville	2,500	D
		Hillsboro	3,750	
Mississippi River Power Co.		Keokuk	128,000	W. & D.
INDIANA				
Interstate Public Service Co.		Bedford	9,000	W. & D.
		Williams	8,000	
Ind. & Mich. Elec. Co.......	156	So. Bend	14,000	W
		Elkhart	2,000	
		Berrion Springs	7,200	
		Twin Branch	4,000	
		Buchanan	2,800	
Ft. Wayne & Northern Indiana Trac. Co........	150	Lafayette	2,000	W. & D.
		Fort Wayne	20,000	
Ind. Gen. Service Co........	100	Muncie	20,000	D.
		Marion	6,500	
		Elwood	1,000	
Terre Haute, Indianapolis & Eastern.................	325	Terre Haute	11,500	W. & D.
		Indianapolis	76,000	W. & D.
		Lebanon	2,400	W. & D.
		Crawfordsville	1,400	W. & D.
Wabash Valley Elec. Co.....		Clinton	1,100	
Indiana Power Co..........	24	Edwardsport	8,000	W. & D.
Indiana Railway & Light Co.	18	Kokomo	10,400	D
IOWA				
Iowa Railway & Light Co...	1585	Boon	3,000	D. & W.
		Cedar Rapids	30,500	
		Iowa Falls	1,125	
		Marshalltown	2,800	
		Hydro Plants	2,400	
Cont. Gas & Elec. Co.......		Red Oak	1,800	D
		Omaha	33,000	
		Shenandoah	1,650	
Iowa Southern Utilities Co..	240	Centerville	3,500	D. & W.
Des Moines Electric Co.....		Des Moines	30,000	D. & W.
		Oskaloosa	1,200	
Mississippi River Power Co..		Keokuk	128,000	
Iowa Light Ht.. Pr. & Co....		Rockwell City	10,000	W. & D.
Citizens' Gas & Elec. Co....		Waterloo	12,500	W. & D
No. Iowa Gas & Elec. Co.....		Eagle Grove	1,900	W. & D.
		Humboldt	1,100	
OHIO				
Dayton Power & Light Co.	125	Dayton	65,000	D
Ohio Power Co............		Fremont	19,000	W. & D.
		Newark	11,000	
		Windsor	120,000	
		Canton	28,000	
Penn. & Ohio Electric Co...		Youngstown	72,000	D
Union Gas & Electric Co...		Cincinnati	110,000	W. & D.
		Newport	6,000	
Defiance Gas & Elec. Co...		Defiance	6,500	W. & D.
		Maumee	3,000	
Massillon Electric Co......		Massillon	8,200	D
MICHIGAN				
Consumers' Power Co......	1300	Battle Creek	17,500	W. & D.
		Jackson	9,000	
		Flint	13,500	
		Bay City	1,500	
		Mio	5,000	
		Five Channels	6,000	
		Cooke	9,000	
		Foote	9,000	
		Kalamazoo	3,000	
		Grand Rapids	26,000	
		Croton	12,000	
		Junction	17,000	
		Webber	2,500	
Detroit Edison Co.........	550	Detroit	28,000	
		Port Huron	4,000	W. & D.
MINNESOTA				
Northern States Power Co...		St. Croix Falls	18,000	D. & W.
		Cannon Falls	2,200	
		Rapidan	1,500	
		Minneapolis	72,000	
		St. Paul	8,000	
		Coon Rapids	8,000	
Ottertail Power Co.........		Fergus Falls	5,000	D
		Fergus Falls	.....	D
Cuyuna Range Power Co...		Sylvan	1,800	
		Pillager	1,800	D 5,000
		Riverton	1,000	
Little Falls Water Power Co.		Little Falls	4,400	W. & D.
St. Cloud Pub. Serv. Co....		St. Cloud	5,500	D
Great Northern Co.......		Virginia	6,000	D. & W.
		Thompson	54,000	
		Duluth	3,000	
WISCONSIN				
Wis. Valley Elec. Co.......	100	Merrill	1,000	W. & D.
		Wausau	4,000	
W. P. S. Co...............	200	High Falls	6,000	
		Green Bay	4,000	W. & D.
		Manitowoc	7,500	
Wisconsin Edison Company.	350	Milwaukee	80,000	W. & D.
		Racine	25,000	D. & W.
So. Wis. Power Co.........	62	Kilbourn	6,000	W
Wis. River Power Co.......	25	Prairie du Sac 25v	6,000	W
	27	Prairie du Sac 60v	10,000	
Wis. Ry. Lt. & Pr. Co......		Winona	11,000	
	71	Hatfield	5,000	W. & D.
Wis.-Min. Lt. & Pr. Co....		Wissota	45,000	W. & D.
		Chippewa Falls	27,000	
		Menominee	1,200	
		Cedar Falls	8,000	
		La Crosse	4,500	

Reorganization Program for N. E. L. A.

Work of New Departments at National Headquarters and New Plans for More Effective Functioning of Geographic Divisions, National Sections and Executive Committee

By **M. H. AYLESWORTH**
Executive Manager National Electric Light Association

CHANGING conditions in the use and regulation of electricity have brought about an immediate need for greater expansion of the National Electric Light Association, coupled with a definite national program which shall assure the continued success of the association as the national representative of the electrical industry. For thirty-five years the National Electric Light Association not only has fulfilled its original object but has courageously assumed the ever-increasing duties and responsibilities which naturally have accompanied the growth in size, influence and importance of the electrical industry.

M. H. AYLESWORTH

Following a general survey made by the writer at the request of the national executive committee, upon the recommendation of President Ballard, it was determined to undertake a program of expansion. In answer to a general letter written to executives of all member companies came a demand for increased service in practical co-operation, which resulted in immediate reorganization of the national headquarters staff. The new plan called for the creation of the position of executive manager to direct the work of the association, including the appointment and direction of the headquarters staff, under the supervision of the president, vice-presidents and national executive committee.

The organization at the headquarters in New York City has been divided into five departments, under the direction of an executive manager. The functions of all of these departments and of the department of education, with its headquarters at Chicago, are outlined in the paragraphs that follow:

Company Service Department.—The rate book and rate research work, which heretofore has been carried on in Chicago, has become a part of the centralized organization, with Fred W. Herbert, superintendent of the company service department, in charge. This department is co-operating also with accounting committees and is prepared to give service to companies, large or small, in the matter of technical accounting, rates, valuation, production, service or other problems. In so doing this department will act as a clearing house for information, experience, statistics and all such matters, thus giving to small and large companies alike the advantages of practical development demonstrations of the other company members. Already numerous inquiries requesting advice on operating matters of all kinds have been received.

Department of Publicity.—This department functions under the direction of George F. Oxley as director, who will supervise the gathering of educational propaganda material from all parts of the country for dissemination to all member companies and to the public. As part of the campaign to inform the public on all matters affecting the electric utilities member companies throughout the country will be aided in carrying on this work and in turn will be called on for assistance. This department will assist in the organization of state committees on public utility information and will act as a clearing house for the committees already formed and those which will be organized during the coming year. The fact is recognized that all publicity problems which are purely local in character or extent must be handled exclusively by local member companies or by state associations or geographic divisions; however, many of the problems and conditions which confront the electric light and power companies are common to all and should therefore be handled through the publicity department at headquarters. The work of this department includes the utilization of the moving-picture industry and educational work through the medium of educational institutions. The department of publicity will supervise the publication of the monthly bulletin of the association and will distribute to the membership letters of information regarding its activities and developments within or affecting the industry.

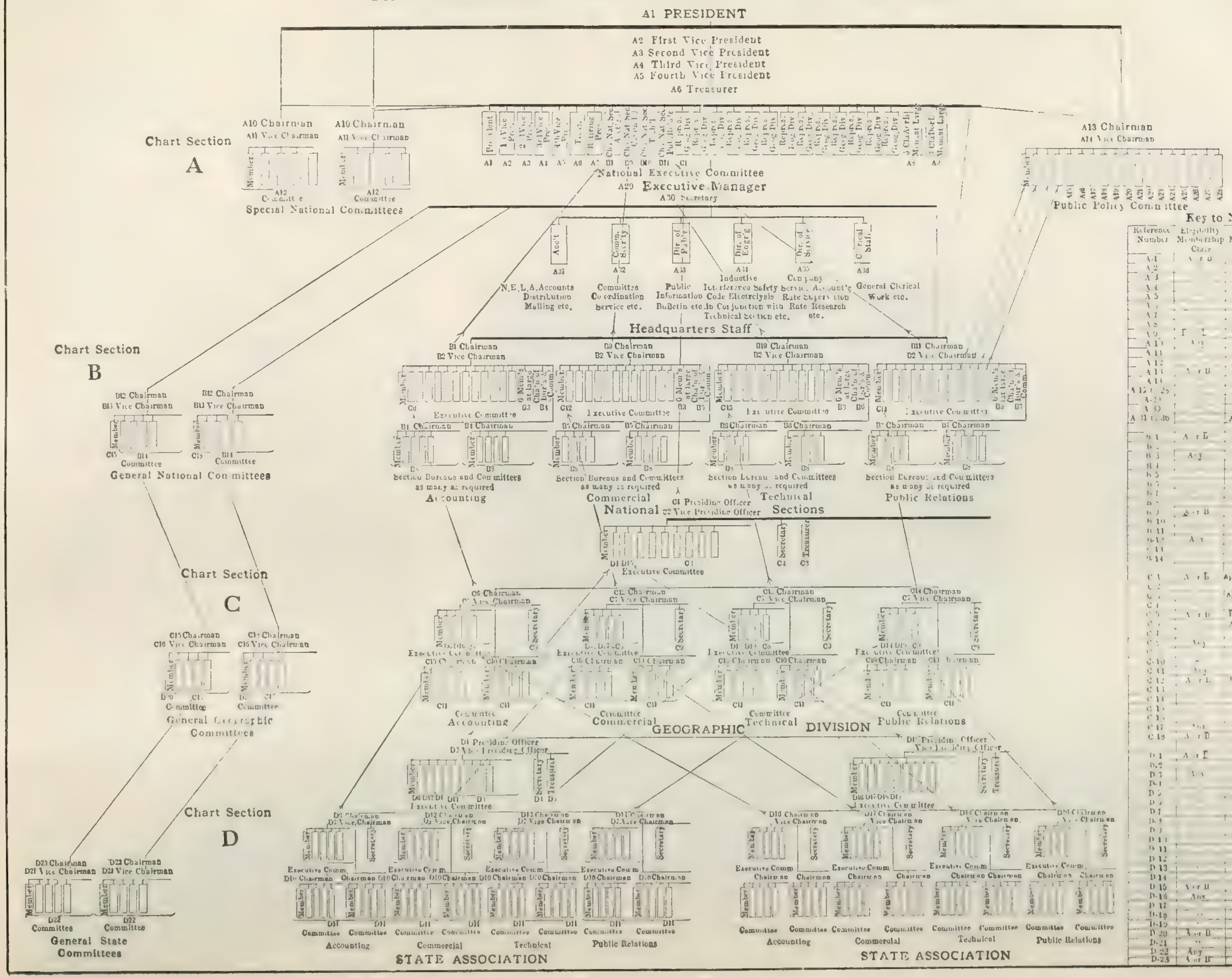
Engineering Department. — Upon the recommendation of the Technical Section, approved by the national executive committee, an engineering department will immediately be established with W. J. Canada as director. A consulting engineer has also been retained. This department is about to engage in gathering statistics and formulating a program on practical engineering problems which today affect the industry, and it will deal particularly with inductive interference, the safety code and electrolysis.

Committee Activity.—A department dealing with committee activity has been formed and is under the direction of A. Jackson Marshall as committee secretary. The service of this department is offered to the various committees to the end that their work may be co-ordinated, duplication of committee activity avoided and continuity of committee and section activity assured.

Accounting Department.—This department is in charge of the accounts of the association, as well as the membership lists and the mailing of all material to the membership.

Department of Education.—As in the past, educational courses will be available through the department of education, headed by Fred R. Jenkins, with headquarters at Chicago. The rapid growth of classes in every state of the Union is the best illustration of the appreciation of these courses by members of organizations of central-station companies.

PROPOSED ORGANIZATION OF NATIONAL ELECTRIC LIGHT ASSOCIATION

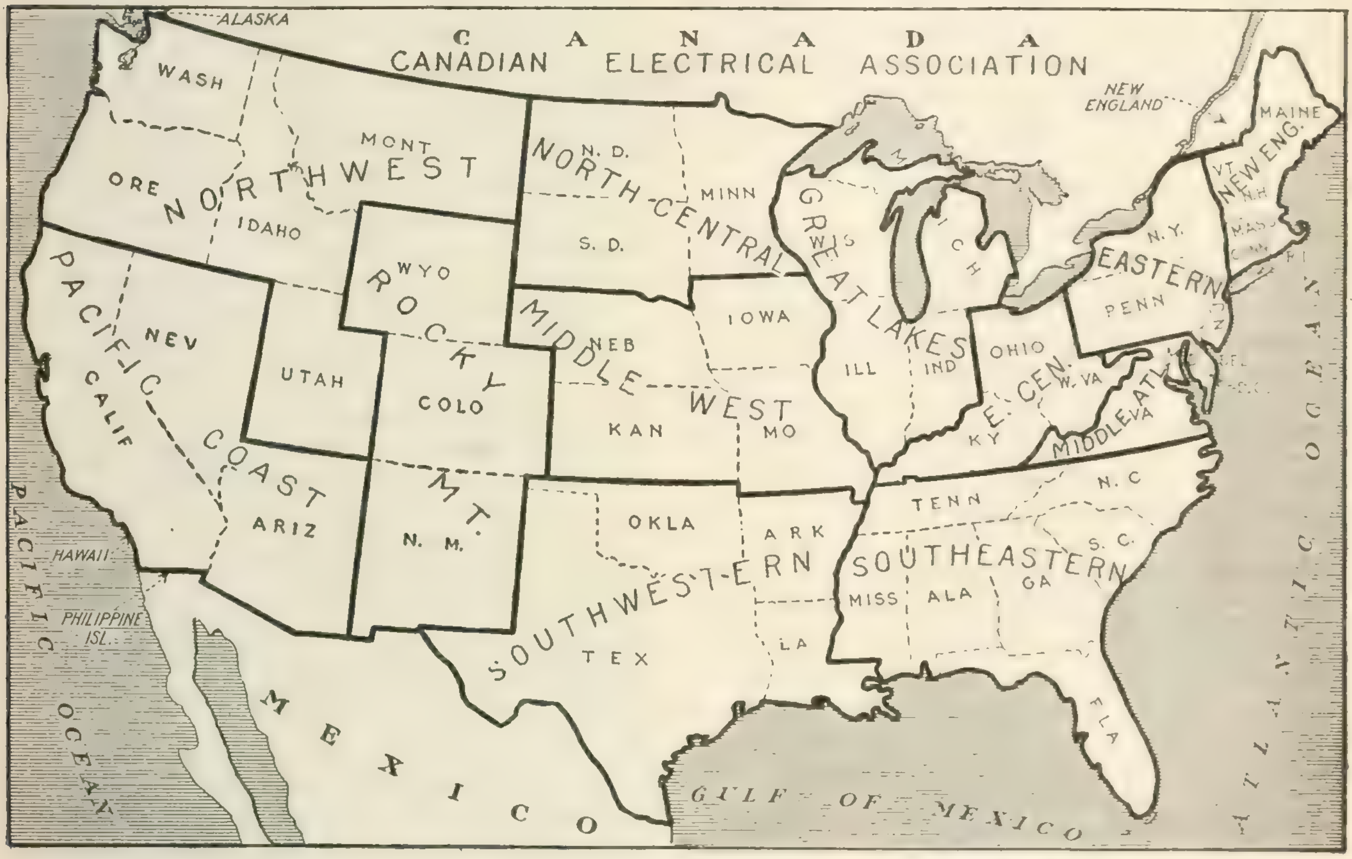


Key to Numbers on Chart

Reference Number	Eligibility Membership Class	Method of Obtaining Office	Term of Office
A-1	A or B	Elected at Annual Convention	One Year
A-2		" " " "	
A-3		" " "	
A-4		" " "	
A-5		" " " "	
A-6			
A-7		Automatically	
A-8		Elected at Annual Convention	Three Years
A-9	[illegible]		
A-10	Any	Appointed by President	One Year
A-11			
A-12			
A-13	A or B		
A-14		"	
A-15 to [illegible]			
A-29			
A-30			
A-31 to 36		Appointed by Executive Manager	
B-1	A or B	Elected at Annual Convention	One Year
B-2			
B-3	Any	Elected at Annual Convention	Three Years
B-4		Appointed by Section Chairman	One Year
B-5			
B-6			
B-7			
B-8			
B-9	A or B	Elected at Annual Convention	
B-10		"	
B-11		"	
B-12	Any	Appointed by President	"
B-13		"	"
B-14		"	
C-1	A or B	Appointed by Geographic Convention	One Year
C-2			
C-3		Appointed by Geographic President	"
C-4			
C-5	A or B	Elected at Geographic Convention	
C-6		Appointed by Geographic President	
C-7			
C-8	Any		
C-9		Appointed by Section Chairman	
C-10			
C-11	Any		
C-12	A or B	Elected at Geographic Convention	
C-13			
C-14			
C-15			
C-16			
C-17	Any		
C-18	A or B		
D-1	A or B	Elected at State Convention	One Year
D-2			
D-3	Any	" " " "	[illegible]
D-4		Appointed by State President	One Year
D-5		Elected at State Convention	"
D-6		Appointed by State President	
D-7		" " " "	" "
D-8		" " "	" "
D-9		Appointed by State Chairman	" "
D-10			
D-11		"	" "
D-12		Appointed by State President	" "
D-13		" " " "	" "
D-14		" " "	" "
D-15	A or B	Elected at State Convention	" "
D-16	Any	Appointed by State President	" "
D-17		" " "	" "
D-18	"	" " " "	" "
D-19		" " " "	" "
D-20	A or B	" " " "	" "
D-21	"	" " " "	" "
D-22	Any	" " " "	" "
D-23	A or B	" " " "	" "

A department operating in conjunction with the committee on company sections and employees' clubs is contemplated. The province of this department will be to assist in the organization of company sections and employees' organizations through correspondence, suggestions and field work where necessary.

While the organization at headquarters was being perfected the officials of the national association were obtaining the views of the representatives of member companies in attendance at state association conventions and geographic division conferences, and by written questionnaires. As a result of this investigation a special committee on reorganization was appointed. Its completed plan, visualized by the accompanying chart and supported by the proposed constitutional amendments necessary to bring about the machinery for the organization, will be submitted to the membership and will be voted upon at the convention at Pasadena, May 18 to 22.



PLAN FOR GEOGRAPHIC DIVISIONS APPROVED BY N. E. L. A. HEADQUARTERS

On Oct. 1, 1919, there were five geographic sections of the National Electric Light Association, composed of two or more states, and seven state geographic sections. Twenty state electrical or public utilities associations existed which were not affiliated with the National Electric Light Association, although the electric central-station members of these twenty state associations were, with few exceptions, Class A members of the national association. The field work carried on since Oct. 1 not only has demonstrated that the work of the national association should be decentralized to a considerable extent and that the country should be organized by geographic divisions, but that there is a unanimous demand for the program of the geographic sections committee, which provided for the division of the country into thirteen geographic sections, including Canada, as defined and named on the accompanying map. The national executive committee may, on its own motion or upon the application of one or more adjacent geographic divisions, modify the boundaries or add to or subtract from the existing number of geographic divisions.

GEOGRAPHIC DIVISION ORGANIZATION

The proposed plan provides two methods of geographic division organization. With certain geographic divisions there exist strong and active state electrical associations or state public utilities associations, while in others, where no state association machinery exists, the geographic division carries on the activities of the membership within the division. Thus it will be seen that the Northwest Electric Light and Power Association, for example, may continue to hold its annual convention and its executive conference or committee meetings without regard to state boundaries, while the proposed Great Lakes division, for example, composed of the States of Wisconsin, Michigan, Indiana and Illinois (two of which states had been affiliated with the national association as state geographic sections, while the other two were unaffiliated), will function through a geographic conference, composed of delegates from the four state associations, who will select the officers of the Great Lakes division and carry on the activities of the national association within the boundaries of the division, the state associations continuing to function in all local matters and, in addition, carrying on their activities as integral parts of the geographic division of the national association.

The purpose of geographic division organization is to decentralize where possible the activities of the national association and harmonize the work of the state association, geographic division and national association through co-ordination of all committee activities from the state association, through the geographic division, and finally into the executive committee of the national association. Where state public utilities associations exist, it is proposed that the electric light and power branch or division of the state association affiliate as part of the geographic division.

Assistance in financing the geographic division will be provided upon budgetary appropriation from the dues paid to the National Electric Light Association. The needs of each geographic division, in budget form, will be presented for approval to the national executive committee by the representative of each geographic division upon the national executive committee. As the proposed plan provides for the elimination of all duplication of committee activity, whether in the state association, geographic division or the executive committees of the national association, it is important to provide a distinct line of division in the scope of committees and departments of the association.

FOUR NATIONAL SECTIONS

Under the proposed plan there will be four national sections: (1) The Public Relations National Section, (2) Technical National Section, (3) Accounting National Section, and (4) Commercial National Section. In addition to these sections, which are really departments of the association, there will be general and special committees appointed by the president, whose scope of activity will be territorial or national; for example, committees on water-power development, electrification of steam railroads, electrical resources of the nation, general membership and national public policy.

There has been comparatively no activity in the national association pertaining to the relationship of the central station with the public, and the proposed Public Relations National Section is intended to provide machinery for the treatment of all subjects relating to management, public policy and relations with the public, such as federal, state and municipal legislation and regulation; federal, state and municipal taxation; uniformity of laws, principles of valuation and depreciation under commission regulation, public information through state committees on public utility information, public utility financing, including customer ownership of securities; municipal ownership, co-operation within the industry and all subjects of similar nature which heretofore have been handled by other national sections and committees of the association.

It has been further provided that the officers of the Public Relations National Section shall be a chairman, vice-chairman and executive committee, consisting of five members at large, to be elected at the national convention or national conference of the association, and the chairman of the public relations section of each of the thirteen geographic divisions of the national association.

Activities of the public relations section within the geographic division shall be controlled by an executive committee consisting of the chairman of each of the state associations' committee on public relations. The membership of the Public Relations National Section will consist of the executive officers of Class A member companies.

The proposed Technical, Accounting and Commercial National Sections are substantially the same in character and structure as those which exist at present, except in so far as their organization is affected by automatic representation from state and geographic divisions, as now proposed.

The chairman of each of the four national sections will become a member of the national executive committee of the association and will present to the national executive committee the section program for the administrative year for approval.

The Public Relations National Section will be represented on the national public policy committee by four members of the executive committee of the section, who shall be recommended by the chairman of the section and indorsed by the chairman of the national public policy committee.

NATIONAL EXECUTIVE COMMITTEE

The national executive committee of the National Electric Light Association will, in addition to the chairman or representative of each of the thirteen geographic divisions and the chairman of each of the four national sections, consist of nine members at large (three of whom shall be representatives of manufacturing companies), who shall be elected at the national convention or national conference of the association, and the following officers of the National Electric Light Association, president, four vice-presidents and treasurer, who shall also be elected at the national convention or national conference.

This method of selection of the members of the national executive committee is indeed democratic and will result in a more equitable representation from the entire country. Under the existing scheme of organization, the presidents of geographic divisions are not members of the national executive committee but are permitted to attend the meetings of the committee and entitled to cast a total of two votes, while the chairmen of the national sections have not been members of the national executive committee, although they have been permitted to attend meetings of the committee and entitled to one collective vote.

With one or two exceptions, the geographic divisions have either permanently or temporarily organized, and thus the machinery to carry out the program for 1921 and the years to follow is provided, should the program receive the official approval of the membership in convention assembled.

COMPLETE CO-OPERATION BETWEEN ALL BRANCHES

The plan of organization provides for complete co-operation between all branches of the industry by inviting the manufacturer, contractor-dealer and jobber to take a definite part in the work of the association, but does not contemplate absorption, consolidation or abandonment of the national organization of any of the different branches of the industry. In other words, the entire plan of organization is based upon the co-ordination of the interests and activities of the industry in the several states of the Union, working through state associations where they exist, and thence through geographic divisions into the executive committee of the national association, so that every member company and its individual membership shall have a voice in the program and management of the National Electric Light Association.

Readers' Views and Comments

Standardizing Panelboards

To the Editor of the ELECTRICAL WORLD:

SIR: We believe that the manufacturers of panelboards and cabinets need a great deal of education in the value of standardization. Panelboards and cabinets are still made today according to the individual idea of each factory, and the consequence is that no one—architect, engineer or contractor—has any standard to follow, and therefore any one in control specifies his own particular ideas for an individual job. The result is that panelboard manufacturers, instead of running the switchboard and panelboard manufacturers' business, are each running a jobbing shop and making up material only for every individual job ordered.

To further the storage of all materials it appears to be a good time to agree on standardization along the lines pursued by the conservation committees during the war. We desire particularly to urge upon our competitors in the switchboard, panelboard and steel-cabinet business the value of the manufacturers first getting together on reasonable standards of design and construction and then asking their customers, the architects, the engineers and the contractors, to take advantage of this work.

FRED B. ADAM,
Secretary Frank Adam Electric Company.

St. Louis, Mo.

High-Tension Direct-Current Transmission

To the Editor of the ELECTRICAL WORLD:

SIR: The economical limit of alternating-current transmission has apparently been reached at somewhere around 150,000 volts, since at this point the effective pressure of over 200,000 volts at the crest of the wave begins to produce corona and other losses which balance any saving. If, however, high-tension direct current were available, the same line that carries 150,000 effective volts with a peak voltage of over 200,000 would carry an effective direct-current voltage of 200,000 volts with no greater peak voltage. In addition, the direct current would all be useful; there would be neither a lagging nor a leading current to gum up the service. Calculations show that high-tension direct current would triple the capacity of a line for the same losses.

There are, however, two problems to be solved. The first is as to whether the steady pressure of the direct current with its possible electrolytic dangers will cause more trouble than the varying alternating-current pressure. Almost the only data available are the data from the Thury lines at 60,000 volts to 70,000 volts. These apparently indicate no increase of trouble from direct current. That there is no trouble at 60,000 volts attributed to the current being direct current instead of alternating is no proof that trouble would not develop at 100,000 volts or 200,000 volts, but it is certainly no proof that trouble will develop.

The chief trouble about high-tension direct current is the cost of producing it. The Thury system provides series direct current by use of several dynamos in series. While the Thury system often works out well on paper and while it is occasionally successful in practice, yet its use does not spread, and this alone is almost sufficient to show that success must be looked for along other lines. The trouble with the Thury system is apparently inherent in the use of machines of not more than 5,000 volts, and this, therefore, involves the series system in order to obtain the necessary high voltage.

The problem is to get the high voltage from machines of large capacity and to get multiple direct current for transmission even if this should be again converted to multiple alternating current for distribution. So far the production of really high direct-current voltage has been limited to the mercury rectifier, or kenetron, and to machines designed on the principle of revolving the commutator only, as in the Hulin-Le Blanc machines. These, however, have been built commercially only for small sizes of 5 kw. or so.

The problem is: Can they be built in large sizes? Some designers say no, but let us consider two things in the history of the art. The first is the story that when power was first produced by electricity—that is, when the first electric motor was shown—some one asked, "Can that ever be used practically?" and the answer was to stop it with a touch of the finger and say, "This will always be a toy." In the same way the steam turbine (invented two hundred years ago) was only a toy until designer and machinists showed that it was no inherent limit that had kept the steam turbine small and that accurate design and workmanship could build, first 10-kw., then 100-kw., then 1,000-kw. and 10,000-kw. machines.

For some things there is an inherent limit. We never expect to use iron for strength at temperature much above 500 deg., nor any material at temperature above say 1,500 deg. C. We have no expectation of using voltages much above 200,000, because at that point the air breaks down. We have no expectation of ever getting material that will sustain more than 300,000 lb. per square inch. On the other hand, we can handle 120,000 volts alternating current on a peak voltage of about 200,000 volts, and we can take 120,000 volts alternating current and change it to 200,000 volts direct current without reaching any limit except in accuracy of design.

It is true that we do not yet know just how we shall do it, just as De Laval and Parsons and Curtis did not at first know how the big turbines were ever to be built. Our ancestors built muzzle-loading firearms for centuries until they worked out how to seal the breech, but now a 16-in. breech-loading gun is merely a matter of mechanical precision. Does it not, therefore, follow that the converter to produce high-tension direct current is in much the same position today that the turbine and the breech-loading gun were two hundred years ago or one hundred years ago?

We don't know whether direct-current high-tension transmission will come in one hundred years or two hundred years (or perhaps ten years, since when it does come it may come fast), but it is pretty sure to come. Already designs have been put on paper and some have been put into copper and iron, and they have all so far failed. We cannot blame the manufacturer for refusing to take long chances with but small chances of profit, but we can at least predict that high-tension direct-current transmission will some day enable a given amount of copper to carry about three times the kilowatts that it does now.

KASSANDRA.

Boston, Mass.

Station and Operating Practice

A Department Devoted to Problems of Installation,
Operation and Maintenance of Equipment for Economical Generation and
Distribution of Electrical Energy

Oil Firing Costs $1,200 Less Per Month for Boilers Rated at 1,000 Hp.

ABOUT $1,205 per month in labor was saved on four 250-hp. boilers by installing fuel-oil burners in place of the coal furnaces of the Economy Steam Heating & Electric Company, Sedalia, Mo. The former cost of firing coal was 14.4 cents per 1,000 lb. (454 kg.) of steam, while with oil this has been reduced to 2.4 cents, giving a saving of 12 cents per 1,000 lb. Regarding labor this plant formerly used twelve men in three shifts of eight hours with four men each. With oil firing two men can handle the work, each on a twelve-hour shift, and they are perfectly contented with the arrangement. The ease of firing as compared with the former hand firing of coal has made them willing to work the longer shift for the extra money. The fuel expense in the installation has remained about the same, as oil of 19,000 B.t.u. costs $1.50 per barrel at the boiler house, and coal of 9,000 B.t.u. costs $5. With this coal the cost of evaporation was 48 cents per 1,000 lb. Therefore the net saving per 1,000 lb. of steam is the 12 cents attributable to labor, or 25 per cent of total costs. Moreover, other advantages have been obtained from the oil fuel, such as ability to obtain a higher boiler output and to carry a more fluctuating load, lower cost of banking boilers, and ease in keeping the heating surfaces clean.

In making this change during the coal famine in the fall of 1919 it was necessary to remove the grates and boiler bridge walls and to install the checker work and piping. A five-car storage tank, unloading pump, oil pump and heater burners were already in place. The total cost charged to making the change is as follows:

Storage tank, pumps, heater burners, etc....	$550
Piping, fittings, etc.	250
Labor, including overhead expense	300
Total	$1,100

Based on these costs, the cost per boiler-horse-power is $1.10 for the complete installation.

Sedalia, Mo. H. A. WOODWORTH.

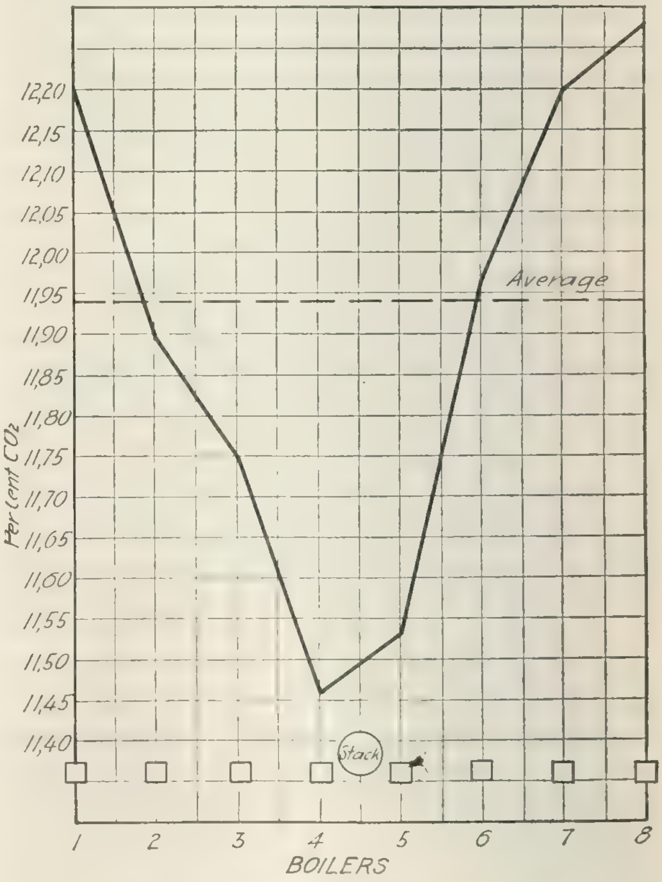
Overload Trouble Traced to Loose Millivolt Connections

DIRECT-CURRENT ammeters in which there is a millivolt circuit taken from an ammeter shunt may read low if the millivolt terminals are not properly tightened. It can be understood that when a manufacturer measures the wire between the ammeter shunt and the ammeter a change of resistance due to a poor connection will affect the reading of the instrument considerably. At one plant where five exciters were connected to an exciter bus a loose connection in the millivolt wiring caused one exciter to be overloaded when running in parallel with the other four. The overloaded exciter commutator was nearly ruined when the trouble was found. The trouble was remedied, however, after the commutator was turned down and the loose connections were properly tightened. L. W. WYSS.

Iron Mountain, Mich.

Distance of Boiler from Stack Influenced Amount of CO_2 in Flue Gas

CAREFUL analysis made of the flue gas from boilers of the Long Beach steam plant of the Southern California Edison Company under the direction of the superintendent of generation, R. J. C. Wood, has disclosed the fact that there is a definite relation between the location of the boilers with reference to the stack and the average CO_2. The curve shows this very clearly. Those boilers that are nearest the stack have a percentage of CO_2 considerably lower than those further away. This curve is based on the average daily analysis as made by the recording CO_2 machines which are installed on each boiler. Charts covering a period of 125 days were averaged to obtain the data plotted.



BOILERS NEAREST TO STACK HAVE LOW CO_2

Chart Used with Two Wattmeters to Determine Power Factor

FOR quickly determining the power factor of a balanced three-phase circuit the accompanying chart may be used in conjunction with two single-phase wattmeters connected to read the total power of the circuit they must be connected as *A* or *B* in the chart. To use the chart values corresponding to the readings from the respective meters are marked on the two side scales of the chart and a straight-edge is laid across the chart through these values. Then the point where this straightedge crosses the diagonal line gives the power factor the circuit. In case the readings of the wattmeters do not fall within the limits of the side scales, the readings may both be divided by any suitable number so that they will fit. As an example, say the meter W_1 reads 20 kw. while W_2 reads 120 kw. As neither of these values falls within the scales, each is divided by 10, giving 2 and 12, which fall on the scales and which give a power factor of about 0.63. It must be noted that when one of the meters reads negative the power factor is below 0.50 and in using the chart the figures underneath the diagonal line must be used. If, in the foregoing example, readings of W_1 had been negative, the power factor would be 0.38.

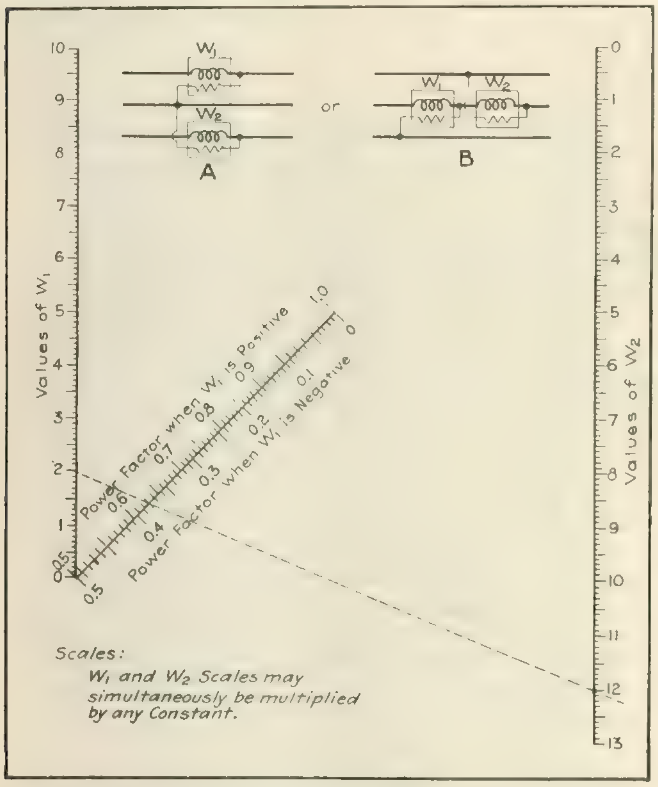


CHART FOR FINDING POWER FACTOR FROM TWO SINGLE-PHASE WATTMETER READINGS

This chart was drawn with values obtained by use of the formula

$$PF = \frac{W_2 + W_1}{\sqrt{(W_2 + W_1)^2 + 3(W_2 - W_1)^2}},$$

which holds in case of two single-phase wattmeters connected as shown by the chart on a three-phase balanced circuit.

For determining the average power factor over a certain length of time two watt-hour meters may be used. Several central-station companies are determining the average power factor of customers by this method. **RUSSELL G. WARNER.**

New Haven, Conn.

Installation Costs of Diesel Engines

COSTS of four-cycle, four-cylinder engines direct connected to three-phase, 60-cycle generators of 80 kw. to 350 kw. rating, as shown in the accompanying table, amount to $125 to $105 per horsepower f.o.b. factory. For the purpose of comparison with the cost of other engines the cost per pound may be used in addition to the cost per horsepower. The same engines which have already been referred to cost from 33 cents to 29 cents per pound f.o.b. factory (15 to 13 cents per kg.). The figures given in the table were prepared by an engine manufacturer in November, 1919, for the use of his men in the field. In addition to the cost of the engines the cost of the proper-size alternating-current, 60-cycle generator is given, as are all items of installation expense except land, buildings and fuel-shortage tanks. A 15,000-gal. (58,000-l) steel storage tank could be purchased for $730 f.o.b. the tank factory at the time these figures were compiled. Such tanks have been installed above ground on concrete saddles at a cost of between $1,000 and $1,200 complete. **S. N. CLARK.**

Chicago, Ill.

INSTALLATION COSTS OF DIESEL ENGINE-GENERATOR UNIT

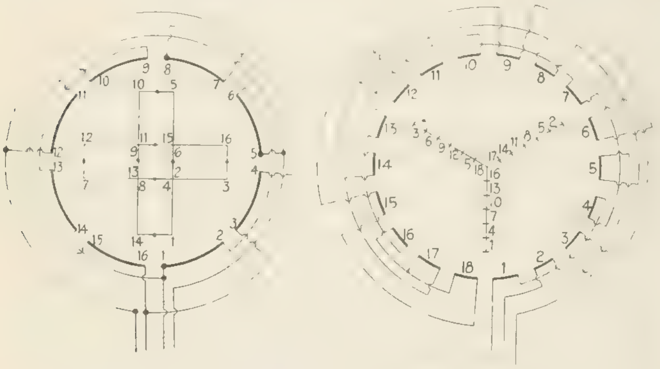
B.-hp. engine	120	165	180	250	365	420
Kw.-generator	80	110	120	170	250	350
R.p.m.	300	276	300	257	225	200
Shipping weight with heavy wheel, lb	47,100	61,600	61,600	92,000	135,400	200,000
Foundations, cu yd	40	50	50	70	90	120
Tentative price engine and standard equipment, f.o.b. factory	$15,000	$19,800	$20,400	$28,750	$40,150	$54,600
Freight at 50c. per 100 lb	236	308	308	460	677	1,000
Hauling at $5 per ton	118	154	154	230	339	500
Erection—Travel	75	75	75	75	75	75
Time and expense	475	510	510	600	715	950
Labor	250	300	300	350	400	450
Piping-engine room (estimated)	340	340	340	450	615	830
Total, engine delivered and erected	$16,494	$21,487	$22,087	$30,915	$42,971	$58,405
Generator, 2,300-volt, three-phase, 60-cycle, and belt exciter, f.o.b. works	$1,880	$2,125	$2,300	$2,525	$3,085	$4,740
10 per cent for foundation bolts, pulley, belt, contingencies	190	215	230	250	310	475
Approximate shipping weight, including exciter, lb	(5,500)	(7,000)	(8,000)	(9,500)	(12,000)	(14,500)
Freight, at $1 per 100 lb	55	70	80	95	120	145
Hauling and erection (estimated)	100	100	100	150	175	200
Generator and exciter delivered and erected	$2,225	$2,510	$2,710	$3,030	$3,690	$5,560
Complete engine generator unit	$18,719	$23,997	$24,779	$33,945	$46,661	[illegible]
Foundations, at $12 per yd	480	600	600	840	1,080	1,440
Total complete unit delivered and erected, including foundations	$19,199	$24,597	$25,379	$34,785	$47,741	$65,405

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

Two-Phase Motor Reconnected for Three-Phase Operation

CHANGING a two-phase, 220-volt, 40-cycle motor to operate on a three-phase, 550-volt, 60-cycle circuit without rewinding was a task accomplished during the war by a Connecticut shop. This motor was wound with seventy-two coils in seventy-two slots connected two in parallel for four poles, giving a speed of 1,200 r.p.m. As the speed was to be the same after the change it was found by applying the formula (2 × 60 × 60 cycle) ÷ number of poles = r.p.m., that the poles should be increased to six. There were originally 72 ÷ 4 or 18 slots per pole, and 180 ÷ 18 = 10 electrical degrees per slot. As the throw of the coils was one to fifteen or fourteen slots, there were 14 × 10 = 140 electrical degrees per coil, giving a chord factor of sin 140 ÷ 2 = 0.94.



TWO-PHASE, 40-CYCLE MOTOR RECONNECTED FOR THREE-PHASE, 60 CYCLES

The throw for full pitch with six poles is 72 ÷ 6 = 12 slots per pole or 180 ÷ 12 = 15 deg. per slot. Therefore if the coils were not rewound the chord factor with six poles would be sin (14 × 15) ÷ 2 = sin 210 ÷ 2 = 0.98. When the windings were connected series-star the voltage was (taking into consideration this change from two-parallel to series, two-phase to three-phase, 40 cycles to 60 cycles, four poles to six poles, and 0.94 to 0.98 chord factor) 220 × 2 × (2 ÷ 3) × (60 ÷ 40) × (4 ÷ 6) × (0.98 ÷ 0.94) × 1.73, or 527 volts. As this was only 6 per cent below 550 volts, the motor was connected in this way and operation afterward showed that it did not overheat. CHARLES A. AUBREY.

Bridgeport, Conn.

Electrical Energy Consumed in Making Yellow Brass

THE consumption of electric energy under average conditions of eight-hour to ten-hour operation is as low as 240 kw.-hr. per short ton of yellow brass and 275 kw.-hr. per ton for red brass in the induction or arc furnaces, according to H. M. St. John. In twenty-four-hour operation figures as low as 200 kw.-hr. per ton or less have been obtained. Less efficient furnace types use from 400 kw.-hr. to 500 kw.-hr. per ton, depending upon conditions.

Adjusting Excitation of Synchronous Motor for Power-Factor Correction

TO GET the maximum possible corrective effect from a synchronous condenser the excitation should be adjusted to the highest value allowable by the field heating. If the motor has a separate exciter which can be operated at any desired voltage, the most economical operation can be obtained if the motor-field rheostat is cut out and the exciter voltage adjusted to give maximum allowable exciting current for the motor. Under these conditions no waste of power occurs in the motor-field rheostat, while any loss in the exciter field rheostat will be relatively small. With most modern designs of motors, the maximum allowable excitation is obtained when the motor-field rheostat is cut out and 125 volts is applied to the windings. Marks should be made on the dial plates to guide the operator in setting the regulators at the best position, and sometimes it is even advisable to block the regulators so that excessive excitation is impossible. JAMES DIXON.

Cleveland, Ohio.

Motors Thrown on Line for Starting in Regrinding Mills

THROWING the motors directly on the line without auxiliary control devices such as compensators, etc., has become standard practice in starting the regrinding mills of the Michigan copper mines. These mills, called "conical" mills in that locality, are used in the secondary process of copper extraction, regrinding the sand from the steam stamp mills after it comes from the first washing. The grinding is done by loose steel balls in the cone-shaped tank, and the motor required to drive such a mill varies from 50 hp. for a 6-ft. (1.8-m.) mill to 75 hp. for an 8-ft. (2.4-m.) mill. Voltages are either 440 or 2,200, depending on the practice of the company. In either case, however, the only control equipment is an oil switch with overload trip coils and a low-voltage release. In starting a motor the trip coils are made inoperative by holding the cores, a suitable holding lug being provided for that purpose. This allows the cores to be set for close protection under running conditions and yet permits starting on the line. In case an ammeter is used it is short-circuited with a plug switch at the time of starting.

Men with the copper-mining companies report that excellent results have been attained with this method, which has been in use for six or more years. The starting switches have in no case given so much trouble as was experienced with control equipment.

Methods of Operating Valves by Motor

VALVES suitable for operation by electric motor may be classed as: (1) Valves with conical or similar seatings upon which the valve may be jammed: (2) Sluice valves, penstocks and similar types, where the valve consists of a plate held in guides and operated up and down by means of a worm or screw gear. Considering valves with seatings, it is possible for a valve to become so jammed on its seat that a directly connected motor may become seriously overloaded before it moves. To overcome this difficulty it is preferable to drive through a clutch and use a high-speed motor, enabling the momentum of the motor armature to be utilized. The clutch may be of the slipping type, so that on closing the valve the maximum effort is applied until the clutch slips to insure that the valve is tight on its seat.

In opening the valve after the motor is up to full speed the clutch is applied in such a way that the momentum breaks the static friction and enables the motor to open the valve. A simple claw clutch may be used with an overload relay trip, or two separate overload relays may be used for opening and closing the valve respectively. The motor should be compound-wound so as to speed up, say 20 per cent, between full load and one-sixth full load and thus to obtain full flywheel effect of the armature.

In case the valve plate is lifted vertically the plate should be balanced, as the load at opening is in excess of that during closing when the weight of the valve plate is assisting the motor. A series-wound motor should be used, and for large unbalanced valves potentiometer control should be employed for the closing side. Limit switches should be provided for both the closed and open positions, and in many cases indicating lamps are required to indicate the position of the valve. In general the motors and control gear have to work in damp locations, steam or water usually being present. Therefore the motor should have gum-impregnated windings and should be at least drip-proof. This also applies to the control gear, which should be drip-proof with parts well protected against moisture.

Liverpool, England. MARK MEREDITH.

Losses Resulting from Use of Improper Brushes

FLUSH mica commutators require a brush with sufficient abrasive action to remove the mica as rapidly as the copper is worn down. On the other hand, undercut commutators require brushes with a minimum of abrasive effect in order to keep the wear on the commutator and the power lost in friction as low as possible. The use of abrasive brushes on unslotted commutators will quickly wear them down and fill up the slots with copper dust, resulting in short circuits and burned-out armatures. It is obviously impossible to secure a brush which will not gradually wear away the commutator, but with an abrasive brush operated at 2 lb. per square inch (140 gr. per sq.cm.) the loss on the average machine is about 2½ per cent of its rating. The brush friction losses on a 100-kw. generator operating at full load ten hours per day 300 days per year would therefore cost about $112.50 per annum if energy cost 1.5 cents per kilowatt-hour. The major portion of this expense can usually be saved on slotted commutators when the proper kind of brush is used and the proper tension is maintained.

A brush pressure of about 1.75 lb. to 2.25 lb. per square inch (125 gr. to 160 gr. per sq.cm.) is generally used on slotted commutators under average conditions. For elevator and mill type motors, however, 2 lb. to 3 lb. (140 gr. to 210 gr.) brush pressure is recommended, on crane motors 3 lb. to 5 lb. (2.0 gr. to 350 gr.) and for railway motors 4 lb. to 7 lb. per square inch (280 gr. to 490 gr. per sq.cm.).

Lubricants are not generally satisfactory for use on undercut commutators. The addition of a lubricant tends to hold carbon dust and dirt in the slots and causes short circuits and burned-out coils. Ordinarily the proper type of brush contains enough lubricant. This is especially true when graphite brushes are used.

Cleveland, Ohio. DONALD S. MERTON.

Number of Wires in Conduit Limited by Heating

WHERE a very large number of the smaller-size wires are contained in a large conduit and where these wires are allowed to carry their full rated current for any great length of time the inner wires of the group reach a temperature which would soon destroy the installation and possibly ignite it. This is the opinion expressed in the 1920 report of the rubber-covered wire committee (V. H. Tousley, Chicago, chairman) of the Western Association of Electrical Inspectors. For this reason the committee recommended that not more than nine conductors be used in a single conduit when each wire carries its full rated current.

In special cases requiring more than nine wires in a conduit the committee recommended that the current carried by the wires be limited so that the aggregate I^2R loss would not exceed that of the largest wire permitted in the particular size conduit under consideration when carrying its rated current. These considerations will limit the application of the formula in the article "Correct Conduit Sizes," on page 533 of the ELECTRICAL WORLD for March 13, 1919. An illustration of the way in which the rule is to be applied is given in the following example:

According to the formula given in the 1919 report of the committee, forty-three No. 14 (2.08 sq.mm.) wires could be placed in a 2-in. (50-mm.) conduit. In the same size conduit the code allows a 1,000,000-circ.mil (506.7-sq.mm.) conductor. This has current-carrying capacity of 650 amp. and its resistance is 0.0000108 ohm per foot (0.0000354 ohm per meter). The permissible I^2R loss on the conduit is therefore 4.563 watts per foot (14.95 watts per meter). The forty-three wires which are to be placed in the 2-in. (50-mm.) conduit would hence be allowed to carry only that current which would give an equal I^2R loss in the aggregate. The 4.563 watts divided by the number of wires (forty-three) gives a loss of 0.318 watt per wire. The square root of this wattage divided by the resistance of the No. 14 wire gives 6.4, which is the current that each No. 14 wire would be allowed to carry when there are forty-three wires in the conduit.

These rules apply only to complete conduit systems and are not applicable to short sections of conduit used for the protection of exposed wiring from mechanical injury. These rules are applied in Chicago, where they have been found to work out satisfactorily.

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

Twenty-seven Systems Each Had an Output of 400,000,000 Kw.-hr. in 1919

In 1915, when operating conditions and the demand for energy were still on a normal peace basis, there were but nine generating systems having a yearly output of more than 400,000,000 kw.-hr., while in 1919, when demand for energy had returned again to a peace basis, there were twenty-seven systems whose yearly output exceeded that figure. This information is reflected in the tabulation on page 1099 of this issue, which gives the peak load, date of its occurrence, yearly kilowatt-hour output and load factor of the largest generating systems in America for 1917, 1918 and 1919. Statements by officials of the power companies which have been made in transmitting the data for the past year reflect a steadily increasing demand for energy which they are finding some difficulty in satisfying.

Companies operating in various sections of the United States and in Canada are experiencing a power shortage. In commenting on this situation, F. A. Gaby, Toronto, Ontario, chief engineer of the Ontario Power Company of Niagara Falls, writes: "As to the power situation in the Niagara district, a serious shortage still exists. The recovery of industry since November, 1918, has been phenomenal, some 80,000 hp. previously used by munitions plants being absorbed entirely in the manufacture of other products. We have on hand requests for the delivery of about 45,000 hp., and at a conservative estimate, 100,000 hp. will be required to meet the growing demand."

John L. Harper, vice-president and chief engineer of the Niagara Falls (N. Y.) Power Company, states that although that company has put in operation the three 32,500-kva. units in the new extension of its plant No. 3, there is still a shortage of supply which will not be met even by total rating of these new units. "Should legislation make possible further advances in development," writes Mr. Harper, "it would probably require five years' constant construction work on the American side to place ourselves in position to meet the requirements for power delivery."

"The power situation is very active," writes F. J. Sill, superintendent of distribution of the New England Power Company, which has an extensively interconnected hydro-electric and steam system. "All of the present power users are increasing their load, and the company is not in a position at the present time to take on a load greatly in excess of that already contracted for."

Companies operating in New York, Chicago, Philadelphia, Detroit, Pittsburgh, Newark and Brooklyn, where a highly diversified load is served, show consistent growth in output. Many companies which at the beginning of the year anticipated a serious falling off due to loss of power load in munitions plants find that their output has materially increased. They have accounted for this largely by the fact that a large number of comparatively small power users were added, isolated plants being abandoned in favor of purchased power. In addition to this, not a small percentage of increased output is due directly to increases in residential demands and commercial lighting business.

Hydro-electric companies in California have been seriously affected by water shortage, necessitating a larger proportion of steam generation. In the Northern and Northwestern States, where operating companies supplied comparatively few munitions plants, the increase in output shows a natural and healthy growth. Regarding conditions in that section, W. N. Ryerson, general manager of the Great Northern Power Company, Duluth, Minn., says: "We did not undergo rapid expansion in this section, but have experienced a steady growth in our business, which, if anything, has been more marked since the signing of the armistice."

It is evident from an examination of the output of the various systems during the past three years that there is a general and rapid increase in the demand for energy, and the shortage of power in many localities emphasizes the urgent necessity for the construction of extensions to existing stations and the building of new plants where the ultimate rating of present stations has been reached. This is true in Canada as well as in the United States. Julian C. Smith, vice-president of the Shawinigan Water & Power Company at Montreal, says: "The Province of Quebec has encouraged the development of water powers, and as a result we were able at the beginning of the war to take care of the situation so that in this district there was no power shortage throughout the whole of the war. We feel now that the time has come to look forward to new developments, and soon, with the gradual improvement in financial conditions and the lessening of the industrial unrest, the new water-power projects will have to be carried out."

This year the table includes the outputs of electric railway companies generating over 100,000,000 kw.-hr. annually. A large amount of energy in some cases is purchased from power companies whose outputs are already reported in the table, therefore only those railway companies generating over 100,000,000 kw.-hr. in their own plants are reported. The total energy generated in 1919 by the forty-seven lighting and power companies included in the table was 24,862,460,942 kw.-hr., or 64.4 per cent of 38,559,000,000 kw.-hr., the total annual output of all central stations during the year. The total energy generated in 1919 by the eight railway companies was 2,473,098,444 kw.-hr.

Data on Output and Load Factor of Largest Generating Systems in America

(This table includes all lighting, power and electric railway companies in the United States and Canada having yearly outputs in excess of 100,000,000 kw.-hr.)

System	1919				1918				1917			
	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Yearly Load Factor (Per Cent)	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Yearly Load Factor (Per Cent)	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Yearly Load Factor (Per Cent)
Lighting and Power Companies:												
Niagara Falls Power Company	275,803	Dec. 29	2,034,608,904	84.2	254,139	Apr. 8	2,054,360,080	92.21	152,340	Aug. 1	1,188,221,770	88.97
Commonwealth Edison Company	428,630	Dec. 15	1,628,340,000	44.6	400,010	Dec. 2	1,508,070,000	43.5	392,330	Dec. 28	1,488,080,000	44.6
New York Edison and United Electric Light & Power Company	330,210	Nov. 25	1,104,521,883	38.5	286,103	Dec. 11	958,878,156	38.2	278,097	Dec. 12	954,913,584	39.2
Shawinigan Water & Power Company	172,900	Jan. 14	1,031,111,695	68.0	136,800	Sept. 24	1,058,136,117	....	119,000	Dec. 21	633,573,610	60.4
Southern California Edison Company	200,020	July 23	1,021,977,519	58.3	163,125	July 12	779,758,000	54.5	166,755	Oct. 11	685,416,000	54.4
Pacific Gas & Electric Company	187,135	Dec. 19	994,557,418	60.7	166,705	June 4	922,037,604	63.1	158,272	Nov. 27	854,099,030	61.6
Ontario Power Company	150,000	Nov. 12	949,223,500	71.3	119,000	Oct. 19	963,845,200	92.4	123,500	Nov. 11	990,086,100	91.5
Detroit Edison Company	210,000	Dec. 5	872,583,200	47.4	172,000	Dec. 13	773,876,700	51.3	152,300	Nov. 27	672,200,600	50.4
Montana Power Company	133,500	June 13	865,998,552	74.0	157,800	Nov. 21	1,108,125,350	....	147,712	Jan. 11	947,732,014	73.0
Montreal Light, Heat & Power Company	164,415	Dec. 16	852,680,550	59.2	166,730	Dec. 6	976,462,529	6[illegible].0	152,665	Nov. 12	946,832,817	70.8
Public Service Electric Company	207,890	Dec. 16	821,355,239	45.1	185,738	Dec. 5	795,481,279	48.9	181,500	Nov. 27	734,665,649	46.2
Philadelphia Electric Company	199,247	Dec. 18	722,615,280	41.4	166,294	Dec. 6	693,447,962	47.6	148,931	Nov. 20	600,583,589	46.0
Duquesne Light Company	157,900	Dec. 22	623,000,000	45.0	141,000	Dec. 6	641,874,585	51.9	125,000	Nov. 9	592,575,925	54.0
Southern Power Company	196,500	Dec.	585,596,925	....	162,600	Dec. ..	551,313,367	...	166,300	May	563,533,763	..
Mississippi River Power Company	113,450	Nov. 18	590,488,000	59.4	102,950	Mar. 8	557,200,000	61.8	86,400	Oct. 31	476,500,000	63.0
Cleveland Electric Illuminating Company	153,878	Dec. 5	576,131,649	43.0	128,319	Nov. 22	543,663,042	48.33	113,228	Nov. 27	444,735,309	45.0
Toronto Power Company	115,000	Jan. 8	548,477,616	54.4	125,000	Dec. 3	897,512,877	81.9	118,000	Dec. 14	800,638,000	84.0
Pennsylvania Water & Power Company	87,000	Nov.	512,138,100	67.2	89,000	Feb. ..	500,641,122	64.2	86,000	......	516,891,000	68.6
Buffalo General Electric Company	106,500	Nov. 22	508,583,680	54.5	104,100	Nov. 22	587,761,870	64.4	95,400	Dec. 6	440,596,100	52.7
Utah Power & Light Company	79,725	Jan. 14	461,532,000	65.9	81,313	Dec. 27	533,044,000	74.83	79,011	Dec. 21	502,183,000	72.5
Consumers Power Company	108,847	Nov. 28	456,230,164	47.8	98,666	Nov. 21	404,412,000	46.8	94,235	....	380,570,917	46.0
Great Western Power Company	84,860	Aug. 1	453,353,358	60.9	75,480	Aug. 12	451,309,000	68.0	74,900	Oct. 6	457,998,635	71.13
Puget Sound Power & Light Company	93,900	Dec. 18	452,209,000	55.0	88,230	Dec. 20	427,800,000	55.4	83,800	Dec. 21	396,600,000	54.0
Tennessee Power Company	82,300	Feb. 14	422,272,590	58.6	87,800	Dec. 11	519,959,383	67.6	85,200	June 15	547,945,475	73.41
Electric Company of Missouri and Union Electric Lt. & Pr. Co.	99,498	Dec. 3	408,920,575	46.6	92,000	Nov. 26	395,820,236	49.1	92,300	Dec. 6	376,891,756	46.5
Consolidated Gas, Elect. Lt. & Pr. Co., of Baltimore	80,640	Dec. 5	392,201,280	54.9	82,760	Nov. 7	433,196,550	64.9	69,980	Dec. 4	343,523,580	62.4
New England Power Company	93,860	Dec. 9	357,303,224	43.5	76,900	Dec. 16	323,127,784	48.0	71,500	Oct. 30	300,600,000	48.0
Alabama Power Company	83,100	Jan. 10	347,993,284	47.7	86,850	Dec. 19	392,247,862	51.5	58,250	Nov. 14	289,715,125	56.7
Minneapolis General Electric Company	72,745	Oct. 24	332,264,401	53.2	66,189	Nov. 1	297,443,050	53.3	54,940	Dec. 6	222,146,210	46.16
Wisconsin Edison Company and Milwaukee Electric Ry. & Lt. Co.	97,912	Dec. 4	331,874,192	39.0	87,855	Nov. 20	327,784,516	43.0	71,106	Nov. 30	275,966,740	44.0
Edison Electric Illuminating Company of Boston	103,136	Dec. 8	328,798,850	36.4	95,774	Dec. 6	293,966,604	35.0	83,966	Dec. 19	265,430,474	36.1
Brooklyn Edison Company, Inc.	105,400	Jan. 15	327,084,075	35.4	86,000	Dec. 11	282,424,822	37.5	78,000	Dec. 19	255,912,300	37.5
Sierra & San Francisco Power Company	57,597	July 20	272,602,349	54.0	52,634	July 16	246,759,842	53.7	45,270	Jan. 11	196,069,588	49.44
Portland Railway, Light & Power Company	56,300	Dec. 22	271,010,300	55.0	56,900	Dec. 23	258,424,940	52.0	50,620	Dec. 31	218,086,315	49.0
Michigan Northern Power Company	35,794	Apr. 23	264,272,468	84.3	33,519	Dec. 24	233,381,654	79.4	32,990	Dec. 3	221,338,737	76.7
Georgia Railway & Power Company	71,700	Dec. 18	262,834,541	41.8	68,000	Nov. 8	238,489,012	.	78,200	Apr. 24	258,607,882	....
Washington Water Power Company	63,220	Dec. 3	241,761,350	43.6	33,956	Nov. 26	195,628,500	65.1	36,707	Dec. 20	188,311,100	58.5
Great Northern Power Company	48,000	May 12	213,189,992	50.7	45,780		180,040,171	44.9	40,000	Oct. 24	185,583,920	51.5
Potomac Electric Power Company	55,000	Dec. 17	204,008,647	42.3	48,000	Dec. 20	173,180,014	41.0	44,800		140,762,646	36.09
Toledo Railway & Light Company	48,220	Dec.	199,771,799	47.4	40,305	Dec. 4	161,103,970	45.7	37,627	Dec.	162,061,232	49.4
Rochester Railway & Light Company	42,500	Dec. 2	172,892,249	46.0	52,300	Nov. 22	196,171,300	42.8	42,154	Dec. 13	162,490,264	44.0
Southern Sierras Power Co. and Nevada California Power Co.	29,200		165,782,785	64.7	28,200	Aug. 6	161,347,690	65.3	25,900	Aug. 9	148,267,885	65.3
Narragansett Electric Lighting Company	57,000	Dec. 23	155,678,890	31.2	45,000	June 20	150,028,780	38.1	33,500	Dec. 19	113,238,441	38.6
Adirondack Electric Power Company	39,500	Dec. 23	144,553,094	41.8	50,250	Nov. 8-Ja. 23	174,567,275	39.6	42,000	Dec. 7 & 14	158,570,164	43.1
Empire District Electric Company	32,030	Oct.	130,114,100	46.3	25,400	Sept. 5	114,446,685	51.4	23,000	Apr. 1	105,487,860	52.4
Virginia Railway & Power Company	42,800	Dec. 18	125,840,000	48.4	35,700	Dec. 18	164,810,750	52.8	37,000	Dec. 8	153,128,026	47.39
Southwestern Power & Light Company	53,034	Dec. 18	121,431,280	45.4	38,100	Sept. 26	148,562,000	44.5	31,500	Nov. 17	126,396,800	46.0
Electric Railway Companies:												
Interborough Rapid Transit Company	239,940	Dec. 19	810,158,475	38.5	204,000	Dec. 30	731,058,965	40.8	184,000	Dec. 11	689,665,975	42.8
Brooklyn Rapid Transit Company	111,000	Dec. 16	406,130,443	41.7	109,892	Feb. 21	385,346,075	40.0	115,792	Feb. 2	396,068,887	39.0
Philadelphia Rapid Transit Company	101,120	Dec. 18	349,542,666	39.4	94,730	Dec. 27	339,232,739	40.8	103,220	Jan. 11	348,37[illegible]	38.5
Boston Elevated Railway Company	71,760	Mar. 23	240,429,915	38.3	67,965	Mar. 23	228,131,265	38.4	79,535	Feb. 12	262,920,075	37.7
Kansas City Railway Company	40,430	Oct. 27	241,707,571	49.0	57,280	Jan. 11	209,378,747	41.7	61,350	Feb. 2	236,675,814	44.0
Pennsylvania Railroad, Long Island City Power Plant	53,900	Dec. 19	181,017,940	34.2	48,600	Dec. 3	165,377,180	36.3	45,000	Dec. 10	161,673,710	37.5
New York Central Railroad Company	44,100	Dec. 29	140,435,406	36.3	38,360	Dec. 22	127,412,457	37.9	42,480	Dec. 10	147,809,842	39.7
Twin City Rapid Transit Company	42,612	Nov. 28	133,676,028	35.8	44,966	Feb. 19	131,351,288	33.4	51,956	Mar. 31	152,469,348	33.5

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

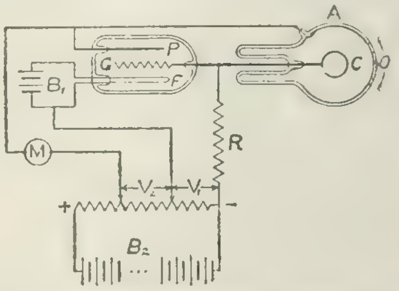
The Alternating-Current Commutator Motor.—B. G. LAMME.—The alternating-current commutator motor has been developed principally for the purpose of obtaining adjustable or variable speeds. In general control of speed with the alternating-current induction motor implies variable or adjustable frequency in some form, and this in turn involves a commutator of some type. The simplest method, according to the author, for viewing both alternating-current and direct-current commutating problems is to consider primarily the actual emfs. short-circuited by the brushes and the resistance in the short-circuited paths—that is to say, the problem of commutation is largely one of the permissible amount of short-circuited current. The author contends that the commutation problem in alternating-current motors is the same as for direct-current when all emfs. are taken into account. The major part of the paper covers the consideration of the different emfs. which should be taken into account in the various types of alternating-current commutator motors, and it is shown in a general way that the emfs. involved in speed control also appear in the commutation problem. In the latter part of the paper certain general conditions of commutation and brush operation are treated and some figures are given for comparison of alternating-current and direct-current commutating limits.—*Journal A. I. E. E.*, March, 1920.

Analysis of the Performance of Alternating-Current Machinery by Means of Vector Locus Diagrams.—LEON OTIS-CHEVALIER.—Certain developments in complex algebra lead the author to a number of theorems of high generality concerning the form and character of the performance diagrams for alternating-current machinery of various types. In this theory neither parasitic effects due to saturation nor iron losses is taken into consideration. As examples of the practical application of the vector locus analysis the cases of a single-phase series motor and a polyphase induction motor are treated. These cases are characterized by the well-known circular diagrams. The Latour compensated repulsion motor, which leads to the loci of parabolic and inversed parabolic form, is also discussed.—*Revue Générale d'Electricité*, March 6 and 13, 1920.

Lamps and Lighting

Glare Measurements.—WARD HARRISON.—Data are presented showing the range of agreement in opinion among a number of observers as to the glare from bare lamps and other more diffuse light sources in comparison with a reference source of variable intensity. The practicability of a rough classification of lighting installations into groups according to the sensation of glare as registered by small instruments based on this method of comparison is discussed.—*Transactions Illuminating Engineering Society*, Feb. 10, 1920.

A Photoelectric Photometer.—ARTHUR H. COMPTON.—In this paper the difficulties are reviewed which heretofore have prevented the use of the photoelectric cells in routine photometry. The use of a thermionic amplifier to increase current readings is suggested, also a filter to reduce the proportion of blue light and render the indications proportional to the photometric value. With such equipment lamps are compared by varying their distances to the cell until the deflection of the galvanometer is the same as that given by the standard lamp. In the illustration the amplifier is indicated by *CGF* and the inner electrode *C* is used as the photosensitive cathode.—*Transactions Illuminating Engineering Society*, Feb. 10, 1920.



ARRANGEMENT OF THERMOELECTRIC CELL FOR PHOTOMETRY

Generation, Transmission and Distribution

Savings Due to Economizer.—R. G. BOHN.—Methods are given for calculating the heat transfer, final temperatures of water and gas and the net savings effected.—*Power Plant Engineering*, April 1, 1920.

The Electrical Problem of Victoria.—In 1918 a committee was appointed by the government of Victoria, Australia, to formulate advice regarding the use of brown coal for power and other purposes. This committee recommended that the brown-coal deposits at Morwell should be utilized to generate electrical energy and that the current should be transmitted to Melbourne for distribution. At present coal from New South Wales is imported into Victoria to the extent of about 450,000 tons per annum, and it is suggested that this quantity should be displaced by the use of electrical energy generated from brown coal. After a careful consideration of the problem the commissioners have arrived at the following conclusions: (1) That the necessary steps should be taken to inaugurate a state scheme for the supply of electrical energy; (2) that as a nucleus of such scheme the Morwell brown coal field should be opened up and a powerhouse established of a capacity of 50,000 kw. for burning it; (3) that the scheme be undertaken with a view to operation early in 1923; (4) that the consideration of hydro-electric power schemes be deferred until further investigations. Other recommendations cover the problems involved.—*Electrical Times*, March 11, 1920.

Traction

Electrification of Steam Railways.—M. SEMENZA.—Previous to the war the electrification of steam railways in Italy was justified by the necessity of improving the traffic of some lines, too expensive for steam traction, or of increasing the traffic of others which had reached their maximum development with steam traction. After the war, however, a supplementary reason arose to justify the electrification, namely, that of limiting so far as possible the use of coal. The author shows how this economy can be obtained and what type of electric locomotive should be employed. His conclusion is in favor of the direct-current system of traction.—*Science Abstracts, Section B*, Dec. 30, 1919. (Abstracted from *Elettrotecnica,* Sept. 15, 1919.)

Modern Practice in the Construction and Maintenance of Rail Joints and Bonds in Electric Railways.—E. R. SHEPARD.—This revised edition of a paper already published on the subject contains an appendix with descriptions of recent improvements in the field of rail bonds and joints not contained in the former article.—*Technologic Paper No. 62, U. S. Bureau of Standards,* Feb. 9, 1920.

Installations, Systems and Appliances

Automatic Control for Motors Driving Pumps and Compressors.—B. W. JONES.—In the use of direct-current motors, squirrel-cage and slip-ring induction motors and synchronous motors for pump and compressor drive there are about eighteen variations in the systems employed for automatic control. Usually the direct-current motors are started on series resistors which are automatically short-circuited when the motor reaches a given speed. The author recommends the use of starting compensators for all alternating-current motors in this field and states that in practically every instance a simple one-point automatic compensator will give just as satisfactory results as a more complicated multi-point type. Wiring diagrams are given of automatic-control panels for a number of representative cases using motors of different types. Pressure regulation is usually accomplished by aid of a diaphragm, which, in a direct-current shunt motor, causes resistance to be cut into the field circuit when the pressure drops. Reversed action is desired when the motor is running a stoker. The diaphragm then is working from the forced-draft pressure, so that when the draft is increased the stoker increases in speed.—*Power,* March 30, 1920.

Electric Motors for Coal Mining.—FRANK BROADBENT.—In this article the author deals with means of increasing the output of the coal fields. He points out that this involves increased handling and transport facilities and a general speeding up of all other operations, including pumping, ventilating, hauling, winding, picking, screening, etc., and for all these purposes electricity is not only the most convenient but also the most economical method of driving.—*Beama,* January, 1920.

Electrically Driven Hoists.—FRASER JEFFERY.—Unbalanced single-drum hoisting and the more efficient balanced hoist employing a second cage or counterweight are considered. The character of load imposed by different types of hoist and different hoisting depths is shown by means of curves. It is said that the slip-ring induction motor is usually applied to this service. Details of electric braking and a comparison of full magnetic and liquid control are included.—*Power,* Feb. 24, 1920.

Electrophysics and Magnetism

Synthetic Electric Furnace Cast Iron.—CH. A. KELLER.—A description of the development in France during the war of electric furnace processes for converting steel turnings from munition plants into low-carbon cast iron, high in silicon and low in sulphur and phosphorus, for the production of cast-iron shells. Several types of furnaces were used, and the method was varied according to whether very low sulphur or very low phosphorus, or both, were desired.—Paper presented before American Electrochemical Society, April 10, 1920.

Telegraphy, Telephony and Signals

The Audion Oscillator.—R. A. HEISING.—The author covers the theory and operation of audion oscillator circuits, embracing phase relations in various circuits, frequency of operation, simplication of complex circuits and the behavior of oscillators as a function of the many variables. Vector diagrams are given of the phase relations in several simple circuits. The similarity of more complicated circuits to the simple ones is illustrated, and the method of determining the mode of operation of these complicated circuits by resolving them into simple ones is given. A series of curves shows the behavior of an oscillator as the six independent variables in the circuit are varied, and a method of quickly and easily adjusting a circuit to its proper working condition is pointed out.—*Journal A. I. E. E.,* April, 1920.

Determination of Damping and Frequency in Triode Circuits.—BLONDEL and LAVANCHY.—Some time ago A. Blondel published (*Journal de Physique,* July 1919) a general method for analyzing triode oscillator problems. This method consists briefly in a discussion of the "characteristic equation" derived from the differential equations of the system. Use is made of a certain general theorem, due to Hurwitz, regarding the conditions of existence of any root with a positive real component such as would correspond to an oscillation with increasing amplitude. In the present communication a résumé of this method is given, and as examples of the technical application of the analysis a number of practically important circuits are treated. The theory is flexible enough to embrace not only what Blondel calls the æolian condition—*i.e.,* when the reaction is just big enough to maintain steady oscillations of very small amplitude—but it permits also the computation of the damping of the system when these conditions are not reached.—*Revue Générale d'Electricité,* Dec. 20, 1919.

Miscellaneous

Oil as a Fuel from the Producer's Viewpoint.—HENRY THOMAS.—The world's production of petroleum in the year 1918 was 514,208,715 barrels of 42 gal., produced by the following countries in the order of their quantity as reported by the United States Geological Survey:

United States	355,927,716	Japan and Formosa	2,449,069
Mexico	63,828,327	Egypt	2,079,750
Russia	40,256,182	Trinidad	2,000,000
Dutch East Indies	12,846,265	Argentina	1,321,315
Rumania	8,730,235	Germany	711,260
India	8,000,000	Canada	304,741
Persia	7,200,000	Venezuela	190,080
Galicia	5,591,620	Italy	35,953
Peru	2,536,102		

The author discusses the use of petroleum as a fuel and oil-burning equipment both for marine and power plant use.—*Journal Engineers' Club of Philadelphia,* February, 1920.

TRANSPORTATION conditions continue to improve in general, although some distant localities in the South and the West have not benefited so far to any extent. Freight shipments in Chicago and the East are much better than heretofore, and the general belief is that all delayed freight now en route will be delivered to jobbers within the next few weeks.

During the past week one jobber in the metropolitan district received two cars of pipe and one car of flexible armored conductor from the Pittsburgh district, thus indicating that of the materials most badly needed some are commencing to come through in good quantity.

Heavy demands for pipe, armored conductor, wire and porcelain for suburban building in all sections is reported, with a question as to whether shipments will continue to arrive in sufficient quantity to keep the building program going. So far immediate needs are being met.

One line of switchboxes has advanced 3 cents on each, and annunciator wire has been marked up 5 per cent by at least one large manufacturer. In addition, fittings for flexible armored conductor have been advanced by several manufacturers.

Local stocks of pole-line materials are almost gone. Mills have plenty of cross-arms, but they cannot move them. Several carloads are en route to jobbers.

It is expected that books for third-quarter ordering of electric sheets are about to open, with little additional capacity over that of the first half year. No let-up in volume of ordering is expected.

From the present rate of ordering, electrical manufacturers will hang up new records this year. Business coming in is in excess of production capacity. Car shortage is backing up shipping schedules.

There will be no Chicago Electric Show in October of 1920 as had been planned, it being deemed poor business judgment to project a show just before the presidential election and at a time when business conditions in the country are so uncertain.

The new Court of Industrial Relations established in Kansas has been declared constitutional by Judge Curran of the district court before which its legality was questioned.

Noticeable progress in the industry and in its service to the public is announced in the second annual report of the advisory committee of the California Electrical Co-operative Campaign.

Eventual success in fabricating ships by electric welding instead of riveting was confidently prophesied by speakers at meetings of the Philadelphia Section, A. I. E. E., and the American Bureau of Welding.

L. K. Sherman, president of the United States Housing Corporation, has been nominated for president of the American Association of Engineers, which convenes in St. Louis on Monday.

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

A special session of the South Dakota Legislature is to be convened this month which will consider the proposal of the water-power commission of the state to dam the Missouri River for the purpose of furnishing hydro-electric power to the cities of the State and possibly also to Sioux City, Iowa.

To promote the safety movement public utilities of New York State and Pennsylvania are organizing a "no accident week," to be observed during June 7-12 in industrial and manufacturing plants.

The annual convention of the National Electric Credit Association will be held in New York City on June 17 and 18, with papers and discussions in which delegates from various cities and sections will participate.

Appraisal and valuation, power and combustion topics and the new elevator code will be discussed at the spring meeting of the American Society of Mechanical Engineers, to be held in St. Louis, May 24-27.

New Jersey will receive this year from her franchise tax on public utility companies nearly $4,000,000, or approximately $1,000,000 more than last year.

That the electrical industry depends upon engineers for its commercial success was impressed upon undergraduates in a talk by Richard H. Rice of the General Electric Company before the Harvard Engineering Society.

Ten recommendations for the guidance of electrical manufacturers who desire to exhibit at electrical shows and for the organization of such shows have been issued by the Electrical Manufacturers' Council.

A low-priced double-base device which allows simultaneous use from one socket of both a lamp and an appliance has been developed by E. O. Schweitzer, chief testing engineer of the Commonwealth Edison Company, Chicago.

Among resolutions passed by the United States Chamber of Commerce at its Atlantic City convention were one condemning the embarkation of the government in businesses that can be successfully conducted by private enterprise and one advocating the further development of the Bureau of Foreign and Domestic Commerce.

Organization of the Council on Industrial Relations for the Electrical Construction Industry in the United States and Canada has been effected between the manufacturers and the brotherhood.

To permit a day's stop-over at Albuquerque, N. M., to view the Grand Canyon, the time for the departure from New York of the N. E. L. A. "Blue Special" has been advanced twenty-four hours, and the train will leave Thursday, May 13, arriving at Albuquerque on Sunday and at Pasadena Tuesday, May 18.

Hydro-electric plants which will effect a saving of $2,000,000 annually in fuel-oil costs alone are to be financed by the Pacific Gas & Electric Company, which is issuing $10,000,000 five-year gold notes at 7 per cent to meet the cost of construction.

In a suit against the Quebec Railway, Light, Heat & Power Company, carried to the Judicial Committee of the British Privy Council, that body found the company negligent in that it had not grounded distribution lines which broke in a storm and caused fire to destroy customers' houses.

Changes made in the water-power bill by the Congressional conferees eliminate the provision that an engineer officer should be executive secretary of the federal commission, strike out the clause giving the government the option of redeeming sites where licenses are transferred, change to 100 hp. the maximum amount of capacity for which a license may be issued without charge to states and municipalities, change the language relating to charges, and strike out the provision that severance damages are not to exceed the actual expenses for maintenance.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Utilities Ask for 12 Per Cent Return Plus 4 Per Cent Reserve

THE difficulties of public utilities in raising money were ascribed primarily to politics, then to the high price of money, inadequate net earnings and lack of confidence on the part of the investing public by leading bankers and utility executives of Illinois at hearings held in Chicago on April 29 and in Springfield on May 3 before the full Public Utility Commission of the State. It was said that by the end of next year the Chicago utilities will need about $80,000,000, and the down-state companies will need almost as much more new capital for essential betterments and improvements. Edgar S. Bloom, of Chicago, president of the Central Union Telephone Company, said that it was impossible for the utility companies to compete either in the money or the labor market with unregulated concerns, and Chairman J. H. Wilkerson of the commission said that the utility companies were facing what was generally conceded to be a serious situation. Utility companies which are among the strongest financially cannot get money without paying 9 per cent and then they must earn more. At the Springfield hearing W. H. Sawyer of the East St. Louis Light & Power Company said that public utilities must earn a 12 per cent rate of return and that they should earn a 4 per cent reserve in addition. It was the evident desire of the commissioners to find out why the public invests in industrial companies in preference to public utilities and what corrective measures could be employed by the regulating body to induce capital to flow into the public utility field. The witnesses gave as two of the reasons that public utilities are used for the aggrandizement of politicians and are not given the support they deserve by the daily press. Utilities are not allowed to earn a sufficient rate of return to provide what investors consider an adequate margin of safety after all operating, depreciation, dividend and interest charges have been met. Furthermore the relief given to a utility in financial straits is usually so long delayed that investments in the property are often put in jeopardy.

The Big Pasadena Convention in a Nutshell

Convention opens in the Hotel Huntington, Pasadena, Cal., Monday evening, May 17, with the president's reception; first general session the following morning.

Four general sessions, one each morning for the first four days of the convention, and eight afternoon sectional meetings, two in one afternoon and three each in two other afternoons, together with ten committee meetings, comprise the business program.

Entertainment features for every day and every evening have been arranged.

During the business sessions there will be eleven addresses of fifteen minutes each.

There will be eighty-one reports and papers presented.

The full text of fifty-three of these papers and reports has been printed.

These reports and papers average seventeen printed pages, 8 in. x 10½ in., or a total of 901 pages.

Each page contains 120 lines, averaging nine words each, or a total of approximately 900,000 printed words, exclusive of space occupied by cuts or graphs illustrating the reports or papers.

Two special trains will leave the East for the convention and one from the Pacific Northwest, and special cars will go from Illinois, Missouri, Kansas, Nebraska and Texas.

More than 2,950 reservations have been made, indicating an attendance of 3,500 to 4,000.

Every large central station in the country will be represented.

Water-Power Conference Report Passes House with Large Majority

ADOPTION of the conference report on the water-power bill was carried by the House of Representatives by 259 to 30. The large vote in the House is regarded as an indication that the Senate will adopt the report by an even more decisive majority.

A summary of the changes made by the conferees in the bill follows:

Instead of an engineer officer as executive secretary of the federal power commission it was provided that the commission "may" request the services of an engineer officer whose duties would be prescribed by the commission.

In the definition of "navigable waters" slight changes were made in the wording to indicate that interruptions by falls or shallows would be "between the navigable parts of such streams or waters."

In that portion of the law providing for the determining of the net investment of a licensee in any project, the conferees inserted the word "legitimate" in defining the costs.

The conferees struck out entirely the proviso with regard to securing the consent of the Indian tribe and also struck out the provision that the commission is to investigate the utility of tunnels in studying storage and conservation.

The Potomac power development was eliminated.

In the matter of transferring licenses the provision that the United States was to have the option to redeem such sites was stricken out.

In the matter of charges the conferees eliminated the language appearing in the bill and provided that the licensee shall pay charges to the United States until the states shall make provision for preventing excessive profits or for the expropriation thereof to themselves, or until the period of amortization as provided is reached.

The conferees changed to 100 hp. the maximum amount of horsepower capacity for which a license may be issued without charge to states and municipalities.

The entire paragraph (j), regarding discrimination in favor of any municipality as against other users, was eliminated.

In regard to the construction of locks to maintain the needs of navigation the conferees provided that the commission "may grant the application with the provision to be expressed in the license that the licensee will install the necessary navigation structures if the government fails to make provision therefor within a time to be fixed in the license."

The provision that severance damages are not to exceed the aggregate actual expenses or loss for maintenance, etc., was stricken out.

Section 17 of the bill, pertaining to distribution charges, was rewritten.

The law providing for the Newlands waterway commission was repealed, as had been provided in the House bill. The Senate amendment to the waterways commission proposal was stricken out. The conferees also struck out the final paragraph of the Senate bill, providing for non-interference with river and harbor projects.

New 300,000-Kw. Station of Unique Design for New York City

TO MEET the growing requirements for electric service in New York City the United Electric Light & Power Company will construct a generating station of 300,000 kw. ultimate capacity. Approximately six acres of land situated on the East River between 132d and 134th Streets, in the Bronx, have recently been acquired by the United company on which it will erect the new plant, to be known as the "Hell Gate station." Present plans provide for steam pressure of 250 lb. (17.5 kg.) at the turbine throttle and approximately 200 deg. normal superheat.

Departures from the usual central-station design are found in the plans of the new station: The turbine room will be built along the river front and the boiler house immediately adjoining. This will eliminate the massive and costly construction work involved in building the conventional type of intake tunnel. The inlet pipes for the circulating pumps will practically have the suction ends in the river. Stationary screens will extend approximately the full length of the station and will provide enormous screening area in comparison with older type stations. The discharge tunnel will be built as part of the foundation work and opened to the river at each end instead of having only one discharge opening as is usually the case. Provision is being made for storing coal immediately adjacent to the station and a flexible coal-handling equipment will be installed. A building adjoining the main station will provide adequate quarters for offices and employees.

The construction of the bulkhead and wharf has been started, and it is expected that the station will be placed in operation during the fall of 1921. A more complete description will be given in the ELECTRICAL WORLD later.

High Special Service Record for Society for Electrical Development

IN SPITE of all handicaps the Society for Electrical Development rendered more special services to members during the past year than in any previous year, according to the statement of J. M. Wakeman, general manager, in his report at the society's annual meeting, held in New York at the Engineers' Club on Tuesday. Almost every member called for such service during the year, it was stated. Particular attention was called to the work of the society in the education of the public.

The following directors were elected to serve four years each: W. W. Freeman, E. W. Rockafellow, L. A. Osborne, Earnest McCleary and James H. McGraw. At the board meeting, held immediately after the annual meeting, a budget for the ensuing year was decided upon, which provides for carrying on all the work of the society, including an "electrical Christmas" campaign.

The following officers were elected: President, W. W. Freeman; vice-presidents, Anson W. Burchard, Joseph E. Montague, Fred Bissell, James R. Strong and J. Robert Crouse. General Manager J. M. Wakeman and Secretary-Treasurer James Smieton, Jr., were reappointed. Charles L. Edgar accepted appointment as chairman of the executive committee and announced his intention to call bi-monthly meetings of this committee to give close attention to the important matters coming up for consideration and obtain for the electrical industry the full benefit of the great work the society is carrying on. The other members appointed upon the executive committee were Joseph E. Montague, L. P. Sawyer, W. D. Steele, E. W. Rockafellow, Fred Bissell, James R. Strong, Fred B. Adam and J. Robert Crouse, with President Freeman a member ex officio.

Industrial Relations Council of Brotherhood and Contractors Effected

ORGANIZATION of the Council on Industrial Relations for the Electrical Construction Industry in the United States and Canada was effected by the representatives of the National Association of Electrical Contractors and Dealers and the International Brotherhood of Electrical Workers at a meeting held in New York on April 30. While the primary purpose of the two member organizations is to remove causes of friction and dispute, the council conceives its principal function to be that of study and research so that it may act with the fullest knowledge of the causes and so that it may secure the largest possible measure of genuine co-operation between the member organizations, and generally between employers and employees, for the development of the industry as a servant to society and for the improvement of the conditions of all engaged in it.

The council consists of five members from each organization. These members may be withdrawn on four months' written notice. All meetings of the council, it is provided, should be open to the public. The council shall interpret the declaration of principles adopted by the two member organizations.

In the adjustment of disputes the council is pledged to adopt the following procedure:

When a dispute arises which cannot be adjusted by the existing local machinery, and notice to that effect is received by the secretary of the council from either of the parties to the dispute, the secretary of the council after investigation may, if circumstances warrant, request each side to submit the dispute to a board of conciliation, to be composed of two representatives from each side, parties to the dispute, and one representative to be selected by the council who shall act as chairman but cast no vote.

The appointment of representatives by the parties to the dispute to act for them on the board of conciliation shall constitute a voluntary agreement between the parties to accept as an effective agreement between them the unanimous decision of the board of conciliation.

If the board of conciliation does not reach an agreement, it shall make a finding of the material facts and state the reasons why it has been unable to reach an agreement. The chairman shall report such finding and statement to the council and the council shall determine the matters so submitted as arbitrator. If the council reaches a unanimous agreement, it shall report its decision back to the board of conciliation through its chairman, and the board shall then state the agreement between the parties to the dispute, the same as if the board itself had reached a unanimous decision. If the council shall fail to reach a unanimous decision, it shall make majority and minority reports and transmit these to the chairman of the board of conciliation, who shall immediately publish them in order to inform the public of the material facts and the reasons why the council has been unable to reach an agreement.

Departure of N. E. L. A. Blue Special Advanced One Day

TO ALLOW a stop-over of one day at the Grand Canyon of Arizona the time of departure of the "Blue Special" via the New York Central from New York for the convention of the National Electric Light Association at Pasadena has been advanced to Thursday, May 13. The special train will thus be one day earlier than stated in the original schedule. It will arrive at Albuquerque Sunday, May 16, instead of Monday, and will lie over twenty-four hours, permitting a visit to the Grand Canyon. The train will leave Albuquerque Monday, May 17, at 12:45 p.m. and reach Pasadena Tuesday, May 18, at 5 p.m., as in the original schedule.

Owing to this change so many additional reservations have been received for the "Blue Special" that it will be run in two sections. The "Pink Special," which was to leave via the Pennsylvania Railroad from New York, has been abandoned, but three special cars will be attached to a scheduled train.

New Jersey Utilities to Pay Record Tax Levies

PUBLIC utilities of New Jersey will pay this year the largest amount of money in franchise taxes ever collected by the municipalities of that State. The figures given out by the State Board of Taxes and Assessment show that a total tax of $3,925,744.42 will be received from nineteen street railways, 110 water, seventy-five gas and electric, thirty-three telegraph and telephone, three district telegraph messenger, seventeen sewer, and seventeen sewer and pipe line utilities. This is an increase of $934,078.28, or 31.2 per cent over last year's tax. Several reasons are given by the board for the increase. This is the first assessment that has been levied at the maximum rate of 5 per cent of the gross receipts as a result of the passage of the 1917 law. Previous to that year the assesment was made at the rate of 2 per cent of the gross receipts, but under this law the rate was raised 1 per cent annually until a maximum of 5 per cent was reached. Utility companies whose annual gross receipts are below $50,000 are still taxed at the rate of 2 per cent. Another reason for the growth in this tax, it is stated, is that in all public utility activities increases in rates have been allowed, resulting in increased gross receipts.

It is interesting to note that gas and electric utilities will pay $1,970,812.82, or over 50 per cent of the total assessments. The tax is based on the gross receipts for the year ended Dec. 31 last.

The Pasadena N. E. L. A. Convention Day by Day

TUESDAY, MAY 18

Meeting Accounting Section's executive committee, 7:30 p.m.

Meeting Commercial Section's executive committee, 7:30 p.m.

Meeting Electric Vehicle Section's executive committee, 7:30 p.m.

Meeting Technical and Hydro-Electric Section's executive committee, 7:30 p.m.

President's reception, 8:30 p.m., ballroom, meeting room No. 1.

WEDNESDAY, MAY 19

First general and executive sessions, 9:30 a.m., ballroom, meeting room No. 1.

Meeting and luncheon, 1 p.m., national executive committee, private dining room, first floor.

Motion picture of convention delegates, 2 p.m., front porches and grounds of the Hotel Huntington. These pictures will be shown on Thursday evening at public policy committee session.

Special meeting Commercial Section, 2:15 p.m., ballroom, meeting room No. 1.

First Commercial Section session, 2:30 p.m., ballroom, meeting room No. 1.

Special meeting Technical and Hydro-Electric Section, 2:15 p.m., meeting room No. 2.

First Technical and Hydro-Electric Section session, 2:30 p.m., meeting room No. 2.

California mission play and entertainment, evening.

THURSDAY, MAY 20

Second general and executive session, 9 a.m., ballroom, meeting room No. 1.

Meeting and luncheon, 1 p.m., public policy committee, private dining room, first floor.

Special meeting Accounting Section, 2:15 p.m., meeting room No. 3.

First Accounting Section session, 2:30 p.m., meeting room No. 3.

Second Commercial Section session, 2:30 p.m., meeting room No. 2.

Second Technical and Hydro-Electric Section session, 2:30 p.m., ballroom, meeting room No. 1.

Public policy committee session, 8:30 p.m., ballroom, meeting room No. 1.

FRIDAY, MAY 21

Third general and executive session, 9 a.m., ballroom, meeting room No. 1.

Second Accounting Section session, 2:30 p.m., meeting room No. 3.

Electric Vehicle Section session, 2:30 p.m., meeting room No. 2.

Third Commercial Section session, 2:30 p.m., ballroom, meeting room No. 1.

"Big Night!" tendered by Pacific Coast Section.

SATURDAY, MAY 22

Fourth general and executive session, 9 a.m., ballroom, meeting room No. 1.

John I. Beggs Again Active in Milwaukee Utility Management

JOHN I. BEGGS, well-known public utility operator of Wisconsin, is expected again to assume active control of the Milwaukee Electric Railway & Light Company, over which he presided some nine years ago. He has continued to be a director of the company and is now chairman of an executive committee which has largely directed the affairs of the company since President J. D. Mortimer resigned. It has been proposed to create the position of chairman of the board of directors on condition that Mr. Beggs would accept the position.

In speaking on the subject to a representative of the Electrical World, Mr. Beggs said that if he accepted the appointment he would maintain the company's present organization as it is and would apply himself particularly to the solution of the company's public policy problems and to finding ways and means of raising the $10,000,000 which the company needs this year.

The election of a new president is not being considered just now. If Mr. Beggs becomes chairman of the board of directors, he plans to perform also the duties of president, at least for the present.

Manufacturers' Council Recommendations on Electrical Shows

RECOMMENDATIONS on electrical shows and exhibits have been made by the Electrical Manufacturers' Council as a guide to all electrical manufacturers to encourage a high standard in electrical shows and to stimulate management and exhibitors to maintain such a standard. This, it is stated, is especially important because of the expense which such shows involve, the difficulties of transportation and the desirability of conserving labor and materials.

The recommendations follow:

For the fullest co-operation, it is strongly recommended that exhibitors as a whole shall have representation in the management of the show equal to that of the local management.

Class and nature of exhibits shall be determined by the show management. Concessions for sale of knicknacks, candy, toys, etc., shall be prohibited as they detract from the education value of exhibits.

Souvenirs represent waste and extravagance of a character which the industry is trying to prevent. They are not beneficial in promoting the main educational object of shows. Their distribution at shows shall therefore be prohibited.

Exhibitors shall not be asked to give financial support through advertisements or in any other way to programs and catalogues. These, if issued, shall not contain any advertisements.

Passes shall be issued to officers, official representatives and attendants of companies exhibiting, the number to be based equitably on the space occupied.

Exhibitors may have trade tickets at one-half the regular admission price, settlement to be made on the basis of the tickets actually turned in at the gate.

The show management shall strive to make the character of the exhibit such as will reflect credit upon the electrical industry and at the same time keep the expense within reasonable limits. Any surplus after payment of legitimate expenses shall be returned to exhibitors in proportion to the amount of space used.

The show management shall have the right to discontinue and remove any exhibit which in its opinion is objectionable to exhibitors, the public or the industry.

For the amount paid for space the show management will provide the following service to exhibitors: Insurance against fire and theft; reasonable protection against fire and theft; watchman day and night; clean aisles and thoroughfare (not including exhibits). Store boxes and other containers in good order and at the proper time deliver them promptly to exhibitors for return shipment.

It is recommended that, before contracting for space or otherwise committing themselves to participate in an electric show or exhibit, all electrical manufacturers ascertain from the secretary of the Electrical Manufacturers' Council if the management thereof has adopted the foregoing recommendations.

Chamber of Commerce Again Favors Private Ownership

INCREASED production was the keynote of the convention of the Chamber of Commerce at Atlantic City in the week of April 26, in which leading topics were the relation of labor to the problem of increased production and the need of leadership for labor which recognizes its responsibility both to the workers and to the public; the broad question of financing the industrial needs of the world, and the several detailed problems of taxation, accounting, transportation, domestic distribution and the ownership of public utilities.

Several speakers representing different branches of industry spoke on the labor situation. Matthew Woll, vice-president of the American Federation of Labor, said that it was labor's point of view that if the right to strike was made illegal the force behind the labor organization would be removed and the opportunity for labor to progress thwarted. Governor Allen of Kansas pointed out that the method of settling labor difficulties in the utility field by an industrial court, such as has been established in his state, substituted a court of justice for a compromise. He said that labor had the same rights as capital in this court and that the public voice was also heard. He emphasized the fact that the court was not against labor or labor unions but against the present system of union leadership, and that an industrial court organized in each state would make unnecessary the present system of labor organization in order for labor to maintain its rights. Dr. Charles A. Eaton emphasized the need for better management as well as better labor in the present situation.

James H. McGraw, representing the business press at the general session, called attention to the educational value of the business press in placing ideas before industry and maintained that the present condition of decreased production was due largely to a state of mind. He showed how the business press, by making possible an interchange of thought between thousands of men in industry, had become a great educational force at work on the problems of the present day.

The convention went on record against government ownership of public utilities. From the presidential address at the opening of the convention to the final adoption of resolutions, whenever this question came up there was most emphatic support for the principle of private ownership and private operation, not only in railroads and local public utilities but also in shipping and the merchant marine as well. This matter was deemed so important that the committee on resolutions was unanimously supported in its recommendation that the meeting reiterate its declaration from the previous annual meeting to the effect that there should be placed "upon the individual only that degree of restraint which shall prevent his encroachment upon the rights of others."

Resolutions concerning industrial courts, public service corporations and other subjects were referred to the board of directors for further consideration and possible submission to a referendum.

South Dakota Legislature to Consider State Water-Power Project

A SPECIAL session of the South Dakota Legislature is to be called by the Governor about the middle of this month to deal with a number of important matters awaiting action. Among these is the question of state water-power development by the construction of a dam on the Missouri River. This project has been under investigation by a water-power commission which is said to have finally selected a site for the dam and to be about to ask the Legislature for an appropriation.

Effect of Being Creditor Nation Is Foreign Trade Convention Theme

DURING the past few years the relation of the United States to foreign trade has undergone a marked change, leaving this country in the creditor class of nations, and it is this situation that has been taken as the theme of the seventh national foreign trade convention, to be held May 12-15 in San Francisco.

The general sessions, which will be held each morning and Wednesday afternoon, will take up in order the following topics: (1) "Fundamentals of Our Foreign Trade;" (2) "Exports and Imports;" (3) "Foreign Trade Policies;" (4) "The Merchant Marine;" (5) "National Program for Foreign Trade."

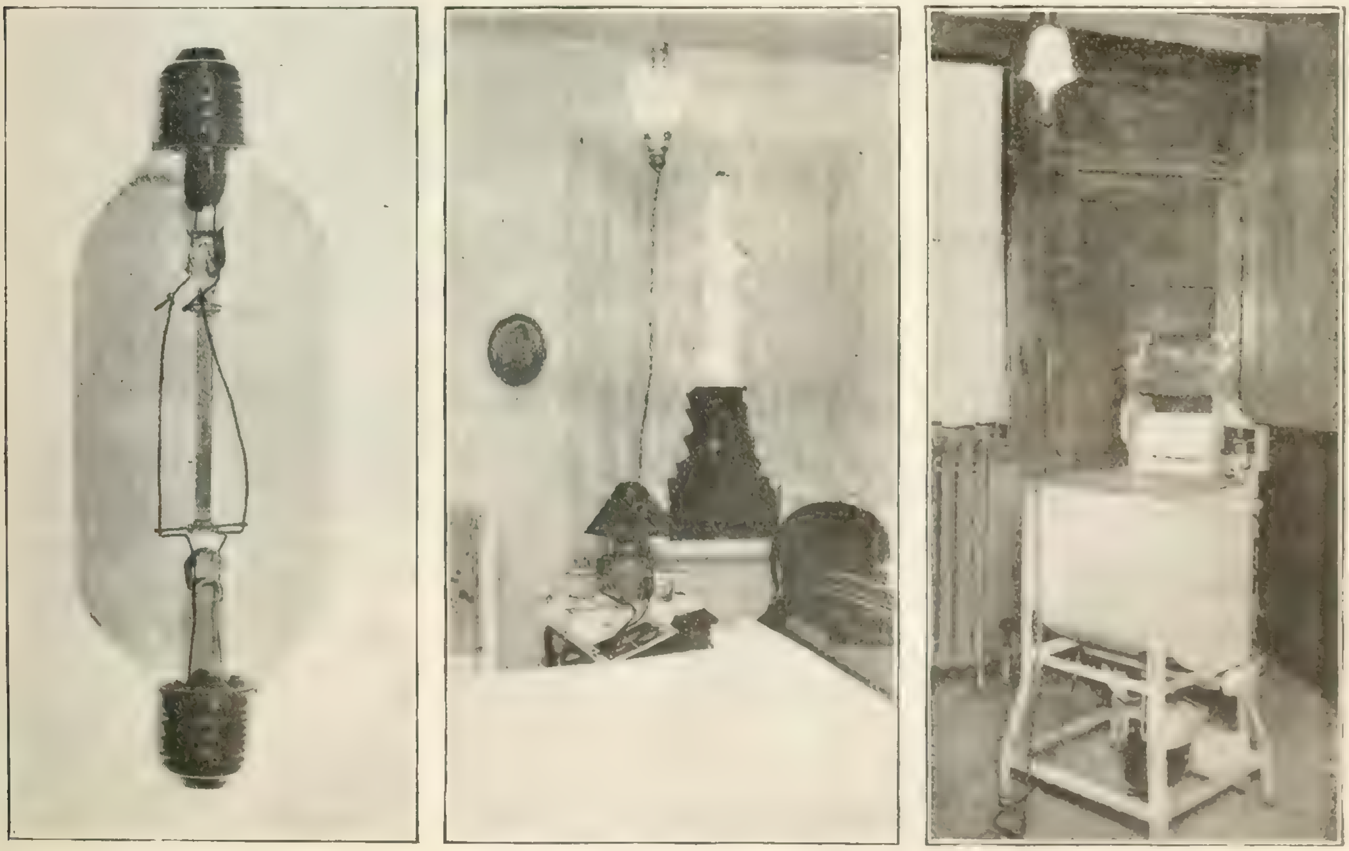
Four group sessions will be held simultaneously Wednesday evening, Thursday afternoon and evening and Friday afternoon, each with a topic assigned, as follows: (1) "Education for Foreign Trade;" (2) "Financing Foreign Trade;" (3) "Transportation and Communication;" (4) "Foreign Trade Advertising;" (5) "Direct Selling Abroad;" (6) "Banking Service to Foreign Trade;" (7) "Sources of Imports;" (8) "American Trade with China;" (9) "Foreign Trade and the Press;" (10) "Foreign Credits and Credit Information;" (11) "American Trade with Russia;" (12) "Foreign Trade Information;" (13) "Practical Problems of the Export Manager;" (14) "Webb Law in Operation;" (15) "Pacific Problems;" (16) "Foreign Delegates."

Double-Base Lamp for Simultaneous Use of Appliance and Fixture

A NEW double-base lamp by means of which household appliances and fixtures may be used simultaneously from the same outlet without the use of double plugs or adapters has been developed by E. O. Schweitzer, chief testing engineer of the Commonwealth Edison Company. The lamp may be made up in any style and capacity. The one shown in the illustration is the 60-watt "Mazda B" 115-volt filament mounting used with the standard S-21 bulb.

The lead-in wires are those used for the standard 500-watt, 115-volt type C lamp and continue through the bulb from base to base, the lamp filament being tapped off from them. The lead-in wires, which are formed into an expansion loop to eliminate strain due to unequal contraction and expansion of the lamp elements, are made with a quarter twist to provide clearance for the filament anchors. Exhaustion is carried out through a concealed tube within one of the bases, thus making a tipless lamp. By the addition of a light brass shell beaded at each end any standard shade holder may be used. With this connector any standard attachment plug can be used in the free end.

By using the double-base lamp a pendent fixture can be converted into a semi-indirect fixture. With such a fixture, it is claimed, any household appliance can be used without interfering with its lighting use.



THE DOUBLE BASE LAMP AND ITS DOUBLE DUTY

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

A New Use for the Chinese Wall.—The United States Navy has erected for its own use upon the ancient wall of China a reinforced-concrete wireless mast, 164 ft. in height.

Ames (Iowa) Municipal Plant Losing Money.—At a recent meeting of the Ames (Iowa) City Council the city engineer reported that the municipal electric light plant was piling up a deficit of $1,000 to $1,200 a month owing to increasing costs and that some of the machinery is wearing out. A proposition to increase the rates was made, but the Council adjourned without adopting it.

Spiders Interfere with Telephones.—From Buenos Aires comes a tale of havoc raised by the ground spider with cable communication. "The spider," says the **Telephone Review**, "is simply working out his destiny. He spins a heavy web which is caught by the wind and wound around the wires. In a humid spell these masses of web become damp and short circuits result. So serious has the problem become that large forces of men are employed following the wires and removing the accumulations."

A Big Niagara Installation.—One of the largest contracts for hydro-electric equipment ever placed has been awarded to the William Cramp & Son Ship & Engine Building Company of Philadelphia by the Hydro-Electric Power Commission of Ontario, Canada. It calls for three turbines rated at 55,000 hp. each, to be installed at Niagara Falls on the commission's hydro-electric system. Five Johnson valves and five governors are included in the equipment, and delivery is to be made in from a year to eighteen months. Each of these units is larger than the original 50,000-hp. installation of the Niagara Falls Power Company.

Obviating Line Trouble in Chile.—Service on the system of the Chile Exploration Company, which has a great steam station at Tocopilla, on the seacoast, with 80 miles of transmission lines running inland, has been interrupted only once because of line trouble, notwithstanding that a salt mist from the sea is carried inland for about 10 miles and falls on the insulators, where it evaporates, leaving a deposit which would eventually cause flashovers. To overcome this condition, the 10 miles of line nearest the coast was built in duplicate, and the insulators on one line are washed while the other line is in use. The washing is done every other week.

Electrical Patents in Japan.—Nine hundred and twenty-eight electrical patents were applied for in Japan during the year ended October, 1919, an increase of 20 per cent over the preceding year. Seventy-six per cent of the applications were made by natives of Japan.

Daylight Saving in New England.—Daylight saving went into effect throughout Massachusetts on April 25 as a result of a recent statute. In northern New England much opposition continues to the plan, but in southern New England a disposition to coöperate is more apparent in local communities. Cities and towns in Rhode Island representing 70 per cent of the state population have adopted the plan and local communities in Connecticut have also made the change.

Hydro-Electricity in the Aluminum Industry.—It is announced that the Aluminum Company of America, which operates a plant at Alcoa, Tenn., covering 18,000 acres exclusive of timber tracts and water-power sites, is about to construct four more dams in the Little River for hydro-electric purposes. A dam already completed after two years' work is said to be the largest in the United States with the exception of the Niagara Falls and Roosevelt dams, and more hydro-electric power is already generated at Alcoa than in Tennessee's larger cities combined.

Electrolytic Refining of Iron.—Konrad Werner Lindman, a Swedish engineer, announces that he has been successful in refining iron by an electrolytic process, after experiments lasting for six months at the Avosta iron works. Hitherto electrolytically treated iron has contained a high percentage of hydrogen and uneven floccose masses, but Lindman makes the claim that by his method, of which the details are kept secret, an even and homogeneous iron plate, chemically free from impurities, can be produced at a minimum cost in sheets down to the thinnest dimensions, which possess a greater magnetic capacity than the usual rolled plate and do not require any after treatment.

Water Power of Nova Scotia.—An official commission has been gathering data on the water-power resources of the Province of Nova Scotia. Though these are not large individually, collectively they can be made of great value, the topography of the province favoring their development, as does the unusually heavy rainfall. The plan is to combine the water powers in isolated groups which can eventually be joined in one great system. The first of these groups is to exploit the hydro-electric possibilities of St. Margaret's Bay. From this source it is estimated that about 10,000 hp. can be furnished to the city of Halifax. While the provincial government is to develop and transmit the energy, its distribution is to be left to private companies.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Association of Municipal Electrical Utilities of Ontario.—The semi-annual convention of this association is to be held at Niagara Falls, Ont., on June 17 and 18.

I. E. S., Philadelphia Section.—"Color Photography" will be discussed before this section of the Illuminating Engineering Society on May 21 by Henry Hess.

British I. E. E. to Have New President.—The council of the Institution of Electrical Engineers, Great Britain, has selected Llewelyn B. Atkinson as president for the coming term, in succession to Roger T. Smith.

A. I. E. E., Philadelphia Section.—As previously announced, Monday, May 10, is to be "students' night" for this section and devoted to a discussion on "Professional and Financial Aspects of Electrical Engineering."

American Society of Heating and Ventilating Engineers.—"The Design of Large Boiler Plants" is the subject of an illustrated paper to be read before this society at Philadelphia on May 13 by J. Grady Rollow.

A. I. E. E., Chicago Section.—A joint meeting of this section and the Electrical Section of the Western Society of Engineers will be held on May 12 in Fullerton Hall, Chicago, at 7:30 p.m., to discuss problems of city planning.

Engineers' Club of Philadelphia.—At the annual meeting of the Engineers' Club of Philadelphia, on May 18, the retiring president, Joseph A. Steinmetz, will speak on "Our Club," and Edward S. Walsh will describe "The Improved Barge Canal System of New York."

Empire State Gas and Electric Association.—On May 1 the headquarters of this association were moved from the Engineering Societies Building to the Grand Central Terminal Building, Forty-second Street and Madison Avenue, New York City, where the association will occupy Room 3052.

Important May Meetings.—Dates of conventions of special interest to electrical men still to be held this month follow: American Association of Engineers, St. Louis, Mo., May 10 and 11; Electrical Supply Jobbers' Association, Del Monte, Cal., May 12-14; Southwestern Electrical and Gas Association, Galveston, Tex., May 13-15; Pacific Coast Section, N. E. L. A., Del Monte, Cal., May 17-18; National Electric Light Association, Pasadena, Cal., May 18-21; Tri-State Water and Light Association, Atlanta, Ga., May 19-21.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Threat of Discharge in Relation to Injury.—Where an employee doing work in a safe way is ordered to do it in an unsafe way with a threat of discharge if he refuses, and by reason of the order he enters upon the work and is injured without fault of his, the Supreme Court of North Carolina has held that he can recover damages. (102 S.E. 397.)

Both Negligence and Injury Therefrom Must Be Proved in Action for Damages from Flooding.—In a suit brought by a landowner against the Pacific Electric Railway Company to recover damages because of the flooding of his property, which he asserted to have arisen from the defective construction of a bridge by the defendant company, the reviewing court has held that in such cases the burden is upon the plaintiff to show by preponderance of evidence not only that the defendant was negligent but that such negligence was the proximate or concurring proximate cause of the injury. (187 P. 976.)

Compensation for Easement in Land Must Be the Same as for Use.—Holding that the right to use condemned land is just as much a taking of the land as if it were actually used all the time, the Supreme Court of South Carolina has held that where lands are condemned for a water-power project the landowner is entitled to compensation for all lands taken, even though as to some of them the condemnor desired only an easement. The owner is entitled to recover full compensation for all the land within the condemned area and the water-power company must pay the actual value of the total acreage over which it acquires the right to impound water. (102 S.E. 331.)

Powers of Public Service Commission and of State Supreme Court.—The Missouri Public Service Commission having refused to assume power to grant to a street-railway company permission to discontinue spur lines included in its franchise but asserted to be unprofitable and the railway's complaint having been carried to the Supreme Court of the state, that body held that the court had no authority to review the facts and make a finding of its own so long as the commission refused to do so. It further found that the commission was in error in holding itself constitutionally prohibited from taking such action, and the inferior court was ordered to vacate its judgment sustaining the commission and to remand the cause to that body for determination. (219 S.W. 380.)

Prejudiced Jurors in Damage Suits Against Utilities.—The Missouri Supreme Court, in Vessels vs. Kansas City Light & Power Company, held that the lower court was within its discretion in rejecting for jury duty a coal dealer who had done a large business with a closely allied utility, who refused to state whether jury duty would embarrass him in his business dealings and who expressed himself as prejudiced against personal injury actions. (249 S.W. 80.)

Public Service Commission's Power to Change Contract Rates.—A public utility is entitled to a rate sufficient to give it a fair return upon the reasonable value of its property at the time it is being used for the public, according to the decision of the Colorado Supreme Court in a suit brought against the Public Utilities Commission of that State by the Ohio & Colorado Smelting & Refining Company, and the Public Utilities Commission had power, for the public weal, to raise the rate fixed by contract between the Colorado Power Company and the smelting company before the creation of the commission. (187 P. 1082.)

Responsibility for Accident Caused by Reversal of Connections.—In Magnuson vs. City of Bainbridge, an electrician claimed damages from the city, which owns the power lines, because of injuries sustained by him while installing an elevator. Changes were made in the transformer connections while he was so employed and he was not informed that the connections had been reversed, with the result that when he was on top of the car and turned the switch with the intention of descending the car mounted instead, crushing him against a beam. The Court of Appeals of Georgia held that there was no cause of action against the city, it being the duty of the plaintiff to find out for himself what effect the alterations to the transformer, of which he was aware, would have. (102 S.E. 459.)

The Los Angeles Infringement Suit.—In its decision upholding a decree of the United States District Court which enjoined the execution of a local ordinance providing for a municipal street-lighting system that was held to trespass upon the privately owned lighting system of the defendant Los Angeles Gas & Electric Corporation, the Supreme Court of the United States said: "It will be observed that we are not concerned with the duty of the corporation operating a public utility to yield uncompensated obedience to a police measure adopted for the protection of the public, but with a proposed uncompensated taking or disturbance of what belongs to one lighting system in order to make way for another. And this the Fourteenth Amendment forbids. What the grant was at its inception it remained, and was not subject to be displaced by some other system, even that of the city, without compensation to the corporation for the rights appropriated."

Commission Rulings

Important decisions of [illegible] bodies involving or affecting electric light and power utilities.

Burden of Proof of Need for Increased Rates Falls on Applicant.—The burden resting upon an applicant under the California public utilities act of showing that a proposed increase in rates is justified cannot, according to the Railroad Commission of that State, be satisfied by a mere perfunctory showing, but requires the applicant to show by evidence of probative value that the existing rates are unreasonably low and that the proposed rates are reasonable.

Steam-Heating Losses Should Not Be Recouped Through Electrical Department.—The rates charged by the steam-heating department of a public utility should render such department self-sustaining, the Illinois Public Utilities Commission has declared as the result of an examination of a new rate schedule submitted by the Decatur Railway & Light Company, and it would be contrary to the ruling of the Supreme Court of the United States to fix rates that fell below this standard on the theory that they are being recouped by the company from its rates for electrical service

City Buying Energy from Company Is in Same Position as Other Customers.—The city of Idaho Falls, Idaho, appealed to the Public Utilities Commission of that State against an order of the commission authorizing the Utah Power & Light Company to apply the emergency service rates scheduled by it to the city. The municipal authorities based their opposition to this order on a contract entered into before the establishment of the commission, but the latter body held that the city stood in no relation with the company different from that of any other patron and that the commission's right to issue the order could not be attacked.

Establishing Equitable Rates.—In proceedings to determine the reasonableness of rates adopted by the Southern Illinois Light & Power Company in several small towns the Illinois Public Utilities Commission has announced that increases in rates affecting a particular consumer are not inconsistent with smaller increases applied to other consumers where such a consumer was formerly served at rates much lower than those charged other consumers, the result of the increase being to eliminate discrimination. Rates for the towns concerned which were calculated to produce a return of 7.4 per cent on the original cost of the plant were authorized by the decision of the commission.

Men of the Industry

Changes in Personnel
and Position—
Biographical Notes

Benjamin F. Pearson, general superintendent of the southern division of the Southern California Edison Company, has recently been appointed power administrator of that company and will have complete authority over all the generating plants and power distribution of both divisions. This will involve control of the generation and transmission of nearly 1,000,000,000 kw.-hr. a year, with a peak load of approximately 190,000 kw., generated by nineteen hydro-electric and seven steam plants. In addition he will have charge of the interchange of energy between the Southern California Edison Company and the Southern Sierras Power Company, San Diego Gas & Electric Company, Mount Whitney Power & Electric Company and San Joaquin Light & Power Company. In this work Mr. Pearson will be assisted by Fred B. Lewis, superintendent of the Los Angeles district. Mr. Pearson, known throughout southern California as "Uncle Ben," was born in Middlesex County, England, Sept. 19, 1868. After only a few years of schooling he served an apprenticeship with the Grand Junction Canal Company, England, as engineer and fitter. Immediately afterward he came to the United States and in January, 1896, entered the employ of the Southern California company. In addition to his duties as general superintendent and power administrator, Mr. Pearson is chairman of the engineering committee of his company, which has the engineering responsibility of the organization. He is also president of the Los Angeles City Civil Service Commission and is prominently identified with many public and philanthropic movements in southern California.

B. F. PEARSON

Bryant White has recently been appointed superintendent of the light and power departments of the Roanoke (Va.) Railway & Electric Company and the Lynchburg (Va.) Traction & Light Company, to succeed W. G. Claytor, who has been advanced to the position of assistant to the general manager of these companies. Mr. White was formerly electrical engineer with the Fred T. Ley Company on the construction of several large munition plants for the government. Prior to the war he was power engineer with the Public Service Company of New Jersey, and previous to that he held the position of sales manager of the Merchants' Heat & Light Company of Indianapolis.

W. J. Canada, who for the past year has been a member of the headquarters staff of Stone & Webster, Boston, associated with W. H. Blood, Jr., in preparing special reports, has been employed by the National Electric Light Association as head of its new engineering department at New York headquarters. Mr. Canada will take up his new duties on June 1 and pay particular attention to questions of inductive interference, insurance, the safety code and work with special technical committees of the association. Mr. Canada was graduated from the Sheffield Scientific School at Yale. After graduation he was employed in the testing department of the General Electric Company and then for two years as electrical engineer and assistant to the manager of the Ohio Electric Railway Company. He resigned that position to become electrical engineer in charge of the Dayton district for the Ohio Inspection Bureau. Later he took up safety work as electrical engineer of the Rocky Mountain Fire Underwriters' Association. In 1913 he resigned that position to become associate physicist for the Bureau of Standards, Department of Commerce, where he made a special study of electrical life hazard. Late in 1917 he resigned his position with the Bureau of Standards to enter work with the American International Shipbuilding Corporation of Philadelphia. That position he held until last fall, when he joined the Stone & Webster organization.

Lafayette Hanchett, who was recently elected president of the Utah Power & Light Company to succeed D. C. Jackling, who has resigned, is president of the Intermountain Electric Company of Salt Lake City, a progressive electrical jobbing house in the intermountain district. He also holds the same position with the Dixie Power Company, which operates in southern Utah in and around the town of St. George. Mr. Hanchett is in addition a director in the National Copper Bank and Bankers' Trust Company of Salt Lake City and is identified with several other large commercial enterprises. During the war he was closely associated with Mr. Jackling, acting as his assistant in charge of the government powder plant at Nitro, W. Va.

H. G. Harvey has resigned as commercial engineer of the Nassau Light & Power Company of Mineola, N. Y., to accept a similar position with the Pennsylvania Utilities Company at Easton, Pa.

Samuel G. Rhodes, who has been a member of the engineering staff of the New York Edison Company since 1891, was appointed assistant to Vice-president Lieb on April 1. Mr. Rhodes' first position with the company was that of wireman. In 1895 he was made fireman of the arc-light department and in 1906 superintendent of that department and engineer of the meter and test departments. Mr. Rhodes has served for a number of years on various technical committees of the National Electric Light Association, of the American Institute of Electrical Engineers and the Illuminating Engineering Society. He has conducted a considerable amount of original work for the New York Edison Company in illumination, particularly in connection with street and park lighting. He is a fellow of the A. I. E. E.

S. G. RHODES

Arden B. Holcomb, whose appointment as general industrial engineer for Crippen & Funk, Youngstown, Ohio, was noted in the "Men of the Industry" for April 3, was then erroneously referred to as having been previously connected with two St. Louis electrical companies. The item should have said instead that Mr. Holcomb was formerly of the general engineering department of the Westinghouse Electric & Manufacturing Company at East Pittsburgh and before that held the post of electrical superintendent for the Standard Tinplate Company of Canonsburg, Pa. Before entering industrial work Mr. Holcomb spent seven years as an instructor in electrical engineering at Cornell University, Ithaca, N. Y., and the Carnegie Institute of Technology, Pittsburgh.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Electrical Materials Being Booked at New High Record

FROM the looks of things, manufacturers of electrical apparatus and supplies are moving on to new high records for the year 1920. Bookings for the first four months are at an unprecedented rate and are well in excess of the amount that manufacturing capacity can turn out. Several manufacturers have admitted this to be the case. Cancellations here and there would be quite welcome because then producers would feel that they could come nearer to filling their schedules. The one great drawback, besides that of the inability to get sufficient labor to man the machines and handle raw materials, in the manufacturing problem today is the shortage of rolling stock and poor transportation conditions, which are holding up the movement of both raw and finished materials. This condition is backing up shipping schedules in the plants and making it increasingly more difficult to close up the gap between booking and billing.

Noticeable increases in orders taken are found in generating apparatus and supplies. Orders on General Electric during the first quarter of 1920 were at the rate of $375,000,000 for the year, and during the month of April even this rate was increased. This brings bookings at a rate of $1,250,000 a day. Orders on Westinghouse during this first three months were at a rate of $180,000,000 for the calendar year, which is $600,000 a day. Shipping dates on a large part of the big apparatus and on certain small material, such as fractional-horsepower motors, will not be consummated during the present year, so that heavy billings are expected to carry over into 1921.

British Court Rules Against Gas-Filled Lamp Patents

WHAT appears to be a difference of opinion in the courts of England and the United States is found in a recent decision of an English justice handed down in the case of the suit brought by the British Thomson-Houston Company, Ltd., against the Corona Lamp Works, Ltd., for an injunction to restrain an alleged infringement of its patent, granted in 1913, for improvements in incandescent electric lamps.

The keynote of the patent was struck on the first pages of the specification, which described it as "relating to a gas-filled lamp of higher efficiency than the best lamp on the market." The defences were reduced to three, namely, want of invention or subject matter, insufficiency and non-infringement.

The court was of the opinion that the evidence clearly established the fact of infringement; on the question of "subject matter" or invention the court held that the patentee had taken "an inventive step of a high order of merit as well as of the greatest practical utility."

Thus far the opinion of the British court substantially agrees with the opinion handed down last fall by Judge Mayer in a suit brought by the General Electric Company against the Nitro Tungsten Lamp Company of Providence. The result of the two suits was, however, very different. It will be remembered that the American court sustained the patent. The English court holds the patent bad.

It seems that the claims of both the English and American patent call for a filament which is actually or effectively of relatively large size. The American court considers this a good limitation and a sufficiently definite one under the circumstances, whereas the British court holds that under the British law the expression "large" is indefinite and that because of the indefiniteness that is thus imported into the claims the patent cannot be sustained.

The ELECTRICAL WORLD is informed that the Nitro Tungsten Lamp Company has appealed from Judge Mayer's decision and that this appeal has been argued before the Circuit Court of Appeals of the Second Circuit. It is also understood that the British Thomson-Houston Company has appealed from the British decision and that it is expected this appeal will be argued at an early date.

Electric Sheet Mills Expected to Open Books in May

PRODUCERS of electric sheets have not in general opened their books for third-quarter or second-half year buying. The one producer who did open his books about the middle of April is reported to have based his prices on those suggested in the Industrial Board schedule. Prospective output is being allotted to the company's regular customers. It is expected that the other electrical sheet producers will open for the next quarter and half year some time between the tenth of May and the end of the month. As far as can be learned it is thought that the prices will be no higher than those ruling for the present term. The attitude is that prices are sufficiently high as they are and that a feeling of relief would follow a halt in the upward movement of steel products. The mills can do no more than to apportion out their sheets as they did previously.

There is very little more capacity available now than formerly, although one mill expects a bigger output about September. No bigger volume of ordering is expected. The demand is about that which existed over the earlier part of the year, and that demand was not satisfied, so a greater demand certainly cannot be filled. What new customers in the field will do for sheets it is hard to predict. Probably a good part of their demand can be satisfied through the jobbing interests at a rate higher than that of the producers. The regular customers will be pretty well cared for, however. Recent shipments have been badly held up by the railroad strikes. Some mills will not be able to clean up on their second-quarter deliveries until along in August because of curtailed production, shortage of raw materials and stoppage in freight movement.

Local Pole-Line Equipment Stocks Almost Gone

SUPPLIES of virtually all pole-line equipment are short in the market. It has been almost impossible to secure delivery on poles, cross-arms and wood pins for some time, and jobbers' stocks in the East and in the Middle West are swept clean. In the South conditions are better. Inquiries and orders in the Mid-West are off a bit, possibly because buyers feel it useless to place orders with deliveries as uncertain as they are. Cross-arms are reported in plentiful supply at the mills, but they cannot be moved to jobbers' yards. In some cases producers have been compelled to curtail operations because of congested shipping docks. Several carloads of arms are en route to Eastern markets but are held up by embargoes.

Wood poles, too, are short, especially in the 30-ft. and 35-ft. lengths. The 40-ft. and 45-ft. poles are in slightly better supply. Red cedar is reported particularly hard to get and is said to be sold up for the year. Lack of snow in certain parts of the Northwest was responsible for fewer poles getting out of the woods last winter because of difficult sledding conditions.

Wood pins are so short in some East and Mid-West markets that Western Union steel pins are being substituted in places. Chicago and New York stocks are virtually exhausted, but several cars are in transit. In New York territory wood-pin prices are very uncertain, while in the Chicago market a recent advance has set lots of 2,000 to 3,000 at $52.94 per 1,000.

Line hardware is in better condition and stocks are in fair shape. Buying is good, in fact better than expected by some jobbers. Porcelain insulators are extremely short for nearby delivery under a good demand in small amounts.

Storage Batteries Sold on Deferred-Payment Plan

RATHER a new departure in the method of payment for storage batteries has been inaugurated by the Edison Storage Battery Company. Edison batteries for all services can now be bought on the deferred-payment plan, which divides payments over a period of twenty months. It is understood that a trade acceptance is taken with the original payment when the sale is made.

Metal Market Situation

ANOTHER week has gone by and there has been virtually no change in the copper market. Prices in the producers' market during the past month have increased one-quarter cent and have held almost the entire month at 19.25 cents. That price still holds for May and second-quarter delivery. Third quarter is marked at 19.50 cents. In the outside market, on the other hand, 18.50 cents is being asked for nearby deliveries, which is three-quarters of a cent below prices asked a month ago. This market is even a little less strong, as a rather large sale was reported this week at 18.37½ cents New York.

Demand in both markets is light. A few sales for near delivery are going through, but sales for futures are quiet. Unrest in four brass mills in New York State and in New England is helping to put a damper on buying for futures as the course of labor is so uncertain. Traffic, too, is still hindering deliveries to refineries, and renewed walkouts in Buffalo railroad yards add uncertainty to the future.

Lead stocks in the East are low. Labor shortage and poor transportation are serious adverse conditions which make production of the metal unsatisfactory. Nearby demand is better at from 8.75 to 9 cents in the outside market in New York. The leading producer's price is still 9.25 cents. Zinc shows little change over last week. At the bid price of 8.30 cents New York exporters were not very anxious to sell futures. There are sufficient stocks available for the small volume of sales going through.

NEW YORK METAL MARKET PRICES

	April 28			May 5		
Copper	£	s	d	£	s	d
London, standard spot	103	10	0	101	5	0
	Cents per Pound			Cents per Pound		
Prime Lake	19.00			19.00		
Electrolytic	19.25			19.25		
Casting	18.37½			18.37½		
Wire base	23.00			23.00		
Lead, trust price	9.25			9.25		
Antimony	10.25			10.00		
Nickel, ingot	43.00			43.00		
Sheet zinc, f.o.b. smelter	12.50			12.50		
Zinc, spot	8.20			8.20		
Tin	61.50			58.00		
Aluminum, 98 to 99 per cent	33.00			33.00		

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.50 to 16.75	16.50 to 16.75
Brass, heavy	10.25 to 10.50	10.25 to 10.50
Brass, light	9.00 to 9.50	9.00 to 9.50
Lead, heavy	7.25 to 7.50	7.25 to 7.50
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

TRANSPORTATION conditions continue to improve. The Central West and the East are commencing to benefit, and much freight is now being received in the unscrambling process. The South and West, however, so far have failed to note any relief.

Heavy demand for conduit, armored conductor, wire and porcelain for suburban building in all sections is reported, with a question as to whether shipments will continue to arrive in sufficient quantity to keep the building program going. So far immediate needs are being met.

From the present rate of ordering, electrical manufacturers will break records this year.

Demand for generating apparatus, synchronous motors and general supplies is very large. Manufacturers are adding capacity, and it is expected that much better deliveries will be quoted in the near future on certain lines.

An increasing number of manufacturers are now billing prices effective date of shipment, with the result that jobbers have been inconvenienced to a considerable extent.

Jobbers are anxious about getting delayed freight shipments within the next few weeks as a considerable amount of the goods en route already have been sold.

NEW YORK

Volume of sales, which have been holding steady for several weeks past at a rate slightly below normal on account of lack of electrical goods, is increasing gradually. Business is reported good by most jobbers. Arrival of conduit, armored cable, wire and porcelain fittings has made it possible for some jobbers to transact more business than heretofore. Demand has been heavy for these roughing materials right along, but in most instances jobbers' stocks have been bare of these materials or so low that orders could not be filled. Lack of building materials, non-electrical, is now holding up some construction work. This condition, however, is temporary. Price changes have been made on switch boxes, armored conductor fittings and on annunciator wire.

Conduit.—Immediate needs are being met. One jobber received two carloads of pipe in different sizes, and others report consignments of 10,000 ft. up to half a car. A considerable amount delayed in shipment probably will be released within the next two weeks.

Flexible Armored Conductor.—Several jobbers have received amounts from a quarter of a car up to a carload. Demand is heavy and jobbers are distributing present supplies over wide limits.

Annunciator Wire.—Prices have been advanced approximately 5 per cent by at least one manufacturer. Shipments are poor and stocks are broken.

Switch Boxes.—One switch box has been advanced 3 cents, making the new price 24 cents. Stocks are low, but shipments en route are expected to help out considerably.

Heating Devices.—Of the Simplex heating devices which will advance on May 10, the 6-lb. flatiron goes to $8, the 8-in. disk stove and tailors' irons will increase $1, No. 27 range $10, and repair parts will be advanced between 10 and 25 per cent.

Schedule Material.—Demand greatly exceeds supply, which is low. Trucks continue to bring in supplies from Connecticut, but larger quantities are needed.

Non-Metallic Flexible Conduit.—Stocks are low, although as much as a car has been received during the week. Shipments by jobbers to contractors are being made by parcels post, 50 ft. to 60 ft. being shipped in each package.

Lamps.—Some stocks have been received by truck, but not nearly enough of the larger sizes. Heavy demand continues for the 75 and 100-watt sizes.

Sockets.—Stocks are dwindling rapidly, especially in the outlying districts. Some sockets have been received by truck with other schedule material, but so far not in large quantities.

Crossarms.—Jobbers' stocks are almost gone, but several carloads are en route from mills where stocks are fair.

Wood Pins.—Local stocks are out and in instances Western Union steel pins are being substituted.

CHICAGO

Continued difficulties in the movement of freight and a marked let-up in the volume of business in other lines have had but small effect on trade in electrical goods. The actual placing of orders seems to be at a somewhat slower rate than a few weeks ago, but inquiries are as heavy as ever. Wholly uncertain deliveries naturally have tended to slow up orders, but it is felt that with shipments moving more freely new business will resume its recent pace.

Extremely high material and labor cost and the consequent reluctance of bankers to finance construction have served seriously to curtail building operations in this district. Building permits are averaging under $2,000,000 a week. At present values this represents about one-third of the volume of construction which had been expected. If this situation persists, manufacturers of schedule material will be able to replenish stocks.

The transportation situation is improving daily. As a labor disturbance the strike about seems to have ceased, with the roads working about as many men as they need. A portion of these men are, however, new and inexperienced, and it will take much time, possibly six or eight weeks, to get freight movements back to normal. There is now no embargo on shipments to or from Chicago, but carriers still refuse to bill shipments through Chicago to points involving a transfer in this switching district.

A recent accident resulting in the complete disablement of the Des Moines (Iowa) gas plant has caused a rush of emergency orders for all manner of heating appliances for that city. As a result, toasters, grills, chafing dishes, ranges and percolators are temporarily unobtainable here.

Lamp Cord.—Silk-covered and cotton-covered cord are not to be had at any price, all quotations having been withdrawn. Cotton-covered cord is in stock in limited quantities at slightly advanced prices. Current quotation on No. 18 twisted is $42 per 1,000 ft. in small lots, $35 in 1,000-ft. lots, $30 in 2,500-ft. lots and $28 in larger quantities.

Motors.—Most makers are refusing to make prices or delivery promises on any fractional-horsepower motors as orders now on file will absorb the entire 1920 output. Some manufacturers can handle business on three months' delivery. Deliveries on large motors are uncertain. New prices have been made on slip-ring induction motors, constant-speed, 25-hp., 60-cycle, two-phase or three-phase, 220-volt dial type now being quoted at $870 list.

Oil Switches.—Inquiries are numerous for oil switches of standard type for protection of induction motors with all stocks low and many sizes missing. Delivery on shipments from factory ranges from eight to twelve weeks. List on the 2,500-volt switch, rated up to 200 amp., is $64.

Outlet Boxes.—Demand is not particularly heavy, limited quantities being found in jobbers' stocks. Delivery on factory shipments is slow. Standard type, 4-in., are quoted at $17 per 100; 3-in. at $13.75 per 100, in lots of from 100 to 500.

Knobs, Tubes and Cleats.—Stocks are fairly well maintained on these items, most jobbers being able to give immediate delivery. No. 5½ split knobs are listed at $48 per 1,000, less 50 per cent in barrel lots. Tubes, size 5/16 in. x 3 in., are $18 per 1,000 list, less 45 per cent in barrels.

Plug Fuses—Normal demand and stocks in good shape mark satisfactory conditions on this item. Jobbers' price on standard size lots of 500 is $5.60 per 100.

Heating Appliances.—Few appliances from factory have been delivered so far this year, probably less than 10 per cent of the expectation on hollow ware having been realized. All factories are reported as shipping every possible piece of hollow ware and many ranges to Des Moines, which will further delay the replenishment of Chicago jobbers' stocks. Orders continue to flow in from dealers in large quantities.

Intercommunicating Telephones.—This business remains merely normal, the largest demand being for factory installations. The almost negligible amount of apartment construction has kept requirements below the amount anticipated. Manufacturers are able to give immediate delivery.

BOSTON

Jobbers report continued intense activity in nearly all quarters. Deliveries are improving and some freight shipments have been received after long delays. Motor-truck shipments are still being used vigorously. The drain upon stocks is so heavy that little accumulation is possible either at the factories or by jobbers. Prices are firm, and further advances in copper wire are expected in some circles. Collections hold up extremely well, April payments being very satisfactory. Rigid conduit, motors below 10-hp. rating and insulating material are scarce. New building operations are slowing down somewhat owing to material supply difficulties, although residential work is increasing.

Wire.—Stocks are fairly satisfactory, although shipments are not in sufficient volume to permit much building up of supplies. Bare copper wire and weatherproof are steady at 24 and 28 cents base, respectively. Rubber-covered No. 14 sells for $11 per 1,000 ft., in 25,000-ft. lots and $11.50 in smaller quantities. Some price cutting is reported.

Flexible Armored Conductor.—Immediate needs are being met. No. 14 single-strip is quoted at $112 per 1,000 ft.

Non-Metallic Flexible Conduit.—Prices range from $35 to $37 per 1,000 ft. on 7/16-in., and from $39 to $40 on ½-in. loom, recent motor-truck shipments adding about $1 per 1,000 ft. to selling expense. Stocks are not very large.

Washers.—Deliveries are improving. Stocks were kept up only by strenuous effort during the recent strike. One jobber shipped several carloads of washers by express at a cost of $8 per machine. An increasing demand is noted.

Vacuum Cleaners.—Shipments from New England are moving well into this market. One distributer of an outside outfit, however, has been unable to get a cleaner from the railroads for three weeks, although 1,500 are on the way. The demand is active, and factory enlargements are cutting down the necessity for night work. New models are being eagerly snapped up. In lots of six a representative make, with attachments, sells for $36.65 and a competitor of well-established design for $47.

Motors.—A slight improvement in factory output is noted. The sale of motors to second-hand machinery dealers for stock is being greatly curtailed, and an effort is being made to refuse motor delivery for speculative buying. Small direct-current motors, around 2-hp. rating, are almost unobtainable. Some factories are now greatly handicapped by sheet-steel shortages, and the supply of copper is giving trouble on account of labor difficulties in the Naugatuck Valley. Prices are firm.

Rigid Conduit.—Supplies are unsatisfactory and deliveries poor in the extreme. Little chance of improvement can be seen at present. One jobber reports not a foot of pipe in his place, and others are unable to care for trade except on a piecemeal basis.

Sockets.—Conflicting reports are heard as to supply, but in general immediate requirements are being well handled. The brass situation is disturbing and insulating material shortages are reported. Prices are steady, pulls in case lots netting 50 cents, keys 28 cents and keyless 25 cents.

Knobs and Tubes.—A few "Nail-it" knobs strayed into the Boston market a day or so since, and were quoted around $31.50 per 1,000, barrel lot basis. Tubes are scarce, a nominal quotation being $10 per 1,000 in barrel lots.

ATLANTA

Fundamental business conditions in the territory have undergone no change during the past week, although a slowing up in activities is becoming quite noticeable because of freight and express embargoes from the East and Middle West. Jobbers report that they have received little or no material from either of these sections since the rail strike became general, and as a result all lines of material have become rather scant, with complete exhaustion of stocks in certain lines. The outlook is for continued activity, provided that jobbers can obtain material in sufficient quantities. One of the largest manufacturers has notified the trade that prices on all material, except motors, panelboards and one or two other items, are subject to quotation at date of shipment only.

Building activities throughout the section continue brisk. A number of the largest textile mills in the country are well under way and new construction is being announced daily. Building permits in the city of Atlanta for the month of April totaled $1,750,000.

Collections continue to show some improvement and might be said to be satisfactory.

Conduit.—The conduit situation has shown no improvement, there being no shipments of moment since April 15; there are no stocks worthy of mention in the popular sizes and shipments are quoted at six months.

Flexible Armored Conductor.—Prices have advanced 10 per cent. There are no stocks in the territory, and such shipments as are being received are being allotted purchasers in an effort to meet the more urgent demands.

Metallic Flexible Conduit.—A price advance of 10 per cent is announced. There are no stocks in the territory, and shipments are quoted at from four to six weeks, which, in the face of the brisk demand, is not expected to be maintained. Prices, ½-in., $104.40 per 1,000 ft.

Armored Lamp Cord.—Demand has slowed up in the past thirty days and good stocks have accumulated in the territory. It is a question whether this article will show renewed activity in the very near future. Price, $55 per 1,000 ft.

Exhaust Fans.—Moving-picture theaters are responsible for the unusual activity, and the anticipation of their demand enabled jobbers to accumulate good stocks, sufficient for the season. Price, 32-in. Ventura, $185.

Printing-Press Apparatus.—There is a heavy demand for push-button-control, single-phase apparatus for flat-bed press machines. Local stocks for this class of apparatus are badly depleted and shipments are reported unsatisfactory.

Panelboards.—Panelboards for all classes of lighting installation are moving briskly, although this line was somewhat dull up to two weeks ago. Industrial and commercial building activities account for this renewed activity. Shipments are from five to six weeks; cabinet boxes, two to three weeks.

High-Tension Transformers.—Stocks of high-tension transformers, 6,600 volts to 44,000 volts, both indoor and outdoor types, are completely exhausted. The demand, due to industrial plant electrification, is very brisk, and shipments are quoted at from fourteen to twenty weeks. Repair parts for this class of apparatus are reported equally hard to obtain.

SAN FRANCISCO

There is plenty of building, despite construction costs that would have been deemed prohibitive a few years ago but which now pass unquestioned because of the dire need for new buildings. The yardmen's strike has delayed westbound shipments so that stocks in many lines are running low. Some shipments have taken as long as forty-five days, about double the normal time. Local shipments are moving fairly well, although the railroad companies will not receive them except on certain stated days of the week.

Sewing Machines.—Sewing machines are now definitely established in electrical dealers' stores. The more expensive, such as the rotary machine, are now selling above the cheaper vibrating machines formerly the best sellers. Increased prices have apparently not hurt the market, for April is reported to be the best month of the year; the average vibrating machine now sells for $60 and the rotary machine for $80.

Motors.—Delivery conditions on motors, especially in the larger sizes, are better than they were, although freight shipments have prevented the accumulation of any stock. The pumping plant business is excellent, and now that the increased amount of reservoir storage permits power companies to handle the load a banner motor year may be looked for.

Farm Plants.—Agents report good sales. Devices for these plants are selling splendidly when they are to be had.

Lamps.—Coast deliveries are fair, owing to the Central Coast location of the Oakland lamp works. In fact, it appears that they are better than those which obtain in the East, where the construction and equipment of many new factories have piled up back orders. Very keen competition for renewal of dealers' contracts is reported with a lessened stabilization of regular renewals. There is keen competition among dealers for industrial contracts.

Fixtures.—Dealers report a good sale for fancy, stand and ceiling lights with parchment or silk shades. More attention is being paid to lighting problems, especially in the larger interior cities, such as Fresno, where the demand, with its new angles of call, has about swamped the local dealers.

Conduit.—Conduit is still scarce, such scattered shipments as recently reached the Coast being common property as long as they last.

SEATTLE—PORTLAND

Stocks along every line are exceedingly short and replacements are coming in so irregularly that attempts to build them up are futile. Sale volumes on all lines, with the possible exceptions of heavy power apparatus, continue to fall, orders being in excess of available supply. There is a brisk demand for domestic appliances, particularly washing machines, fractional-size motors, schedule materials and wiring devices.

Freight embargoes are responsible for the slow and irregular freight service and heavy demand. Collections in Seattle are good. Other cities in the district report collections from fair to good. Applications for new credits are comparatively few.

Building operations on a large scale are being considerably retarded owing to lack of electrical and other materials. However, in spite of this, residence construction is going ahead rapidly and numerous big business projects are being started. Portland territory reports that business in general continues better than last year. However, most of it is being done for future deliveries of from four to six months or more. Merchandise from the East is becoming more and more difficult to obtain on account of the railroad strike. The freight embargo locally, however, has been lifted and little difficulty seems to be experienced at the present time.

Price increases of approximately 10 per cent have been made on practically all motor accessories, including starting switches, and also on turbines.

Recently several lumber companies announced intentions of increasing motor equipment and are preparing to completely electrify their plants.

Lamp Fixtures.—Sales during April, in Seattle especially, far exceeded those of last year. This applies to both industrial and domestic types, although the movement in the latter was by far the heavier. Demand for domestic types has practically absorbed all available stocks. Prices are trending upward.

Vacuum Cleaners.—Trade is exceptionally brisk, with all lines sharing popularity. The majority of jobbers are encountering difficulty in maintaining a semblance of stocks. Prices have shown no recent advance.

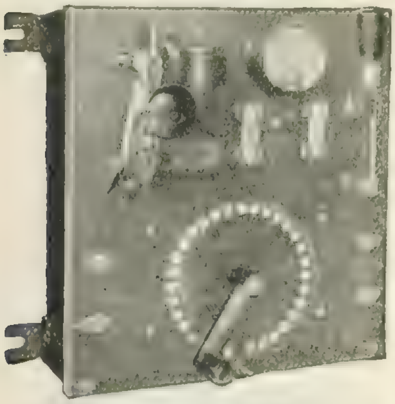
Meters.—Demand is steadily increasing particularly in Puget Sound District. Deliveries are coming through slowly and stocks are broken. Prices have shown no recent advance.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Rheostat for Charging Automobile Batteries

For charging storage batteries used for electric lighting, starting and ignition on gasoline cars, the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has developed equipment which is to be used with a direct-current source of supply. The charging set consists of a slate panel mounted on a wall-type frame and carrying a low-current cutout, single-pole mainline knife switch and fuses, ammeter, and thirty-step rheostat, and, says the manufacturer, is capable of charging from three to forty-two cells in series.


CHARGES UP TO FORTY-TWO CELLS

Circuit-Breaker Relay for Direct-Current Trip Circuits

The type KN relay now being manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., may be used either as a signal relay or a trip-free relay. As a signal relay it operates as audible or visible signal.

MAY BE USED AS SIGNAL OR AS TRIP-FREE RELAY

The signal relay ~~is~~ intended for direct current only, though it may be supplied for alternating-current operation. The standard-voltage coil may be used on control circuits of 100 volts to 250 volts. For voltages below this a special coil must be used, while for higher voltages a resistor must be inserted in series with the coil. The latch release coil is rated in accordance with the current required by standard trip coils, and relays can be supplied for ½, 1 and 3 amps. The signal relay has its main coil wound for voltage operation and its release coil wound for current operation. All coils are designed for momentary operation only and are so connected that they are in the circuit only for the time required by the operation of the apparatus.

Day-Color Lamps for Store Use

A lamp which, by means of a colored glass filter, is designed to produce light resembling natural daylight has been developed by the Western Electric Company. The color is in the glass and is guaranteed not to fade or otherwise change. The lamp casing is of copper, the upright support is of drawn-brass tubing heavily copper-plated, the base is of cast brass or bronze, and the projecting ends of the deck plate—the actual foundation of the lamp—are of cast iron, finished in black lacquer. A 150-watt Mazda C lamp is used.

COLORED GLASS FILTER GIVES DAY-COLOR LIGHT

Washing Machine with Reverse-Cylinder Action

A washing machine that operates on the reversing-cylinder principle is being marketed, under the trade name "G. R. S.," by the General Railway Signal Company, Rochester, N. Y. The perforated maplewood cylinder makes one revolution and then reverses. The clothes are carried through the water and dropped forty-four times a minute. A swinging wringer with reversible drainboard may be locked in five positions. Other features of the machine are double-worm gear drive, a ¼-hp. splash-proof motor and all working parts are sealed in a life-long lubricant. The capacity is eight sheets and floor space occupied is 24½ in. x 28 in.

CYLINDER ACTION IS REVERSING

Inclosed Starting Switch

An inclosed motor-starting switch is about to be marketed by the Frank Adam Electric Company, St. Louis, Mo. The switch is of the safety type and circuit is not opened when changing from starting to running position.

Magazine-Type Dry Cell

The "Mono-Cell" is the 2¼-in. magazine-type dry cell developed by the Interstate Electric Novelty Company, Brooklyn, N. Y.

Notes on Recent Appliances

Ventilating Fan

The "Scouplex" ventilating fan has been placed on the market by the L. J. Wing Manufacturing Company, New York City.

Valve Grinder

The Eclipse Valve Grinder Company, Kansas City, Mo., has placed on the market a motor-operated, internal-combustion-engine valve grinder.

Safety Entrance Switch

A safety entrance switch to prevent theft of current has been developed by the Lewis Electric Company, Massillon, Ohio.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE HAAG BROTHERS COMPANY, Peoria, Ill., manufacturers of washing machines, is constructing a new factory which measures 150 ft. x 280 ft. The company is planning to double its output within the next four or five months.

THE RADIUM LUMINOUS MATERIAL CORPORATION, manufacturer of "Undark" luminous material for wall switches, etc., announces the removal of its New York City offices to 58 Pine Street.

THE BLACK & DECKER MANUFACTURING COMPANY, Towson Heights, Baltimore, Md., has opened its Northeastern branch office at 169 Massachusetts Avenue, Boston. A service station for its product will be maintained at the same address. D. G. Caywood, Northeastern district manager, will have headquarters at this office.

THE WAGNER ELECTRIC COMPANY, St. Louis, Mo., has announced the removal of its Pittsburgh office to 530-534 Fernando Street, to continue in charge of Ludwig Hommel.

THE H. S. B. W.-COCHRANE CORPORATION has been incorporated under the laws of the State of Pennsylvania to take over the entire business and holdings of the Harrison Safety Boiler Works, Philadelphia, Pa. The management of the business, including the engineering, manufacturing and selling organization so long identified with the Cochrane line of steam specialties, continues as before. The officers are: Joseph S. Lovering Wharton, president; John C. Jones, vice-president and general manager; William S. Hallowell, secretary and treasurer; Horace E. Sibson, general sales manager.

THE COMBUSTION ENGINEERING CORPORATION, 11 Broadway, New York City, announces the resignation of its vice-president in charge of sales, E. P. Moritz, owing to continued ill health. No successor to Mr. Moritz has been named by the company up to date.

THE PNEUVAC COMPANY, Worcester. Mass., has acquired a new manufacturing plant in Worcester. This plant has a floor space of 168,000 sq.ft. and will be devoted exclusively to the manufacture of the one type of "Sweeper-Vac" with motor-driven brush. The plant will enable the company to reach an output of 1,500 machines daily.

WESTINGHOUSE CHANGES.—E. A. Wooten has been appointed manager of the industrial division of the Detroit district office, Frank H. Nealis has been appointed manager of the supply division of the Cincinnati district office, and H. M. Wible has been appointed acting manager of the newly established rectifier section, supply department, of the Westinghouse Electric & Manufacturing Company.

THE LUX MANUFACTURING COMPANY, 123 East Kinney Street, Newark, N. J., manufacturer of tungsten and nitrogen lamps, contemplates an addition to its plant. The proposed building will provide about 40,000 square feet of manufacturing space.

THE SETHMAN ELECTRIC & MANUFACTURING COMPANY, Denver, Col., is having plans prepared for the erection of a plant at Forty-second Avenue and Josephine Street, to cost about $400,000. The chief product of the plant will be an electric generator designed by George H. Sethman, president of the company.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has announced that new discounts to the trade applying to lists of spare parts for Emerson oscillating, non-oscillating and ceiling fans and to lists of spare parts for Northwind fans will be found in discount sheet No. 8025, dated March 15, 1920, and effective on that date. Discounts on spare parts formerly appearing in motor price book have been withdrawn and new discounts are being quoted on motor parts on request.

THE WHITE LILY MANUFACTURING COMPANY, Davenport, Iowa, has started work on the erection of its new factory, which will provide about 50,000 sq.ft. additional space.

THE UNITED STATES ELECTRIC COMPANY, New London, Conn., recently organized, has leased a building near the experimental station which it will equip for the manufacture of machines for doing planing by electricity and for heating rivets by electricity.

THE SAFETY CAR HEATING & LIGHTING COMPANY, 206 Erie Street, Jersey City, N. J., has disposed of its local plant and is planning to remove its works to New Haven, Conn., in the fall.

THE A. B. SEE ELECTRIC ELEVATOR COMPANY, Pacific Avenue, Jersey City, N. J., contemplates an addition to its plant, to cost about $16,000.

THE AUTOMATIC ILLUMINATED ADVERTISING CORPORATION, 816 West North Avenue, Baltimore, Md., recently incorporated with a capital stock of $200,000, plans to manufacture outdoor electric displays and automatic machinery for advertising purposes.

THE A. C. ELECTRICAL MANUFACTURING COMPANY, Dayton, Ohio, is preparing plans for a steel and concrete plant, the first unit to contain about 100,000 sq.ft. of floor space. The capital stock of the company has been increased from $100,000 to $600,000, primarily for financing business on hand and contemplated.

THE McMULLEN MACHINERY COMPANY, Grand Rapids, Mich., has organized a handling and conveying department which will specialize on electric and pneumatic cranes and hoists, overhead systems, chain and belt conveyors and construction machinery.

THE SUNLIGHT CARBON COMPANY, Red Fork, Okla., plans to equip a plant for the manufacture of carbon and its products for use in electrical machinery.

THE UNIVERSAL MOTOR COMPANY, Oshkosh, Wis., manufacturer of self-contained electro-generating units for farms, etc., has purchased a site at Fifteenth and South Main Streets on which it will erect a new plant to supplant its present works on Ceape Street. The new works will increase the company's floor space from 12,000 to 90,000 sq.ft.

THE BRYANT ELECTRIC MANUFACTURING COMPANY, Bridgeport, Conn., is enlarging its factory to meet the demands of increasing business. A four-story-and-basement addition of 100,000 sq.ft. floor area will be built at once to hold finished goods and the present finished-goods storage quarters, 155 ft. x 60 ft. and three stories high, with basement, will be used for the storage of parts. The original Bryant factory on State St., 128 ft. x 40 ft., is to be faced with brick, widened to 60 ft. and run up to four stories, giving additional office space. A 36-car garage for company use has just been completed. The Company reports very active business, far exceeding that of last spring to date.

THE AJAX ELECTROTHERMIC CORPORATION was incorporated April 26 to take over from the Pyrolectric Instrument Company, Trenton, N. J., the manufacture and sale of the Ajax-Northrup high-frequency induction furnace. It also takes over from the Ajax Metal Company the Northrup patents. The Ajax Electrothermic Corporation has its offices and works in the old home of the Pyroelectric Instrument Company, 636 East State St., Trenton, N. J. The Pyrolectric Instrument Company continues in the pyrometer and instrument business in other quarters at the same address. Furnaces are now commercially available for operation on single-phase circuits to 20 kw., on two-phase circuits to 40 kw. and on three-phase circuits to 60 kw. Larger units are possible. G. A. Clamer is president of the new corporation, Edwin F. Northrup, formerly of the Leeds & Northrup Company, and at present professor of electrical engineering at Princeton University, is vice-president and technical adviser; H. F. Porter is treasurer, and Dudley Willcox is secretary and sales manager.

Supply Jobbers' Notes

Western Electric Sales Changes

J. L. RAY, manager at Pittsburgh, has been appointed power apparatus sales manager in the general sales department in New York. Mr. Ray started with the company in 1905 in the drafting department, and the next year found him in the power apparatus sales department in New York. In 1912 he was made assistant sales manager in Pittsburgh, and the next year he became sales manager at the same house, from which post he was in 1918 promoted to be manager.

W. H. MACCRELLISH has been appointed manager at Pittsburgh, succeeding J. L. Ray, who was transferred to New York. Mr. MacCrellish began his career with the company in 1905 as shop clerk in Philadelphia. In 1911 he was chief clerk in Boston, the next year he went to Buffalo as stores manager, and with the same title he went subsequently to Minneapolis and then to Boston. In 1916 he went to Buenos Aires as assistant manager.

M. A. BUEHLER, who has been sales manager at Omaha, Neb., since 1917, has been transferred to Minneapolis, Minn., as sales manager of that office.

E. LUM has been appointed sales manager at Omaha, Neb., succeeding M. A. Buehler, who was transferred to Minneapolis. Mr. Lum has been with the company since 1905 and since 1912 has been a salesman in Omaha, Neb.

THE PERRY-MANN ELECTRIC COMPANY, INC., Columbia, S. C., announces the appointment of Col. A. M. Jackson as sales manager, effective May 1. Colonel Jackson comes from the supply department of the Schenectady office of the General Electric Company, with which company he became associated in 1898. He was connected with armature-winding, switchboard assembly and machine-shop practice for three years, and then took up construction work on outside installations. In 1906 he entered the supply department and for four years was interested in engineering and sales of street and interior illumination, transferring to supply-house interests and retail connections of the company in 1910.

A. M. JACKSON

Foreign Trade Notes

CZECHO-SLOVAK TRADE JOURNAL IN ENGLISH.—Volume 1, number 1, of the *Czecho-Slovak Trade Journal*, dated April, 1920, has been published in Prague-Vinohrady, Czechoslovokia. The paper is characterized as the only commercial paper in that country published in English. To acquaint the commercial circles of English-speaking countries with the economical position of Czechoslovakia, 4,000 copies of this first number have been sent abroad.

THE CROWN ELECTRIC MANUFACTURING COMPANY, LTD., 17 Pearl Street, Brantford, Ont., Can., is erecting an addition to its plant, to cost $16,000

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A merchant in Switzerland (No. 32,605) desires to purchase electric supplies and implements of all kinds for the wholesale trade, such as sockets, switches, pull switches, cutouts, flat steel wire clasps, small electric motors (1/10 hp. and 1/25 hp.) and resistance wire for heating apparatus.

A merchant in England (No. 32,608) desires to be placed in communication with the manufacturers of an electrical suction cleaner similar to the one which is being sold on the English market, with a view to purchasing.

An engineer in Belgium (No. 32,575) desires to secure the general agency on a commission basis for the sale of small electric apparatus, electric lamps, etc., used in connection with the mining industry.

A commercial agent in Spain (No. 32,610) desires to secure an agency for the sale of electrical material.

A commercial agent in New Zealand (No. 32,638) desires to purchase and also to secure an agency for electric cloth cutting machines.

Trade Publications

ELECTRIC COOKING APPLIANCES.—The Duparquet, Huot & Moneuse Company, New York, N. Y., has issued catalog No. 22, covering its heavy-duty electric cooking equipment for hotels, restaurants, clubs, steamships, etc.

LIGHTING SYSTEMS.—"Eye Comfort" is the title of a folder inclosing booklet and leaflets being distributed by the National X-Ray Reflector Company, Chicago, describing and illustrating its direct and indirect lighting systems and apparatus for same, including projectors, reflectors, mountings, etc.

INSULATING MATERIALS.—The Continental Fiber Company, Newark, Del., has published an eighty-eight-page booklet entitled "Insulation," in which it describes the various products manufactured by the company, including vulcanized fiber, "conite," "bakelite-dilecto," etc.

New Incorporations

THE RENEW ELECTRIC LAMP CORPORATION of New York, N. Y., has been chartered with a capital stock of $100,000 by C. M. Stuart, Jr., M. V. Ryan and J. R. Moynihan, 408 West 150th Street, New York City.

THE DORRA MANUFACTURING COMPANY of New York, N. Y., has been incorporated by L. E. Rogers, F. A. Stroh and B. P. Ryan, 320 West Eighteenth Street, New York City. The company is capitalized at $5,000 and proposes to manufacture heat and light saving appliances.

THE SUPERIOR ELECTRICAL FIXTURE & APPLIANCE COMPANY of New York, N. Y., has been incorporated with a capital stock of $10,000 by H. and A. and I. Fistel, 332 Bedford Avenue, Brooklyn, N. Y.

THE AMERICAN ELECTRICAL INSTRUMENT COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $500,000. The incorporators are William O'Keefe George G. Steigler and E. E. Aberle of Wilmington, Del.

Construction News

Projects, Plans, Bids and Contracts,
Contemplated or Under Way

New England States

AUGUSTA, ME.—The Central Maine Power Company has been granted permission by the Public Utilities Commission to purchase the plants and system of the Androscoggin Electric Company, the Knox Electric Company and the Oxford Electric Company.

BAR HARBOR, ME.—The Ellsworth & Bar Harbor Power Company has applied to the Public Utilities Commission for permission to extend its lines to Deer Isle and Stoningham.

WEST SPRINGFIELD, MASS.—Contract will soon be awarded by the Wico Electric Company for the construction of the first unit of a new plant to cost about $75,000. McClintock & Craig, 33 Lyman St., Springfield, Mass., are engineers and architects.

PROVIDENCE, R. I.—The Narragansett Electric Lighting Company is planning the erection of offices and modern service buildings for meter, arc lamp, underground cable and transformer departments, on a ten-acre tract of land near Melrose Park.

DANIELSON, CONN.—The Goodyear Tire & Rubber Company, East Market St., Akron, Ohio, has awarded contract to the Hunkin-Conkey Construction Company, Century Building, Cleveland, Ohio, for the construction of a manufacturing plant and power house, to cost about $3,500,000.

NEW BRITAIN, CONN.—The Public Utilities Commission has approved the application of the Connecticut Light & Power Company for the construction of an aerial cable for a 13,200-volt electric distributing system across lines of wires and rights of other corporations and along Myrtle St.

Middle Atlantic States

BROOKHAVEN, N. Y.—The Long Island Lighting Company, Northport, L. I., has applied to the Public Service Commission for permission to erect a transmission line in the town of Brookhaven.

HAMBURG, N. Y.—The Depew & Lancaster Light, Power & Conduit Company of Lancaster has been granted permission to erect an electric light plant in this city.

POTSDAM, N. Y.—St Lawrence Transmission Company has applied to the Public Service Commission for permission to extend its lines to the town of Russell.

REDWOOD, N. Y.—The Northern New York Utilities, Inc., of Watertown is planning to build a substation in Redwood and erect a three-phase high-tension transmission line from Redwood to Alexandria Bay, a distance of about 8 miles. The cost is estimated at about $10,500. J. B. Taylor is president.

DOVER, N. J.—The Richardson & Boynton Company, manufacturer of boilers and furnaces, is planning the installation of new electrical equipment, including motors, compressors, etc., in its factory.

HACKETTSTOWN, N. J.—Plans have been completed by the Town Council for the rebuilding of the municipal electric fire-alarm system, on which work will begin at once.

HARRISON, N. J.—The New Jersey Tube Company plans to change its switchboard outfit and to install two 150-kw. three-phase transformers. Philip Arnheiter is manager.

EDWARDSVILLE, PA.—The Wilbur Robson Silk Company is in the market for seventy-five electric motors.

ERIE, PA.—Plans have been prepared by the Skinner Engine Company, Twelfth and Chestnut Sts., for the construction of a power house and shop building, and alterations to its existing factory, to cost about $80,000.

MILLVALE, PA.—Bids will be received by G. Walter Bauer, borough clerk, until May 11, for the installation of a street-lighting system.

PHILADELPHIA, PA.—An appropriation of $358,000 for the completion of the power house and the installation of an electric transmission system in the Frankford arsenal has been made.

PITTSBURGH, PA.—The East Pennsylvania Gas & Electric Company is reported to have bought a tract of thirty-six acres at Edgely, and plans to build a power plant. At present the company receives its energy from the Philadelphia Electric Company.

SHARPSBURG, PA. — The Borough Council of Aspinwall has applied for permission to incur an indebtedness of $50,000 for improvements and extensions to its electric light and water plant.

YORK, PA.—The York Railways Company is planning extensive improvements to its traction system, including installation of new equipment in its local power station, rebuilding trolley system between Symsers and Hanover and erecting new substations in Martins and Gitts Run, etc.

FREDERICK, MD.—The Hagerstown & Frederick Railway Company is planning the construction of a 33,000-volt transmission line to connect its plant in West Virginia with its local plant, to cost about $60,000.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until May 11, South Charleston, W. Va., Schedule, 6,043—six electric hoists; Yorktown, Va., Schedule 6,020—3,000 porcelain strain insulators; Schedule 6,023—3,000 copper-wire thimbles; Brooklyn, N. Y., Schedule 6021—switchboards and panels. Until May 11, Washington, D. C., Schedule 6,031—7,000 ft. rubber-insulated cable. Until May 18, Mare Island, Cal., Schedule 6,025—electrodes, plug and joint compound; Yorktown, Va., Schedule 6,060—18,000 electric cable connectors. Applications for proposals should designate schedule desired by number.

North Central States

BAY CITY, MICH.—Contract has been awarded to the Bay City Stone Company, 1,704 Woodside Ave., for the construction of a dry kiln and power house, to cost about $50,000, by the Bigelow-Cooper Company.

CINCINNATI, OHIO.—Bids will be received at the office of the United States Engineer, Cincinnati, until May 19, for furnishing and installing river wall power-plant machinery, river wall valve jacks and machinery and lock piping, etc., for Dams 33 and 39, Ohio River. Alternate bids will be received for furnishing and delivering above without installing.

CINCINNATI, OHIO.—Bids will be received by the clerk of the Board of Education, eighth floor, Denton Building, Seventh and Race Sts., Cincinnati, Ohio, until May 24, for furnishing materials and labor to complete the installation of electric lighting in the public school on Seventy-fourth St., Carthage, in the city of Cincinnati. Plans and specifications may be obtained at the office of C. W. Handman, business manager, 511 West Court St.

CLEVELAND, OHIO.—The Public Utilities Commission of Columbus has authorized the Cleveland Electric Illuminating Company to issue $1,150,000 bonds for improvements.

EARLINGTON, KY.—Arrangements are being made by the St. Bernard Mining Company to extend its electric light service to the towns of Hanson and Slaughters.

VINCENNES, IND.—The Board of Works has approved a five-year franchise with the Indiana Power Company to furnish street lighting for the city.

CHICAGO, ILL.—The Illinois Malleable Iron Company, 1,801 Diversey Boulevard, plans to erect a new central power plant to replace three separate plants. The generating equipment will include two direct-connected engine-driven units, one of 350 kw. and the other of 500 kw.

TAYLORVILLE, ILL.—Bonds to the amount of $80,000 have been voted for the construction of a municipal electric light plant.

SHEBOYGAN, WIS.—Contract has been awarded by the Badger State Tanning Company to Westinghouse, Church, Kerr & Co., Inc., 37 Wall St., New York, N. Y., for the construction of a tannery, to cost about $750,000. Considerable electric equipment will be required.

LETTS, IOWA.—Plans are being considered to connect the town with a high-tension transmission system. Improvements to the local street-lighting system are also under consideration.

KANSAS CITY, MO.—The South Main Street Improvement Club has appointed a committee to investigate and decide upon its lighting system, to be installed on Fiftieth Street between Armour Boulevard and Thirty-ninth Street. The extension of the lighting system to Westport Avenue or Forty-third Streeet is also being considered.

DOLAND, S. D.—Bonds to the amount of $17,000 have been voted for improvements to the local electric light plant.

JOHNSON, NEB.—A bond issue will be submitted to the voters of the village of Johnson for the purpose of erecting a transmission line to Auburn or to the Graf terminus of the Tecumseh light system.

AMERICUS, KAN.—At an election to be held on May 14 the proposal to issue $18,000 in bonds to establish a lighting system in the town will be submitted to the voters. The present plans contemplate the erection of a transmission line to Emporia to obtain electricity for the proposed system.

DWIGHT, KAN.—The local electric light plant, owned by the R. B. Fegan Company, has been sold to H. P. Bader and W. S. Scott of this city.

Southern States

GREENSBORO, N. C.—The Southern Power Company of Charlotte, it is reported, will apply for a franchise to erect and operate an electric system in this locality.

TAMPA, FLA.—An issue of $280,000 in bonds for the erection of a new power plant, improvements to the waterworks system, etc., is under consideration.

KNOXVILLE, TENN.—The question of electrifying the filtration plant of the local waterworks is under consideration.

TAZEWELL, TENN.—The Claiborne County Light & Power Company, recently organized with a capital stock of $25,000, is planning to erect a transmission line to connect at Cumberland Gap with the transmission system of the Kentucky Utilities Company of Louisville, Ky. The plant and system of the Tazewell Light & Power Company will be taken over by the new company of which J. P. Ritchie of New Tazewell is president.

HEBER SPRINGS, ARK.—Contract will soon be awarded by the Arkansas Hydro-Electric Development Company for the erection of the first unit of the power plant and dam on the Red River, to cost about $320,000.

TECUMSEH, OKLA.—The State Board of Affairs has awarded contract to the Manhattan Construction Company, Oklahoma City, Okla., for the erection of an administration building, a school, two cottages and a power plant, to cost about $153,000.

ABILENE CITY, TEX.—Arrangements have been made whereby the American Public Service Company will take over and operate the Abilene street-railway system. Improvements, consisting of new equipment, repairs to power plant, track and transmission lines, will be made, costing more than $60,000. A. Hardgrave, Southwestern Building, Dallas, is state manager for the company.

Pacific and Mountain States

FRESNO, CAL.—The San Joaquin Light & Power Company has been granted permission by the State Water Commission to divert 3,200 acre ft. per annum for storage and 900 ft. per cubic second from the San Joaquin River for power purposes. The cost of the project is estimated at $4,000,000.

McFARLAND, CAL.—Steps have been taken by farmers in this vicinity to establish a community electric power plant, operated by steam power, using natural gas for fuel. The cost is estimated at about $250,000. Mr. Carter, a member of the McFarland Farm Center, is one of the promoters.

SAN FRANCISCO, CAL.—Application has been made to the State Power Commission by the Snow Mountain Water & Power Company for permission to appropriate 400 cu.ft. per second from the South Fork of the Eel River in Lake and Mendocino Counties for power purposes. The cost of the project is estimated at $3,000,000. The company has also filed similar application for appropriation of water from the same stream for municipal purposes, to supply Berkeley, Oakland and Alameda.

SAN FRANCISCO, CAL.—Extensions to the street-lighting system, to cost about $5,000, are planned.

BRIGHAM, UTAH.—The City of Utah is planning to rebuild its hydro-electric plant with an increase of 1,500-hp. capacity.

OGDEN, UTAH.—Application has been filed with the state engineer for permission to divert water from the Ogden River to be used in connection with the new hydro-electric plant to be constructed for irrigation purposes in Weber and Boxelder Counties, and to have a capacity of 5,000 hp. O. D. McKay of Ogden is engineer.

WINNETT, MONT.—C. B. Davis has been granted a franchise to construct and operate an electric light plant in Winnett.

LARAMIE, WYO.—At an election to be held soon the proposal to issue $60,000 in bonds for improvements to the electric light plant will be submitted to the voters.

DENVER, COL.—Plans have been completed by the Mineral, Metal & By-Products Company for the construction of electric smelting and refining works, to cost about $1,000,000, including the erection of a power house, a plant for electrical retorts, a combination electric smelter and refinery, etc. G. Rasmus is second vice-president and managing director of the engineering department.

Canada

ACTON, ONT.—Bids will be received by E. A. James Company, 36 Toronto St., Toronto, engineer, until May 13, for improvements to the waterworks to include electrically driven deep-well centrifugal pumps, to cost about $30,000.

TORONTO, ONT.—Contract has been awarded to Wells & Gray, Confederation Life Building, by the Canadian National Carbon Company and Prest-O-Lite Company of Canada, Ltd., joint owners, for the construction of two factory buildings, to cost about $450,000. Both plants will be equipped for electrical operation.

MONTREAL WEST, QUE.—Bids will be received by Charles I. Fraser, secretary-treasurer, Town Hall, Montreal West, Que., until May 20, for the installing of a complete underground system of wiring, with standard posts and lamps, for the lighting of streets as shown on plans and specifications which may be seen at the Town Hall.

MURRAY BAY, QUE.—The Murray Bay Power & Pulp Company is contemplating the construction of a power plant, to cost about $500,000.

THREE RIVERS, QUE.—Contract has been awarded to the Canadian Comstock Company, Ltd., for the furnishing and installing complete electrical and mechanical equipment in the pulp and paper mill of the Maurice Lumber Company, including motors, transformers, electrical feeders and distribution, etc. The total cost is estimated at $6,500,000.

Record of Electrical Patents

Notes on United States Patents

(Issued April 20, 1920)

1,336,932. Rail Bond; William C. Starkey, Mansfield, Ohio. App. filed June 26, 1916. Applied by intense heat and protects flexible portion of bonds from heat. Time of contact is short and bond is made integral part of rail.

1,336,939. Electric Furnace; Svend Barfoed, Berkeley, Cal. App. filed Sept. 25, 1916. Water-jacketed type.

1,336,940. Rail Bond; John R. Brown, Mansfield, Ohio. App. filed Nov. 2, 1917. Bond secured by application of heat having terminal members of a higher melting point than body.

1,336,966. Trolley Retriever; John Kozak, Milwaukee, Wis. App. filed Nov. 26, 1918. Readily applied to trolley poles of common construction without alteration.

1,337,062. Ozonator; Milton W. Franklin, Bloomfield, N. J. App. filed Aug. 3, 1916. Machine produces a gaseous reaction by an electric discharge.

1,337,080. Multi-conducting Leads; Ward E. Krone, Pittsfield, Mass. App. filed June 16, 1919. Small power losses in dielectric insulating material employed.

1,337,100. Electricity Transforming and Converting Apparatus; Charles W. Stone and Henry M. Hobart, Schenectady, N. Y. App. filed Sept. 6, 1916. Receives high-pressure polyphase current from a supply system and delivers relatively low-pressure direct current to a distribution system.

1,337,106. Process of Making Nitric Acid; Elihu Thomson, Lynn, Mass. App. filed Dec. 6, 1918. Process and an apparatus for utilizing the solubility at low temperature of the nitric oxides in nitric acid.

1,337,120. Electric Water Heater; William F. Cutler, Oakland, Cal. App. filed May 5, 1919. Avoids use of large wires and heavy currents.

1,337,129. Distribution of Electrical Energy; Charles Grover, Gravesend, Eng. App. filed Oct. 24, 1919. System effects a more equal distribution of stresses of what are known as intersheaths or grading sheaths.

1,337,156. Electric Furnace; Julius A. Pickens, Easley, S. C. App. filed June 14, 1919. Construction of the electrodes and combustion chamber whereby all substance treated is brought in contact with and forced to move through flame of an electric arc.

1,337,160. Battery Tester; George H. Riebeth, Minneapolis, Minn. App. filed May 28, 1919. For testing dry batteries while contained in round or square cartons of usual type.

1,337,163. Protective Casing for Electric Meters; Joseph J. Schickuna, Buffalo, N. Y. App. filed Jan. 25, 1915. Prevents tampering with wires.

1,337,189. Vaporizing Stopper; Ellsworth W. Austin, Plymouth, Conn. App. filed June 2, 1919. Contains resistance units.

1,337,197. Telephone-Exchange System; Henry P. Clausen, Mount Vernon, N. Y. App. filed July 9, 1917. Variable adjusted phonograph device informs operator of desired number.

1,337,198. Calling Device; Henry P. Clausen, Mount Vernon, N. Y. App. filed July 12, 1917. Impulse senders for automatic or semi-automatic telephones in which selector switches are directively controlled by current impulses.

1,337,245. Rehealing Process for Condensers; Byron Macpherson, Roxbury, Mass. App. filed Nov. 19, 1919. Intermittently including condenser in a circuit to fuse a coil and heat dielectric at defective spot.

1,337,246. Building Stand for Condensers; Byron Macpherson, Roxbury, Mass. App. filed Nov. 19, 1919. For sheet or plate type.

1,337,284. Twin-Bar Suspension Insulator; Sol S. Sonneborn, Brooklyn, N. Y. App. filed July 10, 1918. Provides in combination with an insulator a spark gap.

1,337,285. Automatic Selecting Switch; Arthur B. Sperry, New York, N. Y. App. filed June 6, 1918. Switch used as a trunk hunting or line switch.

1,337,297. Telephone-Exchange System; Horace W. Ulrich, East Orange, N. J. App. filed May 11, 1918. Trunk circuit with a signal-control relay whose operating circuit is partially established upon connection being made with incoming end of trunk circuit.

1,337,299. Annunciator; Eugene W. Vogel, Oak Park, Ill. App. filed June 20, 1914. Visible three signal mechanism.

1,337,301. Telephone-Exchange System; Ray S. Wilbur, Lyndhurst, N. J. App. filed May 13, 1918. Private branch exchange switchboards joined by means of trunk circuits.

1,337,304. Speech-Reproducing Device; George F. Atwood, Newark, N. J. App. filed June 22, 1917. Speech-reproducing device repeating telephone numbers or letters designating a telephone line.

1,337,305. Process of Melting and Melting and Reducing Metals; Morris H. Bennett, Waterbury, Conn. App. filed June 26, 1918. Reduces the overheating of metals of the non-ferrous group by utilizing characteristic of high thermal conductivity.

1,337,309. Telephone System; Charles L. Goodrum, New York, N. Y. App. filed Feb. 26, 1916. Brush sets carried on same movable-switch element and employed in simultaneously hunting for a desired line.

1,337,310. Telephone System; Charles L. Goodrum, New York, N. Y. App. filed July 26, 1917. Electromechanical switching for extending a call from one subscriber's station to another.

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician
Published by McGraw-Hill Company, Inc.

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Volume 75 New York, Saturday, May 15, 1920 *Number* 20

N. E. L. A. Convention

NEXT week at Pasadena, Cal., the forty-third convention of the National Electric Light Association will be held. Always of great interest and importance to the industry, this year's assembly has a special significance because it is to pass upon the reorganization program that has been drawn up at national headquarters in accordance with administration plans. The association should give its unanimous approval to this progressive movement, the details of which were explained by Executive Manager Aylesworth in our preconvention issue last week. The program of association meetings and entertainment, as printed in our recent issues, is ample assurance of a highly successful convention. On May 22 and 29 the ELECTRICAL WORLD will give its usual complete report of the proceedings.

Cornell's New President

IN THE selection of A. W. Smith, for sixteen years dean of Sibley College, to succeed Dr. Schurman as president of Cornell University, the trustees of that institution have honored an eminent technician who is also what every eminent technician is not—a man of all-around culture and development. An athlete in his younger days, president and orator of his class and an honor graduate of the university where he is now to be the head, Dr. Smith's tastes have led him to take an active interest in literature of all kinds, and we are told that, in addition to texts pertaining to his own profession, he has written other things, including rhymes. A poetical engineer, or for that matter an engineer qualified to be the president of a great institution of learning where the humanities as well as the sciences are fostered, is sufficiently unusual to draw comment; but why should not an engineer as well as other educated men possess the broadened outlook and the enriched imagination that come with the pursuit of letters?

Centralization and Over-Development

THE influence of centralized energy supply in preventing over-development of plant deserves emphasis in view of the growing recognition of the improvement in operating efficiency resulting from the co-ordination of generating stations and line facilities, either through consolidation or interconnection. The Maine Public Utilities Commission discussed this point effectively in a recent decision which will be found among the "Commission Rulings" in this week's issue. The wisdom of permitting a consolidation which will result in one public utility's occupying a large and important part of the state was under consideration, and the commission concludes that so far as hydro-electric companies are concerned, the union of relatively small companies into one large corporation is for the benefit of all the customers of each of the companies and is best for the state as a whole. This doctrine is hardly novel, to be sure; but in setting it forth the commission throws additional light upon over-development as related to centralization, and in words well worth heeding. Its recognition of the far-reaching economic advantages of centralization evinces an understanding of the less evident as well as the more patent aspects of interconnection and unification which deserves to be brought to public attention. It is one among a number of proofs that public service commissions in all parts of the nation are studying with zeal and intelligence the questions that come before them for adjustment.

Precaution Better Than Litigation

EXEMPTION from responsibility for damages caused by "acts of God," in other words, due to the uncontrollable working of natural phenomena, has always been claimed by those to whom others trust their safety. This must have been the defense at the back of the official mind of the Quebec Railway, Light, Heat & Power Company when it fought clear through to the Canadian court of last resort—the judicial committee of the British Privy Council—the suit of a number of roadside customers whose houses had been destroyed by fire caused by the conductors of the company's 2,200-volt transmission line in a storm coming into contact with the branch lines that supplied the residences. The fact that the electric supply company had not followed the ordinary practice of grounding the secondary wires was, however, to the judicial mind sufficient reason for finding for the plaintiffs, despite the company's contention that the loss was an unavoidable incident of its legal right to distribute energy by overhead lines. The great preponderance of engineering authority is, of course, on the side of the court's decision. Grounding the secondary is a requirement of the National Electrical Code, and for that matter the practice had been recommended to the Quebec company by the Canadian fire underwriters. Were consumers of electricity, along a rural road or elsewhere, forced to assume the risk of losing their houses in every violent storm, their number would naturally and with reason shrink.

Electricity in the Home

THE ELECTRICAL WORLD presents this week a somewhat exhaustive study of the use of electrical energy in the American home, particularly with reference to the actual as compared with the possible extent of this fundamental service. The degree to which electrical distribution covers the country can be written down proudly in blazing figures to mark the progress of the last quarter of a century. Nearly 60 per cent of the total population live today in territory reached by central-station service; yet only about half of this population, or 30 per cent of the total, actually enjoy the benefits of electrical service. The proportion varies greatly, as might be expected, from part to part of the country. California leads, with 79 per cent of its people living in electrically lighted houses, and Utah is a good second, with more than 74 per cent. So much for the transmission networks that have been there developed. On the Eastern coast Massachusetts and Connecticut are in the van, but the figure for these states and for Illinois, the ranking state of the Middle West, falls to about 55 per cent. And so the list runs down, ending with Mississippi at 8.4 per cent, though in mitigation of that low figure it may be said that it represents substantially half the population reached by central stations, lack of distribution rather than lack of desire for electricity being the trouble.

These figures furnish serious food for reflection. They show very plainly that the central stations of the country as a whole have not made the most of their domestic opportunities. More than 44 per cent of the dwellings in territory actually covered by central stations are not wired, the figures running up from 7.2 per cent in Utah and 8.6 per cent in California to about 70 per cent in Pennsylvania, Maryland, Louisiana and, horrible to relate, the District of Columbia. Now, one cannot put "juice" in cold storage. It must be delivered, for the most part, as made, and the only way to deliver it to the domestic consumers with their fifteen million unwired houses is to start an energetic campaign for wiring—difficult, it is true, in these times of high prices, but necessary if electric service is to reach its full development. It was at one time considered almost beneath the dignity of central stations to cater to the small consumer, but the aggregate amount of load which he can absorb is very large and the total revenue correspondingly large and well worth getting. Especially is this true since the cost of extending the area of service is great, and the more service to be extracted from existing territory covered the better from the standpoint of economy.

Of equal importance is the increasing use of electrical appliances in domestic service, which is capable of adding very largely to the income of the central stations with very great advantage to the consumer. It is to the appliance load that electric companies must chiefly look for the fuller utilization of their lines, especially those lines outside the industrial districts. Wherever active wiring and appliance campaigns have been waged good results have been shown, results which year by year will become more plainly evident. Once a house is wired and equipped with appliances its load shows a steady increase as time goes on, and this again means intensive use of the distribution system, particularly as the larger part of such load is off the general peak. The wiring of the two hundred thousand houses likely to be built this year will for the most part go on as a matter of course, but the central stations should see to it, as far as possible, that new installations are laid out with reference to the use of electrical appliances so that no rearrangements will hinder their installation. The wiring of old houses presents a more difficult problem, and every effort ought to be made to work out and encourage methods of minimum cost for this important work. Broadly, there is an opportunity for more than doubling the domestic load within reach of existing central stations, and it is emphatically up to the central stations themselves to win as much as possible of this added output.

Power Needs of Eastern Industries

MUCH has been said in the last few years in favor of the wholesale distribution of electric power, and the exigencies of war-time demand have pointed more plainly than ever to this particular need. Lieut.-Col. Lacombe in this number gives a striking analysis of the situation as it now exists as well as details concerning proposed remedial measures. There is no doubt that the nation stands today in a very critical industrial situation. The war which turned the world upside down has left in its wake an enormous increase in the cost of everything. This may be attributed to many co-operating causes, of which not the least is the world inflation of currency, amounting to something like one hundred billion dollars. The most conspicuous feature of the industrial situation is the unprecedented rise in wages. Second only to this stands the general increase in cost of production.

During the last five years the cost of coal has more than doubled, and the survey of power plants carried on by the government showed that the waste in the utilization of this high-cost fuel was startling, especially in the numerous relatively small plants in which the consumption ran as high as 7 lb. (3.17 kg.) of coal per unit of power furnished. Now, aside from all questions of conservation, increase of operative efficiency would mean a very great economic gain. Colonel Lacombe estimates that the introduction of super-power plants with suitable distributing systems would save in the Northeastern States alone more than $18,000,000 worth of fuel, equivalent to 12 per cent on more than $300,000,000—a sum fully ample to carry out the projects outlined. The total amount of fuel supposed to be available in this country is more than three thousand billion tons, a quantity which sounds very big, but in fact is not nearly so great as the figures indicate. Most of it is extremely low-grade lignite or the meanest of bituminous coals. Much of it is of a quality difficult and costly to transport in the face of increasing railroad charges, and as time goes on deep mining must be resorted to more and more, implying lessened output per man and further increased expense. Conservation therefore must be reckoned with, not in terms of a future of three thousand billion tons, but right here and now to avert prohibitive increases in price.

The hydraulic resources of the country are very great, more than 50,000,000 hp., but of this a considerable majority is in the Rocky Mountain region and west thereof. New England and the Middle Atlantic States are not now rich in undeveloped powers which can be brought into service at moderate cost. It is this consideration which impels the study of super-power stations worked from coal at the mine's mouth, if feasible, and preferably where the cheaper grades of fuel can be utilized. The project put into concrete form by Colonel Lacombe involves first the Northeastern territory—that in New York, New Jersey and Pennsylvania—and it gives the impression of thorough feasibility from an economic standpoint. It is our opinion, however, that if anything of the kind is to be undertaken under government auspices it should go much further. There are now in existence various huge networks covering areas much greater than that here contemplated which, although interconnected, are still not efficient from the industrial standpoint. They have been built up of too many heterogeneous units in size, character, voltage and even frequency and, while united, they are not so tied together as to reap the full advantages of interconnection. If the super-power plant project is worth carrying out, and we think it is, it is worth carrying out on a scale suitable to the larger problem in hand and with a view to the future as well as the present.

Oil Fuel on the Pacific Coast

WE HAVE frequently had occasion to consider the question of fuel oil for central stations and have been inclined to sound a note of caution on account of uncertain prices. The economic conditions, however, which hold true in the East are not altogether maintained on the Pacific Coast. Through the East and a good part of the Middle West coal is relatively of low cost, and the distances of transportation are, except on the Atlantic seaboard, not very great. On the Pacific slope the situation is altered. The coal available locally is in relatively small supply and not of a particularly good quality, and the use of good steam coal necessitates a very long haul. California, however, is a large oil-producing state, and some of the Mexican oil fields are not far distant. In this issue W. F. Durand and C. H. Delany consider the economic side of the matter with respect to the steam auxiliary plants which necessarily play no inconsiderable part in the transmission systems along the Coast. The hydro-electric supply has not been yet developed up to the point where storage is sufficient to carry the plant through in a dry season, and there have been several successive dry seasons. Consequently local steam plants have come into considerable use, with units as high as 20,000 kva.

Of the available fuels California oil is the one generally used. In certain localities natural gas comes into play with good advantage, but the supply is as yet somewhat limited. Of other fuels coal and sawmill refuse are employed, but only to a limited extent, on account of the cost of the former and the bulk of the latter and the difficulty of transporting it. The coal supply is most freely available in the Northwest, and if any further considerable supply is necessary it must probably be derived from the Alaskan mines, not yet developed, as freight costs from Eastern coal fields are prohibitive. Unless the California oil production increases, there is likely to be a large demand on the Mexican oil, which is heavier and more viscous than the native product and consequently somewhat less desirable as a fuel. In general, the auxiliary steam plants thus far considered have been of moderate size, boiler units of 600 to 800 rated horsepower being the maximum.

In burning the oil both steam and mechanical atomizers are in use, the latter having some advantages when output has to be forced. Some furnaces are being constructed with a view to an easy change to coal later. In our judgment this precaution is less necessary in the West than in the East. At all events, it pays to furnish liberal furnace capacity, more liberal than has been customary until recently. Economizers have proved to be somewhat less useful than with coal-burning plants owing to the smaller degree of heat in the flue gases when oil is properly burned. There is a steady tendency to work toward the higher steam pressures and higher superheat. The authors of this week's article point out that as between these two, for the same ultimate steam temperature, there is a tendency to slightly better economic results by forcing the pressure rather than the superheat. The questions of actual relative cost, including the capital charges and upkeep on the higher steam pressures, have not been thoroughly worked out, particularly near the present limiting temperatures for the steam, determined by available materials of construction. In the Pacific Coast oil-fired plants there is an interesting tendency toward automatic fire-room control, from which some gain in economy has been reported. On the whole, it appears to us that oil firing is a better proposition in this Western country than it is in the East, and one less likely to suffer from price changes in the future.

Ownership of Trunk Lines Along Electrified Railroads

BECAUSE of the small size and widely separated locations of many towns in the Northwest, it is financially impossible for the utilities to provide electric service from high-voltage transmission lines at the present time. However, towns along railroads that are to be electrified can be served if the new transmission lines are built parallel to the right-of-way and the step-down apparatus is owned by the power company instead of the railroad. This raises the question whether railroads that plan to electrify in the future should not give up the idea of operating their own trunk lines and thereby enable small communities along the road to obtain service.

The argument has been advanced by one electrified railroad that it does not want to have these trunk lines subjected to the interruptions of service which might be caused by having other loads attached to them. With the protective equipment now available, however, service to towns along the line should not reduce the reliability of service to the railroad. Surely an electric service company whose special business is to generate and transmit electricity is more able to maintain uninterrupted service than a company which gives only part of its attention to this problem. Furthermore, since the growth of a community is so materially hastened by electric service, railroads should welcome this means of developing towns along their rights-of-way. Still other advantages would result from the power company owning the trunk line and step-down apparatus. The railroad would be relieved of the investment, operating and maintenance expense connected therewith. In addition, measurement of the power and energy supplied to the railroad would be greatly simplified by meters on the low-tension side in place of high-tension meters at various points where the power company feeds in. Again, where railroads parallel each other, transmission lines can be built by the electric service company to serve both much more economically than the individual roads can build their own independent lines. In view of the ultimate prospect of extensive electrification of railroads in certain sections, this question of trunk-line ownership presents aspects of great economic importance to the electrical development of the sections passed through. If it is to be approached and properly solved on the basis of service to the public, electric service companies will have to take the initiative.

Edward N. Hurley

The man who turned chaos in the Shipping Board during the war into orderly production, a pioneer manufacturer of electrically operated home-labor-saving devices and a commanding personality as a business man and in public office

BY WAY of the apprentice-boy route, Edward Nash Hurley has stepped from one success to another until through sheer ability without political or monetary pull he stands acclaimed as one of the foremost straight thinkers in American business, whether it be at Washington on national matters or at the head of his own interests among fellow business men. Although he has devoted considerable time to national affairs, first as trade commissioner to Latin-American countries, next as Federal Trade Commissioner, and finally with marked credit as chairman of the United States Shipping Board during the war, he has always been classed as a business man and never as a politician.

Mr. Hurley was born at Galesburg, Ill., fifty-six years ago on July 31 of this year. At Chicago, when not yet of age, he entered the railway shops of the Chicago, Burlington & Quincy Railroad, and at twenty-four was an expert locomotive engineer. When a strike deprived him of a job he became interested in an invention involving the use of compressed air to operate hand tools and decided to establish a factory for the manufacture of these devices. In a manner typical of his determination to overcome financial obstacles, he carried his idea to England. After organizing the International Tool Company of England he returned to Chicago to establish the Standard Pneumatic Tool Company and became its president in 1896. Six years later he sold his interest in this company and took up farming. In 1906, however, he conceived the idea of utilizing the electric motor as a labor saver and organized the Hurley Machine Company in Chicago to make scrapers for dressing hardwood floors and electrically operated washing machines. The reversing-cylinder washer, a domestic size of electric ironing machine and an electric cleaner have since been developed. Three large factories, employing 2,000 persons, and a fourth, larger than all the rest, measure the success of his accomplishments in this field.

To men of the type of Edward N. Hurley the American public owes much, for only on conceptions of service such as his can those in charge of the business and production of American industries found the solution of our national problems. His book, published in 1916, on "The Awakening of Business," dealing with the relation of government to business, is full of straight thinking and common sense on the problems of the day, and will prove a factor in the perpetuation of his name.

Steam-Electric Generation in Far West

Present Tendencies of Design—Leaning Is Toward Higher Pressures and Higher Superheat, Centrifugal Pump Auxiliaries, Automatic Control and Use of Recording Meters in the Boiler Room

By W. F. DURAND and C. H. DELANY

USE of oil as fuel is the one distinctive feature of steam-plant generation on the Pacific Coast. Natural gas, coal and sawmill refuse are burned in some sections, but not extensively. This oil is burned under boilers 600 hp. to 800 hp. in size and operating up to 200 per cent of rating. There is a general tendency toward higher superheat temperature and toward higher pressures, which run as high as 250 lb. For auxiliaries turbine-driven centrifugal pumps are the practice. The largest units operating in this section are rated at 20,000 kva. Careful supervision, especially in the boiler room, is becoming more widely recognized as the best means for securing high efficiency of operation.

CONSTRUCTION OF LARGE FUEL-OIL TANKS

At left, vent pipes are fixed on top of the main fuel-oil tanks of the Long Beach plant of the Southern California Edison Company to allow gases to escape. The mouth of these pipes is covered with a fine mesh screen.

At right, a concrete wall surrounds the 30,000-barrel oil-storage tank at the plant of the Sierra & San Francisco Power Company to prevent the oil spreading in case of a leak in the tank

The present shortage of hydro-electric power has created an unusual situation in that the demand for power is so great that steam plants intended originally to act merely as standby installations and to assist the hydroelectric systems in case of trouble are now being operated at full capacity and carrying a large proportion of the total load. Other steam plants are being planned, and those already under way are being rushed to completion so as to tide over the emergency fast becoming acute.

California oil is used almost exclusively along the Western Coast. However, unless its production is greatly increased, in the next few years Mexican oil will be introduced into California as it has been in Arizona, Texas and the Atlantic Coast. Mexican oil is generally much heavier, dirtier and more viscous than California oil. Oil in the Panuco field runs in gravity about 12 deg. Beaumé and is so viscous that it cannot be unloaded from a car without being heated and must be kept up to a temperature of 120 deg. Fahr. (50 deg. C.) in the pipes in order to keep it flowing. It is therefore necessary to use large pipes, covered on the outside and containing internal heating pipes through which steam or hot water is passed. Mexican oil usually contains a large proportion of silt, and it is necessary to provide strainers at both the suction and discharge of pumps as well as at the burners. To burn properly it must be heated up to 190 deg. Fahr. (90 deg. C.) and in some cases even as high as 250 deg. Fahr. (110 deg. C.).

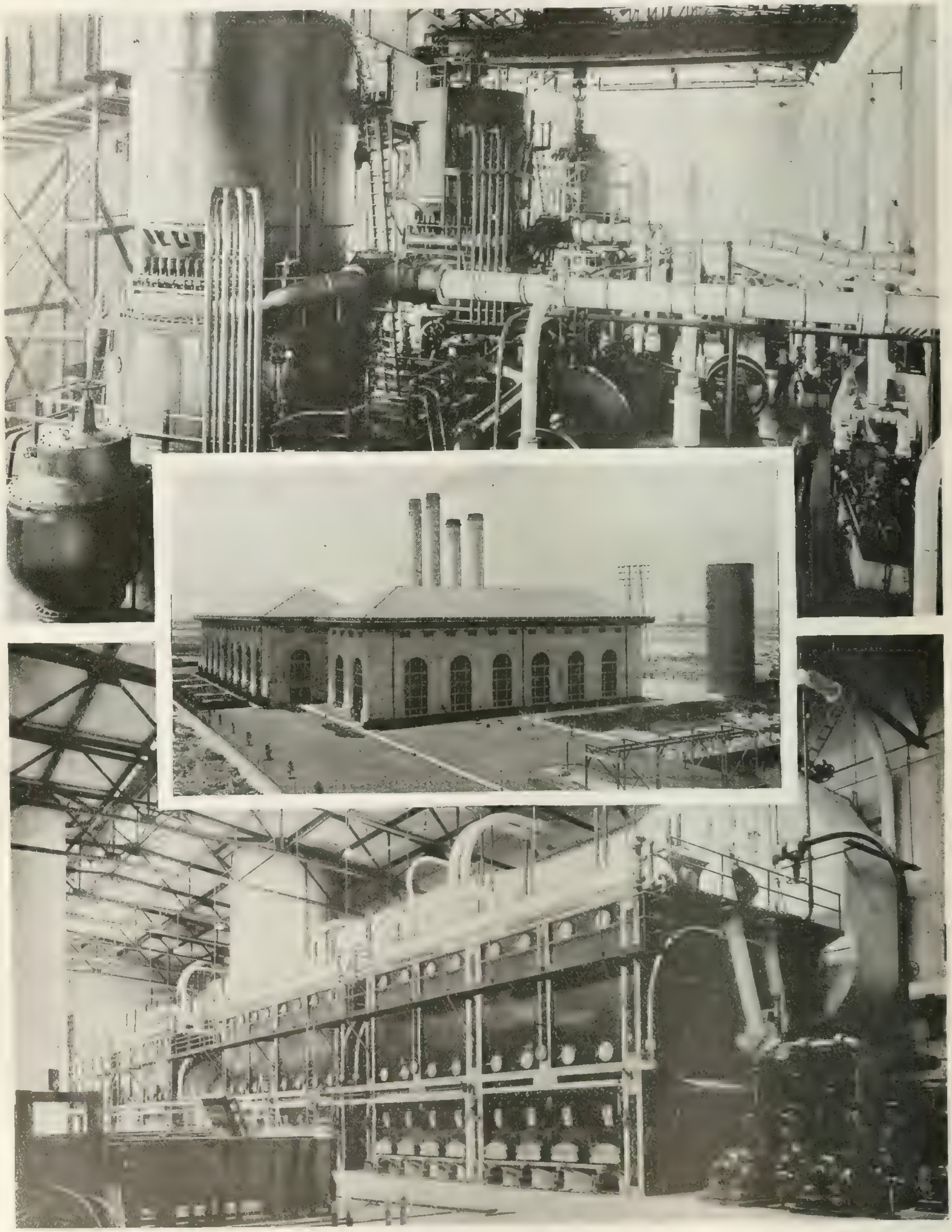
Natural gas is now being used in Bakersfield and in Los Angeles. This is the only available fuel that is superior to fuel oil. It has all the advantages of oil, and in addition does not require atomizers or bulky storage tanks if it is piped direct from the wells.

Coal is used quite extensively in the Pacific Northwest, both in pulverized form and stoker-fired. In California, however, there is no coal marketed at the present time except for domestic purposes. If oil continues to advance in price, the question of the available supply of coal will become of paramount importance. The most promising source appears to be the Alaskan coal fields, which are known to be very extensive and to contain coal of excellent quality. Vast developments must be made, however, in the way of transport and docking facilities before Alaskan coal becomes available in quantities sufficient to represent a factor of importance in connection with power developments.

The design of a coal-burning plant differs in many respects from that of an oil-burning plant. Boilers must be set higher for coal than for oil so as to provide room for mechanical stokers or to provide ample combustion space for powdered fuel. A basement under the boilers is required for handling ashes. The building must be high enough to allow for coal bunkers and conveyors above the boilers, larger smokestacks are necessary, and forced-draft apparatus is usually required. In most cases, therefore, it would be impracticable to change over existing oil-burning plants to coal-burning plants, although, on the other hand, it is an easy matter to change a coal-burning plant to an oil-burning one.

In some cases oil-burning plants have been specially designed with a view to converting them to coal-burning at a future date. However, since it is impossible to anticipate the rapid changes that occur in engineering practice, the extra expense involved in thus attempting to design for the future is hardly warranted.

Long Beach Steam Plant of Southern California Edison Company



This station is notable for its generous equipment of recording instruments in the boiler room. Above is the newest installation of boilers in the plant, No. 3 bank. The view of the engine room shows a 20,000-kw. turbine, the largest size installed on the Pacific Coast, and two other turbines rated at 15,000 kw., 12,000 kw. respectively. Note in the center picture the short stacks required for burning oil.

Another fuel used quite extensively in the Northwest is the refuse from sawmills, known as hog fuel. This is an extremely cheap fuel if used close to the mill. Owing to its bulk, however, it is difficult to transport, and its field of usefulness is therefore limited.

LOCATION OF STEAM-ELECTRIC POWER PLANTS

Economy of design in the vast hydro-electric transmission lines of the West, in which steam-electric generation serves as an auxiliary, necessitates the location of the steam-electric plant as near to the large industrial centers as possible. This reduces to a minimum the distance through which the steam-generated power must be transmitted, thus avoiding the necessity of burning extra fuel to make up for transmission losses. The exact location within the industrial center depends mainly on the four following factors: (a) An adequate supply of water for condensing purposes; (b) access to deep water, to enable oil to be delivered by barge; (c) railway facilities for the delivery of machinery and possible delivery of fuel; (d) proximity of the transmission lines through which power is delivered from the hydro-electric system.

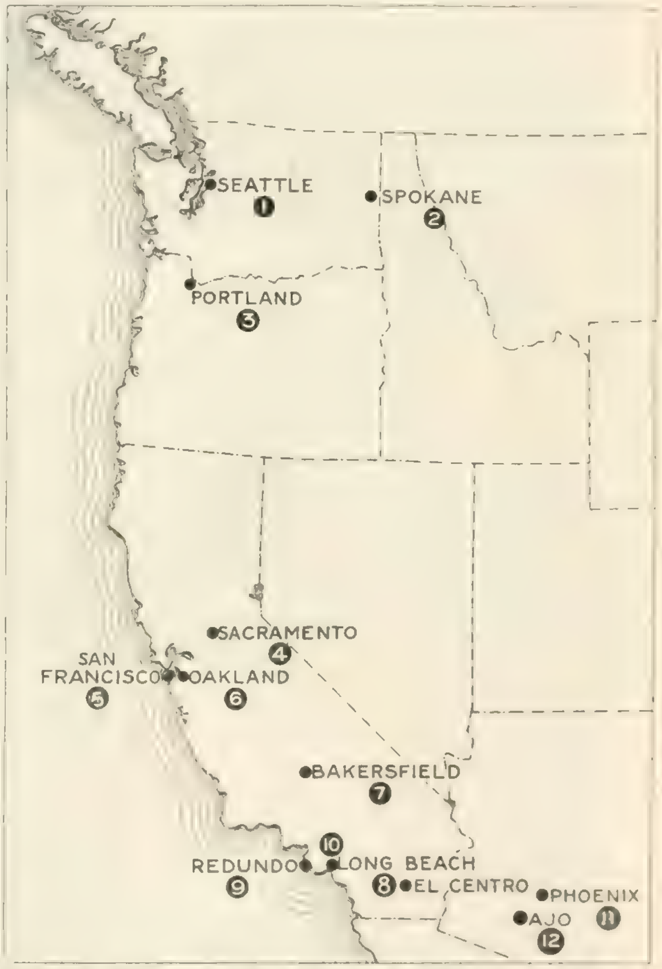
A large interconnected hydro-electric system may have one large auxiliary steam plant or several small ones. As most of the hydro-electric systems in the West have grown to their present huge proportions through combinations of several smaller systems, in the majority of cases there are several steam plants connected to each system. While, if properly designed, a large single plant is in general more economical to operate than a number of small plants, the distribution losses may be much less in the latter case. The question of economical distribution is, therefore, a very important factor in determining both the size and the location of a plant.

SIZE OF STEAM PLANT UNITS

The size of turbine selected for a plant depends largely on the question of spare units required. If the units are too large, this spare requirement results in too expensive a plant. In the case of steam plants interconnected with a large hydro-electric system the necessity for spare units is not so great, since it is always possible to take the load off one plant temporarily and carry it on another. The largest single unit on the Pacific Coast at the present time is rated at 20,000 kw., although machines as large as 45,000 kw. are operating in the East.

The size of the boiler unit is also affected by the necessity of having enough spare boilers to permit frequent cleaning and repairs. It is desirable in any central station to have at least four or six boilers. In the East many plants have boilers up to 1,500 hp. or 2,000 hp. each, but on the Pacific Coast 600 hp. to 800 hp. is the maximum. For oil burning the best results are obtained with boilers having a relatively large combustion chamber, and the present tendency is to raise boilers higher than formerly so as to increase the furnace volume and enable the boilers to be forced to high capacities. Oil-burning boilers have not as yet been forced to such high overloads as has been done in Eastern cities with coal-burning boilers. Capacities of 200 per cent of rating have been obtained with steam atomizing burners, and a recent plant on the Atlantic Coast firing Mexican oil with mechanical atomizing burners has operated up to 300 per cent of rating. Mechanical atomizing burners produce a softer flame that is less damaging to brickwork than the steam atomizing burner, and give a higher boiler efficiency at high overloads, owing to the more perfect combustion maintained when firing large quantities of oil in furnaces of limited volume. They require strong forced draft, however, and the power required for this as well as the extra steam used for heating and pumping tends to offset these advantages.

Owing to the small amount of excess air required with oil burning, there is less heat in the gases leaving the boiler and hence less necessity for economizers. At present prices of fuel oil it would undoubtedly pay to install economizers in any plant that is to be operated at a fairly high load factor. For a poor load factor, however, and especially for a plant that is expected to act during most of its life as a standby plant, economizers are not considered a good investment. Where economizers are installed it is necessary either to increase the height of smokestack or to provide induced-draft apparatus. This increases the cost of the economizer installation and must be considered when balancing interest and other fixed charges against the increased efficiency resulting from the economizers.

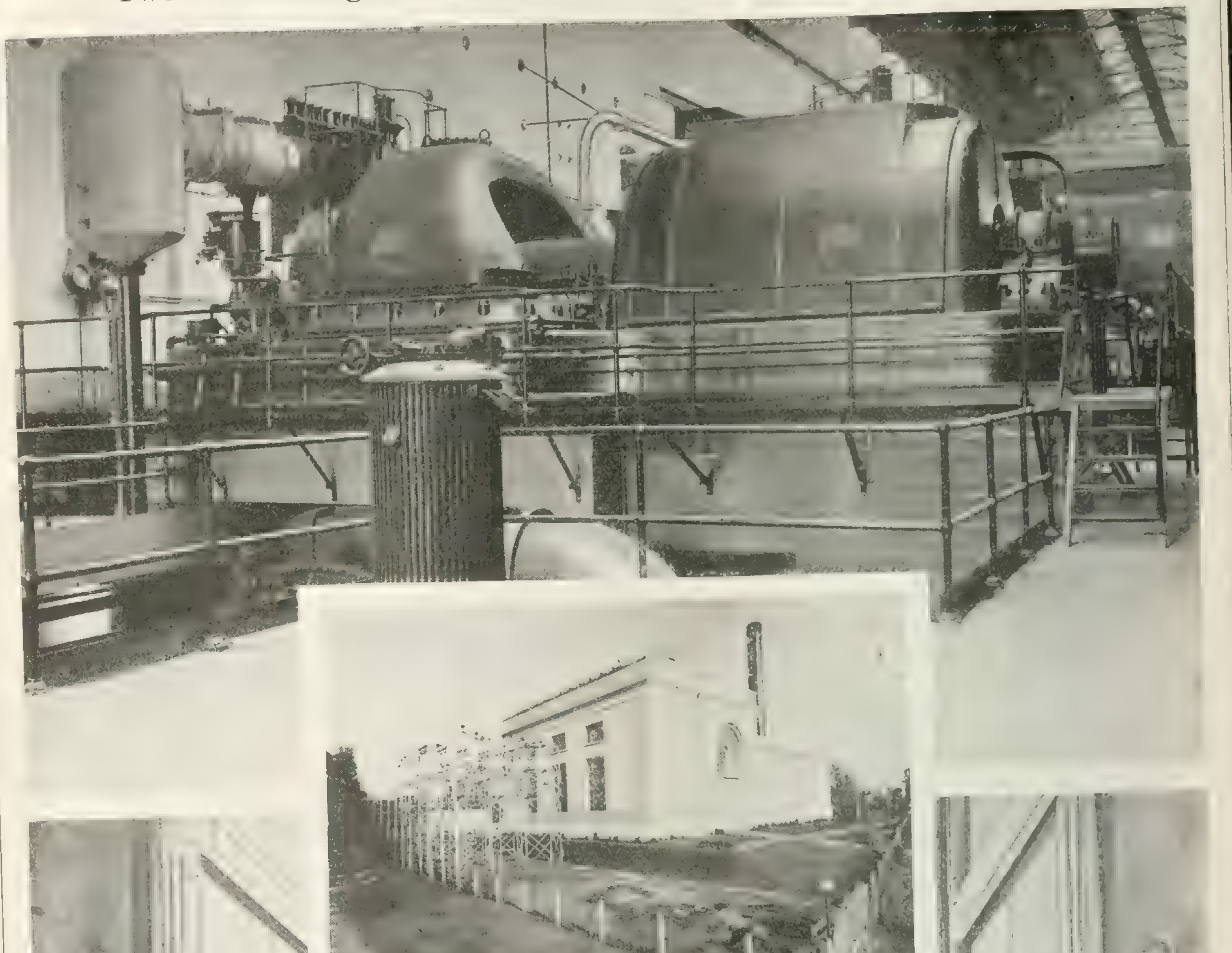


WESTERN STEAM PLANTS AND THEIR INTERESTING FEATURES

1. Seattle—Made for a ready changeover from fuel oil to coal. 2. Spokane—5,000-kw. electric heater for feedwater. 3. Portland—Plant designed for use of hog fuel. 4. Sacramento—Well-planned and attractive exterior. 5 and 6. Oakland and San Francisco—Extensive operating tests on furnace installations. 7. Bakersfield—Use of natural gas as a fuel. 8. El Centro—Use of artificial draft in chimney construction. 9. Redondo—Combined use of reciprocating engines and turbines. 10 Long Beach—Extensive use of recording instruments in maintaining economy. 11. Phœnix—Record efficiency in fuel oil consumption. 12. Ajo—Extensive use of automatic regulation.

The modern tendency in the operation of central steam stations is toward higher steam pressure and higher superheat. Theoretically in any heat engine the maxi-

Two Oil-Burning Plants of the Pacific Gas & Electric Company



A new 15,000-kw. turbo-generator in Station "A," San Francisco, is shown above. Below are four new 823-hp. oil-fired Stirling boilers. Recent tests on furnace operation at this station have done much to advance thought on this line. In the center is shown an example of attractive architecture applied to power-house design, the 5,000-kw. oil-burning steam-turbine station of Pacific Gas & Electric Company, Sacramento.

mum efficiency is obtained, as shown in the Carnot cycle, by having the temperature at which the heat is supplied to the working substance uniform at the highest attainable value and the temperature at which heat is withdrawn uniform similarly at the lowest attainable value. With steam the upper temperature range may be raised either by increasing the pressure or by increasing the superheat, or both. In neither case, however, is the upper temperature range uniform. Increase of pressure does, however, carry the elevated temperature through a longer part of the range than increase of superheat and thus more nearly approaches the condition for maximum efficiency with any given extreme upper limit of temperature. We should thus expect that a given extreme upper limit of temperature reached through high pressure and relatively moderate superheat would give better conditions for economy than lower pressure and higher superheat.

This may be illustrated by the following example, in which steam at 200 lb. pressure and 200 deg. Fahr. superheat is compared with steam at 300 lb. pressure and 166 deg. Fahr. superheat, both of these combinations giving actual temperature of superheated steam at 588 deg. Fahr.:

Pressure, gage, lb. per sq. in.	200	300
Temperature saturated steam, deg. Fahr.	388	422
Degree of superheat, deg. Fahr.	200	166
Temperature superheated steam, deg. Fahr.	588	588
Heat per lb. steam (above 32 deg.), B.t.u.	1310	1300
Heat (above 32 deg.) per lb. steam after expanding adiabatically to 1-in. absolute, B.t.u.	892	866
Heat available per lb. steam, B.t.u.	418	434
Heat utilized at 75 per cent efficiency, B.t.u.	313	325
Moisture in exhaust steam, per cent	9.2	11.4

It will be observed from the above comparison that while the quantity of heat present in the initial steam in the two cases is practically the same, the heat utilized in the case of steam entering the engine at 300 lb. pressure is about 4 per cent more than in the case of the 200 lb. pressure steam. It will also be observed that there is more moisture in the exhaust steam in the case of 300 lb. pressure initial steam than in the case of 200 lb. initial steam. This means that there will be less work to be done by the condenser as more of the steam is already condensed. This results in a still further advantage to the higher pressure steam. On the Pacific Coast steam pressures up to 200 lb. have been used for many years, station "A" of the Pacific Gas & Electric Company, San Francisco, having been built for that pressure in 1901.

Within the last two or three years higher pressures than this have been adopted, several plants having been built for boiler pressures of 250 lb., while in the Eastern states plants are already in operation at 300 lb. pressure and pressures even as high as 590 lb. are being talked of as possibilities. The maximum limit to pressures and superheat is determined at the present time by the temperature that the materials of construction will stand. With present steels 700 deg. Fahr. is about the limit. This limit would be reached at 500 lb. pressure and 230 deg. Fahr. of superheat. One of the main advantages of higher steam pressure is the fact that the increase in cost of equipment is very small compared to the advantages obtained, since it is merely necessary to design the machinery to withstand the greater pressures.

For auxiliaries steam drive is cheaper if the exhaust steam can be used for heating purposes. Otherwise electric drive is cheaper. It may be desirable to install duplicate auxiliaries in which one set is driven by steam and the other by electric power. A system which has been used to advantage at the Connors Creek plant of the Detroit Edison Company and other stations in the East, but not yet introduced on the Pacific Coast, employs a separate auxiliary turbine and generator for supplying the auxiliaries. With heavy loads the exhaust steam from this turbine is used for heating feed water. With light loads the turbine is shut down and hence no exhaust steam is wasted.

At the present time centrifugal pumps are used in all cases except for fuel oil and lubricating pumps, where the reciprocating type is still used. Steam turbines are preferred to reciprocating engines even where slow speed is desired.

AUTOMATIC CONTROL

As economical operation of a plant is obtained by the careful watching of all details, it is a growing conviction that personal control under trained supervisors is the one way to produce high economy. This is especially true of the boiler room, and it is common practice in the best plants to employ a combustion engineer to make flue-gas analyses and to keep a continual check on the boiler efficiency. There is a tendency toward introducing automatic control into the fire room. Automatic oil-fire regulators have been placed in service in a number of plants on the Pacific Coast and increases in efficiency as high as 3 or 4 per cent are reported. Another tendency at the present time is to equip the plant with recording meters which register automatically all important elements of operation throughout the full twenty-four hours of the day. It was formerly the custom to operate boilers with no instruments except a steam gage, but it is now customary to install steam-flow meters which register the quantity of steam produced by the boiler, the quantity of steam used by the burners, and air meters which indicate the amount of air passing through the boiler settings. These instruments are of great value in assisting the combustion engineer to secure maximum efficiency from the boiler plant.

AUTOMATIC OIL REGULATION PROVED ECONOMICAL IN THIS PLANT

In this plant of the Cornelia Copper Mining Company, Ajo, Ariz., oil consumption was reduced 3 per cent to 4 per cent by extensive use of automatic fuel regulators.

Urgent Need of Super-Power Developments

Increased Industrial Production and Shortage of Power Over Large Manufacturing Districts Call for Immediate Development of Great Power Projects and Elimination of Small Steam Plants

By LIEUT.-COL. C. F. LACOMBE

THE world destroyed, burned up and exploded more wealth in the recent four years of war than in any similar previous period. The cost of the tremendous effort necessary on the part of the free nations of the world to save their institutions has been financed by promises to pay in huge amounts. These promises to pay cannot be redeemed entirely in gold—there is not enough in the coffers of the nations—they must be paid to a large extent in property and products as yet unmade. To produce the raw material necessary and to make it into salable property, products or goods requires labor, machinery and power. Our goods must be made cheaply so that we can compete with other countries in spite of the conditions imposed by our industrial requirement of higher wages. To accomplish this the product of each individual worker must be sufficient to pay the wages required profitably, for the amount of these wages must be obtained from the proceeds of the sale of the workers' product. Such production cannot be made solely by the strength or skill of the individual; this must be supplemented by mechanical aids, which, in turn, require power to drive them.

Energy is produced by the burning of fuel, the explosion of gases or the propelling force of water and appears in the form of heat, steam or electricity. Anything affecting the cost of fuel and its transportation, or the cost of making the country's water powers available and profitable, affects directly the cost of heat and power both in the home and the factory. In the latter increased cost of energy makes for higher costs of product and decreased production, while a cheap and ample supply of energy has directly the opposite effect. The cost of fuel to the consumer doubled during the four years of war by reason of the increased cost of mining, higher interest rates, higher wages and higher costs of transportation, appliances and supplies. With the increased wages of engineers and firemen, as well as the greater cost of supplies, added to the increased price of fuel, the cost of producing energy has advanced materially in every engine room throughout the country. Fortunately, during the last fifteen years, by improved processes and appliances, the amount of good coal required to produce a unit horsepower for an hour has been greatly reduced and the cost of large steam plants per unit of capacity has greatly decreased. This is true, however, only in the larger and most improved type of power plants, for in small, old or unimproved plants operating under the conditions of 1900 the high cost of the energy produced, at the present prices of fuel and labor, is startling and must very materially affect production and costs.

GROWTH IN FIRST COST OF BOTH STEAM AND WATER-POWER PLANTS

The decreased unit cost of steam plants over that of former years has had a decided effect on the value and utilization of water powers. The great factors in this case are the first cost of the water-power plant and the annual fixed charges on it. The cost of the labor and material to build a water-power plant has materially increased in the last four years and is comparable to the increased cost of new steam plants. In the northeastern section of the country, east of the Mississippi and north of Virginia, the water-power development which is feasible and profitable now is only a fraction of the present demand. This accentuates very strongly the necessity and value of developing every profitable water power within reach of a possible energy market, not only in order to reduce the cost of energy and increase production but to conserve fuel resources.

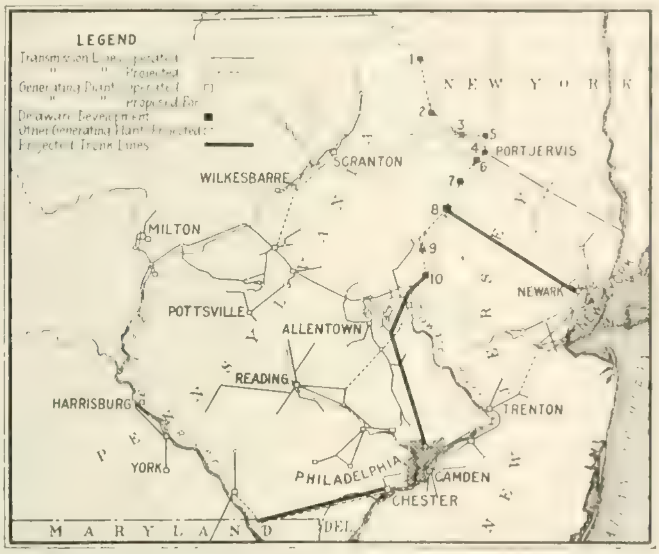
FACTORS MAKING DEVELOPMENT NECESSARY

The necessity for cheaper energy and larger production is the most important reason now for these developments, but the conservation of fuel follows them closely. We have ample fuel resources in quantity for a prolonged period, although the cost will increase and the quality decrease as the most available and best deposits are exhausted; but the fact that this ample supply does exist is no excuse for wasting fuel as we are doing at the present time. We owe something to posterity, but what is more important, we owe to ourselves the duty and profit that can be derived from using our fuel so as to obtain the greatest and cheapest output of energy from it. This, in turn, aids the workman to increase his output so that the manufacturer can sell in greater quantity and at lower cost, employ more skilled labor, pay higher wages, and so complete the cycle of production and reward upon which the nation lives and thrives.

The director of the Bureau of Mines has stated that out of the total production of bituminous coal in 1917 25 per cent, or 150,000,000 tons, was being wasted by inefficient use in the boiler plants throughout the country. This waste was found most frequently in the boiler rooms of plants or factories where the production of energy was treated as incidental to the main purpose and where there was little, if any, trained supervision, technical or otherwise. These wastes strongly indicate that wherever possible energy should be supplied from a plant that manufactures energy alone and which must succeed by its economical production.

Coal is being mined and used as fuel at a tremendous rate. During 1918, under pressure, 685,000,000 tons of coal were mined in this country, or more than were mined in Germany and England together in 1913. This country possesses enormous potential quantities of coal, estimated at over three thousand billion tons, but a large portion of it is of extremely low grade. England has been mining coal for six hundred years. Now her mines are deep and the most profitable and best veins are practically worked out. The difficulties of mining have increased and her output per miner has decreased one-fifth. America must expect the same result at some future date, and the enforced consumption of this low-grade coal will increase the cost of energy production very materially.

A diagrammatic map published in the ELECTRICAL WORLD of Feb. 22, 1919, made by O. C. Merrill, chief engineer of the Forest Service, Department of Agriculture, showed the distribution of our hydraulic resources and of primary power in the United States. A study of this indicates that in the great industrial district north of Virginia and east of the Mississippi, even if all its hydraulic resources were suddenly developed, more than 20,000,000 hp. must be furnished by fuel for all time, and provision made as well for all increased demand in the future. The development of water power in this area is most important, although at most it can provide only a fraction of the energy required. All that is feasible should be developed quickly, and in the meantime the power industry should use its fuel with thrift instead of continuing the present economic waste. The advantage gained from the co-operation of great interconnected steam and hydro-electric plants, generating according to the dictates of economy and distributing their energy over great industrial fields, was demonstrated by obtaining data in 1918 from the larger generating stations in New England, New York, New Jersey, Pennsylvania, Delaware and Ohio. Including all the larger towns in New England, New York City, Buffalo, Rochester, Syracuse and other cities on the Niagara system, Cleveland, Lorain, Toledo, Pittsburgh and a number of towns near it in eastern Ohio, Philadelphia, eastern Pennsylvania towns, New Jersey, Wilmington and Baltimore, it was found that in 1918 the principal distributors of energy generated 6,605,000,000 kw.-hr. This amount was produced from coal alone and does not include that also produced by water power in New England, New York and elsewhere. The fuel necessary to produce this energy totaled 8,621,000 tons and was valued at $42,788,000. The same amount of fuel in 1915 would have cost only $21,056,000. The increased cost due to present conditions was therefore $21,731,000.



POWER SYSTEMS OF EASTERN PENNSYLVANIA INDUSTRIAL SECTION AND PROJECTED TRUNK LINES

In the industrial district described a survey showed in one center 258 small plants of about 1,000 hp. each which used over 7 lb. (3.1 kg.) of coal per unit, 2,565,000 tons annually, while the large plants throughout the whole district averaged 2.61 lb. (1.18 kg.) per unit. Similar conditions exist in each large manufacturing center, and this indicates that in the whole area small individual plants generated about the same amount of energy as the combined large ones, but on a most conservative basis used more than twice the amount of fuel and generated at more than double the cost of the large stations. It should be remembered that the cost of fuel is double what it was in 1915, and hence the cost of this waste is twice what it was at that time.

This startling and useless loss can be stopped by using instead power from large steam-turbine generating stations erected where they can obtain sufficient quantities of water for condensing purposes, as well as cheap fuel, and located with a view to efficient distribution of the energy produced.

Generating plants of this advanced economic type with an installed generator capacity of 100,000 hp. cost from $90 to $100 per horsepower, not including the secondary distribution system. Such plants would use about 1½ lb. of coal per horsepower-hour, including transmission and distribution losses. In comparison with 1½ lb. of fuel used by such a plant a small plant uses at least 3¾ lb., giving a saving in favor of the large generating station of 2¼ lb. per horsepower-hour of energy produced. The investigation indicated that the fuel consumption of the central stations from which data were obtained could be reduced to a little less than 1½ lb. per horsepower-hour if the stations were remodeled and enlarged. There are a number of potential water powers in the area under consideration upon which engineering estimates have been made. In New England 600,000 kw. is possible of development, but it is believed feasible at present to develop only about 323,000 kw. on account of unsolved problems of storage and steam auxiliaries. Such a development would save about 1,378,000 tons of coal per year. The increasing demands for energy in New England will absorb this water-power capacity in about four years, and further energy production must depend upon the use of fuel or further possible hydraulic developments requiring extensive storage works.

Further development at Niagara Falls has been limited to improvements in methods of utilizing the water and to the fraction of the water allowed by treaty but not previously used. These extensions and improvements can replace the annual use of 500,000 tons of coal in cities served by the Niagara systems. Similar extensions and improvements at hydro-electric plants near Baltimore would yield a saving of 133,000 tons of coal.

Developments on the Delaware and Susquehanna Rivers would save about 1,600,000 tons of coal now used annually in the large power plants of New Jersey, Philadelphia and Wilmington. If these power markets were interconnected, supplied with energy from these water powers to the north and the south, and this system linked with large steam plants in the anthracite region of eastern Pennsylvania, and also to the new large and economical steam stations at Philadelphia, not only could the separate sources of power be used jointly, to their best economy and consequent lower cost of production, but an ample supply of power would be available for increased production. During the war there was an acute shortage of energy supply over a large part of this territory, and a similar shortage may occur from the demand for energy for reconstruction purposes unless extensions are provided in the near future.

The economies and new developments itemized above would therefore bear two marked results. The first effect would be to decrease the fuel used by the large power plants generating and distributing energy as a business. The saving of coal would be 2,300,000 tons from increased fuel efficiency in the present steam plants remodeled and enlarged, and 3,611,000 tons from additional water power in New England, Niagara Falls, Baltimore, the Delaware and the Susquehanna.

The second effect would appear in the use which could be made of this amount of fuel and the steam machinery saved by substitution of water power. The fuel is sufficient to develop 7,881,000,000 hp.-hr. at 1½ lb. per hour. The new water power would free sufficient machinery now in use to produce 4,815,000,000 hp.-hr. of energy. If this energy were distributed by great plant systems to replace the wasteful use of coal in the smaller individual manufacturing plants, a great additional saving in fuel would be made. The saving from this source would be more than 2¼ lb. per horsepower-hour or 5,416,000 tons of coal. Adding to this the 2,300,000 tons of fuel saved in the larger stations through increased fuel efficiency, a total of 7,716,000 tons of coal would be saved annually in this great industrial district at a present average cost of about $5 per ton, or a total of $38,580,000.

This huge saving in fuel is equivalent to 12 per cent on an investment of $321,500,000, a sum which would more than accomplish the power-conservation schedule outlined. The accomplishment of this plan would require four or six large steam plants in the western Pennsylvania and eastern Ohio territory, about three large tidewater steam plants in New England and improvements yielding increased efficiency from the larger steam plants now existing in these industrial areas. The water-power developments involved would include the full development of feasible water powers in New England and northern New York, increases at Niagara, and the developments mentioned on the Delaware and Susquehanna Rivers. For ultimate success the plan must include certain interconnections between plants in a given district and the co-operation of steam and hydro plants wherever possible in order to obtain the highest general efficiency in generation.

A part of these developments is shown as an example on the accompanying map of the eastern Pennsylvania and Philadelphia districts. Apparently a stupendous task, but not so difficult as might be supposed if all those interested could be given the incentive to get together and develop the plan in each power center. Some of this work has already been started at Pittsburgh, Philadelphia and Niagara, but still more encouragement must be given to larger plans if the desired result of increasing industrial production is to be accomplished.

That the central station power industry throughout the country is the best means of producing and distributing a public supply of energy is confirmed by the great growth in the supply of energy furnished by these plants, both steam and water, in late years. It has been claimed on good authority that energy derived from these plants furnished 60 per cent of the products necessary to the successful conduct of the war. Census returns show that the output of energy of these plants throughout the country in 1907, 1912 and 1917 was, in billions of kilowatt-hours, 5.86, 11.53 and 25.43 respectively.

While these utilities operated during the war under very difficult conditions, they were the only emergency source of power in the country; that is, the only one that could be called on for sudden increases in output even to the danger point of capacity and continuity of service. These companies succeeded in responding to this demand in many cases by operating every generator without reserve for more hours a day than ever before, for the reason that machinery was practically impossible to obtain and install in time to be of service. As a matter of fact, when war was declared all the spare power capacity not already at work for the Allies was quickly appropriated in certain important sections of the country, and had the war continued there would have been a forced delay in equipment for the enlarged army as planned, for the power needed to make it was not obtainable. The measure of this delay would have been the length of time necessary to manufacture and install new generators of the large sizes, which usually takes over a year.

Central Station Becomes a Large Factor in Manufacturing Industry

The emergency of the war proved quickly that the electric generating industry had taken another stride forward and had developed from a lighting and small power business to the supplying of energy in any quantity to all industries over many hours of the day, or during the whole day, every day in the year. This stride forward, like others the electric industry has taken, develops new problems of construction, operation and financing. Larger plants are necessary, carefully located for the best productive and distributive advantage, and larger individual machines must be made and operated to meet the new demand. Very large sums of money must be obtained to accomplish this. The new power business differs from the older lighting business as at present regulated in that it must meet competition. A manufacturer needs little protection by law from the power industry or monopoly, for he can install his own plant, whereas the small lighting consumer requires protection.

The power capacity of the electric industry must be increased largely to meet the recent and future demand for power. In doing this the industry is confronted by regulatory laws enacted in thirty-eight states after 1905. These laws established electric utility service as a monopoly, prevented uneconomic competition and caused through commissions the supervision of the issue of securities, the regulation of the rate of return on the investment and the review of the rates to be charged the public. In this manner these laws gave the securities of utilities a stability and safety as investments not previously possessed, but the rate of return was established at 6 or 8 per cent, depending on the rate of interest prevailing in their state. In other words, a fixed reward or profit was established for the electric utility business. No further incentive was provided, and all that remained to work for was the advantage accruing from large growth and a great volume of business.

Fundamental Conditions Completely Changed

This state continued more or less satisfactorily until the upheaval of 1914. Since then fundamental conditions have completely changed, not only as to costs of fuel and materials but also as to money. At first regarded as temporary, it is now seen that these changes may endure for a prolonged period. This country lost less by war than any other combatant, and must do its full share of production to make up the enormous waste of the great war. This production calls for an ample supply of power, more than is now available, and the signs of this demand are unmistakable. The loss and waste in individual energy production is sharply realized. Individual manufacturing plants are requiring more energy than they can produce without increasing their own power plants at high costs and in consequence are calling for cheaper energy from central distributing plants. Sections that showed insufficient capacity during the war years of 1917 and 1918 are showing symptoms of a similar lack of capacity at the present time. The power industry can meet the demand, but requires a measure of relief in order to do so.

For the last three years at least the normal program of development and capacity has been very greatly retarded by the effects of the war. The margin of reserve capacity existing before the war has been much reduced, and the industry is not equipped to meet heavily increased demands for power. To increase the power capacity by the improved methods already described requires the investment of very large sums of money. The power industry finds it is exceedingly difficult to obtain these necessary funds, for the reason that it is not allowed to earn enough to pay the cost of money at this time in competition with industries whose earnings are not restricted. The laws regulating public utilities, otherwise good in many respects, have affected the borrowing power or credit of these utilities. They set a fixed and now insufficient reward for the work of making power by utility corporations and for transportation by railways.

These laws were made in days when supply met demand. Now it is necessary to create the supply to meet the demand, but these regulations have removed the incentive to the investor to invest money in the utilities, because he can do better with it elsewhere. Nor have the utilities the incentive to borrow the money and take the risks of construction and operation when they are allowed to earn only 6 or 8 per cent on their investment and receive no additional reward for increased effort and efficiency.

In the last three years the cost of making power has so increased that the commissions have allowed advances in rates or allowed the higher cost of fuel to be added to power bills. Without this even the permitted rate of return could not be earned. If the existing financial conditions continue over a long period without any change in the regulations governing the rate of return, there will be great difficulty in getting the cheap and ample supply of power needed during a period when the utmost industrial production is required.

An analysis of the resolution of increased rates shows that it is not the best solution in that it does not attain the best results. It merely passes the extra cost to the consumer, raises the cost and lessens the amount of production, because the high cost of product reduces sales; and, further, it encouarges waste of fuel. A much more efficient reward and incentive must be devised which will result in obtaining the funds with which to increase our supply of power, enlarge production, keep costs down and stop our senseless waste of fuel. This incentive can be provided by allowing the power industry to earn the present allowed rate of return, with necessary reserves, maintenance and replacement charges, and adding to it a fair division of the savings that could be made by the cheaper production of power through improved and enlarged power systems. A provision somewhat along this line, allowing additional returns to the railroads, has been incorporated in the railroad bill recently passed by Congress.

It is certainly just that the power industry should receive a share of the profit it enables others to derive by furnishing cheaper power than could otherwise be obtained. A fair share of the profit gained from improved processes will enable the industry to obtain money for new plants without additional cost to the public. At present neither the public nor the power companies is gaining any advantage from the existing arrangement, owing to the existence of the fixed rate of return. The public is actually penalizing itself by meeting the extra and avoidable costs. These costs exist because the industry cannot get the money to reduce them, nor would it receive a reward for doing so were this feasible.

If this situation were fully realized, the power users of the country would appeal to the commissions even more strongly than the power makers for means of increasing the supply and reducing the cost of power by providing the incentive of a just division of the profits of production. The manufacturers in a given community logically constitute the market which should absorb the securities of the power companies, for they would be the greatest beneficiaries, receiving not only the rate of return on their investment but a further reward derived from their profits on increased production at decreased cost.

Obtaining Satisfactory Graphic Meter Records

Care Must Be Exercised in Selecting Proper Meter for Any Particular Service—All Necessary Explanatory Data Should Appear on Chart

BY WALTER L. HAMILTON
Holyoke, Mass.

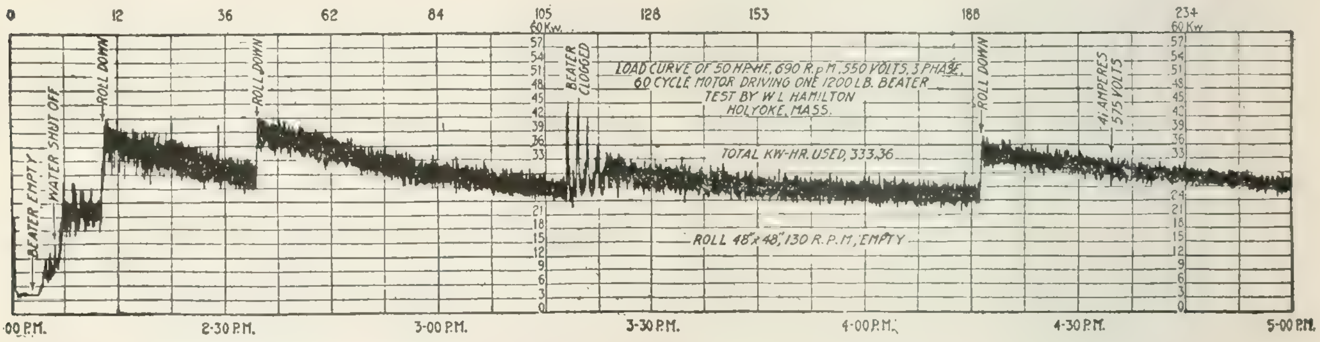
TO THE uninitiated, records obtained from graphic meters are often as difficult to interpret as is the method by which they are obtained. To facilitate interpreting graphic-meter records a study of meters producing them is useful. These meters are principally of types used to record such conditions as temperature, flow of liquids and gases, speed, voltage, current, power-factor, power, etc.

The charts furnish a permanent record covering the total period of test, including all important conditions of interest. These records may be used for discussion before committees or individuals at any time and have the advantage of showing results in pictorial form, which is much more readily comprehensible than is a mass of data.

In selecting curve-drawing meters for installations the character of the service to be recorded and the results desired should be carefully considered, for a little study may often save annoyance and disappointment later. Record charts may be circular in form, the circumference representing a period of time usually from twelve hours to one week. They may be oblong in shape and placed on the periphery of a cylinder, their total length representing a definite period of time. Other charts are of the continuous-strip type with 1 in. (2.5 cm.) of their length representing one hour or fraction there-of. The continuous charts are usually found in high-grade, high-priced meters, as a more powerful clock and more complicated paper-feeding mechanism are required than in meters using circular chart. It is sometimes desirable to have charts calibrated to represent only a portion of the meter capacity. Voltmeters and frequency meters, for instance, are commonly calibrated for about 60 to 100 per cent of their capacity. This arrangement permits a wide scale over the probable variation of the service to be recorded.

Meters may be very sensitive, or damped and direct-operating, or of the relay type, adjusted for sensitive or sluggish operation. Erroneous conclusions are often obtained owing to the time lag of the curve-drawing meter. Very sensitive meters will try to record accurately every variation in the load. This gives a wide curve and for rapidly fluctuating loads is not altogether desirable. Other meters may be damped to such an extent that their record may represent more nearly average conditions.

In making special tests with portable curve-drawing meters, it is desirable to mark on each test the time in seconds required for the pen to travel across the chart without load on the meter. This may be done by holding the pen over against the top of the record and with a stop watch noting the time the pen requires to reach the bottom of the chart, or it may be determined by noting the advance in paper during the return travel of the pen, provided that high-speed paper feed is used.



OBSERVE COMPLETE ANNOTATION ON CHART FOR TEST OF MOTOR-DRIVEN BEATER IN PAPER MILL

When curve-drawing meters are to be permanently installed, the paper feed should be as slow as possible, as the problem of filing away their records is often found very annoying. The circular chart should be small in diameter.

Meters should be somewhat sluggish in movement, as a record of average conditions is usually desired and not peaks of momentary duration.

The clock forms a very important part of the meter, as the records would be of little value if the clock failed to keep proper time or stopped altogether.

Of the various installations and purposes for which curve-drawing meters may be used, the greatest value and usefulness lie in their use for portable work and for intensive study under the supervision of a competent engineer. When they are to be used for a short period of time to obtain engineering data or to investigate operating conditions the continuous-chart meter should be used, adopting sufficient paper speed to prevent the recording pen traveling more than twice over any portion of the chart. Oftentimes when slow paper feed is used the repeated travel of the pen over the same part of the chart causes ink blots and unintelligible records. For this service every precaution should be taken while obtaining records which will facilitate explaining them to persons unfamiliar with meter records. Meters using charts having rectangular co-ordinates and straight-line pen movements are best suited for this service.

While making special tests it is not only necessary to have high-grade apparatus, but it is also important that the persons making the test shall be careful observers of operating conditions and the equipment being tested. The explanation of certain parts of the records would be difficult to obtain later unless at the time the record was made the cause for each variation in load was determined. Very few data should be left to memory while making tests. The records should be carefully and profusely lettered. Too often valuable tests are obtained, but, owing to the lack of sufficient explanation, after a short period of time they become practically useless.

The accompanying illustration represents a test in which the various points of interest are well noted. As many data as possible should be placed on the original record, not kept in a notebook, for after a short period the mind will not be able to connect these data with the original record, and persons unfamiliar with the test will find it difficult to interpret. Moreover, there is the possibility of the data being lost. This record embodies several interesting points. The curve was obtained by using a wattmeter of the straight-line relay type and was damped, twelve seconds being required for the pen to cross the record without load on the meter. It represents the load on a 50-hp., three-phase, 60-cycle, 550-volt motor, driving a beater in a paper mill by means of a silent chain drive. Owing to the length of this record, which covers a period of twenty-four hours, only a short section is shown. The meter producing this curve was of 100-volt, 5-amp. capacity, polyphase, and for this test 600-volt to 100-volt potential and 50-amp. to 5-amp. current transformers were used. In obtaining curves care should be used in selecting the proper size of current transformers for the tests in order that the curve shall be well up on the chart and yet not go off the chart at any time; thus any variations in the load will be recorded with greater accuracy.

In this case paper without time or capacity markings was used, and the meter pen was arranged to use Higgins' black drawing ink. This permits making blueprints from the original, which are easier to interpret than the original records.

Electric Service in the American Home

Detailed Study of Reports from More Than 5,000 Central Stations Indicates That 33,008,500 Americans, or 30.7 Per Cent of the People, Live in Electrically Lighted Homes—Houses Wired Number 6,291,160, Farm-Lighting Plants About 340,000

THE home is the center of civilization from which flows the attributes which make or unmake a nation. In the council of nations the importance of a people can be judged from the enlightenment to be found in the homes of that people. The tendency toward retrogression is always in full force, and the advancement of a people as a whole can be accomplished only under the most favorable conditions. Americans are now living in what may be termed the "electrical age," for the field of usefulness of electrical energy is being more rapidly developed in American homes than in the homes of any other people. In an endeavor to ascertain the extent to which the American homes are now wired for electric service and the proportion of the people within the present reach of central-station distribution systems the ELECTRICAL WORLD has made a detailed study based upon recent reports from more than 5,000 electrical generating companies submitted in connection with the compilation of the 1920 edition of the "McGraw Central Station Directory and Data Book." This study has been very carefully made from information covering the details of electric service in more than 10,000 cities and towns and the surrounding country districts. The summarized results are presented in Table I.

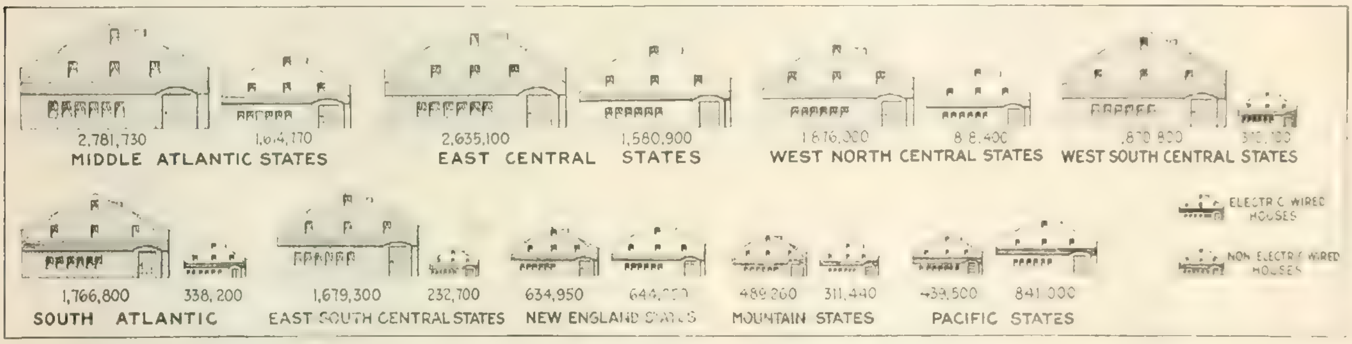


FIG. 1—PROPORTIONATE NUMBER OF ELECTRICALLY WIRED AND NON-ELECTRICALLY WIRED HOUSES IN VARIOUS SECTIONS OF THE UNITED STATES

The central stations of the country cover at the present time territory populated by 62,023,400 people, or about 57.3 per cent of the total population of the United States. Of this population within reach of central-station service, about 55.8 per cent live in electrically lighted houses. Of the total population of the country, however, only 33,008,500, or 30.7 per cent, are enjoying the benefits of electricity in their homes. There is a total of 6,291,160 houses wired for electricity, of which 48.0 per cent are in the Central States. California ranks first in number of houses wired per capita with 79 per cent, while Mississippi ranks lowest with only 8.4 per cent. The total number of stores wired was determined to be 1,459,169.

Other estimates of this nature have been made in the last few years. In 1915 it was estimated that not more than 10 per cent of the residences of the country were connected with central stations. The same year the National Electric Light Association conducted a survey in which returns from more than 100 cities of a population of 5,000 or less, taken at random from all parts of the country, indicated that 58 per cent of the houses in these cities were wired. In cities ranging from 5,000 to 10,000 the percentage was 54, and thirty-two cities with a population of more than 10,000 or less than 20,000 showed that 60 per cent of the houses were wired. The Society for Electrical Development also issued a summary of a similar survey as of Jan. 1, 1918. This valuable contribution, entitled "Customers versus Population," gave the population reached and the residences served by the larger central stations. The statistical department of the Western Electric Company made a detailed study of the situation as of Jan. 1, 1918, estimating that 5,000,000 houses were wired at that time. However, there seems to be no record of any prior estimate by states based upon direct reports of a majority of the operating companies of the country, and it is believed that the survey and information reported herein will be of service to the industry.

The value of electric service for the home is now well recognized, and it is estimated by capable authorities that about 98 per cent of the houses being built in cities and towns are wired for electricity. It is most important, therefore, that the architect and contractor should consider carefully the proper location and proper number of outlets for lighting fixtures, sufficient appliance outlets for the numerous labor-saving devices now used for heating, cooking and power, as well as the proper location of the switch control. To obtain the maximum use of small household apparatus every inducement to their operation should be given, and slipshod building plans which do not consider the conveniences of the occupants should be discouraged. In anticipation of a large consumption of electrical energy by electrically operated household appliances, a separate wiring system for these devices should be installed in new houses which will permit them to be connected to a separate meter. This enables the central station to adjust rate schedules when the demand merits a lower rate and to encourage the use of electrical appliances on an attractive basis.

As in all lines of industry central stations and distributing companies have been cutting down operating expenses to a minimum and making a minimum number of extensions. This enforced economy has resulted in the elimination of line extensions which under normal conditions would be considered essential to the proper

Table I—Present Status of Domestic and Commercial Electric Service by States and Sections

(Electrical World Survey, 1920)

State	Population of State (Estimated from 1910 Census)	Population Reached by Central Stations	Per Cent of Total Populat'n Reached by Central Stations	Persons per Dwelling	—Dwellings in Territory Covered by Central Stations—					Dwellings in States					—Population Living— in Electric Lighted Houses		Stores Wired	— Farm-Lighting Plants —		
						Electric Wired		Not Electric Wired			Electric Wired		Not Electric Wired							
	(2)	(3)	(4)	(5)	Total Number (6)	Total Number (7)	Per Cent of Total (8)	Total Number (9)	Per Cent of Total (10)	Total Number (11)	Total Number (12)	Per Cent of Total (13)	Total Number (14)	Per Cent of Total (15)	Total Number (16)	Per Cent of Total (17)	(18)	Total Number of Farms (1910 Census) (19)	Farms Served by Farm Plants (20)	Per Cent of Total Farms (21)
Alabama	2,446,000	632,000	25.9	4.8	131,600	52,400	39.8	79,200	60.2	510,000	52,400	10.3	457,600	89.7	252,000	10.3	8,550	262,901	2,500	1.0
Arizona	286,000	144,000	50.3	4.5	32,000	12,920	40.4	19,080	59.6	63,500	12,920	20.4	50,580	79.6	58,200	20.4	4,980	9,227	590	6.4
Arkansas	1,836,000	436,000	23.8	4.8	90,800	48,200	53.1	42,600	46.9	383,000	48,200	12.6	334,800	87.4	221,000	12.6	13,020	214,678	3,260	1.5
California	3,267,000	2,827,000	86.5	4.6	613,000	561,000	91.4	52,000	8.6	710,000	561,000	79.0	149,000	21.0	2,580,000	79.0	76,700	88,197	2,410	2.7
Colorado	1,058,000	700,000	66.3	4.3	162,800	99,100	61.0	63,700	39.0	246,000	99,100	40.3	146,900	59.7	427,000	40.3	19,050	46,170	2,690	5.8
Connecticut	1,320,000	1,160,000	88.0	6.1	190,000	119,830	63.0	70,170	37.0	216,000	119,830	55.5	96,170	44.5	731,000	55.5	33,200	26,815	1,820	6.8
Delaware	220,000	141,000	64.0	4.7	30,000	9,270	30.9	20,730	69.1	46,800	9,270	19.8	37,530	80.2	43,600	19.8	3,130	10,836	310	2.9
Dist. of Columbia	437,000	430,000	98.3	5.7	75,400	21,800	28.9	53,600	71.1	76,700	21,800	28.4	54,900	71.6	124,000	28.4	2,980	217	0	0
Florida	976,000	447,000	45.8	4.5	99,400	67,000	67.3	32,400	32.7	217,000	67,000	30.9	150,000	69.1	302,000	30.9	8,500	50,016	2,510	5.0
Georgia	3,001,000	832,000	27.7	4.9	170,000	80,700	47.5	89,300	52.5	612,000	80,700	13.2	531,300	86.8	396,000	13.2	22,500	291,027	7,240	2.5
Idaho	489,000	246,000	50.3	4.5	54,700	38,160	69.7	16,540	30.3	107,600	38,160	35.4	69,400	64.6	172,000	35.4	9,775	30,807	1,800	5.8
Illinois	6,454,000	5,150,000	79.8	5.6	919,000	626,000	68.1	293,000	31.9	1,153,000	626,000	54.3	527,000	45.7	3,505,000	54.3	174,700	251,872	15,300	6.1
Indiana	2,885,000	1,700,000	58.9	4.3	395,000	197,700	50.0	197,300	50.0	671,000	197,700	29.4	473,300	70.6	850,000	29.4	32,450	215,485	11,250	5.2
Iowa	2,224,000	792,000	35.6	4.5	176,000	107,400	61.0	68,600	39.0	494,000	107,400	21.8	386,600	78.2	482,000	21.8	22,650	217,044	18,700	8.6
Kansas	1,911,000	930,000	48.7	4.4	211,200	145,700	69.6	65,500	30.4	434,000	145,700	33.6	288,300	66.4	640,000	33.6	21,790	177,841	8,940	5.1
Kentucky	2,433,000	754,000	31.0	4.9	153,800	90,200	58.7	63,600	41.3	497,000	90,200	18.2	406,800	81.8	442,000	18.2	25,330	259,185	5,330	2.1
Louisiana	1,931,000	676,000	35.0	5.0	139,200	44,800	29.5	90,400	70.5	386,500	44,800	11.6	341,700	88.4	224,000	11.6	9,670	120,546	2,670	2.2
Maine	790,000	639,000	80.8	4.7	139,900	77,700	57.2	58,200	42.8	168,000	77,700	46.2	90,300	53.8	365,000	46.2	22,880	60,016	1,480	3.3
Maryland	1,403,000	826,000	58.9	5.1	162,000	50,000	30.9	112,000	69.1	275,000	50,000	18.2	225,000	81.8	255,000	18.2	16,900	48,923	2,850	5.8
Massachusetts	4,126,000	4,030,000	97.8	6.6	612,000	338,500	55.3	273,500	44.7	625,000	338,500	54.2	286,500	45.8	2,232,000	54.2	49,250	36,917	880	2.4
Michigan	3,199,000	1,945,000	60.7	4.5	432,000	257,000	59.5	175,000	40.5	710,000	257,000	36.2	453,000	63.8	1,156,000	36.2	38,300	206,960	6,770	3.3
Minnesota	2,399,000	1,393,000	58.2	5.5	253,200	188,000	74.3	65,200	25.7	435,500	188,000	43.2	247,500	56.8	1,034,000	43.2	39,800	156,137	7,320	4.7
Mississippi	2,042,000	347,000	16.9	4.8	72,300	35,600	49.2	36,700	50.8	426,000	35,600	8.4	390,400	91.6	168,000	8.4	7,980	274,382	2,490	0.9
Missouri	3,479,000	2,080,000	59.8	4.9	424,500	207,000	48.8	217,500	51.2	709,000	207,000	29.2	502,000	70.8	1,014,000	29.2	66,000	277,244	6,460	2.3
Montana	508,000	311,000	61.3	4.5	69,200	51,300	74.2	17,900	25.8	113,000	51,300	45.4	61,700	54.6	231,000	45.4	7,830	26,214	1,610	6.2
Nebraska	1,318,000	568,000	43.2	4.6	123,500	88,700	67.3	34,800	32.7	286,000	88,700	31.0	197,300	69.0	407,000	31.0	19,620	129,678	10,580	8.1
Nevada	122,000	66,300	54.3	3.6	18,420	14,480	78.6	3,940	21.4	33,900	14,480	42.7	19,420	57.3	52,200	42.7	1,427	2,689	200	7.5
New Hampshire	449,000	422,000	93.8	4.8	87,900	29,900	34.0	58,000	66.0	93,600	29,900	31.9	63,700	68.1	143,000	31.9	6,260	27,053	320	1.2
New Jersey	3,189,000	2,707,000	84.8	6.2	435,000	218,000	50.2	217,000	49.8	514,000	218,000	42.4	296,000	57.6	1,350,000	42.4	24,070	33,487	1,360	4.1
New Mexico	439,000	104,200	23.7	4.3	24,300	13,300	54.8	11,000	45.2	102,100	13,300	13.0	88,800	87.0	57,200	13.0	1,450	35,676	230	0.6
New York	10,954,000	8,620,700	78.7	7.7	784,000	440,000	54.6	344,000	45.4	997,000	440,000	44.2	557,000	55.8	4,835,000	44.2	209,000	215,597	8,530	4.0
North Carolina	2,518,000	539,000	21.4	5.1	105,700	49,200	31.3	56,500	68.7	493,000	49,200	10.0	443,800	90.0	250,500	10.0	9,330	253,725	6,560	2.6
North Dakota	834,000	283,000	33.9	4.9	57,750	42,300	73.3	15,400	26.7	170,000	42,300	24.9	127,700	75.1	207,000	24.9	12,080	74,360	32,340	43.0
Ohio	5,375,000	3,550,000	66.1	4.7	755,000	362,500	48.0	392,500	52.0	1,143,000	362,500	31.7	780,500	68.3	1,705,000	31.7	70,000	272,045	30,200	11.0
Oklahoma	2,522,000	602,000	23.9	4.8	125,300	60,900	48.6	64,400	51.4	526,000	60,900	11.6	465,100	88.4	293,000	11.6	13,730	190,192	4,250	2.2
Oregon	931,000	580,000	62.3	4.6	126,000	80,000	63.5	46,000	36.5	202,500	80,000	39.5	122,500	60.5	368,000	39.5	10,060	45,502	400	0.9
Pennsylvania	9,025,000	6,220,000	68.8	5.1	1,218,000	365,500	30.0	852,500	70.0	1,770,000	365,500	20.6	1,404,500	79.4	1,863,000	20.6	135,500	219,295	36,400	16.6
Rhode Island	656,000	643,000	98.0	6.8	94,600	41,800	44.2	52,800	55.8	96,400	41,800	43.4	54,600	56.6	285,000	43.4	12,720	5,292	100	1.9
South Carolina	1,690,000	357,000	21.1	5.0	71,400	51,000	71.4	20,400	28.6	338,000	51,000	15.1	287,000	84.9	255,000	15.1	8,360	176,434	4,320	2.5
South Dakota	765,000	269,000	35.2	4.6	58,400	39,300	67.3	18,700	32.7	166,000	39,300	23.7	126,700	76.3	181,000	23.7	9,240	77,644	30,530	39.0
Tennessee	2,348,000	621,000	26.4	4.9	126,800	54,500	43.0	72,300	57.0	479,000	54,500	11.4	424,500	88.3	267,000	11.4	9,060	246,012	2,890	1.2
Texas	4,742,000	1,758,000	37.1	5.0	351,700	218,800	62.3	132,900	37.7	948,000	218,800	23.0	729,200	77.0	1,095,000	23.0	33,900	417,770	32,000	7.7
Utah	470,000	377,000	80.2	5.1	73,900	68,600	92.8	5,300	7.2	92,200	68,600	74.4	23,600	25.6	350,000	74.4	8,110	21,676	340	1.6
Vermont	368,000	254,000	69.1	4.6	55,230	36,320	65.8	18,910	34.2	80,000	36,320	45.3	43,680	54.7	167,000	49.2	11,620	32,709	490	1.5
Virginia	2,268,000	667,000	29.4	5.1	130,800	90,300	69.1	40,500	30.9	445,000	90,300	20.3	354,700	79.7	461,000	20.3	10,140	184,018	6,700	3.7
Washington	1,765,000	1,280,000	72.5	4.8	266,700	200,000	74.9	66,700	25.1	368,000	200,000	54.3	168,000	45.7	960,000	54.3	49,500	56,192	2,980	5.3
West Virginia	1,483,000	390,000	26.3	5.1	76,400	37,200	48.7	39,200	51.3	291,000	37,200	12.8	253,800	87.2	190,000	12.8	6,270	96,685	2,860	3.0
Wisconsin	2,598,000	1,471,000	56.7	5.0	294,500	147,700	50.2	146,800	49.8	519,000	147,700	28.4	371,300	71.6	738,000	28.4	47,000	177,127	7,440	4.2
Wyoming	199,000	104,900	52.7	4.7	22,300	13,580	60.8	8,720	39.2	42,400	13,580	32.0	28,820	68.0	63,800	32.0	2,807	10,987	800	7.3
Sections																				
New England	7,709,000	7,148,000	92.7	6.0	1,175,630	644,050	54.8	531,580	45.2	1,266,000	644,050	50.9	634,950	49.7	3,903,000	50.9	135,930	188,802	5,090	2.7
Atlantic	37,164,000	22,177,200	59.6	5.7	3,358,100	1,479,970	44.0	1,878,130	56.0	6,075,500	1,497,970	24.3	4,595,500	75.7	8,905,000	24.0	456,680	1,580,260	79,640	5.0
Central	53,741,000	25,957,600	48.3	4.8	5,287,600	3,014,700	56.9	2,272,900	43.1	11,046,000	3,014,700	27.3	8,031,300	72.6	14,881,000	27.3	674,870	4,219,103	241,220	5.7
Mountain	3,571,000	2,053,400	57.5	4.5	457,620	311,440	67.9	146,180	32.1	800,700	311,440	39.5	489,260	61.1	1,411,500	39.5	55,429	183,446	8,260	4.5
Pacific	5,963,000	4,687,200	78.6	4.7	1,005,700	841,000	84.1	164,700	15.9	1,280,500	841,000	65.6	439,500	34.2	3,908,000	65.6	136,260	189,891	5,790	3.0
United States	108,148,000	62,023,400	57.3	5.2	11,284,650	6,291,160	55.8	4,993,490	44.2	20,481,700	6,291,160	30.7	14,190,540	69.3	33,008,500	30.7	1,459,169	6,362,502	340,000	5.3

growth of a company. In some cases the station and line capacity will not permit large additional load until new equipment is installed. Such companies are not encouraging new residence connections but are concentrating on the increased use of small household apparatus by their present customers. The use of household electrical devices creates essentially an off-peak load.

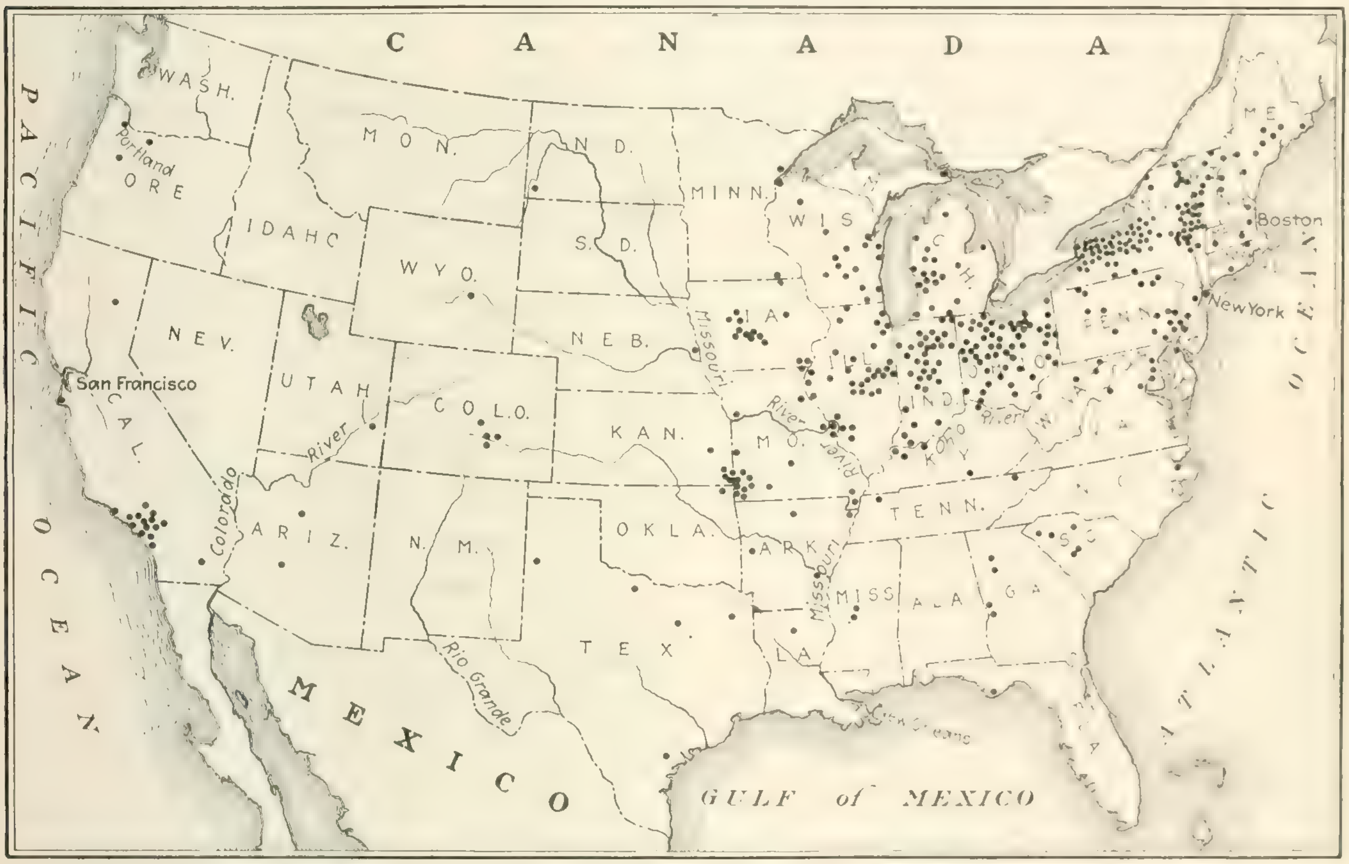


FIG. 2—MAP SHOWING LOCATION OF CENTRAL-STATION SERVICE AT FREQUENCIES OTHER THAN 60-CYCLE

Many cities possessing the necessary station capacity have undertaken extensive house-wiring campaigns with complete success. In Elmira, N. Y., for instance, the number of houses wired was raised from 6,000 to 7,500 in one year, more than three-quarters of the houses in that city being now electrically wired. There is, however, little or no direct relation between the increase in number of new houses wired and increase in revenue. This was clearly demonstrated in Worcester, Mass., in 1917, when the number of wired houses increased 21.7 per cent while the revenue increased 32.4 per cent. It is also quite possible that a selling campaign will increase the revenue by the sale of small household appliances, while additional houses wired may raise the revenue without the sale of small household apparatus. Campaigns for wiring new houses and selling appliances conducted together make up the ideal combination.

The diagrams in Fig. 1 indicate the saturation of wired houses in the various sections of the country. The illustrations do not, however, indicate the location of the field of active operation for new wiring. The East South Central States show the largest ratio between wired and unwired houses, but the North Central, Middle Atlantic and New England States present the most fruitful field for future operations.

The present year holds forth large gains in wired houses in districts where there is ample generating capacity or where additional installations are contemplated. The new building in 1919 was estimated at five billion dollars, of which about 40 per cent was for residences, giving about 200,000 new houses. The building operations in 1920 are estimated at six billion dollars, of which about two and one-half billion dollars will be spent on about 240,000 residences. Such construction offers a tremendous field for domestic lighting as well as a large growth in the use of small household electrical apparatus, and to this field must be added the old houses, a large quantity of which will undoubtedly be wired during the year. There is, however, a time lag of from six to nine months after building permits are issued before the effect of new house installations is shown from central-station records, so that building undertaken in the fall of the year will not appreciably affect the central-station output of the present year.

The American farmer, while happy and satisfied with his surroundings, still has a secret yearning, with reason, for some of the comforts which are to be found in the town and city dwelling. He is becoming convinced that electricity offers him light, running water, labor-saving devices and sanitation at small cost. Thus the farm furnishes a field of no small proportions for electrical development in the future. Farmers as a whole are financially able to install electrical appliances in their houses and barns, but they have not as yet been fully educated into the advantages of electric service.

Three ways are open to the farmer to get electric service: (1) Direct from a central-station transmission line; (2) by a small private plant run by a gasoline engine; (3) by a small private plant run by water power. In order that an idea might be obtained of the present development of the farm-plant industry extensive correspondence was undertaken in connection with the present survey. From various sources actual data and estimates have been obtained covering the distribution of farm plants of various makes throughout the country. While the estimates varied over wide ranges, the consensus of opinion is that there were about 340,000 farm plants in the United States at the present time, and that from 100,000 to 110,000 plants will be sold during 1920.

The figures given in Table I showing the number of farm-lighting plants at present installed in the various states must not be considered as exact, but are based on reports received from various manufacturing concerns and are believed to represent correctly the proportionate distribution of farm plants throughout the country. While there are about 6,400,000 farms in the nation, yet only about two-thirds of them can be considered prospects for farm-lighting plants, on account of their small size, their unproductiveness or the personality of the farmer.

Farm lighting opens up a field involving hundreds of millions of dollars. At an average rate of $500 for each plant, the farm-lighting business of 1920 will amount to $50,000,000 or $55,000,000. This does not include accessories and appliances. The installation of lighting plants on the farm will mean the installation of sanitary plumbing fixtures, water-supply equipment and up-to-date heating apparatus. The servant problem is especially serious on the farm, and the farmer's wife will find a way to obtain various household labor-saving devices once the electric service to operate them is available.

One of the primary causes of slow progress in introducing complete electric service in the homes of some sections of the country is the existence of odd frequencies and odd voltages of central-station service; that is residence service at other than 60 cycles and 110 volts. Most small household devices are designed for standard ratings. Fig. 2 shows the location of the central stations of the country where the service to residences is at a frequency other than 60 cycles. Numerous plants of this type are located in northern New

TABLE II—CENTRAL STATION FUEL AND GENERATOR STATISTICS

		Voltage				Frequency			Fuel Used										
State	Number of Central Stations Jan. 1, 1919	110 Volts, A.C. (No. of Stations)	Other than 110 Volts (No. of Stations)	D. C. (No. of Stations)	Undetermined (No Report)	60 Cycles (No. of Stations)	Other than 60 Cycles (No. of Stations)	Undetermined (No Report)	Water Power	Coal	Internal Combustion Engine (Gasoline Distillate)	Coal and Wood	Coal and Water Power	Oil	Wood	Oil and Coal	Oil and Internal Combustion Engine	Miscellaneous	Undetermined (No Report)
Alabama	82	54	11	4	13	65	0	13	1	34		4			11				32
Arizona	39	19	5	1	14	24	2	14	1	5				11				2	22
Arkansas	104	57	11	13	23	64	4	23	1	28	4	7		6	9				47
California	130	97	28	2	5	86	39	5	10	1	3			10					106
Colorado	89	45	28	7	9	69	4	9	4	12	2		1	1					69
Connecticut	51	30	17	5	9	46	1	9	5	12		1	1	1					31
Delaware	20	12	2	2	4	13	1	4		6									14
Dist. of Columbia	2	1	0	0	1	0	1	1		1									1
Florida	110	60	12	1	37	71	1	37		21	3	4		27	10			1	43
Georgia	198	87	32	4	75	114	5	75	8	47		10	1	2	14		1		116
Idaho	60	28	21	3	8	49	0	[illegible]	6		1	2			1				50
Illinois	365	263	53	39	30	282	34	30	5	163	10		1	19		2		2	163
Indiana	257	140	38	24	55	146	32	55	2	105	4	2	1	6		2		2	133
Iowa	300	201	55	34	10	240	16	10	18	118	8		1	26		4	1	2	122
Kansas	335	164	27	23	121	186	5	121	2	54	25		1	86		7	7	2	151
Kentucky	130	57	12	20	41	64	5	41		60	4	1		20	3	1			41
Louisiana	82	33	10	8	31	42	1	31		7	6	2		23	8	4		2	30
Maine	111	46	14	1	50	51	9	50	29	11	1	1	1		4	1		1	62
Maryland	59	27	9	3	20	33	3	20		20	3							3	33
Massachusetts	261	91	37	4	129	125	3	129	5	45	1			1		1		2	207
Michigan	258	106	66	17	69	152	20	69	22	88	2	4	6	10	4	1	1	4	116
Minnesota	279	130	17	52	80	145	2	80	6	92	6	6	1	25	5	5	3	5	125
Mississippi	110	40	15	7	48	72	3	48		44	2	5		11	5	2			194
Missouri	263	137	29	32	65	147	19	66	1	103	2	5		41	3	13	5	1	89
Montana	71	33	14	6	18	46	1	18	11	15	2		1	12			1	1	28
Nebraska	251	119	18	61	53	130	1	53	10	59	9			65		10	15	10	73
Nevada	30	9	1	0	20	8	0	20	2	1								2	25
New Hampshire	65	28	20	1	15	44	6	15	12	12			4		2		1	4	30
New Jersey	74	45	15	7	7	57	9	7	3	34				6		1		3	27
New Mexico	34	19	5	0	20	22	1	20	3	11				7		1		1	11
New York	389	201	93	11	84	217	99	84	60	110	6	1	4	6		1	1	6	194
North Carolina	148	68	33	2	45	98	1	45	14	45	2	8		2	7			1	69
North Dakota	133	41	7	51	34	44	1	34		27	11			42		1	2	17	32
Ohio	331	159	103	28	41	204	59	41		144	0			6				38	143
Oklahoma	174	109	18	3	44	125	1	44		53	39	1		23	1	5	5	4	43
Oregon	70	34	36	0	0	71	6	0	25			1		4	17			3	20
Pennsylvania	272	184	68	20	0	234	19	0	26	115		1	2					15	114
Rhode Island	26	8	10	0	8	15	1	8		2						1			23
South Carolina	93	48	23	0	22	63	7	22	2	32	2	3		1	3		1		51
South Dakota	126	53	11	33	29	61	0	29	2	22	12		3	21	1	4	14	5	42
Tennessee	111	53	11	6	41	61	2	41	7	48	1	5	4	1			1		44
Texas	300	200	40	25	35	232	6	35	3	36	17	5		103	7	12	13	27	77
Utah	73	26	47	0	0	45	1	0	17	2									54
Vermont	68	25	31	1	11	45	7	11	15	14			2					1	36
Virginia	101	41	28	10	22	63	2	22	13	38	1	2	1	4				1	41
Washington	150	98	42	6	6	132	0	6	20	10	1	1		8	7			2	101
West Virginia	75	40	7	5	23	41	4	23	2	21	4							17	31
Wisconsin	327	161	77	67	22	202	17	22	53	87		2	3	24	14	1	2	21	120
Wyoming	36	22	7	2	5	23	1	5	3	13	2			7					11
Sections																			
New England	582	228	129	12	213	326	27	218	66	96	2	2	[illegible]	2	6	3	1	8	388
Atlantic	1,541	814	322	65	340	1,004	152	340	128	490	21	29	8	48	34	2	3	48	732
Central	4,318	2,277	629	547	865	2,664	228	865	133	1,372	162	49	21	558	81	74	69	143	1,656
Mountain	432	201	128	19	84	286	10	84	47	59	7	2	1	38	1	1	1	4	271
Pacific	350	229	106	8	343	289	45	343	55	11	4	2		12	24			5	237
United States	7,223	3,749	1,314	651	1,509	4,569	462	1,509	429	2,028	196	84	38	658	146	80	74	208	3,284

York, Illinois, Indiana and Michigan, and California possesses a considerable number. Many of these are old plants of small rating, operated under conditions that do not warrant new or rehabilitated installations. As transmission networks are extended these plants will gradually be eliminated or taken over and their service standardized. Table II gives the location of plants with odd voltages.

As a matter of information the kinds of fuel burned by the various central stations are included in Table II. The relation between the use of coal and oil as a fuel is very clearly indicated. These statistics are as of Jan. 1, 1919, and it is probable that later data will show many changes.

Industrial Tractors Serve to Move Loads Economically

Replace from Three to Ten Men and Show Operating Economy of from 1.1 Kw.-hr. to 3.8 Kw.-hr. per Ton-Mile

A RECENT study of the operation and maintenance of industrial tractors used in Chicago by manufacturers and warehouses of several kinds showed that the owners consider them satisfactory and in some cases indispensable. In these industrial plants the tractors have each replaced from three to ten laborers, which at the present time the managers think is a great advantage. The survey uncovered the fact that there is a regrettable lack of accurate cost keeping in connection with electric industrial tractor and truck operation. Out of ten companies interviewed only two had anything like complete records of tractor performance. Practically all users, however, gave favorable opinions and were willing to estimate the admitted extent of the saving in labor which their tractor or truck equipment afforded. Some of these opinions and estimates are recorded in this article, and the data from the two companies which kept definite records are given in tabular form.

Sears, Roebuck & Company have seven tractors at their main building, of the size shown in the table. These are used for hauling wooden trailers in trains of five to twenty-four. They handle all kinds of general merchandise, each load weighing from 600 lb. to 2,000 lb. (242 kg. to 907 kg.). They run over concrete floors, over brick and asphalt paving and up one grade of 4 per cent. Not more than twelve trailers are pulled up this grade. Definite measurements were made on the routes by two of these tractors, the average length of haul being 200 yd. (182 m.). They are loaded at each end of the trip, never running with empty trailers. Two men are used with each tractor, one operator and one man to hook trailers. The tractors work about eight hours a day and are charged by a motor-generator set for seven and one-half hours each night. The Edison batteries have never given any serious trouble.

One length of concrete floor which was worn badly by the tractors and trailers was covered with asphalt about 1.5 in. (3.7 cm.) deep. In two years of heavy hauling this asphalt has shown very little effect of wear, while concrete under the same conditions has cracked and developed holes. However, slightly more power is required to pull a load on the asphalt.

This work at the Sears, Roebuck & Company plant was formerly done by hand, one man handling one trailer. It would not be possible, it is said, to handle the present amount of hauling by the old method on account of limited space in the hauling aisles.

Another concern which has kept records of its tractor operation is the Chicago warehouse of the Minneapolis, St. Paul & Sault Ste. Marie Railroad, which has two 135-amp.-hr. tractors. These are used for pushing steel cars on rails 60 yd. (54 m.) in either direction to or from the warehouse elevators. These cars hold an average load of 2,500 lb. (1,133 kg.), and the two tractors handle from 375 tons to 400 tons of freight per day of ten hours to twelve hours. Each tractor hauls loaded cars one day and empty cars the next to equalize the duty cycle. The charging is done at night. The batteries are "Exides," and a new set has recently replaced the original set, which ran for four years with no trouble. The complete data on the operation of these tractors and those of Sears, Roebuck & Company are given in the accompanying table.

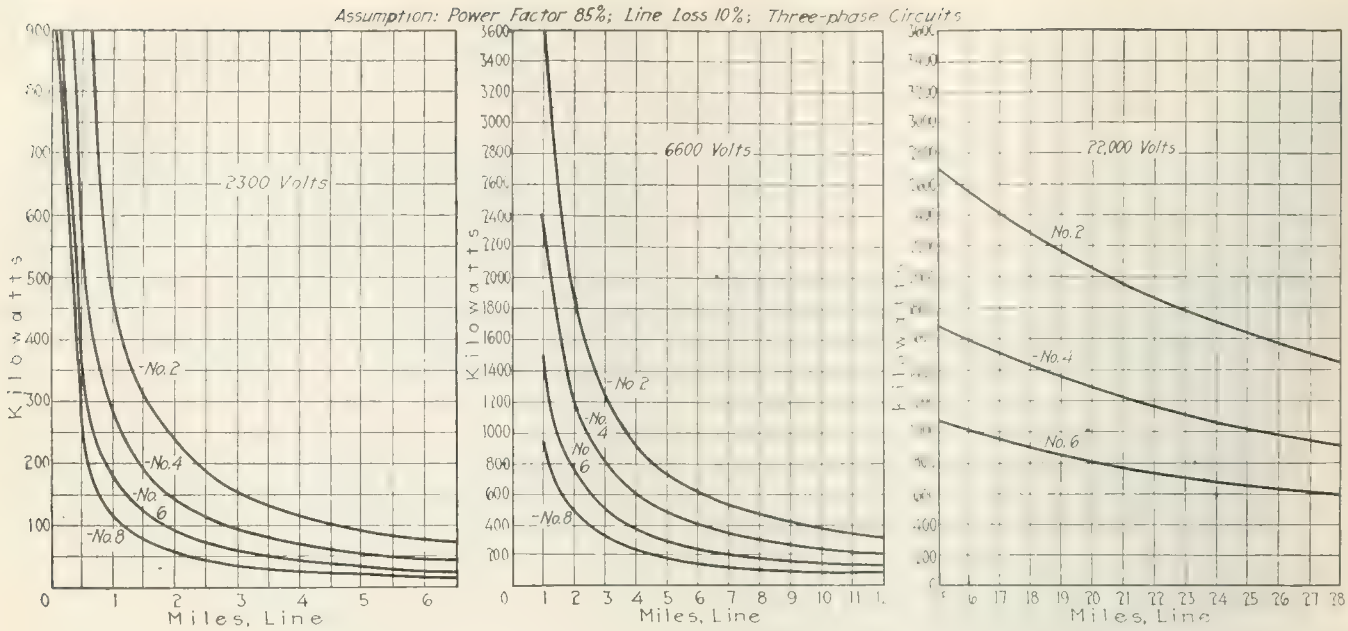
DATA ON TRACTOR OPERATION

Company	Sears, Roebuck & Co	M., St. P. & S. St. M. Warehouse.
No. of tractors	Four 300 amp.-hr. Mercury One 450 amp.-hr. Buda Two 600-amp.-hr. Mercury	Two 135 amp.-hr. Lakewood
How hauled	On wooden trailers 6 in. to 24 in train	Steel cars, pushed
Roadway	Concrete floor, asphalt floor, brick pavement One grade of 4 per cent	Steel rail
Average distance of haul	200 yd. and return, loaded both ways	60 yd.
Material hauled	General merchandise	Heavy freight
Load per trip	2 to 12 tons	2 to 2½ tons
Amount per day per tractor	30 to 100 tons	185 to 200 tons
Ton miles per day per tractor	7 to 25	6 to 7
Kw.-hr. per day per tractor	27	10 to 11
Kw.-hr. per ton-mile	3.8 to 1.1	1.7
Men saved per tractor	4 to 10	5

Two other concerns which did not have definite records did have interesting and valuable comments on their tractor operation. One of these, the Kellogg Switchboard & Supply Company, has three tractors which are used with small trailers. Two of these are run on a regular schedule on a round trip about the plant. These make a distance of about 18 miles (29 km.) per day. They pick up loads of small telephone parts aggregating from 1 ton to 2 tons and transfer them from one department to another. The third truck is used for all jobs which cannot be taken care of by the "schedule" trucks. About thirty men are replaced by these three trucks. The practice of operating two of these trucks on definite schedules while the third does odd-job work is thought to be responsible for the high record of mileage and the large amount of work which the trucks do.

The Goodman Manufacturing Company, Chicago, has two 225-amp.-hr. trucks. These are equipped with an elevator platform, which is used extensively for handling the heavy motors and other machinery made in this plant. The loads handled are from 2 tons to 3 tons. Two trucks are often used under the same load to haul as much as 6 tons. The trucks operate satisfactorily on a grade of more than 8 per cent, which is encountered in this plant.

In none of the plants visited had the trucks or tractors failed to convince their owners that they were effecting a saving in labor.



FIGS. 1, 2 AND 3—RATING OF 2,300, 6,600 AND 22,000-VOLT LINES OF DIFFERENT LENGTHS

Approximate Ratings of Three-Phase Lines

APPROXIMATE ratings of three-phase transmission lines at various voltages and with different sizes of conductors can be had almost at a glance from the accompanying curves. In fact, the curves represent three qualities—distance, load and wire size—any of which can be scaled off when the other two are known. The calculations for the curves were all made on the basis of 85 per cent power factor and 10 per cent loss, this being judged an average condition. A. Evans, assistant engineer of the Arkansas Light & Power Company, Pine Bluff, Ark., who worked up the graphs, has stated that for calculations where high accuracy is not required these plates have proved quite useful. In preparing the material it was the aim to cover all of the more common sorts of lines on which estimates might be required. This decision placed the very practical limits on the distances and wire sizes used for the various voltages. For instance, Fig. 1 covers a rather complete set of conditions for 2,300-volt lines up to 6 miles (9 km.) long. Beyond this distance it is generally not good practice to use 2,300 volts. It should be noted that the figures of distance given are for miles of line, not miles of wire. The wire sizes are Nos. 8, 6, 4 and 2.

Similarly Fig. 2 covers 6,600-volt lines from 1 mile (1.6 km.) to 12 miles (19 km.) long using wire sizes Nos. 8, 6, 4 and 2. Fig. 3 covers 22,000-volt calculations for lines from 15 miles (24 km.) to 29 miles (46 km.) long using Nos. 6, 4 and 2 copper wire. Thirty-three-thousand-volt lines being the more common and covering a wider range of applications in the Central West have been given more detailed treatment than the others. Fig. 4 covers this class of construction for distances from 30 miles (48 km.) to 56 miles (90 km.) and for the following wire sizes: Nos. 4, 2, 0, 2/0, 3/0 and 4/0. This gives a range of line ratings from 1,000 kw. to 9,000 kw. For distances of from 60 miles (96 km.) to 86 miles (136 km.) and for loads between 5,000 kw. and 20,000 kw. Fig. 5 covers problems on 66,000-volt lines.

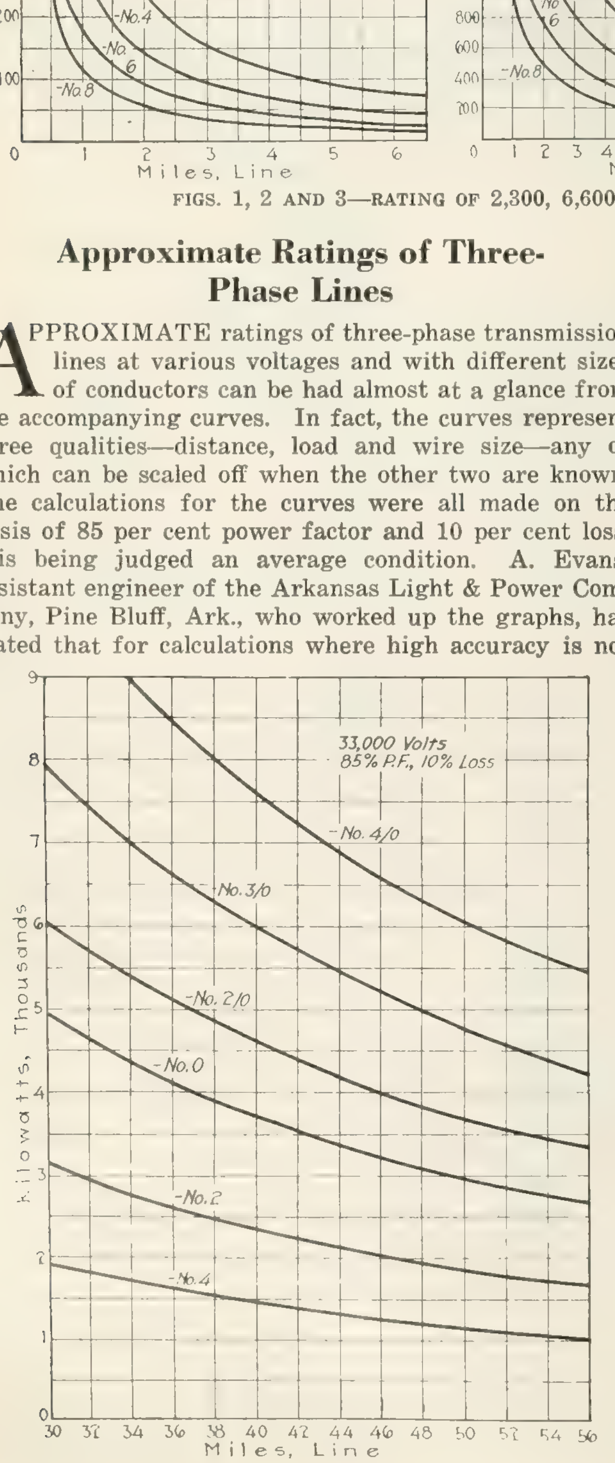


FIG. 4—EFFECT OF LENGTH ON RATING OF 33,000-VOLT LINES

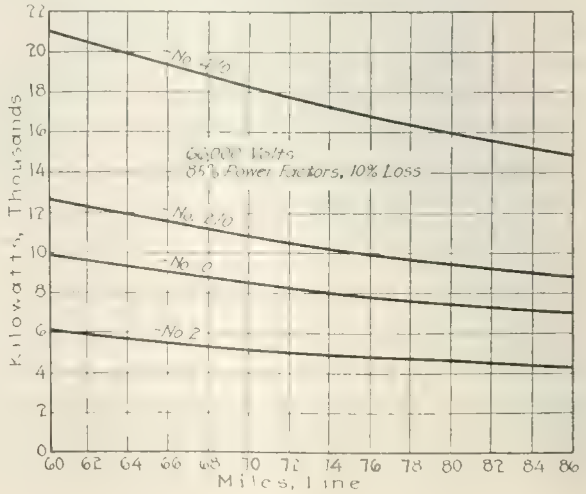


FIG. 5—RATING OF VARIOUS-LENGTH 66,000-VOLT LINES

Readers' Views and Comments

Specialization in Colleges

To the Editor of the ELECTRICAL WORLD:

SIR: I was very glad to see the decided stand taken by the ELECTRICAL WORLD, in the issue of April 24, in an editorial on "The Danger of Specialization in Colleges." As an employer of technically educated men, I agree absolutely with you in your stand on this matter. It is quite true that a broadly educated college graduate is not so immediately valuable to a company, but his value after a period of service is immeasurably greater. I think that employers who discuss this matter of immediate value of college graduates lose track of the fact that even in the practical, unskilled labor field a man is not of full value until he has been in an organization for some time. In fact, the evidence of this is shown in cost of labor turnover and the instruction of new labor.

W. D. A. PEASLEE,
Electrical Engineer.
Jeffery-Dewitt Insulator Company, Huntington, W. Va.

Pulverized Coal for Steam Generation

To the Editor of the ELECTRICAL WORLD:

SIR: In regard to the results obtained with powdered fuel in Milwaukee, as outlined in the article by John Anderson on page 589 of the March 13 issue of the ELECTRICAL WORLD, the writer believes it is fundamentally wrong to take coal and bring it to the most expensive form imaginable (powder) and still burn it in its raw state, *i.e.*, with all its hydro-carbons. A more rational procedure, affording a much more fertile field of research, is to extract some or all of the by-products, leaving coke and gas for fuel. Ultimately we must come to some such process in this country, and until that time it will be difficult to find a complete analysis of figures that will show anything but a loss for powdered fuel as compared with stoker firing.

The ash carried out by the chimney gases is a serious matter. It is reported as forming 82.8 per cent of the ash content of the coal. This is an item that should not be lightly passed. It is not sufficient to state simply that it is "apparently carried a long distance" or that "no deposit could be noticed in the street." Some accurate way of measuring this discharge should be found before definite statements concerning it are made.

In figuring the cost of coal preparation only the equivalent fuel cost was charged, and that at 1.5 lb. (680 gr.) of coal per kilowatt-hour. This comes to 17,826 B.t.u. per kilowatt-hour. Few if any stations can assume such economy as this. The correct figure for cost of energy should include all items—coal, labor, capital charges, in fact everything that goes to make up the ultimate cost of a kilowatt-hour at the point of consumption. The author of the paper is misleading himself by using only partial costs for fuel preparation.

The cement industry has used powdered coal for twenty years and no doubt has many more data on the subject than steam producers. Such plants, with established figures on cost of pulverizing coal, find that it costs in excess of $1 per ton (900 kg.) to prepare the coal. If complete costs were figured for the Milwaukee installation, the cost of preparation would probably approach this figure and more than offset the alleged saving.

The type of stoker with which the comparison is made has a 7.7 per cent difference between the gross and net efficiency. This is due to the type of stoker selected for the comparison. This type of stoker has auxiliaries costly to operate, reducing the gross or apparent efficiency to a net figure below that which can be obtained with other stokers. With chain grates, for example, the net efficiency when operating at any such ratings as shown in this report is in excess of 76 per cent. Such a figure shows 5 per cent in favor of stoker firing over pulverized fuel.

From the author's presentation of the subject, the writer believes therefore, first, that the ash nuisance is unsolved; second, in order to present even a slight saving in favor of pulverized coal it is necessary to: (a) use low-moisture coal; (b) omit interest and depreciation on the additional investment; (c) omit a large part of the cost of preparing the fuel; (d) compare with underfeed stokers having low net efficiencies due to auxiliaries expensive to operate.

Correcting these items, the showing is all in favor of stoker firing.

T. A. MARSH,
Chief Engineer Green Engineering Company.
East Chicago, Ind.

Government Control of Monopoly

To the Editor of the ELECTRICAL WORLD:

SIR: The proper attitude of government toward monopoly is one of the fundamental problems of modern life and one on which public opinion ranges all the way from the views voiced by the easy-going exponents of *laisser faire* to the theories of socialists and communists. Most citizens hold ideas somewhere between the extremes and, so far from thinking private monopoly necessarily a thing either to ignore or to abhor, adhere to the Rooseveltian doctrine of "good trusts and bad trusts." It has been said by a well-qualified thinker along these lines that monopoly produced by unfair methods of competition is bad and should be prevented, while monopoly produced by the highest human efficiency is good and should be encouraged.

This is an attractive program, but is it a practicable one? Who is going unerringly to separate the sheep from the goats? What infallible judge will discriminate between methods that are fair and methods that are not? Moreover, is it wise to lose sight of the real line of demarcation between monopolies—that which separates the natural from the artificial? Artificial monopolies, though any abuses of which they are guilty should, of course, be subject to governmental correction, will sooner or later, be they good or bad, fall to pieces from their own weight and competition will again ensue. Natural monopolies, in which class public utilities fall, must recognize that their franchises render them primarily the servants of the people and that over them the people's government holds always the whip of taxation, which can be made destructive. So to order themselves that, while a fair profit shall be theirs, no clamor for the whip to fall shall arise is the problem that confronts them.

OBSERVER.
New York, N. Y.

Station and Operating Practice

A Department Devoted to Problems of Installation,
Operation and Maintenance of Equipment for Economical Generation and
Distribution of Electrical Energy

High Pressure on Extra Gage Indicates Turbine Trouble

Any trouble in a steam turbine affecting its efficiency may be detected by means of a steam gage placed between the governor valve and the first set of nozzles. This gage should be connected when the turbine is installed so as to obtain records of the pressure while the turbine efficiency is high. Records of steam pressure at the throttle, the kilowatt load and the vacuum should also be kept.

Since the economy of a turbine varies approximately in inverse proportion to the absolute pressure shown by the gage mentioned, a reading which is high compared with the records taken when the unit is new indicates trouble and warns that an investigation should be made. When it is noticed that economy is falling off the cause should be sought. The condenser system should be inspected for lack of vacuum. The buckets of the turbine may have been damaged by scale and cuttings from steam pipes or core sand in the castings.

To prevent this trouble a strainer should be put in the strain line at installation. Another possible trouble is partial clogging of nozzles or buckets with deposited material. Regular inspection of the turbine will tend to forestall most of these troubles before they appear.

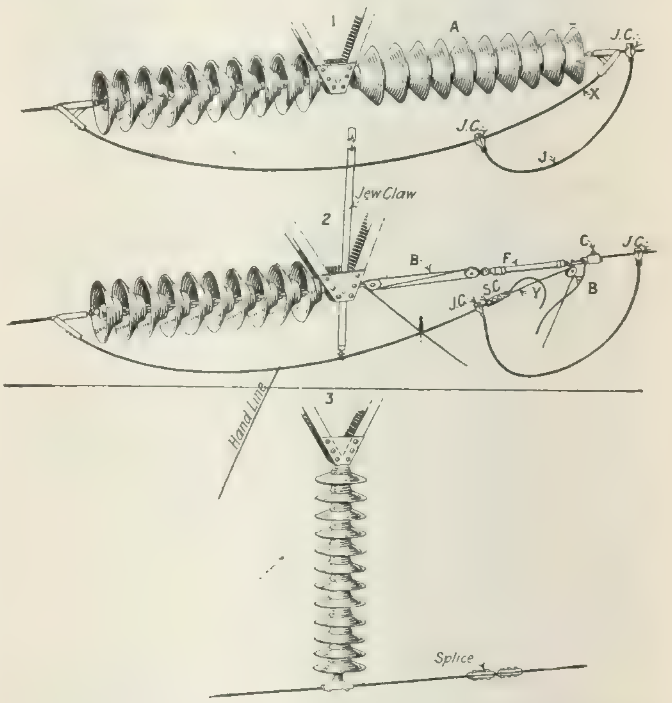
Ridgway, Pa. THOMAS HALL.

Dead-Ends on Towers Changed to Suspension on Live 110-Kv. Line

To AVOID the rapid insulator depreciation which was occurring on a 110,000-volt transmission line of the Georgia Railway & Power Company, Atlanta, the dead-end construction shown at (1) in the illustration for 500 towers was changed to the suspension installation shown at (3). This operation was performed while the line was alive, only twenty-one minutes being taken in some instances to accomplish the change on each phase. In making the change a splice had to be made in the line so that its slack would be absorbed. The following procedure for making this splice was devised by T. F. Johnson, Jr., general electrical superintendent of the company:

A jumper (*J* in Fig. 1) is attached to the line by means of Johnson clamps, after which a wedge "come-along" (*C* in Fig. 2) is attached to the line by means of the same stick used for the clamp. Through a clevis in this "come-along" the wooden strain member *F*, called a "fuzz stick," is hooked. The double block *B* holds this stick to the cross-arm. After taking up tension on this block the string of insulators *A* is removed. To pull the slack out of the loop in the wire a rope passed through a single sheave block *B*-1, hooked to the "come-along," is used to pull on the clamp *SC*, which has been bolted to the wire by a special stick. When this slack is removed the line is cut at *X* by means of a hack saw mounted on a switch handle. While the line is being cut it is kept from swinging by means of a handline (Fig. 2) from the ground and by a tool known as a "jew claw," which is a stick having a steel hook which screws in or out of a brass head by rotating the stick when the hook is placed over the line.

After the line is cut the clamp *SC* is pulled up by the rope until the ends of the line overlap, and these ends are spliced by means of two three-bolt clamps. These clamps are lifted up to the wire by a stick which has spring steel jaws which fit a nut of the clamp. In order to force the wires into the clamp a turn of rope is taken around them, and by pulling the rope the lines are squeezed together and into the clamp. Then the bolts are tightened by socket wrenches at the ends of insulating sticks.

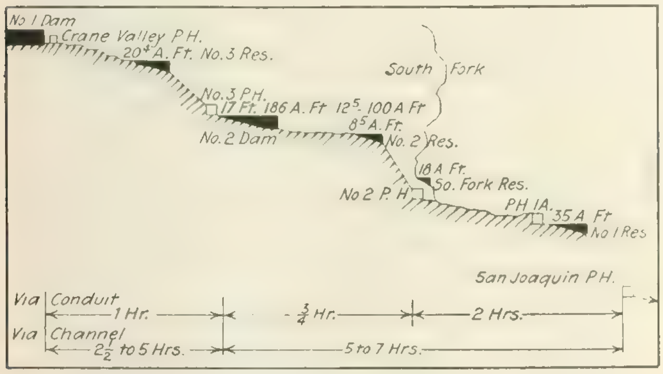


METHOD USED TO CHANGE LIVE 110,000-VOLT LINE FROM DEAD-ENDS TO SUSPENSION IN TWENTY-ONE MINUTES

When the splice is completed the jumper *J* and the block *B*-1 and its clamp are removed. Then by means of another "fuzz stick" and block the line is suspended from the cross-arm while the "come-along" *C* and the blocks *B* are transferred to the other side of the arm for removing the other string of insulators. After these are removed the vertical string is installed and the line is fastened in the line clamp by means of a live-line socket wrench. When the line is fast the "fuzz stick" which was supporting the line may be removed and the job is completed.

Difficulties of Dispatching Loads of Several Plants on Same River

SINCE many rivers in the Pacific Coast region are developed at several points to take advantage of the entire fall, it is sometimes quite difficult to hold a load if one of the plants should fail. Although the water can be passed around the plant, it takes time to reach the next lower plant. Moreover, it may be allowed to run either through its natural channel or through shorter artificial channels or conduits. All this makes a complicated job for the load dispatcher, who handles all water flow as well as electric load. An example of such a water-power system is shown in the accompanying diagram of the Crane Valley plants of the San Joaquin (Cal.) Power & Light Company. On this system the water may be bypassed around any plant or around any conduit, thus allowing operation of the remaining plants in case of failure of either a power house, a ditch or a penstock. It will be noted, however, that the time taken for water to flow through the natural channels is two and a half to five times that required through the conduits. Therefore in case of a conduit failure, unless there is some stored water in the reservoirs below, the plants may have to drop part of their load until the water diverted through the river channel shall reach them. This trouble is one of the reasons which are necessitating the development of storage lakes even at the lower elevations of the river.



TRAVEL OF WATER IS MUCH SLOWER BY NATURAL CHANNEL THAN BY TUNNEL

E. J. CRAWFORD,
Assistant Superintendent.
San Joaquin Light & Power Corporation,
Fresno, Cal.

Maintenance of Demand Meters

A SCHEDULE of tests and inspections for the printometer demand meters of the Yonkers (N. Y.) Electric Light & Power Company includes (1) an acceptance test, (2) an installation test, (3) periodic inspections, (4) periodic service tests, and (5) a laboratory test after removal. The acceptance test made in the laboratory constitutes a very thorough inspection of the meter and the clock and a three-hour preliminary run for making adjustments, followed by a two weeks' run at a fair average load.

After installation a three-hour test is run, with the customer's load on the meter if possible. The results are compared with the watt-hour meter readings, and a complete analysis is made of the printed record with respect to its accuracy during particular intervals and during the whole time of the test. Coincidently, a three-hour accuracy test of the clock is made. To catch any trouble that may develop while the meter is on the customer's premises, it is inspected twice a week when the tape is removed. A careful and full report of each inspection is handed in to the office by the inspector. Furthermore, a periodic service test is made on the demand meter in the same manner as tests are made on the watt-hour meter used in conjunction with it.

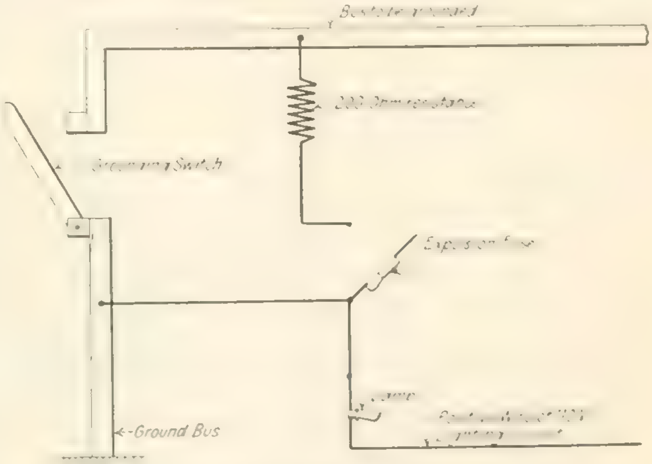
After removal of the meter from service, in order that any inaccuracies which it may have developed may be corrected before it is placed in stock, a laboratory test is made of the same character as the acceptance test.

E. E. HILL,
Yonkers, N. Y. Assistant Superintendent
Meter Department.

Permanent Station Buses for Grounding and Testing

TO ELIMINATE the unsafe practice of trailing cables through a station and of making temporary ground or test connections, the Philadelphia Electric Company makes use of permanently installed buses. These buses, which run the length of the feeder terminal compartment, may be used for grounding the feeders or for connecting them with the test set in the station. Each conductor of the feeders entering the station terminates at the middle point of a double-throw switch, the upper position connecting the feeder to its station conductor and the lower to this test bus.

In order that a live bus or feeder may not be connected to a ground bus, the following test is employed: A double-throw knife switch carrying a small-capacity expulsion fuse in its blade is mounted as shown in the accompanying diagram, with the middle point of the switch connected to the ground bus. The fuse is first tested by throwing down the switch to a clip which places it in series with a test lamp across the lighting circuit. The burning of this lamp indicates fuse integrity. Then to determine if the bus is alive the blade is swung up to the clip connected with the bus. A resistance of about 200 ohms is inserted between this clip and the bus to limit the current to a value that can be safely ruptured by the fuse. If the fuse blows, the bus is alive, and if not, the bus may be safely grounded.



BLOWING FUSE INDICATES LINE IS ALIVE

WALTER C. WAGNER,
Philadelphia, Pa. Assistant Chief Engineer.

Supplying Light and Power in an Emergency

On account of the rapid growth of the load at an amusement park it became necessary for the electric service company to feed both the lighting and power load from the same bank of transformers, this being done as follows: Transformers with 220-volt secondaries were joined in delta and three-phase motors connected therewith in the ordinary manner. The lighting load was served from each phase of the delta connection, it being balanced thereon as accurately as possible. In order to use 110-volt lamps it was necessary to tap each leg at its center and thus make a three-wire, 110-220 volt system. While the neutrals of three-wire, 220-volt lighting circuits should be grounded it is impossible to ground all of them with the delta transformer connection because a difference of potential exists between mid-phase points. However, one neutral is grounded, this arrangement giving more protection than no grounding at all. The power load is measured by three-phase meters, while each of the three lighting circuits contained single-phase meters connected as shown. The meters and transformers are installed at a pole-type out-door substation, the transformers being mounted on a platform and the meters below in a sheet-metal cabinet.

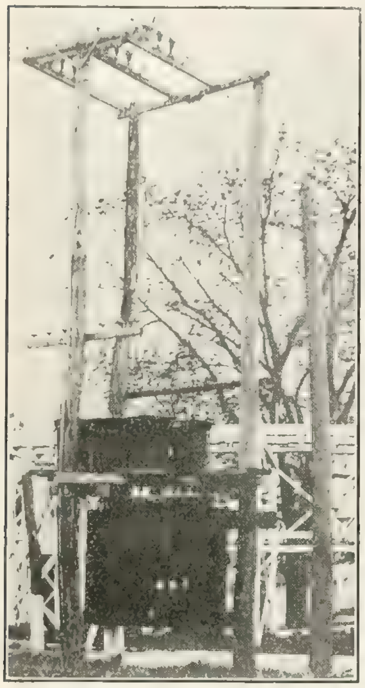


FIG. 1—TRANSFORMERS AND STEEL SERVICE BOX MOUNTED ON THREE POLES

Of course this method of supplying lighting and power load may not be the best that could be obtained, but it served its purpose and obviated the complete revamping of circuits which otherwise would have been necessary.

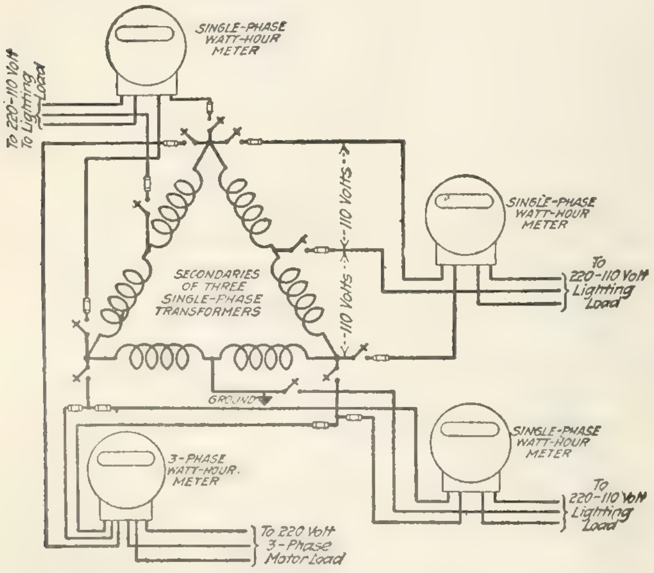

SINGLE-PHASE WATT-HOUR METER
To 220-110 Volt To Lighting Load
110 Volts
110 Volts
SINGLE-PHASE WATT-HOUR METER
To 220-110 Volt Lighting Load
SECONDARIES OF THREE SINGLE-PHASE TRANSFORMERS
GROUND
SINGLE-PHASE WATT-HOUR METER
3-PHASE WATT-HOUR METER
To 220-110 Volt Lighting Load
To 220 Volt 3-Phase Motor Load

FIG. 2—SCHEMATIC DIAGRAM SHOWING METHOD OF SERVING SMALL POWER AND LARGE LIGHTING LOAD

Pulverized Coal Halves Cost of Banking Boilers

Strictly speaking, there is no such thing as a banked boiler when it is fired with pulverized coal. However, the same effect can be obtained very simply and with a coal consumption of about one-half that required with underfeed stokers. To cut out a boiler using pulverized fuel it is only necessary to shut off the coal feed and close all the dampers and auxiliary air inlets to the furnace. By doing this the Milwaukee Electric Railway & Light Company has found by test that a boiler can be held up to pressure for about ten hours by the radiant heat stored in the furnace and boiler setting. The loss which occurs can be compared to the banking loss in a stoker-fired boiler. It is the heat which is radiated from the boiler and setting and is equivalent in amount to that required to reheat the boiler and setting to the temperature attained when steaming.

In a plant where the ratio of boiler hours to boiler steaming hours averages 43 per cent or greater, which corresponds to an average daily plant load factor of 67 per cent, the saving resulting from the use of pulverized fuel is worth considering. Assuming 0.2 lb. (90 gr.) of coal consumed per banked boiler-horsepower-hour, in a plant equipped with underfeed stokers, this loss amounts to about 1.5 per cent. In a pulverized coal-burning plant this loss should easily be reduced to one-half of this amount, resulting in a net saving of 0.7 per cent on this one item alone.

Paul W. Thompson,
Technical Engineer of Power Plant.
Detroit Edison Company,
Detroit, Mich.

Factors Essential to Good Line Construction

A safe job of line construction or repairing can nearly always be depended upon to render continuous and satisfactory service. Solid foundations are essential to good line construction, and this means that holes must never be skimped and that poles must be properly aligned and tamped, tamped, tamped. The old rule "Three good tampers and one shoveler" should still be followed if the best results are desired. An insufficient number of guy wires will soon cause a line to become unsightly and dangerous. This results in criticism from the public and frequent attention from the repair men. The objection of property owners sometimes makes it difficult to place guys, but neat work and the aid of city officials can overcome such obstacles.

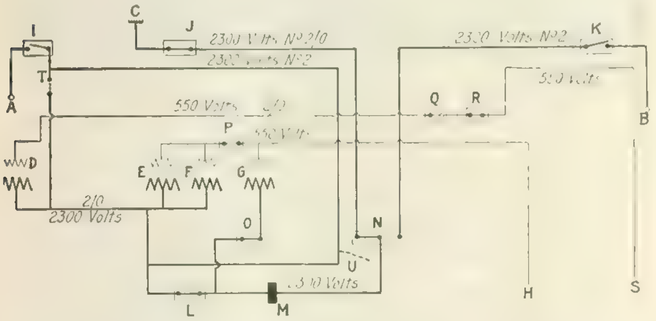
Wires which are left in contact with trees and boughs will have to come down sooner or later, so all trees should be carefully trimmed. Flexible brackets, tree molding and other devices should be used to safeguard wires through trees only when it is impossible to trim. Such devices are better than nothing, but they are not to be compared with a good clearance. These are the recommendations made by G. J. Oglebay of the Interstate Public Service Company, Bedford, Ind.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

Flexible Distribution System Proves Economical

IN A FLEXIBLE distribution system of the Simplex Wire & Cable and Simplex Electric Heating companies energy may be received from any one of the three 2,300-volt service lines shown in the accompanying single-line diagram. The factories of these companies, extending over several blocks, are furnished with energy at 2,300 volts by the Cambridge (Mass.) Electric Light Company through one overhead line *C* and two underground lines *A* and *B*. Normally but one primary main is utilized, feeding from *C* through the oil-switch *J* and thence to the principal substation, where switch *N* is installed. *B* and *C* form sources of alternative feeding, *N* being a double-throw switch at which an emergency connection *U* may be made by jumper in case it is desired to feed from *A*.



SYSTEM THAT MAY BE FED FROM ANY ONE OF THREE SOURCES

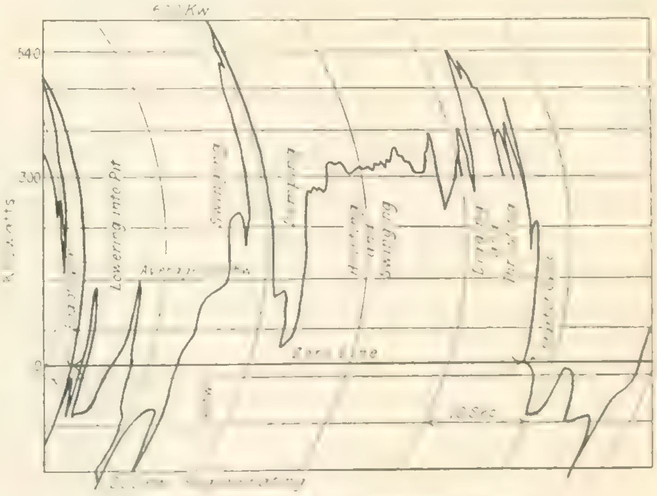
Key to single line diagram: *A*—2,300-volt service from manhole. *B*—2,300-volt service from manhole. *C*—2,300-volt service from overhead line. *D, E, F*—Three banks of three 100-kva. transformers. *G*—Bank of three 10-kva. transformers. *HS*—550-volt shop feeder lines. *I, J, K, L, N, O, P, Q, R*—Oil switches. *M*—Metering equipment. *T, U*—Jumper connections.

Four banks of transformers are provided, banks *D*, *E* and *F* being rated at 300 kva. each and bank *G* at 30 kva. Local distribution within the plants is at 550 volts, three-phase. The local lighting service is obtained through 550/110-volt transformers. Transformer bank *G* is used chiefly in supplying energy outside regular working hours, thus saving the increased core losses of the larger transformers. This bank is controlled by oil switch *O*, banks *D*, *E* and *F* being controlled by oil switch *L*. Whenever these larger banks are cut out of service by the primary oil switch *L*, it is the practice to open also switch *P*. Transformer bank *D* is located at a distribution center about 625 ft. (187 m.) from banks *E*, *F* and *G*, and under normal conditions the 2,300-volt feeder from switch *I* to switch *N* is used in parallel with the 2,300-volt connection from switch *L* to bank *D*. This requires opening switch *I* in order not to short-circuit the metering installation *M*. Should it be desired to feed from *A*, the 2,300-volt connection to bank *D* is opened at *T*, the jumped connection is made at *U* to *N* and the line beyond *U* opened. In the 550-volt feeding system the various oil switches enable the northerly and southerly factory groups to be sectionalized and isolated as desired.

This installation virtually provides a through set of 2,300-volt and 550-volt buses, with a centrally located metering installation and sectionalizing switches and alternative feeds affording extremely reliable service. The value of three sources of supply has been demonstrated by experience, the third source in one instance enabling the plants to be maintained in full operation where cable and line trouble on the other feeders would have cut off service for twenty-four hours. The location of the transformer banks away from the ends of the system reduced the size of copper required and also cut down the energy losses, as compared with terminal feeding.

Large Electric Shovel Saves Time of Two Men

COMPARED with a steam shovel, the large electric shovel the load curve of which is shown here eliminates the services of two men—the fireman and the coal passer. It is estimated besides that 3 lb. to 5 lb. (1.3 kg. to 2.3 kg.) of coal is required by the steam shovel for 0.7 kw.-hr. to 0.8 kw.-hr. needed for the electric shovel. The greater results possible with the electric shovel, however, are mainly due to the few shutdowns for repairs. The electric machine is also more desirable where the feed water is bad and when cold weather causes frozen pipe lines and boilers. No time is wasted in raising steam when starting. This amount of energy mentioned before, 0.8 kw.-hr., was required in the electric shovel in question per yard of material raised to



OPERATING CYCLE OF ELECTRIC SHOVEL

Shovel has 90-ft. boom, 5-yd. dipper, and is loading car 65-ft. above bottom of pit.

cars 65 ft. (20 m.) above the bottom of the pit. The total input to this shovel, which has a 90-ft. (28-m.) boom and a 5-cu.yd. (3.8-cu.m.) dipper, is shown here. Beginning at the right of the curve, where positive readings start, the dipper starts digging at the bottom of the pit. As a rule when the dipper starts digging the thrust motor is also on the line and the input is irregular on account of variations in hardness of the bank. When the dipper is full the swing motor is thrown on while hoisting and thrusting continue. After dumping, the dipper is raised to clear the car. This action and accelerating the swing motors cause the short high peak of about 600 kw., which, incidentally, does not occur in stripping work. After this peak, swinging requires small input, then the dipper is lowered and regenerates power, causing the negative readings. This completes the cycle, which averages fifty seconds.

In stripping, the time runs as low as thirty seconds per cycle, and the input with smaller shovels is from 0.1 kw.-hr. to 0.3 kw.-hr. per yard, depending on the hardness of the material. Dippers with a capacity of 8 yards (6 cu.m.) are made, and since the tests shown here this shovel has been operating one of that size.

In the shovel described here two heavy-duty wound-rotor induction motors of 200 hp. are used for the hoist, because the flywheel effect is less than that of one large motor and because this class of motor is not made in sufficiently large sizes. The swing motor and the thrust motor are each of about 125 hp. capacity.

Milwaukee, Wis. P. S. Stevens.

Commutator Troubles, Their Cause and Remedies

Poor commutation, as evidenced by glowing and pitted brushes, sparking and darkened commutator, is frequently caused by wrong brush position and a wrong type of brush. In the accompanying table the visible effects of a number of commutator troubles are shown together with the causes of the trouble and the remedies. One of the most puzzling causes of sparking, as mentioned in the table, is electrical unbalance of a machine which has no equalizer rings. This unbalance occurs if the armature is not exactly centered in the field, or it may be caused by blow holes in the frame or by shorted field coils. The effect is to cause local current to flow through the bus rings between brushes.

There are two ways to test for this trouble—*i.e.*, by separately exciting and by self-exciting the machine. For both the bus rings are removed and the machine is driven as a generator. In the first method, in which the field is separately excited, the voltage between all adjacent studs is measured. If it shows high on one side of the armature the machine is unbalanced.

In the second method the machine is run with only two adjacent brushes down. The voltage is measured between these brushes, and this procedure is carried entirely around the commutator. In passing from one pair of brushes to the next at least two sets of brushes of opposite polarity must be down at all times to avoid opening the field circuit when raising a brush, as this would burn the commutator and brush. For making this test the switchboard voltmeter may be used. As in the former test, a high reading on one side of the machine denotes unbalance. The remedy for this unbalance is to shift the fields until the armature runs in the magnetic center of the motor.

Another cause of trouble which appears as ring firing and even unsolders tails and burns out coils is short-circuited commutator bars. This trouble may be caused by carbonizing of oil which has soaked into the mica. To remedy this the mica should be dug out and a filler put in its place. A good filler may be made from two parts of powdered mica and one part of plaster of paris mixed with shellac to form a thick paste which is worked into the hole and baked with torch. Other fillers are made of litharge mixed with glycerine, with water glass or with dental cement. A large hole may be filled with a block of mica set in with shellac. James Dixon.

Cleveland, Ohio.

COMMUTATOR TROUBLES, CAUSES AND REMEDIES

	Trouble	Cause	Remedy
Brushes	Pitting, general	Contact resistance too low	Higher contact-resistance brush
	Pitting, certain brushes	Not lined with commutator bars	Line with bars
		Cover too many bars	Use thinner brush
	Glowing	Same as pitting	
	Sparking	Wrong position or spacing	Correct position
		Electrical unbalance	(See details above)
	Sparking, under load	High armature reactance	Install interpoles
	Sparking, at certain brushes	Corresponding interpole too weak	Insert shims on interpole
		Corresponding interpole too strong	Remove shims; attach shunt to interpole
		Brush arm off neutral	Shift arm
		Short circuit in interpole	Remove short
Commutator	Gray	Protruding mica	Put in gritty brush of same electrical properties; undercut mica
		Vibration; shaft throw	More lively holder
		Eccentric commutator	More lively holder; turn commutator true
		Dirty	Clean
	Black spots	Vibration; shaft throw	More lively holder
		Eccentric commutator	More lively holder; turn commutator
		Poor joints between commutator and coils	Resolder bad joint
	Ring fire	Protruding mica	Put in gritty brush of same electrical properties; undercut mica
		Carbonized mica which has absorbed oil	Dig out mica and fill (formula for filler above)
	High mica	Brush may be soft	Put in gritty brush of same electrical properties; undercut mica
	Flat spots	Overload has been on machine; loose bars	Tighten commutator while hot and turn true
	Hot commutator	Excessive brush pressure	Loosen brushes
		Insufficient lubrication	Insert one graphite brush per arm, staggered; apply parafine (temporary)
		Brushes off neutral	Shift brushes
		Brush density too high	Use larger brush
	Unsoldered tails	Bars short-circuited	Remove short circuit
Brush holders	Hot	Bad contact with brush	Clean; use pigtail brushes
Coils	Burned out	Bars short-circuited	Remove short

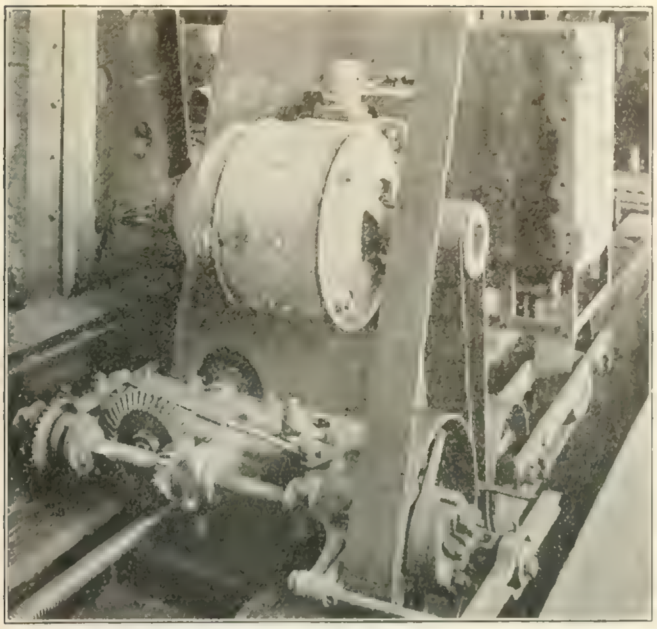


FIG. 1—MOTOR MOVES WITH TOOL CARRIAGE OF MILLING MACHINE

Automatic control switches are mounted in box to right of motor

Motors and Control Mounted on Large Milling Machine

A DIFFICULT problem in mounting a motor and control equipment on a Sellers milling machine used for milling large pieces was accomplished in the manner shown in the halftones in the shops of the Chapman Valve Manufacturing Company, Indian Orchard, Mass. The 10-hp. motor (Fig. 1) is mounted on the machine and travels with the tool-carriage frame, propelling it as well as driving the cutting equipment and feed mechanism. In this case the frame of the tool was large enough to provide an excellent base for the motor bolting, and there was space on the side of the frame to carry a light metal structure supporting a cabinet which contains a Cutler-Hammer automatic-control installation. This light structure is made up of 1½-in. x 1½-in. x 3/16-in. (38-mm. x 38-mm. x 5-mm.) angles bolted to the tool frame by ⅜-in. (1-cm.) bolts. By using a single pulley and a long belt one motor suffices for all the machine service, idler pulleys being freely used to make the necessary changes in direction.

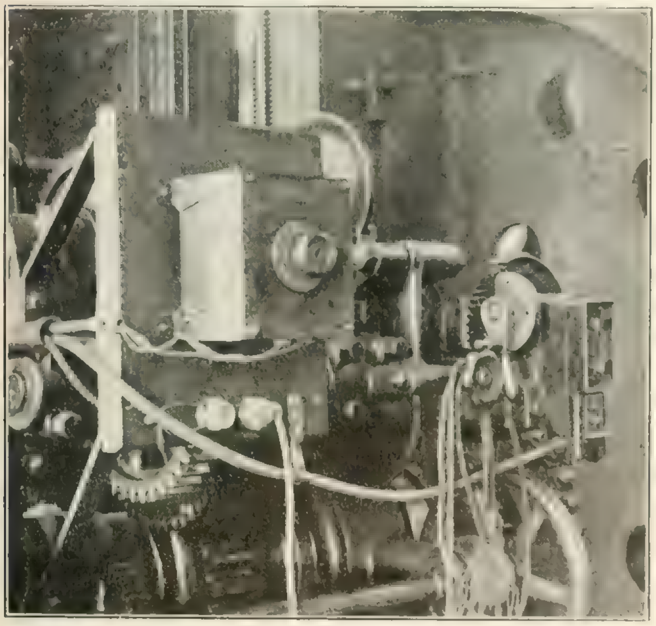


FIG. 2—RHEOSTAT AND PUSH-BUTTONS CONVENIENT TO OPERATOR

The mounting of the push-button control box and of a speed-controlling rheostat (Fig. 2) presented much difficulty on account of the absence of adequate plane surfaces on the machine frame within easy access of the operator. It was finally determined to mount the rheostat on a 16-in. x 18-in. x ¼-in. (40-cm. x 45-cm. x 3-cm.) wooden base supported by 1½-in. x ⅝-in. (3.8-cm. x 1-cm.) iron straps attached to the bearing housing. The button box was attached to the bearing frame by a short, thin plate of steel. The leads connected with the rheostat and the leads to the push-buttons were of armored flexible conductor which was clipped to the edge of the baseboard.

W. B. ATCHINSON,
Electrical Engineer,
Chapman Valve Manufacturing Company.
Indian Orchard, Mass.

Changing a 220-Volt Direct-Current Motor for Operation on 110 Volts

A 220-VOLT, 10-hp., 1,200-r.p.m., four-pole, shunt-wound motor was recently received at a New York repair shop with a request to make the necessary changes to operate it on 110 volts at the same power. For operation on 110 volts instead of 220 volts without changing the horsepower or speed, the number of turns in series on both armature and fields had to be halved while the wire cross-section was doubled. As the field coils were in good condition, they were changed from a series to a parallel connection for operation at 110 volts. The armature, however, was badly roasted and therefore had to be rewound. The armature had 37 slots and 111 commutator bars. The coil pitch was 1 and 10 and the throw of the leads 1 to 57, making a single series, two-circuit, progressive winding of three coils per cell and six coils per slot. The coils were wound with two No. 16 double-cotton-covered wires in parallel, the first coil having three turns, the second coil four turns and the third coil three turns. In other words, one coil in every three had four turns while the rest had three turns, the coils being arranged in this order: 3-4-3-3-4-3.

It was possible to rewind the armature as it had been wound before and to connect the coils in a single-parallel, four-circuit winding for 110-volt operation; but to simplify the work of making the coils and connecting them on the armature it was decided to use a single-series two-circuit winding with only half the number of turns of No. 13 wire, which has twice the cross-section of the No. 16 used before. In the original winding there were $3 + 4 + 3$ turns per half a slot, or ten turns. For the 110-volt winding, therefore, the turns should be five per half a slot, which were divided in the order of 2 — 1 — 2 turns in consecutive coils. Therefore thirty-seven coils were wound of two No. 13 double-cotton-covered wire in parallel, twenty-four of these coils having two turns and thirteen having one turn.

In order to facilitate assembling, red, white and blue sleeving was placed on the ends of coils while winding.

Bronx, N. Y. C. A. JOHNSON.

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

Benefits from Bonus Plan for Store Salesmen

AFTER experimenting with a straight 5 per cent commission as an inducement to employees to obtain information leading to sales of electric appliances and finding it only partially satisfactory, the Portland (Ore.) Railway, Light & Power Company has adopted the plan of giving a bonus to its electrical store salesmen.

The company has found that the interest of the store salesmen cannot be maintained consistently without stimulus. On the straight salary basis attention to customers tended to become perfunctory. The plan now adopted is to divide 5 per cent of the gross profits between the store salesmen, payable at the end of the fiscal year in accordance with the amount of sales made by each. Under this system one man has earned as much as $484 and no salesman in the store has received less than about $200. If an employee leaves during the year, his bonus for that period is divided among the others.

This plant stimulated sales to such an extent that $2,000 has been available for distribution among the store salesmen at one time. Furthermore, it has been observed since the adoption of the plan that customers receive more prompt and satisfactory attention and that the salesmen are encouraged to follow up "prospects." This is believed to be due not merely to an increase of effort but also to the fact that effort is far more intelligently directed when a personal gain depends upon the success of each sale.

Features of Agreement to Build Rural Lines

FOR the sum of $600 per mile (1.6 km.)—50 per cent upon execution of the contract and 50 per cent when the line is completed and energized—the Peterson (Iowa) Power & Milling Company will build single-phase, 6,600-volt rural lines for farmers. Twenty-eight 6-in. x 30-ft. (15-cm. x 9-m.) good cedar brush-treated poles per mile will be erected, with standard Washington fir cross-arms, No. 6 medium-hard-drawn copper wire, and galvanized hardware. Each mile of line will be built independently. Standard copper wire will be used over all highways and railroad crossings.

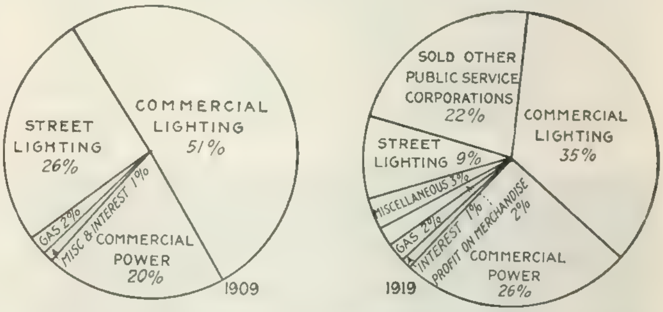
The customers agree to trim all trees when necessary to allow for the construction and operation of the line and to make all negotiations and settlements with the telephone companies affected by the building of the line. The line becomes the property of the customer when it has been built and paid for according to this agreement.

The agreement becomes operative when the signatures of an average of two customers per mile have been obtained. In case additional customers want connections not provided for in the contract, the company may sell the additional connection privileges for not less than the amount paid by the original subscribers. The money received by the company for this purpose must then be distributed equally among the original parties to the contract. All customers agree to pay individually for the transformer and for all equipment leading from the copartnership transmission line to their premises.

Each customer signs a separate service contract agreeing to purchase service for twenty years at a minimum charge of $50 per year for service from a 3-kva. transformer, and $60 per year if a 5-kva. transformer is installed. The customer is allowed 425 kw.-hr. for the $50 and 500 kw.-hr. for the minimum charge of $60. Any excess consumption has to be paid for at the rate of 8 cents per kilowatt-hour. The minimum charge is paid quarterly in advance.

Sources of Central-Station Income

THE accompanying charts, which have been prepared by the Narragansett Electric Lighting Company, Providence, R. I., show in an interesting way what proportion of total income each class of customers contributes. One chart shows how the company's income was divided in 1909 and what changes had taken place during the ten years to 1919. When the company began operation its total income was received from commercial lighting. In 1884 a contract for street lighting was obtained and the sources of income were thus increased. Power installations were added from time to time, but even as late as 1909 street and commercial lighting furnished 77 per cent of the company's revenue. A study of the chart shows that in 1909 street lighting furnished 26 per cent of the total, while in 1919, although the amount received for this service had not decreased, receipts from other sources had increased to such an extent that the income from this class of business amounted to only 9 per cent of the company's total revenue. In 1909 practically all energy generated was transmitted and sold directly to the consumer. Since that time, however, the company has been selling energy to other public service corporations, so that now 22 per cent of its total revenue is from that source.



DIVISIONS OF INCOME OF NARRAGANSETT ELECTRIC LIGHTING COMPANY FOR 1909 AND 1919

Central Stations Need Quality Customers

THAT the promised saturation of rural lines has not materialized and that there is an increasing demand for extensions was the assertion of P. H. Palmer of Kokomo, Ind., in an opening address before the Fort Wayne meeting of the Commercial Section of the Indiana Electric Light Association. "Central stations," Mr. Palmer went on, "cannot arbitrarily refuse to extend their lines as they did during the war, even though wartime financial conditions still prevail. Central-station commercial men have become accustomed to having their activities limited, and they have learned to analyze the characteristics of customers' load and pick out those which are most desirable for the central station. The loading up of existing lines is one of the principal functions of the sales department today. However, the salesman must consider power factor, load factor and the time of maximum demand, none of which were given much thought in pre-war times."

Combating Water Shortage and Cost of Oil in Southern California

CHARLES H. PEIRSON, in the March issue of *Edison Current Topics*, the house organ of the Southern California Edison Company, Los Angeles, makes the following statement concerning the threatened power supply and the ways proposed for meeting it:

"Southern California is confronted with a shortage of precipitation that is unparalleled in the past twenty-five years. It follows directly upon three years of embargo upon hydro-electric developments as a result of war conditions and has resulted in a stringency of power supply which can be met only by a scientific shifting of the agricultural load. Officials of the company are endeavoring so to distribute the hydro-electric energy during the peak months of agricultural demand—July, August and September—that crops will not suffer from want of irrigation, manufacturing will not be interfered with, nor light or domestic service curtailed. The demands of the war have increased production enormously, in some instances as high as 40 per cent, which is very largely reflected in irrigation requirements.

"General Agent S. M. Kennedy has had several meetings with the district agents and has impressed upon them their responsibility in protecting the production of the foodstuffs of the land and keeping the wheels of industry in motion during the coming summer. That the conservation of electric power is the big question of the moment in southern California there can be no doubt, and Mr. Kennedy and his associates have worked out a tentative plan by which it is hoped that a great saving in electrical energy can be effected through night irrigation, which has the advantage of lessening water losses through evaporation, and through alternating the operation of plants working fifteen days or less every month and limiting the operation of plants working more than fifteen days a month to off-peak hours, from 10 p.m. till 8 a.m., on week days. No embargo will be placed on Sunday irrigation. The whole idea is a new one, but it is in line with the conservation of energy and the lowering of high costs, and it is believed that the agriculturists and manufacturers will co-operate.

"The shortage of water for hydro-electric plants is going to cost the Southern California Edison Company approximately $2,000,000 above the normal cost of generating by steam 200,000,000 kw.-hr. of electrical energy necessary to meet the extraordinary condition for an emergency shortage. The company has made application to the Railroad Commission for an emergency rate increase based upon facts that are briefly as follows:

"There have been three years of subnormal precipitation coincident with the years of war embargo on material which was necessary for constructing power plants; there were strikes in the steel industry in the East and in San Francisco, delaying the delivery of material required for work that is under way, and the Southern California Edison Company during the coming summer season must face the proposition of increasing generation by the use of steam plants that it owns or can secure, notwithstanding greatly advanced prices for oil, which will have to be bought in the open market. During previous water shortages the company has been able to generate its auxiliary steam load by using its modern and efficient steam turbines, which generate electricity at the smallest expenditure for oil. This year it will have to use additional plants of types which are older and less efficient and which will use more oil in proportion to the amount of energy generated.

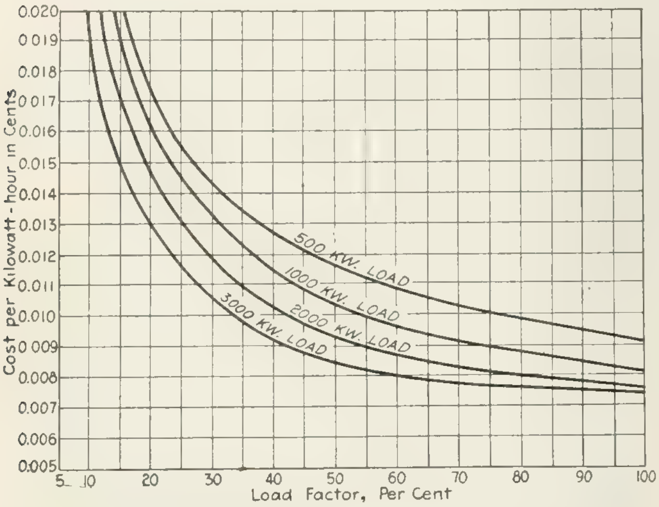
"Without some measure of relief from the Railroad Commission, the company would probably have to reduce the supply of energy for irrigating purposes by one-half, and thus restrict the production from more than 200,000 acres of cultivated land. The productiveness of each acre is estimated by experts to average $100. Thus it would appear that a power shortage would mean a loss to the agricultural community under the Edison lines of $20,000,000 during the ensuing year."

The Electric Furnace and Central-Station Rates

THE need of closer co-operation between the electric furnace user and the central station was emphasized in several papers presented at the Boston joint meeting of the American Electrochemical Society and the American Institute of Electrical Engineers. H. L. Hess, Hess Steel Corporation, Baltimore, Md., pointed out that basic differences of opinion in the steel mill and central station cause differences of ideas concerning billing for power. He maintained that it is unusual, if not impossible in most cases, for the steel-melting plant to use the allowances of the power company and obtain the minimum kilowatt-hour charge, although it was admitted that the method of billing by a service or demand charge and an energy charge is entirely fair. In dull times it is especially difficult to produce steel cheaply, in comparison with flush times, on account of the demand charges being maintained through both dull and busy periods. In one case this situation has been relieved by the establishment of a new demand for each interval of six months. This permits increase of equipment on both sides and does not impose a long term of undue hardship on either party, be times good or bad.

W. G. Berlin, electric furnace operator for the Taylor-Wharton Iron & Steel Company, High Bridge, N. J., pointed out that the smaller power companies cannot, and the less progressive will not, equip themselves to handle the new furnace loads without charging excessive rates; for they must take account of the impossibility of selling their capacity to some other industry in case the furnace is abandoned. Furnace loads with fluctuating characteristics should necessarily be connected to a central station turning out large blocks of energy, otherwise the heavy surges caused by poor contact and intermittent arcs would produce poor voltage regulation on the central-station system.

From the consumer's standpoint rate schedules appear unduly complex. It is unnecessary for the furnace operator to be confused, however, for if he will state his operating conditions, the power engineer will figure the rate and explain it very quickly. The most essential factor to the furnace operator is the cost of power per ton of steel produced. The following wholesale power rate may be taken as a fair example of the average make-up of rates submitted to a large power user:



CURVES SHOWING HOW POWER RATES VARY UNDER DIFFERENT LOAD FACTORS AND SIZES OF INSTALLATION

Rate Per Month:

(1) Demand charge:

For the first 200 kw., $1.50 per kw.
For the next 800 kw., $1.00 per kw.
For excess over 1,000 kw., 75 cents per kw.

Plus:

(2) Energy charge:

1.5 cents per kw.-hr. for the first 10,000 kw.-hr. used per month.
1.0 cent per kw.-hr. for the next 90,000.
0.8 cent per kw.-hr. for the next 200,000.
0.6 cent per kw.-hr. for excess over 300,000.

Maximum demand determined, at option of company, from the customer's connected load (total of name-plate ratings) or by suitable instruments—same to be calculated by averaging the daily recorded maximum thirty-minute peaks of the month. The succeeding eleven months' billing to be based on these calculations, unless the connected load is increased.

Minimum charge for any month, whether energy is used or not, to be no less than the demand charge.

Deduction of 5 per cent on the demand charge when the customer takes and measures current at power company's primary voltage.

Successive deduction of 5 per cent on the total bill for payment within ten days from date of bill.

No discounts for use of off-peak power considered.

No deductions for maintenance of good power factor considered.

The accompanying curves show the average rates that would apply under various conditions of furnace operation on the above rate schedule. For example, a 3-ton furnace operating on a demand of 1,000 kw. and a load factor of 20 per cent (which would be the operating conditions running single shift and turning out three heats a day) would earn a rate of 1.6 cents per kilowatt-hour. The same furnace operating on a twenty-four-hour schedule, or a load factor of say 45 per cent, would earn a rate of 1.1 cents per kilowatt-hour. Where the power consumption per ton of steel would be 700 kilowatt-hour the saving in power alone would amount to $3.85 per ton of metal. Under the same conditions, a furnace with a demand of 3,000 kw. and operating on a load factor of 20 per cent would earn a rate of 1.35 cents per kilowatt-hour, and if operating with a 45 per cent load factor, the rate would be 0.9 cent per kilowatt-hour. This shows that the larger furnace using the larger block of energy, even with the higher demand, will earn a rate which if considered alone would favor the larger furnace installation; also that the smaller furnace operating a larger number of hours will earn a rate far better than a larger furnace operated only a few hours. For example, a 3-ton furnace operating at 1,000 kw. demand and having a 45 per cent load factor would earn a rate of 1.1 cents per kilowatt-hour, while a larger furnace with a demand of 2,000 kw. and on a 20 per cent load factor would only earn a rate of 1.47 cents per kilowatt-hour. The advantage, of course, is with the smaller furnace operating at full capacity rather than with the large furnace at half capacity.

Parallel operation of two or more electric furnaces taking power from a single power station is economical where there is an ample and reliable power supply, provided that they are run to capacity, and bearing in mind that the rate per kilowatt-hour depends on the load factor more than on the demand.

Porch Lighting to Prevent Robberies in City of Denver

IN DENVER, Col., the civic and legislative bureau of the Civic and Commercial Association has proposed a plan, it is stated in the April number of *Doherty News*, to have every resident of the city keep a light on his porch burning at night. This plan, according to the committee, would considerably brighten the aspect of the residential section and in a large measure do away with hold-ups and other crimes on dark streets.

The Denver Gas & Electric Light Company has agreed to supply the power for one 20-cp. light to be used on the porch from dusk to midnight for 30 cents per month, and if residents wish to burn the light all night, the cost will be 50 cents per month.

Avoiding Overcharge Complaints by Educating the Public

ON THE theory that overcharge complaints are more easily avoided than satisfied, the Santa Cruz (Cal.) office of the Coast Counties Gas & Electric Company has for some time been conducting special classes in meter reading. The work is under the direction of M. L. Smith of that office and consists of a brief explanation of the meter dial and the method of figuring bills, as well as other simple electrical information of value to the housewife. Much interest has been shown in these classes, which are held Saturday afternoons between 2 and 5 o'clock, the attendance for the first few weeks averaging seventy-five. The value to the company is indicated by the fact that overcharge complaints have virtually ceased. Ninety per cent of this result is credited to the better understanding which the customers have gained from the weekly lessons.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

A Unique Design of Waterwheel-Driven Alternator. —A. E. GLASS.—The waterwheel-driven alternator described in this article is one of three which are being built to operate in a power house hewed out of the solid rock of a mountain in Norway. The conditions which prevail in this most unusual installation have necessitated the adoption of a unique design for the generating units. These features of design are clearly explained and illustrated by the author.—*General Electric Review,* February, 1920.

Finding the Polarity of Transformer Coils.—PAUL GIRAULT.—The polarity of transformer coils may conveniently be determined by means of direct-current ballistic methods. For this purpose a certain coil on the transformer is excited by direct current, and the deflection on a direct-current voltmeter connected across any other coil or combination of coils is observed when closing the circuit. The author has in an earlier communication given certain theorems by the aid of which this method may be extended to polyphase transformers (*Rev. Gén. d'El.,* Jan. 20 and Dec. 29, 1917). In the present article the whole method receives a thorough mathematical analysis and also the theorems are generalized.—*Revue Générale d'Electricité,* Feb. 21, 1920.

Generation, Transmission and Distribution

Communication Between Power Stations.—A. LAUCAGNE.—A side issue in power distribution which deserves the most careful consideration is the problem of obtaining and maintaining a reliable intercommunication service, by telephone or telegraph, between the different power stations in an interconnected system and between the generating station and its various substations. The obvious course is to install telephones connecting to the commercial telephone systems. This, however, has the grave disadvantage of sometimes causing serious delay in case of trouble on the power lines, when immediate connections are imperative. It remains for the power company to install its own telephone system, with its lines for convenience and reasons of economy carried on the transmission-line poles. By careful transposition and by use of drainage coils, etc., the interference can be brought to a minimum, but in case of break on a power conductor the telephone usually gets out of order at the very moment when it is most urgently needed. In such a case temporary telephone service may be maintained over one of the remaining power conductors of the disconnected power line. However, a more satisfactory solution seems to be the use of radio-telephone sets similar to those developed during the war for field service. These and other points are brought out by the author, who concludes that in every system there ought to be a private intercommunicating telephone system for the load dispatcher's use and in addition thereto a system of radio-telephone stations for use in emergencies and also for communicating with repair gangs working on the lines.—*Revue Générale d'Electricité,* Jan. 31, 1920.

Improvements in Electric Coal-Handling Machinery. SYKORA.—The article describes some interesting details of design of modern Austrian coal-handling machinery such as is used in coaling steam locomotives. Three systems with different drives are discussed—three-phase induction motors, alternating-current single-phase motors of the Déri repulsion type with speed adjustment by means of movable brushes, and finally direct-current drive. Special attention is given the Brown-Boveri motor brake. This brake is operated by a heavy cast-iron weight, suspended by inclosed springs with strong oil damping, an arrangement which eliminates absolutely all shocks and jars in setting the brake. The brake weight is lifted by a small auxiliary electric motor, which is run only while lifting the brake and thus consumes very little power.—*Elektrotechnik und Maschinenbau,* Feb. 29, 1920.

Installations, Systems and Appliances

Electric Starting Systems for Automobiles.—F. C. BARTON.—The design, characteristics and operation of the single-unit, two-unit and combination-unit types of starting and lighting of automobile equipment are discussed in great detail. Description and examples are also given of the methods employed in selecting the size of units for assumed requirements. The author relates what has been done by the Society of Automotive Engineers in standardizing the mountings of starting motors and lighting generators.—*General Electric Review,* March, 1920.

Contactors for Tapping Transmission Lines.—ACH. DELAMARRE.—With electric motors in ever-increasing sizes being used in agricultural field work, it becomes increasingly difficult to supply these motors at such a low voltage that an accidental touching of the conductors will not be dangerous. Portable transformer stations therefore are used where the secondary side is in one way or another tapped off a medium-voltage transmission line. In a system due to the Siemens & Halske Company the line is at certain intervals provided with tapping points in the form of hooks. The heavily insulated intake cables of the transformer end in rings which may be hung on the hooks. In another system the contactor itself is made in the form of a hook, carried on a long bamboo stick, and may be put across the line conductor at any place. The author criticises these systems and draws attention to their danger when handled by electrically unskilled men. A new type of contactor is suggested which consists of a special plug contact built into a porcelain insulator of suitable voltage rating. One such plug terminates each intake cable, and corresponding receptacles are provided on certain poles at convenient points along the line. *Revue Générale d'Electricité,* March 13, 1920.

Electrophysics and Magnetism

Corona Discharge.—Earle H. Warner and Jakob Kunz.—This bulletin represents a study of direct-current corona extending over a period of several years under the direction of Dr. Jakob Kunz at the University of Illinois. The corona discharge was studied and measured at both positive and negative wires in air at different pressures and in hydrogen at different pressures. The effects of moisture and temperature were also investigated. As a result of this work Dr. Kunz suggests the following equations for corona dicharges:

$$Ki = \frac{Vo}{e}(P_i - P_o)\frac{1}{t} + \text{a constant},$$

where i is the corona current, V_o the volume of the tube, e, the potential difference between the wire and the tube, $P_i - P_o$ the pressure increase, K, a constant and Po the initial pressure.—*Bulletin No. 114, Engineering Experiment Station, University of Illinois.*

Ionization and Resonance Potentials for Electrons in Vapors of Lead and Calcium.—F. L. Mohler, Paul D. Foote and H. F. Stimson.—The resonance and ionization potentials of lead are 1.26 volts and 7.93 volts respectively. The line $\lambda = 10{,}291$ gives the probable theoretical value of the former as 1.198 volts. Calcium has two resonance potentials, 1.90 volts and 2.85 volts, of which the first is more prominent. Ionization was observed at 6.01 volts.—*Scientific Paper No. 368, U. S. Bureau of Standards*, Feb. 26, 1920.

Units, Measurements and Instruments

A Method for Measuring Frequency.—August Zacek.—The test circuit is divided into two branches, one containing a purely ohmic resistance, the other containing an inductance coil. In each branch furthermore is inserted the heater of a thermo-element. The thermocouple ends of these thermo-elements are connected to the two windings of a direct-current differential galvanometer. The resistance branch is varied till the galvanometer shows zero deflection. The frequency may then be easily calculated from the circuit data.—*Physikalische Zeitschrift*, Aug. 1, 1919.

Measurements at High Frequencies.—In connection with military developments in radio engineering some very valuable research in high-frequency precision measurements was carried out in France during the war, mainly through the energies of M. Armagnat. Some of the results of this work have now been compiled by Léon Brillouin. Much attention was given the question of accuracy in radio direction finding. The great importance of exact tuning of the circuits in the Bellini-Tosi radiogoniometer was emphasized by the experimental results, and it was found that very large errors may result from parasitic currents in the apparatus. For the purpose of determining the effective resistance of coil antennas an interesting method was devised, according to which the heating of the coil due to a known high-frequency current was observed by measuring the direct-current resistance of the winding. Another feature is a very accurate nul-method for comparing wave meters. An interrupted current from an aperiodic buzzer circuit was passed through two coupling coils, each coupled to one of the two wave meters to be compared. By means of two other coupling coils and an aperiodic detector-telephone circuit so arranged that there is no direct induction from the buzzer circuit, the wave meter may be adjusted for zero sound in the telephone, which corresponds to an equality in tuning of better than one part in one thousand.—*Bulletin de la Société Française des Electriciens*, August-November, 1919. (Abstracted in *Revue Générale d'Electricité*, Jan. 31, 1920.)

Miscellaneous

Electric Dredging of the Yukon.—Allen E. Ransom.—The writer states that the analysis of a dredging proposition should be made under the following headings: (1) Quantity of gold-bearing gravels in the properties acquired; (2) distribution and value of gold contents; (3) depth and character of gold to be worked; (4) cost of labor, transportation and supplies; (5) length of operating season each year; (6) cost of power operation and maintenance; (7) quantity, nature and cost of removal of overburden soil; (8) proportions of gravel to be treated by hydraulicking hill claims, ground-sluicing bench claims and dredging river-bottom claims; (9) cost of thawing glacial frozen gravel; (10) cost of thawing plant, operation, fuel and maintenance; (11) clear titles; (12) continuous claim-dredging permits to prevent holding back of dredging operations; (13) keystone placer drill-hole tests on all claims ahead of the dredges, hydraulic or sluicing flumes. For two typical dredging operations, one with a capacity of 5,000 cu.yd. (3,820 cu.m.) a day and the other with a capacity of 12,000 cu.yd. to 16,000 cu.yd. (9,180 cu.m. to 12,200 cu.m.), data are given in the table, not including the cost of thawing ground.—*Electric Journal*, March, 1920.

	Yukon No. 5	Canadian No. 3
Running time	3,189 hours	5,745 hours
Power consumed	461,590 kw.-hr.	2,457,200 kw.-hr.
Ground worked	801,667 cu.yd.	2,341,910 cu.yd.
Total operating expense	$34,227	$86,376
Cost per cubic yard	4.28 cents	3.67 cents

Power-Factor Correction.—M. Nott.—A summary of power-factor-correction schemes is given in the following table:

Apparatus	Advantages	Disadvantages
Phase advancers	Small kw. absorbed. Can be used with normal induction motors	Not standard machinery; alternating-current commutators.
Static condensers	Extremely high efficiency. Low maintenance charges. Has no moving parts	Bulky and inflexible of adjustment, also danger of surges.
Rotary converters	High efficiency where direct-current load is required	Not suitable for running at more than unity power factor; voltage variation causes variation in power factor.
Motor-generator sets	More adjustable than rotary converters	Low efficiency; large amount of floor space.
Synchronous condensers	Very good control of wattless current	Mechanically "idle" machines.
Synchronous motors	Also good control and constant speed	Heavy starting current on expensive starting apparatus.
Synchronous induction motors	Good control; self-synchronizing and comparatively small starting current	Subject to limitations in design due to rotor voltage.

The author states that it is commercially economical to work at a power factor in the neighborhood of 0.9 and where low load factors and slow-speed induction motors are used it is advantageous to use some method of correcting the power factor to approximately this value.—*Beama*, March, 1920.

Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

HEAT-INSULATING PROPERTIES OF MATERIALS USED IN FIRE-RESISTIVE CONSTRUCTION.

A comparison of the relative efficiencies of the different classes of materials commonly used in fire-resistive construction to protect load-bearing members from the heat of an accidental fire has recently been made in an investigation by the Bureau of Standards. All materials were made up into specimens in the form of solid cylinders, 8 in. (20 cm.) in diameter and 16 in. (40 cm.) long. These were tested separately in a specially designed gas-fired furnace, the furnace temperature being raised gradually to 927 deg. C. in ninety minutes and held at approximately that point for two hours. The investigation included three clays that are used for the manufacture of terra-cotta tile, concrete from two mixtures, 1:2:4 and 1:3:6, with a number of different coarse aggregates, gypsums of several different mixtures from raw materials from different parts of the country, and lime mortar. The most rapid heat penetrations were found in the denser specimens of the burned clays. A porous burning clay, light-burned, heated through as slowly as most of the concretes and much less rapidly than the denser, harder-burned clays. No clay specimens of the porosity of terra-cotta lumber produced by the addition of sawdust were included. The results are consistent with earlier information as to the relative thermal qualities of the three classes of materials, burned clays, concretes and gypsums, but are favorable to members of each class; namely, porous clays, limestone concretes and the denser gypsums. The showing of gravel concrete both thermally and in respect to loss of strength was unfavorable. —*Walter A. Hull, Bureau of Standards, Washington, D. C.*

[This is important in building bus compartments.—EDITOR.]

MAGNETIC TESTS OF STEEL RODS IN INTENSE FIELDS

A method has been developed whereby megnetic tests can be made upon long rods in intense fields. The apparatus consists essentially of a Du Bois electromagnet with flat pole pieces separated by an air gap and pierced coaxially so that a rod may be extended through them and the electromagnet. Surrounding the specimen are three coaxial test coils wound on brass forms. When the inner coil is connected in series with a balistic galvanometer the normal induction is measured by the throw of the galvanometer upon reversal of the magnetizing current. By connecting either the inner and middle or middle and outer coils in opposition the value of the magnetizing force is determined. Normal induction curves obtained for a number of specimens of different materials show very good agreement with similar curves obtained by the Burrows method within the range of the latter. Hysteresis values, however, have not proved so reliable. In some specimens there seem to be two constituents of different degrees of hardness which reach the maximum intensity of the magnetization for different values of H.—*W. L. Cheney, Bureau of Standards, Washington, D. C.*

TRANSMITTER, CONDENSER TYPE

In a recent paper in the *Physical Review* (Vol. 10, p. 39, 1917), E. C. Wente has given an account of the condenser transmitter which he developed for the purpose of measuring sound intensities in absolute terms. This instrument has a sensibility which is nearly uniform over a large range of frequencies—a property which results from the high stiffness and dissipation brought into play by the air film between plate and diaphragm. A study of air damping and elasticity as they occur in this instrument shows that both damping and stiffness can be calculated according to a simple theory and that there are important frequency variations in these quantities. For example, Wente found that the damping coefficient of his system at resonance was of the order of 6,000, while theory and experiment show that the damping at 100 p.p.s. is more than 100 times as great. The theory enables an absolute calibration curve to be readily computed which is sufficiently accurate for practical purposes. The mechanism of air damping has been determined, and formulæ have been obtained from which practical calculations can be made. The principle has also been given for the design of a simple air-damped system which has rigorously uniform sensitiveness over an extended range of frequencies including zero.—*I. B. Crandall, Research Laboratory of the American Telephone & Telegraph Company and Western Electric Company, Inc., New York City*

Suggestions for Research

FIELDS, ELECTRIC AND MAGNETIC MEANS FOR PLOTTING.

The methods suggested in the past by different investigators are not entirely satisfactory. The problem is becoming of greater practical importance every day, and a satisfactory method of mapping out and plotting irregular fields of force would be of great scientific and commercial value.—*C. Fortescue, Pittsburgh, Pa.*

INSULATION, SERVICE TEST ON.

The question of periodically testing the insulation of generators, motors, transformers, etc., in actual operation is of extreme importance for obtaining uninterrupted service. The resistance test of insulation is of very little value, because it does not indicate the actual physical condition of the material. The high-potential test may break down a weak spot which otherwise would have stood in regular service for a considerable length of time. It is desirable to develop a new test which would combine the advantages of the two and give a reliable indication of deterioration in a dielectric without further weakening it. A first step in this research may consist in collecting a large number of samples of insulation taken from machines of different age and condition of service. Such samples should be subjected to careful physical, mechanical and chemical tests for the purpose of determining that property which changes to the greatest extent with deterioration and therefore could be taken as a reliable criterion thereof.—*Editorial Suggestion.*

METERS, WATT-HOUR, IMPROVEMENTS IN.

Radical improvements are needed in the direct-current commutator meter. For important alternating-current metering installations a much more accurate meter should be made, even at the expense of much greater weight and cost. To accomplish this the braking flux due to permanent magnets should be very largely increased, and a very much higher grade of steel should be developed for use in the voltage magnet. —*H. B. Brooks, Bureau of Standards, Washington, D. C.*

POLYPHASE SYSTEMS, BOOSTER FOR CORRECTING UNBALANCE.

There are in this country a few large power distribution lines of the two-phase, three-wire type. With heavy loads the impedance drop in the common return conductor badly unbalances the phase voltages. Voltage regulators on each outside conductor will keep the phase emfs. approximately correct in magnitude, but the phase angle becomes considerably greater than 90 deg. It is desired to devise a stationary booster or a combination of boosters which would automatically compensate for the impedance drop in the common wire with varying load and would maintain the two-phase voltages at the proper magnitude and in phase quadrature.—*Editorial Suggestion.*

PORCELAIN, MATHEMATICAL EXPRESSION OF PROPERTIES.

Porcelain, concrete, ferro and other alloys are essentially conglomerates of two or more substances. The ultimated strength, modulus of elasticity and temperature coefficient of expansion of each of the constituents are different from the corresponding properties of any other component. Mathematical expressions of the properties of such materials in terms of those of their constituents are at present not available, and any theoretical research is desirable that would advance the value of our knowledge beyond the extent of experience.—*W. A. Hillibrand, San Francisco, Cal.*

POWER COLLECTION FROM HEATING PLANTS.

Dr. C. P. Steinmetz suggests that wherever fuel is burned in considerable quantities to produce steam for heating purposes the steam be generated at high pressure and first passed through a turbine connected to an induction generator tied into an electric supply system. The value of the recovered power would be a substantial percentage of the fuel cost, and, according to his computations, the saving in coal that such an arrangement would effect makes it a problem of considerable national importance (*Proceedings A. I. E. E.*, 1918, p. 614). It is urged that this arrangement be tried in a large city or in an industrial district in which a considerable amount of low-pressure steam is used. An opportunity arises every time an old boiler plant is being replaced by a new one.—*Editorial Suggestion.*

STEAM AUXILIARIES

A study of steam requirements per ton of material handled from steam-jet ash conveyors would be of great interest; also a study of automatic feed-water regulators.—*J. M. Drabelle, Iowa Railway & Light Company, Cedar Rapids, Iowa.*

TRANSFORMERS, CURRENT, ERRORS IN.

Current transformers as now made are the most unsatisfactory link in the chain of devices used for metering alternating-current energy, and much better ones should be made available, so that meters could be adjusted to be accurate on the secondary energy.—*H. B. Brooks, Bureau of Standards, Washington, D. C.*

WELDING, ELECTRIC.

The research work on electric welding has only just begun and practice has preceded the scientific investigation. The field, therefore, is full of most interesting fundamental problems. The investigational questions may be grouped into three main divisions: (1) *Metallurgical.*—The metallurgist has yet to tell what the conditions of the metals are after the electrode material has fused with the parent metal and to determine the proper conditions for a good weld. This problem has in it a great many variables. (2) *Physical.*—The physicist must explain the atomic or electronic conditions which permit of the combinations at the high temperatures involved. (3) *Electrical.*—The electrical investigator must determine all the various phenomena connected with the preferences between and the advantages of the use of different forms of electrical energy and the varying characteristics of the electric circuit in producing different types of welds.—*H. A. Hornor, Proceedings, 1918, A. I. E. E.* [illegible]

JOBBERS' sales have fallen off because an increased demand has absorbed most of the stocks which were available up to the time of the railroad embargo and which have been diminishing gradually since that time.

Only a small amount of electrical goods has been received by freight during the week, and sales must necessarily continue to drop off until shipments are greatly improved.

Considerable shipping is being done by truck and by parcel post, but most of this activity is confined to short-haul shipments.

Failure by contractors and dealers to receive goods billed by jobbers has resulted in a slowing up of collections.

An increase in the price of heating appliances is expected to be made on May 15 by at least one manufacturer.

Building contracts in 1920 to date are more than double those of the corresponding period last year. Demand for electrical goods has increased in even greater proportions.

Exports of electrical materials during March exceeded those of February by more than $2,000,000. Port strikes are holding back shipments, and the export demand is not being filled because certain manufacturers have no policy of allotting a certain percentage of their output to that field.

Freight tie-ups are holding back coal and raw materials from factories and power stations all over the country to such an extent that many mines and mills are closed down and electric power consumption is being curtailed in some districts.

Demand for high-tension farm switching substations is heavy in the Middle West and West and in Canada and is increasing at a favorable rate.

In the suit of the Consolidated Gas Company of New York City to have the legal rate declared confiscatory the special master declared that the company is not forced by its ownership of the electric distribution companies in that city to set profits from electricity against losses from gas.

A budget of $27,000 will be raised by the electrical industry in California to finance the enlarged work of the California Electrical Co-operative Campaign for 1920.

A referendum is being taken by the United States Chamber of Commerce to ascertain the opinion of the business men of the country on the proposed federal Department of Public Works.

William Marconi is now conducting experiments from his yacht on the high seas in an effort to discover the cause of unexplained interference with radio operation.

At the annual business meeting of the American Institute of Electrical Engineers next Friday the Edison medal will be presented to W. L. R. Emmet.

News in Brief

Summary of Market Conditions and of Recent and Approaching Happenings of Importance to the Industry

Figures of the Geological Survey on energy production for January and February are 124,300,000 kw.-hr. and 121,800,000 kw.-hr. respectively, of which one-third was produced by water power.

Organized opposition to the water-power bill as reported by the Congressional conference committee has developed, largely from New England, and there is danger of a filibuster that will prevent its passage before Congress adjourns for the national political conventions.

Deploring the restrictions which make it impossible for public utilities to raise capital in competition with unregulated enterprises, W. S. Barstow told the Electrical World that these companies must look to their consumers and employees to buy their securities.

In a four weeks' campaign the Metropolitan Edison Company of Reading, Pa., sold through its employees to employees and customers $558,600 of 7 per cent preferred stock.

Central stations in the Middle West, including the Commonwealth Edison Company of Chicago, have stopped soliciting all business except on off-peak basis. This is due to lack of reserve capacity and inability to get funds with which to build new plants.

Arthur Williams, speaking before the New York Electrical League, emphasized the duty of the electrical industry to take part in public work.

Although Chicago utilities should spend $80,000,000 before the end of 1921 to extend their operations, they are unable to raise that sum in the present credit situation, according to Samuel Insull's statement at a hearing before the Illinois Public Utilities Commission.

Objection to the provision of the sundry civil appropriation bill carrying $125,000 for a survey of power production and distribution on the Atlantic Coast was made by several members of the House of Representatives, but the item was carried by a large majority.

Six subsidiaries of the Lehigh Power Securities Corporation of Philadelphia, together with the Pennsylvania Lighting Company, are likely to be merged into a new corporation to be called the Pennsylvania Power & Light Company.

Denial of reports that it has purchased stock of the German General Electric Company is made by the General Electric Company of this country.

A block of $5,000,000 of twenty-five-year 6 per cent general and refunding mortgage gold bonds is being offered by the Southern California Edison Company at 88½, which will yield 7 per cent.

About 125 members and guests attended the Power Club meeting at Chattanooga, Tenn., last week. Plans for broadening the club's activities were discussed and a change of name was proposed.

Addressing the convention of the Southwestern Electrical and Gas Association at Galveston, Tex., George L. Burr of the Guaranty Trust Company, New York, declared that the solution of the utility credit problem lies in local investment.

Five proposed amendments to the constitution of the Illuminating Engineering Society have been placed before the members for letter ballot.

Marketing methods employed in different sections of the country were outlined by delegates to the convention of the Electrical Supply Jobbers' Association at Del Monte, Cal., this week.

A resolution favoring more uniform rates for Hydro-Electric customers in the various parts of the province has passed the Ontario Legislature.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Harry A. Wheeler Suggests Additional Rate to Absorb Higher Costs

PREVIOUS witnesses were cross-examined, other witnesses testified and additional solutions were suggested for the credit and financial problems of public utilities at the continuation of the general hearing before the Public Utilities Commission of Illinois in Chicago this week. The hearing was adjourned until May 26.

Harry A. Wheeler, vice-president of the Chicago Union Trust Company and for three years president of the Chamber of Commerce of the United States, advocated a fair normal rate of return for utilities plus an increased rate which would be sufficient to permit the companies to pay off the present excess cost of men, money and materials out of a few years' earnings. Only the normal cost of present financing and construction should be passed on to future generations, Mr. Wheeler held.

The Interstate Commerce Commission started the public distrust in utilities securities, according to Charles Piez, who was general manager of the Emergency Fleet Corporation. He also said it was essential to the prosperity of a business community that public utility development should lead and not lag behind industrial development.

Possibility of Senate Filibuster on Water-Power Bill

NO OPPORTUNITY was offered on Tuesday to call up in the Senate the conference report on the water-power bill, although it had been the plan to open discussion on the conference bill on that day. Owing to the fact that organized opposition to the measure had developed and extended debate was in prospect, the leaders insisted on taking up the Knox peace resolution. The conference report on the water-power bill will not be taken up until after the peace resolution is out of the way.

The opposition to the conference bill comes largely from New England, although Senator King of Utah has announced that he will fight the adoption of the report. There is a chance that most of the opposition may be mollified by minor changes in the language of the conference bill. The opposition has all plans laid for a filibuster against the bill. In view of a pending adjournment until July 12 the chances are good for a successful filibuster. The stand taken by the opponents of the conference committee bill is virtually that of Senator Fernald of Maine, who expresses his opinion of the bill in the following language:

"I am against the licensing system. The states should have the right to determine their own policy for regulating the use of water power. Maine has determined that electricity generated by water power shall not be carried out of the state. This bill overthrows the state's policy of regulating the use of water power. Under this bill a man who desires to build a small dam to be used for logging or other purposes would have to secure permission from Washington. In my opinion, the interpretation of the conference bill would make this necessary even if the development were contemplated on the smallest of streams, if by any chance they empty into a river that is navigable."

Objection to Government Development of Super-Power Zone

WHEN the item of the sundry civil appropriation bill carrying $125,000 for a survey of power production and distribution along the Atlantic Coast came before the House of Representatives at Washington objection was made by Representative McKeown on the ground that this development should be conducted by private enterprise and not by the government. The item was strenuously defended by the chairman of the appropriations committee, Representative Good, and by Representative Byrns of Tennessee. The latter is the ranking Democrat on the committee. In the course of his remarks on the subject Chairman Good said:

"We may smile at this proposition. We may laugh it out of Congress just as we did by ridicule the proposition of Mr. Langley in regard to the aeroplane. I say to you that it has within it the very things we must adopt to utilize these forces and to make a greater use of coal at the mouth of the mine and at tidewater. At the same time it would open up a plan whereby private capital, not government appropriation, would be used. I would not be in favor of appropriating a single dollar for the government to go into that kind of a scheme. Private capital should do that. When there is so much of wildcat and watered stocks being circulated and sold, how far would you get in promoting a company of this kind that had back of it only the estimate of some private individual or company? It is intended to have a government survey and a report, something that would have the stamp of the government officials on it."

Representative MacGregor of New York objected to the item on the ground that he sought to have incorporated into the water-power bill a provision requiring that power developed at Niagara Falls be distributed equitably to the industries of that vicinity. That provision was rejected by the House, which held that Congress had no right to dictate to the states as to the manner in which the power developed within the states is to be distributed. Only a few days after that action, Mr. MacGregor declared, Congress is appropriating money looking to exactly that end. A vote was taken on the question of retaining the item in the bill and but few votes were cast against it.

Proposal to Amend I. E. S. Constitution Placed Before Members

PROPOSALS to amend the constitution of the Illuminating Engineering Society and the nominations for national and section officers for the year 1920-1921 have just been placed before the members of the society for a letter ballot. There are five proposed amendments to the constitution.

The first amendment is to create a new class of members, to be known as student members, by doing which the officers of the society state they feel the society would be extending its usefulness and at the same time providing for future growth.

The second amendment provides for affiliates, in order, the officers state, that non-members may be interested in the activities of the society, especially in connection with the proposed local chapters.

Amendment No. 3 provides for increased dues to meet rising costs. In this connection the officers state that the society has an opportunity to do exceptionally good work, but it cannot keep up the effective work of past years with its present income. The changes would raise associate members' dues from $5 to $7.50; members' dues from $10 to $15 and sustaining members' maximum dues from $250 to $500.

The fourth amendment provides for local chapters, which would be something smaller and less formal than a section.

The last amendment would make amendments to the constitution effective Oct. 1 instead of twenty days after adoption.

Associated Manufacturers to Meet at New London in June

ALL sections of the Associated Manufacturers of Electrical Supplies will hold their regular summer meetings and the board of governors will holds its June meeting at the Griswold, Eastern Point, New London, Conn., June 26 to 30 inclusive.

Standing committees of the association for 1920 have been announced as follows:

Membership Committee — J. H. Trumbull, chairman, Trumbull Electric Manufacturing Company; W. E. Barker, United States Rubber Company; Russel Dart, Alphaduct Company; A. H. Englund, Electric Service Supplies Company; Edward Sawyer, Atlantic Insulated Wire & Cable Company; M. H. Sigafoos, Hazard Manufacturing Company; W. E. G. Mitchell, Mitchell-Rand Manufacturing Company.

Finance Committee—W. H. Thornley, chairman, Tubular Woven Fabric Company; Charles L. Eidlitz, Metropolitan Electric Manufacturing Company; E. B. Hatch, Johns-Pratt Company; B. E. Salisbury, Pass & Seymour, Inc.; J. E. Way, R. Thomas & Sons Company.

Law Committee—W. H. Thornley, chairman, Tubular Woven Fabric Company; D. R. Bullen, General Electric Company; Le Roy Clark, Safety Insulated Wire & Cable Company.

Entertainment Committee—Le Roy Clark, chairman, Safety Insulated Wire & Cable Company; Frank V. Burton, Bryant Electric Company; J. W. Perry, H. W. Johns-Manville Company; Edward Sawyer, Atlantic Insulated Wire & Cable Company; Charles E. Dustin, general secretary, and the president, ex officio.

Special Committee on Section Activities—D. R. Bullen, chairman, General Electric Company; W. H. Thornley, Tubular Woven Fabric Company; Le Roy Clark, Safety Insulated Wire & Cable Company.

Special Committee on Nomenclature—J. H. Trumbull, chairman, Trumbull Electric Manufacturing Company; John J. Gibson, Westinghouse Electric & Manufacturing Company; Shiras Morris, Hart & Hegeman Manufacturing Company.

Solution of Utility Credit Situation Is Local Investment, Says Banker

THAT the public utilities, struggling "between the upper millstone of regulation and the nether millstone of rising costs of operation," can attract new capital and offer a safe investment only by creating a genuine and effective interest among their customers and the people in the territories they serve was asserted by George L. Burr, manager of the bond department of the Guaranty Trust Company of New York, at the annual convention of the Southwestern Electrical and Gas Association, held this week at Galveston, Tex.

"It is generally felt among investors," Mr. Burr declared, "that many public utility companies have not had the public support which is due to them as honestly and ably managed public servants and that the problems of these companies and the just deserts of their owners and creditors have not been appreciated by the public bodies. It is therefore feared by many that, as a result of the combination of these circumstances and the rising costs of operation, financial disaster for many companies may be just around the corner in the shape of possible disappearance of 'net after taxes.'

"Compare on any such basis the case of the public utilities with the flexible earning power and favorable current asset position of an industrial company and it is not difficult to understand why it is almost impossible today to finance any but the exceptionally fortunate public utilities.

"That the characteristics of industrial investments are not necessarily the only basis upon which money can be obtained is shown by the sale of foreign government obligations and the bonds of our own states and municipalities and of some of our public utilities. I believe that if the investor can be shown that a public utility obligation will be paid, principal and interest, and that there will continue to be a good market for it, he will buy it; but he has taken many heavy losses in this type of investment and has very properly grown to be a discriminating person. Investment bankers, in protecting his interests as one of their customers, have exerted every effort to help him in his powers of discrimination, but also they have always been and still are equally ready to help utilities on any basis that is fair to their clients.

"It is not necessary for us at this time to consider the details of a company's corporate structure, the proportion of its debt to its total capitalization or the ratio of its earnings to its fixed charges. But I would like to call attention, as emphatically as I am able, to the fact that the gates to new capital are virtually closed to public utility companies whose customers and the people in the territories which they serve do not take an intelligent and effective interest in them, but regard them as outsiders and not as integral parts of their communities which must be fostered and developed as much as any other industry.

"It is not necessary that a company's requirements be financed entirely in this manner, but it is in many cases essential that there be on the part of the community served a sufficiently large good faith investment in its stock and debt to assure outside investors that the company will receive the same consideration as the other home industries in the territory which it serves."

Activities of Power Club Broadened

Board of Governors at Chattanooga Meeting Decides to Employ Secretary and Establish Central Headquarters—Sections Report on Work

JAMES BURKE
Re-elected President Electric Power Club

ABOUT 125 members and guests, including 25 ladies, attended the annual meeting of the Electric Power Club at Chattanooga, Tenn., May 5 to 8. The program, which called for four days of meetings, was made up of morning sessions on each day and evening sessions on the first two days. All were general meetings to which members, guests and others interested were invited following the plan of the club to hold no meetings behind closed doors. In addition to these general meetings, at which the work of special committees and sections was discussed, the various sections of the club held independent meetings on the second day. This was the first annual meeting since the adoption at Hot Springs, Va., last year of the section form of organization covering other groups of electrical apparatus than motors and generators. The creation of the storage-battery section this year out of the original mining and industrial locomotive section now brings the total of organized sections up to ten under the following designations: (1) Transformer section; (2) industrial control section; (3) power switchboard and oil circuit-breaker section; (4) motor and generator section (not including turbo-driven apparatus); (5) turbo-driven apparatus section; (6) storage-battery section; (7) electric welding section; (8) electric furnace section; (9) portable electric tool section; (10) electric measuring instrument section.

CHANGE IN NAME SUGGESTED

At the general meeting on the evening of the second day of the convention a suggested change in name of the Electric Power Club was brought up for discussion. Owing to the fact that the work now being conducted is of a broad engineering character, covering many phases of the electrical industry, and includes matters of standardization and application of other equipment than motors and generators, which was its original function, it was the feeling on the part of some members that the name "club" should be eliminated from the official title and some more comprehensive designation substituted. The name "Associated Manufacturers of Electrical Apparatus" was proposed, and after some discussion it was voted to refer this matter to the board of governors for further deliberation and report at a future meeting.

It was decided at this meeting and announced by the board of governors that, owing to the additional work created by extending the scope of the club to include section divisions, a paid secretary will be employed at an early date and official headquarters established at some central point.

The following reports of committees and sections were presented in printed form: Underwriters' committee; wiring committee; wiring and industrial locomotive section; fractional-horsepower-motor committee; large power-motor committee; generator committee; transformer section, and tariff committee. The reports of other committees consisted of brief outlines of the work done and in progress.

MORE COMPLETE COST DATA NEEDED

In presenting the report of the foreign trade committee and the tariff committee, S. L. Nicholson as chairman drew attention to the lack of data on manufacturing costs and emphasized the need for full knowledge of material and labor costs in each line of equipment made. This information is essential in order to be able to offer goods in foreign markets on a competitive basis. While the cost of labor in foreign countries, particularly in Japan and Germany, is much lower than in the United States, he showed that the productivity of labor is likewise lower. However, European countries are now installing labor-saving devices, so that this advantage in favor of American manufacturers is being rapidly eliminated. He said also that there is a need for a change in the basis on which tariff valuations are made so that the assessments will be on American instead of foreign values. The committee is to continue its study of foreign conditions and the economic needs of the electrical manufacturing industry.

Mr. Nicholson also outlined in considerable detail the work of the Electrical Manufacturers' Council, referring to the article which appeared in the ELECTRICAL WORLD of May 1, page 1002. At this time it was announced that the Electrical Manufacturers' Council will maintain a foreign trade bureau at its executive headquarters, which will shortly be established in New York City.

At the annual banquet of the club Harry F. Atwood of Chicago spoke on "Our Constitution the Antidote for Bolshevism." His plea was to return to a strictly republican form of government and the true interpretation of the Constitution as a code of government by the people and for the people. This, he contended, is the solution for industrial unrest and a correction of the tendency toward mob-mindedness and retrogressive tendencies.

At the final meeting of the board of governors, on the last day of the convention, the present officers of the club were re-elected for another year as follows: President, James Burke, Burke Electric Company; Erie, Pa.; vice-president, A. L. Doremus, Crocker-Wheeler Company, Ampere, N. J.; secretary, C. H. Roth, Roth Brothers & Company, Chicago; treasurer, R. J. Russell, Century Electric Company, St. Louis, Mo. Four memthe club were re-elected for another year as follows: R. J. Russell, Century Electric Company, St. Louis; T. E. Barnum, Cutler-Hammer Manufacturing Company, Milwaukee, Wis.; C. L. Collens, 2d, Reliance Electric & Engineering Company, Cleveland, Ohio; C. H. Roth, Roth Brothers & Company, Chicago.

The re-election of Mr. Burke as president is a recognition of his unselfish devotion to the work of the club during the past year and his constructive thinking and leadership under the new plan of organization and the growing importance of the section idea.

The next meeting of the club will be held at Hot Springs, Va., during the latter part of October or the first of November, according to which date offers better arrangements for accommodation. The exact time will be announced later.

Insull Analyzes Utility Credit Situation

TWENTY million dollars is needed by the Commonwealth Edison Company for essential plant extensions and betterments during the next two years, Samuel Insull, president of the company, testified at the recent hearing before the Illinois Public Utility Commission on the credit situation faced by the utilities of the state. All the utilities of Chicago, it was pointed out, should spend in the aggregate about $80,000,000 before the end of 1921. However, Mr. Insull said, they have been unable to get the funds in spite of the fact that it would take about twice as much money as was criginally invested in their properties to duplicate them today.

The Commonwealth Edison Company has never passed a dividend on its stock, but the testimony showed that it has difficulty in getting money at any price, and unless money is forthcoming the company cannot respond to the needs and growth of the community.

Mr. Insull could not explain why a utility as strong financially as the Commonwealth Edison Company could not borrow capital on an even basis with industrial companies except by saying that the general attitude of the investing public toward utilities affects those with the best as well as the poorest credit ratings. He said that conditions would be much better if the press would give public utilities the co-operation and support to which a business of such magnitude and public importance is entitled. Mr. Insull thought the commission would either have to allow an increased return to cover the price the utilities would have to pay for money at the present time or else make rates high enough to leave a sufficient margin to make extensions out of earnings.

Stoker Manufacturers to Meet at Lakewood, N. J., Next Week

ON TUESDAY, Wednesday and Thursday of next week the Stoker Manufacturers' Association will hold its annual meeting at Lakewood, N. J. A complete program of entertainment, including golf, motor trips and horseback riding, has been prepared for each day. The meeting will be opened Tuesday morning, May 18, by President P. A. Poppenhusen of the Green Engineering Company with an address on "The S. M. A.—Past, Present and Future." This will be followed by an address by S. A. Armstrong of the Underfeed Stoker Company of America on "Development of Stoker Organizations from the Standpoint of Ideals and Ethics." A business session will be held in the evening, at which reports will be presented by the commercial committee, P. A. Poppenhusen chairman; the public policy committee, S. L. Nicholson chairman, and the traffic committee, A. V. Pope chairman.

On Wednesday morning, May 19, reports will be made by the engineering committee, F. H. Daniels chairman, and the membership committee, J. H. Roach chairman. Henry Kreisinger, bureau of mines, Pittsburgh, Pa., will present a paper on the "Relation Between the Combustion Space and the Efficiency of Combustion." J. G. Worker will also lead a discussion on the question, "How can each individual stoker manufacturer give better service in furnishing stoker repair parts, with methods for building up this part of the business?"

On Thursday morning, May 20, A. R. Manjer, Chicago, will speak on "Advertising and How It Can Be Done by an Association," followed by reports of the publicity committee, R. C. Beadle chairman; cost-accounting committee, A. G. Pratt chairman, and entertainment committee, R. C. Beadle chairman.

Duty of the Industry to Participate in Public Works, Says Arthur Williams

SPEAKING at the monthly luncheon of the New York Electrical League on May 11, Arthur Williams, general commercial manager of the New York Edison Company, who during the war was food administrator for New York City, urged those associated with the electrical industry to lend their efforts toward the reconstruction problems now facing the country. Mr. Williams stated that he believed the time had come for the electrical men to get back into public thought by service to the public.

Being particularly fitted by training and environment to visualize the future, Mr. Williams held that they should take their places in public work. He pointed out that the country is confronted by many important problems, for the solution of which adequate methods have not been offered. Among these problems he mentioned that of the establishment of relations with the European countries with which we were recently at war.

Mr. Williams also made a plea for mutual understanding and intelligent co-operation between capital and labor, pointing out that labor must receive a fair wage, for which there must be a fair return in production. With this end in view partnership of capital and labor is already in successful operation in many instances. He said that those engaged in the electrical industry could be of great assistance in spreading this idea in their own and other industries.

Public Does Not Understand, Says Aylesworth

REGULATING commissions, M. H. Aylesworth, executive manager of the National Electric Light Association, declared at a luncheon in Boston on April 29, under the auspices of the New England Section, are well informed as to the issues facing the utilities today, but without a popular appreciation of the part the utilities are playing in modern life and correct ideas as to their prosperity and costs the whole scheme of commission regulation must fall far short of what is needed.

"Today we have an intelligent, honest body of public utility commissioners," said Mr. Aylesworth, "but the public itself does not understand the conditions under which the companies work, and for the reason that agitators have too long proclaimed the false doctrine that the utilities are robbing the people. We have on our part made the mistake of pulling down the blinds and waiting for the storm to subside, then going out into the streets and blushing as though we had been doing wrong!"

It is the intention of the association to change this condition henceforth, and the speaker outlined the work of the committee on public information, which has already had such good results in newspaper relations. Seven states have already organized under the guidance of the association a definite program for publicity, and to this effort a nation-wide scope will be given.

Market Economics Outlined

Electrical Supply Jobbers' Meeting This Week at Del Monte, Cal., Hears of Methods Employed in Different Sections of the Country

THE regular semi-annual meeting of the Electrical Supply Jobbers' Association was held on Tuesday, Wednesday, Thursday and Friday of this week at Del Monte, Cal. Most of the delegates from the Eastern and Central divisions of the association arrived on a special train and were welcomed on Monday afternoon at Sacramento, and all the rest of the week when not in session the convention delegates were entertained in Western fashion by members of the Pacific Coast Division. The first session was devoted to an illustrated lecture on the water powers and electrical features of the Pacific Coast by Robert Sibley, editor of the *Journal of Electricity*.

Meetings of the three divisions were held on Tuesday morning, and a joint session of all divisions was held in the evening. A. M. Little of Syracuse, N. Y., chairman of the Atlantic division, spoke of the desirability of each company charting its organization, and a committee was appointed to report on the fundamentals of organization for smaller companies.

Jobbing Practice in Different Sections

C. C. Hillis, chairman of the Pacific Section, showed how jobbing on the Pacific Coast differs from jobbing in other sections of the country, owing to distance from manufacturing centers. On the Pacific Coast jobbers carry larger and more diversified stocks. Direct shipments are unheard of and closer co-operation prevails than elsewhere. Moreover, business is conducted on a net price basis and not on lists and discount. Manufacturers are not encouraged to quote jobbers' prices nor to take orders and turn them over to jobbers to fill. Stocks are interchanged between jobbers and every encouragement is offered to dealers.

F. D. Van Winkle of Cincinnati spoke of the jobbing conditions in the Middle West and showed some samples of advertising done by his company. E. W. Rockafellow of New York reported on the dry battery, flashlamp and conduit situations.

Addressing the Central Division, C. W. Banta, vice-president of the Wells-Fargo National Bank of San Francisco, said on the subject of the present business and financial situation:

"Manufacturers are just commencing to realize that cost, intrinsic value and the price dictated by the supply are not such powerful factors in the maintenance of the price level as are the dictates of the public mind. This state of mind is already apparent in the case of the clothing industry and in the shoe business.

"A most important recent development of the general situation is the decision of the Federal Reserve Bank of Kansas City to adopt the Phelan plan of graduated discount rates; this plan will accomplish its purpose of curbing extensions and speculation.

"There has always been enough money to care amply for the demands for the necessaries of life, and there is always some surplus for the discovery and developments of new human comforts. We can expect to see a tendency toward lower prices start with declining food price levels. This should be ample warning when it comes.

"For my part," said Mr. Banta in concluding, "I cannot help siding with those moderates who feel that the present year should be a good one in business and that it will take at least another year so to clarify the situation that lowered costs and lessened demand will allow competition to work out its course in lower prices. With the return of a real price level, incompetent, inefficient businesses are going to be eliminated from the business body. The key to the solution of all our problems lies in co-operation. Get co-operation by all means, both inside and outside your organizations, and drag into the light of knowledge every unprofitable practice.

L. L. Hirsh, Electric Supply Company, New Orleans, read a paper entitled "Should the Jobber Receive a Better Profit?"

On Thursday F. A. Wilson-Lawrenson of the Union Carbide & Carbon Corporation addressed the convention on business distribution, outlining a quota plan of sales through jobbers, who in turn appoint the distributers. J. M. Wakeman of the Society for Electrical Development spoke on the aims of that organization. At the Thursday evening session W. L. Goodwin made an interesting address on business opportunity.

Friday's session was devoted to the California Electrical Co-operative Campaign, which was explained by L. H. Newbert. Interpretations were made as follows: "The Jobber's Viewpoint," by D. E. Harris of San Francisco; "The Contractor-Dealer's Viewpoint," by C. L. Chamberlain of the California Association of Electrical Contractors, and "The Manufacturer's Viewpoint," by Garnett Young of San Francisco.

A feature of the entertainment was an old timers' "forty-nine" camp on Wednesday evening, when the entire Pacific Coast delegation was attired in appropriate costumes, and a grand ball on Friday night.

The entire executive committee of the association will attend the convention of the National Electric Light Association at Pasadena next week.

W. L. R. Emmet to Receive Edison Medal Next Friday Night

NEXT Friday night at the annual business meeting of the American Institute of Electrical Engineers to be held in New York the Edison medal will be presented to W. L. R. Emmet, to whom it was awarded "For inventions and developments of electrical apparatus and prime movers."

At this meeting the board of directors will make its annual report, including a financial statement for the year ended April 30, 1920. The report of the tellers will also be presented, giving the results of the election of officers for the ensuing administrative year.

Immediately following the business meeting the ceremony of the presentation of the Edison medal will take place. This medal was founded by the Edison Medal Association, composed of associates and friends of Thomas A. Edison, and is awarded annually by the American Institute of Electrical Engineers "For meritorious achievement in electrical science, electrical engineering or the electrical arts."

The presentation ceremonies will be as follows: "The Edison Medal," by Carl Hering, chairman Edison medal committee; "Achievements of W. L. R. Emmet," by H. W. Buck; presentation of the medal by Calvert Townley, president A. I. E. E.; response by W. L. R. Emmet.

Owners of Dual Service Not Obliged to Set Electric Profits Against Gas Loss

THE fact that the Consolidated Gas Company of New York City also controls the New York Edison Company and the United Electric Light & Power Company has no bearing on the suit of the former company to have the 80-cent rate imposed by law set aside as confiscatory, in the opinion of Abraham S. Gilbert, to whom, as special master, the federal district court referred the case. "The complainant company," said Mr. Gilbert in his report filed with the court last week, "appears entitled to have the rate chargeable by it for gas kept adequate without regard to the rate charged for electricity by companies in which it owns stock control. Moreover, the Legislature has seen fit to provide separate regulation of gas and electric lighting companies."

Mr. Gilbert sustains the Consolidated Gas Company in its contention. If the court approves the finding the city will appeal, and the case will go through the circuit court of appeals and thence to the United States Supreme Court for a final decision.

Boston Utilities Co-operate with City in Fire Protection

CONTRACTS between the city of Boston, the Edison Electric Illuminating Company and the Boston Elevated Railway have been agreed upon in connection with the operation of a high-pressure fire service system begun eight years ago with a municipal loan of $1,000,000. The completion of this system has been delayed through various changes in administration, the earlier city authorities having been severely criticized for their failure to carry the work to a conclusion, but Mayor Peters states that in six months the installation will be in active operation. In the earlier plans it was proposed to place electrically driven pumping equipment on Boston Common, on the Charles River Esplanade and in the North End. Considerable progress has been made in the installation of the underground piping and hydrant system. By the terms of the contracts now agreed upon the Edison company and the railway company will house the pumping machinery in their own plants, supervise its operation and attend to its maintenance.

At the Atlantic Avenue generating station of the Edison company two multi-stage centrifugal pumps of a capacity of 3,000 gal. (1,135 l.) per minute each will be installed this year, space also being provided for a third. Two similar pumps will also be installed later in the Stuart Street substation of this company in the heart of the Back Bay district. Each of these pumps is to be driven by a direct-current motor, and storage batteries at these locations will furnish a temporary emergency supply of energy. At the Lincoln power station of the railway company two steam-turbine-driven pumps will be installed, with space for a third, all of 3,000 gal. per minute capacity against 300 lb. per square inch (21 kg. per sq.cm.) pressure.

At each of these stations the city will pay the utility a fixed charge of $200 per month for rental, the space required at Lincoln power station being about 20 ft. x 48 ft. (6 m. x 14.6 m.). At this plant a fuel charge will be made consisting of 24 cents per 1,000,000 B.t.u. (whether coal or oil is burned), with coal at $4.80 per ton and fuel oil at 0.92 cents per barrel of 42 gals. (158 l.), plus a labor and material charge of 10 cents per 1,000,000 B.t.u. For coal or oil at higher prices proportional readjustments will be made in the fuel charge. The regular Edison power rates will be applied to the service at the Atlantic Avenue and Stuart Street installations. Contracts will shortly be let for the motors, control and switchboard equipment for the two water-front installations.

Public Utility Burdens Must Be Lightened, Says New A. A. E. President

LEROY K. SHERMAN, president of the United States Housing Corporation, who was also elected president of the American Association of Engineers at its sixth annual convention, held at St. Louis on Monday and Tuesday of this week, thus summarized in his inaugural address the problems that confront the engineering profession:

"In our relations to the public there are many important matters pending: The equitable compensation of engineers in municipal and railway service; the engineers' license law; a national Department of Public Works; the enactment of modification of proper building laws and laws regarding reclamation and public improvements; the question of professional ethics involved in outside work undertaken by public employees or officials. It should be our duty to aid in the solution of problems involving relations between the public and the various utility companies which are fundamentally engineering works. For example, the removal of onerous burdens on public utility companies which increase cost of operation without resulting in an improvement to the service. The public utilities companies may have sinned against the public in the past; now they have suffered the penalty and they are entitled to redemption."

California Electrical Co-operative Campaign on Larger Scale

A SECRETARY, three field representatives, an architectural representative, an advertising representative and an office assistant, making a total staff of seven, are to be employed in 1920 by the California Electrical Co-operative Campaign, according to the second annual report of that enterprise recently issued by the advisory committee, of which Lee H. Newbert, manager of the commercial department of the Pacific Gas & Electric Company, is chairman. To finance the undertaking a budget of $27,000 has been provided, 90 per cent of which has already been pledged by various organizations in the following proportions per centum: Power companies, 35; manufacturers, 29; jobbers, 23; contractor-dealers, 12; technical press, 1.

The sum named is nearly $10,000 more than the sum raised by subscription for 1919. Receipts from all sources for that year were $23,476 and expenditures $18,809, leaving a balance of $4,667. The assistance in merchandising given to contractors and dealers in 1918 and 1919 is summarized in the following table:

	1918	1919	Total	Contemplated
New stores	12	67	79	8
Better locations	21	49	70	10
Remodeled stores	13	50	63	15
Total	46	166	212	33

The number of electrical solicitors in California has been tripled in two years' time, fifty-seven electrical dealers have adopted the standard accounting system of the National Association of Electrical Contractors and Dealers, a system of sales bonuses has been worked out, newspaper advertising has increased 400 per cent, membership in the State Association of Electrical Contractors and Dealers has grown, and a salesmen's auxiliary to the co-operative campaign has been organized.

The advisory committee will continue during 1920 its educational advertising and co-operative work along the same broad lines as in the past, giving special attention to the problems of the contractors and beginning active work with the architects, builders and owners.

Chamber of Commerce Taking Vote on Public Works Department

IN ORDER to ascertain the sentiment of the business men of the country with respect to the proposed federal Department of Public Works, a referendum is being taken by the United States Chamber of Commerce. The three proposals of the referendum follow:

1. Shall a Department of Public Works be established by the national government?
2. Shall a Department of Public Works be established by a suitable modification of the existing Department of the Interior, excluding therefrom the non-related bureaus and offices, and by change of name from Department of the Interior to Department of Public Works?
3. Shall a Department of Public Works be established by creation of an entirely new department?

Central Maine Hydro-Electric Merger and Interconnection Approved

THE Maine Public Utilities Commission has issued a decision approving the acquisition by the Central Maine Power Company of control of the Androscoggin Electric Company, the Knox County Electric Company and the Oxford Electric Company, thus sanctioning one of the most important hydro-electric centralization plans proposed in New England in recent years. As recently stated in the ELECTRICAL WORLD these properties will be operated in a single interconnected system.

The Central Maine company has rights in nine of the sixteen counties of the State, serving nearly ninety cities and towns. The Androscoggin company has a light and power business in Auburn and Lewiston, also owning and operating an interurban electric railway between Lewiston and Portland. The Knox County company does a light and power business in Rockland and adjoining territory, and operates a street railway between Warren, Rockland and Camden, purchasing energy from the Central Maine company. The Oxford company does a light and power business in South Paris, Norway and Mechanic Falls.

The commission finds that the rapid growth of Lewiston and Auburn and of the territory of the Androscoggin company in general can be better served through the tying in of the systems than through sole reliance upon plant expansion on the Androscoggin River, limited as it is in comparison with the facilities to be co-ordinated through interconnection and centralized control. The new plant of the Central Maine company under construction at Skowhegan will provide a surplus of energy which can be utilized to advantage on the other parts of the co-ordinated system.

Engineering Is the Foundation for Progress in Electrical Industry

TOO little appreciation exists at present of the dependence of the electrical industry upon engineers, especially among undergraduate students looking forward to an early entrance into business and professional life. Richard H. Rice, manager of the Lynn works of the General Electric Company, emphasized this point recently before the Harvard Engineering Society, stating that the volume of business in each branch of manufacture runs parallel to development work by the designing engineers. If the flow of new ideas subsides, the orders for the particular class of apparatus concerned almost immediately begin to decrease. Most of the executives of the company represented by Mr. Rice have attained their posts as engineers via the test-room and drafting-table route, and the more commercial tasks are taken up only after a preliminary experiience in the technical side of the art. There is a mistaken feeling among young men to the effect that engineering design offers few opportunities for financial advancement, but there is no short cut to commercial success in industries resting upon so technical a base as applied electricity.

Belief Expressed in Electric Welding for Future Shipbuilding

ALTHOUGH progress will be slow, eventually ships will be fabricated by electric welding instead of by riveting. Such was the prophecy expressed at recent meetings of the Philadelphia Section of the American Institute of Electrical Engineers and the American Bureau of Welding. It was admitted that the efforts of the Shipping Board during the war had not been successful up to the armistice, when the experiments on three large spot welders were discontinued, but the idea has not been given up.

To show their belief in the ultimate success of replacing rivets by welding, the Baldwin Locomotive Works of Philadelphia have offered $10,000 for experiments along this line and other firms have offered contributions. Prof. Comfort A. Adams of Harvard University, in his talk at Philadelphia, showed pictures of two foreign boats that had been welded and which had stood rough service successfully.

Saving of $2,000,000 in Fuel Oil from Hydro Development

TO PROVIDE for the construction of hydro-electric plants which when placed in operation will effect a saving of $2,000,000 annually in fuel-oil costs alone. the Pacific Gas & Electric Company of California is issuing $10,000,000 five-year 7 per cent collateral trust gold notes, due May, 1925. These notes are being placed on the market at 97½ and interest, yielding about 7.7 per cent and at the option of the holder are convertible into the company's preferred or common stock.

Proceeds from the sale of these notes, it is stated by A. F. Hockenbeamer, second vice-president of the company, will also be invested in transmission and distribution facilities in addition to the hydro-electric development on the Pitt River, where the installation of the first 20,000-hp. unit is now under way, and it is expected that energy will be delivered by Jan. 1, 1921.

A "No Accident Week" to Help the Cause of Safety in Utilities

AN ADDITION to days and weeks devoted to special objects is the "no accident week" set aside by public utility interests of New York and Pennsylvania for the observance of an "accident-prevention drive." E. R. Dobbin of the Empire Gas & Electric Company, Geneva, N. Y., is the chairman and G. R. Rinke, 5 Nassau Street, New York City, the secretary of the 1920 safety committee, having the plan in hand. The second week in June is the period selected. A similar effort made last November under the name of "safety week" had excellent results in accident reduction.

An attractive colored poster and six daily bulletins, as well as an artistic button for coat lapels, will help to carry on the propaganda, which has the earnest support of the Buffalo General Electric Company, Harrisburg Light & Power Company, Niagara, Lockport & Ontario Power Company, Northern New York Utilities, Northwestern Electric Service Company, Rochester Gas & Electric Corporation, Western New York Utilities Company and the Wilkes-Barre Company.

Great Growth of the Local Stock Sale Reported by Standard Gas & Electric

AN OUTSTANDING feature of the 1919 report of the Standard Gas & Electric Company, which embraces thirteen subsidiary companies operated by H. M. Byllesby & Company in fourteen Western states, is its announcement of steadily increasing sales of the securities of its various constituent utilities to the public in their respective territories. These sales, says President Byllesby, are assuming such proportions that in some instances virtually all construction expenditures of the company concerned were met from their proceeds. Preferred stocks form the greater part of the securities sold in this way, and the growth in the number and value of sales since the latter part of 1915, when the plan was first tried, is as follows:

Year	Sales	Shares, Par Value	Average Par Value per Sale
1915	326	$206,300	$632.82
1916	2,039	1,146,800	562.46
1917	3,305	1,700,100	514.40
1918	4,923	2,419,400	491.44
1919	5,723	3,421,900	597.91
Totals	16,316	$8,894,500	$545.12

"It will be seen," the report continues, "that the average sale amounts to slightly less than six shares. Permanent financing of this character, relieving the companies in no small way of the necessity of providing from time to time for maturing obligations, has greatly strengthened the financial structure of your subsidiaries. In addition to the $3,421,900 par value of preferred stock sold locally in 1919, $1,429,200 face value of other securities was sold in the same manner in the same year. The benefits accruing to your respective subsidiaries, as well as to their respective customers, from such extensive and increasing 'customer ownership' are so manifest as to require no further comment, and the growing popularity of this movement may be gaged by the fact that local sales of preferred stock during the first quarter of 1920 amounted to $2,597,600 par value, equivalent to 76 per cent of the entire 1919 sales."

The Standard Gas & Electric Company finished the year 1919 with the largest surplus in its history, amounting to 7.7 per cent on the common stock after payment of increased dividends on the preferred. The aggregate gross increase in earnings of subsidiaries amounted to $3,813,850, or approximately 16½ per cent, as compared with an increase of $4,002,698 in 1918.

Valuation and Combustion A. S. M. E. Spring Meeting Topics

THE spring meeting of the American Society of Mechanical Engineers will be held in St. Louis on May 24-27, with headquarters at the Hotel Statler. The elevator code drawn up as the outcome of several years' work by a committee of the society will be discussed at this meeting, and power and combustion topics, including stokers, pulverized fuel, feed-water heaters and feed-water treatment, will come in for review. On the opening day there will be an appraisal and valuation session, with discussion of the following papers: "Appraisal and Valuation Methods," by David H. Ray; "Fundamental Principles of Rational Valuation," by James Rowland Bibbins; "Data on the Cost of Organizing and Financing a Public-Utility Project," by the late F. B. H. Paine (contributed by Dean M. E. Cooley); "The Construction Period," by H. C. Anderson, and "Price Levels and Value," by Cecil Elmes. A visit on Sunday, May 23, to the Keokuk (Iowa) hydroelectric development and a trip to the Tulsa (Okla.) oil fields on May 27 have been arranged.

Marconi Investigating Origin of Radio Disturbances

FOR some time there has been considerable discussion relative to the origin of radio disturbances, and in an effort to clear up this scientific mystery William Marconi is now at sea in his specially fitted up yacht Electra, from which he is undertaking a series of experiments. This picture shows Signor Marconi seated in his wireless laboratory on board the Electra.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

A Central European Plan for Combined Canal and Power Development.—A scheme to connect the Rhine, Main and Danube Rivers by a waterway that would accommodate ships of 1,200 tons and at the same time permit the hydroelectric development of 100,000 hp. is reported as taking shape in Central Europe.

New Course in Communication Engineering at Harvard.—The Harvard Engineering School faculty has voted to establish a new undergraduate course in electric communication engineering, comprising the study of the telephone, telegraph, hydrophone and radio work. The curriculum will include existing studies in electrical engineering theory, machinery, transmission and power distribution and will utilize the Cruft radio laboratory and other facilities of the electrical department. Considerable work will be included in mathematical physics, and the course will fit students to enter the research field as well as that of engineering.

New Stock Issue for Great Western Power Company.—An increase of approximately 20 per cent in the cost of labor and material, unexpected and unforeseeable construction difficulties and a change in the power-house plans are the reasons given by the Great Western Power Company in an application to the California Railroad Commission for permission to issue $1,500,000 in stock. The company asserts that it will need the money raised through the proposed sale of the preferred stock to complete the Caribou power house on the north fork of the Feather River. According to the company's application, the plant will cost $1,924,670 more than the original estimate.

The British Electricity Bill.—A bill to amend the electricity supply act passed last session has been introduced into the British House of Commons. As amended, the bill is to include the compulsory clauses which were abandoned in order to insure the passage of the original measure, and it contains a clause providing for financial assistance to the extent of £25,000,000 by means of electricity bonds. This procedure, the London *Electrician* remarks, is objectionable to a number of strongly vested interests, and the government will need all its strength to push it through, although some financial powers must be given to the commissioners if a "cheap and abundant" supply of electrical energy is to be an accomplished fact within the near future.

Wireless Telephoning Over Long Distances.—Among recent successful European experiments in long-distance telephoning have been the transmission of a long message from Chelmsford, England, to Rome by the editor of an Italian newspaper, and tests between Berlin and Karlsborg, Sweden, a distance of 440 miles, and Berlin and Moscow, a distance of 1,000 miles.

Railway Tunnel Fans to Be Operated Electrically.—Until two or three weeks ago two immense fans employed to rid the Big Bend (W. Va.) tunnel of the Chesapeake & Ohio Railroad of gas and smoke were driven by steam power at the eastern end of the tunnel. Under the direction of J. M. Wilson, manager of the Virginia-Western Power Company of Hinton, W. Va., electric drive has been substituted, and the fans are now operated by two 350-hp. motors installed at the western end of the tunnel.

Lynn General Electric Employees Attack H. C. L.—A vigorous attack on the high cost of living was launched recently at the Lynn (Mass.) works of the General Electric Company, when a clothing store was opened under the direction of the Lynn General Electric Employees' Co-operative and Collective Buying Association. The organization is incorporated and capitalized at $100,000, shares at $10 each being sold only to employees of the company. Officials of the General Electric Company are not connected with the organization, although its plans are heartily approved and space in the works buildings has been set apart for the store. Overalls, haberdashery, suits and shoes will form part of the stock in trade. In the near future another organization of employees will be incorporated to sell foodstuffs under the direction of the Metal Trades Council of the General Electric Company.

Metric System Not to Be Favored in the Army.—Confusion in the army arising from the increased use of metric units of weight and measure has prompted the Secretary of War to order the use of British units wherever practicable. His instructions are as follows: "Hereafter the customary former units of weight and measure (including the degree Fahrenheit) will, as far as practicable, be used throughout the army as they were before the war. Material and equipment now graduated in metric units will when worn out be replaced by articles graduated in British units in such manner as will cause all parts of a regiment or similar organization (or smaller organization when there is no regimental organization) to be provided at all times with material and equipment graduated alike. This order shall not be construed to prevent the utilization of metric units of weight and measure when desirable in connection with specifications and contracts, medical and scientific supplies, scientific research and developments, international meteorology, foreign maps, monographs, handbooks and similar subjects."

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

American Electric Railway Association.—The annual convention of this association has been fixed for Atlantic City, N. J., Oct. 11 to 15.

Business Meeting of A. I. E. E.—The annual business meeting of the American Institute of Electrical Engineers is to be held next Friday, May 21.

National Electric Credit Association.—The twenty-first annual meeting of this body will be held at the Hotel Commodore, New York, on June 17 and 18.

Industrial Relations Association of America.—The second annual convention of this association will be held at the Auditorium Theater, Chicago, on May 19, 20 and 21.

Society for Electrical Development Moves.—Headquarters of the Society for Electrical Development, formerly in the Engineering Societies Building, are now in the Guaranty Building, 522 Fifth Avenue, New York City.

Iowa Section, National Electric Light Association.—This section will hold its next annual convention at the Colfax Hotel, Colfax, Iowa, on June 23 to 25, inclusive. The convention will be a strictly business meeting, and managers of small independent companies have been specially urged to attend. Executives of the larger companies have also been requested to send their department heads and local managers. A consolidation of the Iowa Section with the proposed Middle West Geographic Division of the N. E. L. A. will probably be approved. Rex H. Fowler, 510 Crocker Building, Des Moines, Iowa, is assistant secretary.

A. I. and S. E. E., Philadelphia Section.—Officers elected for the ensuing year at the May 1 meeting of this section of the iron and steel engineers were: Chairman, A. J. Standing, Bethlehem Steel Company; vice-chairman, R. B. Gerhardt, Bethlehem Steel Company; secretary, L. O. Morrow; executive committee, Walter C. Kennedy and H. Cosdon. R. B. Gerhardt, in a talk on "Electrical Transmission in a Steel Plant," described the selective operation of relays in protecting the double-ring bus transmission system of the Bethlehem Steel Company's Sparrows Point plant. Other papers were: "Waste-Heat Boilers for Open-Hearth Furnaces," by T. R. Tate; "The Giant Pull," by G. W. Richardson; "Methods Used in Laying Out the Electrical Equipment for a New Steel Plant," by H. Cosdon, and "How the Accounting Department Can Serve the Operating Department," by R. F. Gale.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Early-Morning Lighting in Small Town.—The Public Service Commission of Missouri has decided that the proprietor of an electric lighting plant in Leeton, a town of 500 population, will not be required to furnish electricity between 4:45 a.m. and daylight from May to September, although the terms of his franchise so require, unless the patrons are willing to pay rates commensurate with such service.

Payments in Lieu of City Tax Must Be Prorated Among Customers Benefited.—The Idaho Power Company having agreed to pay to the city of Boise certain sums annually in lieu of a tax formerly paid in consideration of a franchise which has been canceled to obviate duplication of equipment, it has been held by the Idaho Public Utilities Commission that these payments must not be charged into general operating expenses but prorated among the company's Boise consumers.

Unprofitable Lines Ordered Continued.—The Public Service Commission of Nevada has denied the Nevada-California Power Company authority to discontinue operation of its electric power line from Lundy, Cal., to Nevada districts, excepting Fairview and Wonder. The company desired to withdraw service from Hawthorne, Mina and other southwestern Nevada points. The commission held that inasmuch as the company had used profits from its Nevada business to build a new line in California it would not be fair to abandon Nevada patrons because the service was less remunerative.

Right of Supply Company to Prescribe Types of Motor Denied.—The Illinois Public Utilities Commission has refused its approval to proposed rules of the Commonwealth Edison Company designed to raise the power factor of the company's system and to this end requiring future installations of motors rated at 100 hp. or more to be of the synchronous type and motors rated at 50 hp. or more, if operated at variable speeds or if normally started at frequent intervals, to be of the wound-rotor or slip-ring type. The commission having prescribed rules establishing standards and limits of voltage regulation, the consumer is held to be entitled to service which conforms to such standards and should be put to no extra expense to obtain this service so long as he is not unreasonable in his use of it. Consumers, the commission declares, are entitled to a direct benefit for the additional expense of installing synchronous motors.

Consumers' Economy May Benefit Electric Utility.—That the exercise of economy by consumers of electrical energy is often a benefit to the generating company is pointed out by the Wisconsin Railroad Commission in a decision permitting the Hayward Electric Light & Power Company to change its power rate from a flat to a meter basis. Economy by consumers, the commission says, "is to the utility a very important consideration both on account of the cost of extra generation and on account of loading down the generating equipment, which may mean the installation of additional equipment to take care of new customers. Another consideration enters into the case of hydraulic plants. During periods of low water the water used in generation may exceed the stream flow, in which case the load must be cut off in part or temporarily in entirety."

Centralization and Over-Development.—In authorizing the acquisition by the Central Maine Power Company of the Androscoggin, Knox County and Oxford companies, the Maine Public Utilities Commission made the following explanation of the principles governing its approval: "If a relatively small hydro-electric company is serving a fairly small community, the development of the facilities with which it renders service is likely to be expensive, and if it over-develops, as is natural in providing for future growth, this over-development has to be supported by the customers of the company and often results in a considerable burden. If additional power is desired and a new development has to be made, good judgment on the part of the company will require it to over-develop in anticipation of future business. The result is that each small company is likely to be carrying as a burden a fairly large amount of idle property which has to be supported by its customers until the time when a use therefor is found. If the company does not develop its own energy but purchases from a generating company and, as sometimes happens, the company from which it purchases is also a purchaser from another company, there is at least one profit, and sometimes two, that the last company has to pass along to its customers. Further than this, the character of the service rendered by a small company is likely to be not entirely satisfactory, the means for extensions are not always available or obtainable, the territory is frequently only partly served, and the rates charged are likely to be fairly high. On the other hand, if one financially strong company, with ample power or with reserve facilities from which ample power may be secured, is occupying a large territory, that entire territory gets the full benefit of the combined facilities, each part of the territory getting as good service as any other part. If a new development has to be made there is but one development, and there are no profits to be paid to outside generating companies."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Failure to Call Witnesses Construed Unfavorably.—Failure of a plaintiff public utility in a rate case to call available witnesses who could have testified as to accessibility of books, and who without them might have thrown light on the original cost of construction, justifies the conclusion that their testimony would have been unfavorable to it, the Supreme Court of New York recently asserted. (180 N.Y.S. 570.)

Boiler Room of Electric Plant Not a Place of Extra Hazard.—A fraternal benefit society having refused to pay a policy taken out by a man who subsequently changed his occupation without notice to the society and took employment as a fireman in the boiler room of an electric plant, the society's life certificates classifying "electric works" as places of extra hazard, the Texas Court of Civil Appeals ruled that where the boiler room was separated from the generating room by a partition and the fireman was not required to enter the generating room the contention that his employment was extra-hazardous could not prevail. (219 S.W. 492.)

What Constitutes Proof of Confiscation.—In denying the suit of the Kings County Lighting Company to have the legal rate of 80 cents for 1,000 cu.ft. for gas declared confiscatory, the Supreme Court of New York declared that unless the evidence is conclusive that confiscation is inevitable under a rate law a public utility attacking it fails to meet its burden of proof where it has made no practical test by actual operation under the prescribed rate; nor are rates fixed by law for a public utility necessarily confiscatory because for an abnormal year its income is thereby reduced below what would ordinarily be deemed an adequate return on the investment. (180 N.Y.S. 570.)

Crossing Street Diagonally and Failure to Observe Dangling Wire Not Negligence.—An employee of an electric light company while pursuing his duty was injured by coming into contact with a telephone wire which had come loose, fallen across a high-voltage line and was dangling five or six feet above the ground. The Supreme Court of Pennsylvania, in affirming a verdict for recovery of damages, held that the fact that the plaintiff crossed the street diagonally and failed to look up did not constitute contributory negligence, as any pedestrian has the right to cross a street diagonally and no one was obliged to anticipate danger from overhead wires. (109 A. 211.)

Men of the Industry

Changes in Personnel
and Position—
Biographical Notes

H. J. Butler, power administrator of the Railroad Commission of California, has recently been placed in charge of all of the power generated in that state. Prior to this Mr. Butler's activities were confined to the northern part of the state, but, owing to the shortage of power for the present year, it was felt necessary that the entire state should be under the control of one man. Mr. Butler has carried on the duties of power administrator since June, 1918. He was graduated from the University of Illinois with the class of 1906 and after graduation was connected with several railroads in the Middle West, including the St. Louis & San Francisco. In 1911 Mr. Butler went to Panama for the government, having charge of the railroad yards there during the canal's construction. At the completion of the canal Mr. Butler was called to the California Railroad Commission, acting in the capacity of assistant chief engineer until two years ago, when he assumed his present position.

H. J. BUTLER

M. Imai, consulting engineer for the South Manchurian Railroad of Northern China, is visiting this country making an investigation of high-head hydro-electric power development.

Howard S. Phelps, who was electrical engineer for the Iowa Railroad Commission, Des Moines, Iowa, has accepted a position in the engineering department of the Philadelphia Electric Company, Philadelphia.

J. C. McLaughlin, who for some thirty years has held the position of manager of the commercial department of the Potomac Electric Power Company, Washington, D. C., resigned May 1 to open an electrical retail store in Washington.

Walter A. Hall, who for twenty-two years had been connected with the Lynn Works of the General Electric Company and during recent years served in the capacity of assistant to the general manager, has resigned to become vice-president and general manager of the Murray & Tregurtha Company, builder of gasoline engines.

Louis H. Egan, who became vice-president of the Union Electric Light & Power Company of St. Louis last year, has been elected president of that company, succeeding J. D. Mortimer of New York, whose resignation was recently announced in the ELECTRICAL WORLD, as president of companies controlled by the North American Company, of which the Union Electric Light & Power Company is one. Mr. Egan was graduated from the Sheffield Scientific School of Yale University in 1904 and for about eighteen months thereafter worked for the Algoma Steel Company, Sault Ste. Marie, Ontario, as an electrician's helper. He then entered the central-station field and for the next five years worked in various engineering and sales capacities for the Edison Sault Electric Company and the companies affiliated with the Detroit Edison Company, finishing that period as division manager for the Eastern Michigan Edison Company. From 1910 until 1916 he was general manager of the Kansas City Electric Light Company and in November, 1916, became affiliated with the North American Company properties in St. Louis. Mr. Egan was first appointed general manager of the Electric Company of Missouri, and after that company was combined with the Union Electric Light & Power Company he was made assistant general manager of the combined properties. In the fall of 1919 he was elected a vice-president. Mr. Egan has also served as vice-president and general manager of the St. Louis County Gas Company, of which he also becomes president.

Fred H. Heimburg has been appointed assistant to the chief engineer of the Turners Falls Power & Electric Company, with headquarters at Greenfield, Mass. Mr. Heimburg was graduated from Columbia University in 1916 and has since been employed at the Schenectady works of the General Electric Company. He has been assistant to H. M. Hobart in general engineering work for the past sixteen months.

Warren G. Lewis, who for the last fourteen years has been electrical engineer of Knowlton Brothers, Inc., Watertown, N. Y., has been appointed superintendent of power for that company in charge of steam and electrical power service for the works. Charles Stebbins, recently electrical engineer for the Racquette River Paper Company, Potsdam, N. Y., has been appointed assistant superintendent of Knowlton Brothers, Inc.

William Cotton Lounsbury, general manager of the Superior (Wis.) Water Light & Power Company, who has been re-elected president of the Wisconsin Electrical Association, has been with the Superior Company for thirteen years. He graduated from the Massachusetts Institute of Technology in 1904 and after spending the next few years in Worcester, Mass.; Washington, D. C., and New York City, he took charge of all construction work for the Superior (Wis.) Water, Light & Power Company. In 1912 he was made general superintendent of the company in charge of the operation of the water, gas and electric departments and after making an enviable record reducing operating costs was appointed general manager in 1918. Mr. Lounsbury is a fellow of the American Association for the Advancement of Science and, in addition to being active in many associations connected with his business, he is serving his second term as president of the Superior Park Commission.

W. C. LOUNSBURY

Charles H. Carpenter, formerly manager of the Buzzards Bay Electric Company and well known in New England electric utility circles, has received the decoration of Officier d'Académie Française, in recognition of his services as lieutenant in the fourth section of the United States Army general staff, at the headquarters of General Pershing. Mr. Carpenter is the son of Eugene Carpenter, long prominent in the development and management of public utilities in the Cape Cod and White Mountain districts of New England. He is at present treasurer of the Mason Perkins Paper Corporation, Bristol, N. H.

William Milnes Maloy, Annapolis, Md., formerly State Senator from that district, has been appointed chairman of the Board of Public Service Comissioners of the state by Governor Ritchie. Mr. Maloy succeeds the late Milton Reifsnider.

George Rosenberger, Manassas, Va., has been appointed manager of the Herndon (Va.) Electric Light & Power Company.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler
and Jobber of Electrical Equipment and Supplies Notes on Industrial Activities
and Business Methods

Freight Tie-Up Causing Shut-Downs to Industry

ALTHOUGH the switchmen's strike had been declared ended, the after-effects of that tie-up have been much worse than were anticipated by manufacturers. Railroads report that they are handling freight in varying amounts up to almost normal, but manufacturers are finding little encouragement in these reports. Renewed yard walkouts are making the situation much more serious.

Material connected with the electrical industry is not moving in quantity to relieve the demand for it. In the steel-mill regions lack of coal, coke and raw materials has shut down furnaces and mills in many centers. Buffalo mills are reported at 60 to 70 per cent operation, while those in the Youngstown district are reported at less than 50 per cent normal. Conditions around Chicago mills are given as 75 per cent of normal, while Pittsburgh is placed as high as 90 per cent. If coal is not moved into these centers in greater quantity, it is expected that these values will drop. At the same time hundreds of coal mines are reported idle.

In the New York district there is a threatened shortage of coal. Already in Chicago the seriousness of reduced utility consumption of coal has been reported, and it is also felt in Detroit. The lake boats themselves are getting short of coal and are tying up at their docks idle.

While the railroads are apparently exerting all efforts to move coal and food, they are handicapped by lack of men, cars and locomotives. The facilities do not seem to be at hand to unscramble the mass of cars that have piled up in the yards. The Interstate Commerce Commission sets the normal functioning of the railroads under the best conditions at not under sixty days.

Active Demand for Farm High-Tension Substations

THROUGHOUT the central portion of the country, and in the West, the demand for high-tension switching substations for farm service has grown to be a real factor in the business. The demand is also good in Canada. In the East and South there has not been so much call for this service as these sections are not strictly farming districts. At the same time, these sections report that an increasing interest is being taken in this high-tension equipment, and orders are coming through fine.

In Canada, in particular, central stations have reported a marked increase in orders for this service, which could not be accepted because the station capacity was not available. Another reason given for the unfilled orders was the lack of utility finances to extend the lines where capacity was available and the indecision of the farmers as to the best methods of financing it on their part. They would prefer to buy the substation equipment outright, but were not in all cases able to do so.

Central stations in the Middle West are buying the substations outright from the manufacturer and reselling them to the consumers, sometimes for cash and at other times on some sort of a payment plan. In this connection it is found that farmers prefer lump payments over long terms of a year or so rather than on monthly instalment basis. So it seems that the method of payment has a great deal to do with the distribution of high-tension farm substation equipment. As far as could be learned there has been no definite policy adopted either by central station or by manufacturer in regard to this matter of payment.

Apart from the transportation delays which manufacturers are experiencing, shipments of this equipment are being quoted at from three or four weeks to five months. Factory conditions now are badly congested, and it is probable that still further delays will add to this shipping time. The demand in the Middle West is reported for sizes running up to 150-kva. units, while in the East it is rarely above 20 kva. Small farms in all sections, however, are averaging around 1 kw. for light load and may run up to 5 kw.

March Electrical Exports Far Ahead of February

IN SPITE of the foreign exchange situation the export of electrical goods for the month of March reached a value of $8,874,884. This is an increase of $2,291,656 over the month of February, 1920, and of virtually $1,000,000 over March of last year and is the highest amount exported since last June. Each succeeding month of the year has shown an increase over previous months, and the total amount for the first three months reaches a value of $21,805,549, as against $22,164,966 over the same period of 1919. The new year is starting off favorably when low exchange values to European countries are considered.

Manufacturers of electrical apparatus report an exceedingly heavy demand from outside the country. Those who have capacity reserved for foreign fields are having little difficulty in finding a ready market for every bit of material they can produce and move. Conditions of rail transportation are seriously affecting shipments to coast ports, and much material that does reach the coast is being held up by port loading and shipping strikes. This is an increasingly serious factor in the export field.

	March		Three Months Ended March	
	1919	1920	1919	1920
Batteries	$ 579 708	$ 690.866	$ 1,345,956	$ 1,592,568
Carbons	98,923	128,531	449,391	344,757
Dynamos and generators	390,765	464,178	1,028,063	1,240,811
Fans	269 934	115.069	567,463	224,436
Heating and cooking apparatus	151,693	135,450	321,344	389.289
Insulated wire and cable	1,025,867	543,546	2,541 178	1 772 424
Interior wiring supplies	172.622	230,315	578,589	594,718
Arc lamps	308	1,088	3,216	1,351
Carbon-filament lamps	14,039	19,986	50,738	36,865
Metal-filament lamps	426,128	427,348	1,407.682	1,002.436
Magnetos spark plugs, etc.	321,499	444,240	856,953	957,658
Meters and measuring instruments	273,373	207,655	853,272	615,242
Motors	838,448	1,247,806	2,626,598	2,807,355
Rheostats and controllers	38,565	72,896	103,443	177,936
Switches and accessories	225,305	356,631	592,133	1,031,870
Telegraph apparatus	60,186	61.530	246,323	261,684
Telephones	255.154	414,451	802,506	898,094
Transformers	449.077	347,195	1,159,699	992,744
All others	2,284,759	2,966,103	6,630,419	6,863,312
Total	$7,876,353	$8,874,884	$22.164,966	$21.805 549

The biggest increases noted in March over February of this year are in carbons, fans, arc lamps, magnetos, motors, telegraph and telephone apparatus and miscellaneous equipment. Exports of motors increased 50 per cent, while those of carbon-filament lamps doubled. The above items and batteries, metal-filament lamps and interior-wiring supplies have shown a steady increase each month this year.

The figures in the table above are by the Bureau of Foreign and Domestic Commerce and include, for the sake of comparison, the exports of March, 1919, as finally revised.

Heating Device Makers Issue New Price Lists

Prices were advanced this week by some of the leading manufacturers of household heating devices and ranges. The new lists include Hot Point price list No. 19, Hughes price list No. 23 and Edison price list No. 8. There are also revised price lists of the Simplex Electric Heating Company and heavy duty Edison equipment. These were all made effective May 10. A new price list of the Landers, Frary & Clark line is made effective May 15. In no case has the entire line been affected, but where there has been a change in the price of the socket appliances it has generally been an increase of 5 or 10 per cent. Six-pound household irons have been increased by 50 cents.

Car Tie-Up Reacts on Schedule Material Producers

MANUFACTURERS of schedule material are at present struggling to keep their factories going in face of extraordinary difficulties arising from transportation shortage. A representative of the ELECTRICAL WORLD last week visited a number of large Connecticut factories producing this class of goods and reached the conclusion that only by the exercise of executive far-sightedness and by a substantial improvement in railroad conditions can a shortage of considerable magnitude be forestalled. Of course it has been hard to obtain raw material. Labor, while less scarce than in many lines, needs to take up a deal of slack in production, and beyond this, greater facility in accomplishing outgoing shipments of finished products to all parts of the country is of vital importance. Continued strikes in railroad and marine circles hamper material movement badly, and while some improvement in the railroad situation was evident on Saturday, the contrast between normal and present-day transportation facilities remains acutely painful. Production is throttled at both ends of the plant under such conditions.

Heavy shipments of sockets and other devices have been made to New England jobbers by local factories, following the imposition of strict embargoes on shipments through New York City and the gateways leading to Western points. These jobbers built up stocks rapidly in the weeks following the outbreak of the switchmen's strike, and such deficiencies as existed in territory within relatively easy reach of the factories were soon overcome. Within the last few days the flow of schedule material into Boston, New York and other centers adjacent to the manufacturing plants has lessened considerably, although there has not been any general tendency by jobbers to cancel orders. Instead, instructions have been sent to the factories temporarily to suspend shipments to particular jobbers whose stocks have been heavily enlarged. The difficulties of obtaining raw materials by rail, combined with iron-clad embargoes on outward shipments, led a leading manufacturer in Connecticut to close his factory for a week. Production there was resumed on Thursday of last week, and carload shipments are reported to have been resumed to Chicago, although on a subnormal scale.

One Middle Western representative of an Eastern factory did not receive a pound of schedule material for a month, and even boat shipments have been delayed and upset by labor troubles along shore. It is doubtful if manufacturers in this line are receiving more than 40 per cent of the material at the outside needed for full production, but the primary cause appears to be transportation inadequacy and not acute shortage of materials in themselves. Brass and copper have been in good supply notwithstanding strikes in the Naugatuck Valley. Porcelain and other insulation, while far from plentiful, has been obtainable in many instances by motor-truck service. Manufacturers who have forecast their raw material needs and ordered well ahead from regular sources are much better off than those who buy from hand to mouth.

Prices are steady in this branch of the industry. The volume of trade is much larger than was the case last year at this time, and in one representative plant the equivalent of 47 per cent of the entire business of 1919 was produced in the first quarter of this year. In April, however, only 40 per cent of the March output was shipped, owing to the transportation situation. Foreign business is extremely active in plants catering to that class of trade, April showing the best figures in the history of one important manufacturer. Deliveries of schedule material are now quoted on a three to four months' basis. There are no comprehensive factory stocks, although stocks of finished goods due for shipment will burden floor space for some time, pending material improvement in transportation conditions. Some extensions of plant are to be made at once, including the provision for increased storage facilities. The demand for these products bids fair to run into heavy totals for a long time to come, and if the transportation problem can be even partially solved, in comparison with recent stringencies, schedule material manufacturers will be able to serve the electrical industry better than at present seems possible. One more schedule material manufacturer, the Hart Manufacturing Company, has eliminated plus discounts by doubling lists and changing discounts to leave the same net. This change was effective April 1.

Greater Care Being Exercised in Credit Situation

WITH the general stifling of freight movement and the volume of orders overwhelming the manufacturers, credits are being watched extremely close. The wave of buying which has been sweeping the country has resulted in a severe taxing of the entire credit system. Raw and finished products are taking weeks and sometimes months to reach their destinations, and meanwhile the investment tied up in those shipments may have to be carried at a rate of 8 to 10 per cent. Warehouses are piled with finished goods, held up for lack of cars, and here too is the idle investment. Jobbers and distributers are being billed for goods shipped weeks ago which they have not received and on which they are getting no return.

All along the line it is costing more to do business and costing more to meet obligations than it did before the winter. Collections are lengthening. Where thirty to forty-day collections have been holding rather steadily, they are running up into the forty and fifty-day periods. Financial houses are scrutinizing very carefully the paper that is being offered them, and that of a speculative character is carrying relatively less weight than it did a short time ago.

Motor Stocks Almost Gone from Market

CONTRACTORS are having considerable difficulty in getting motors for their jobs. An extremely heavy call seems to be coming from the rather smaller shops, which are expanding their productive capacity and need a few motors. The larger manufacturers, too, are demanding motors in increasingly larger numbers, and it is almost impossible to keep up with the pace. Manufacturers' local stocks throughout the country are virtually depleted, and second-hand dealers and motor agents have only the barest semblance of a stock.

Freight tie-ups are permitting manufacturers who have raw materials to get a little bit ahead on their stocks, but little is moving away. Motor trucks are still taking a small percentage to the most essential jobs, but are hardly scratching the demand. This demand is running now to the sizes up through 10 hp., while two years ago it was around 20 hp. One prominent manufacturer states that outside of the fractional sizes 25 per cent of present demand is for 5-hp. motors.

Quoted shipments on these sizes up to 25 hp. are in the most favorable instances found to be around twelve weeks, and from there on up into the fall months. This embraces both polyphase alternating-current and direct-current motors. Starters are nearly as bad as the motors as far as shipments are concerned.

Production of Ferrous Wiring Materials Is Light

WIRING materials employing steel or iron in their make-up are virtually out of the market for the time being. It is true that here and there jobbers report receipt of a carload of pipe or flexible armored conductor, but it is found that this material comes from the general sorting out of freight cars in yards. These yards still contain many carloads of steel strip and pipe and fittings. Condulets and fittings of this type are in better supply as they are being substituted by contractors for elbows and other pipe fittings. The dearth of this steel and iron material is acute; jobs are being held up here and there for lack of it.

Virtually no flexible armored conductor is being produced, and supplies of its connectors and other fittings are exceedingly low. The small amount of steel strip that is being trucked is hardly a factor in the market. It is reported that, with steel mills working much below capacity, there is little sheet steel available for the electrical industry after supplying the demand of the automobile industry, which is willing to pay a premium to get it. From one source supply of sheets for industrial reflectors is shown to be extremely low, with little available before next fall. From another source there is sufficient in this manufacturer's stock for present needs.

Metal Market Situation

FREIGHT conditions are to a large extent responsible for a quiet copper market. Little interest is being taken in nearby shipments because consumers feel there would be no use in doing so with traffic virtually at a standstill. There was a little better interest displayed last week, however. Practically all the large consumers have covered their requirements through the second quarter, and just little fill-in lots are now going through.

Producers are asking 19 cents for nearby and June copper, and in a few instances they are going into July on that price. But future positions are attracting almost no attention. In some quarters it is felt that this period of freight stagnation will put off the period of future buying for a short time. The second market is making prices of from 18½ to 18¾ cents, and this market is receiving an increasing number of inquiries from electrical manufacturers and wire drawers. Refineries are shipping almost no copper, except where consumers will truck it away. They are short of raw materials and coal. Embargoes are keeping the New England market almost dry.

It is reported that the Copper Export Association is financing purchases of copper in America by French consumers. The demand from this source is off a bit because of labor disturbances in France.

The price of lead was lowered by the leading interest on May 7 to 8.50 cents, New York, a drop of ¾ cent. There is little spot in New York and May delivery is well sold. There is little interest in June and beyond, the price of June lead being about 8.10 cents.

NEW YORK METAL MARKET PRICES

	May 5	May 12
Copper	£ s d	£ s d
London, standard spot	101 5 0	101 5 0
	Cents per Pound	Cents per Pound
Prime Lake	19 00	19 00
Electrolytic	19.25	19 00
Casting	18 37½	18.37½
Wire base	23.00	22.50-23.00
Lead, trust price	9 25	8.50
Antimony	10 00	9.75
Nickel, ingot	43 00	43 00
Sheet zinc, f.o b. smelter	12 50	12 50
Zinc, spot	8 20	8 10
Tin	58 00	56 50
Aluminum, 98 to 99 per cent	33 00	33 00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16 50 to 16 75	16 50 to 16 75
Brass, heavy	10 25 to 10 50	10 00 to 10 25
Brass, light	9 00 to 9 50	8 75 to 9 00
Lead, heavy	7 25 to 7 50	7 00 to 7 25
Zinc, old scrap	5 00 to 5 25	5 00 to 5 25

THE WEEK
IN TRADE

SERIOUS shortages in electrical supplies are reported from all parts of the country. Business generally is good wherever supplies are to be found, but stocks are so badly broken in most localities that contractors are having difficulty in going ahead with any kind of a building program. Lack of transportation is largely responsible for the serious condition in which many jobbers now find themselves. In the East shortages of cement, brick, lime, etc., are holding up much building work. Labor troubles in the building trades in various centers, including Chicago and New York, a coastwise shipping strike and embargoes put on by the railroads all have been effective in slowing down building construction.

Business during the next six weeks, which ordinarily would be exceedingly heavy on account of spring building, promises to be a severe disappointment unless freight now held up is rapidly released.

NEW YORK

All jobbers are faced with serious shortages of electrical supplies. Some of the jobbers' stocks are so low that it is only with great difficulty that any business at all can be transacted. Business for those jobbers who have been able to maintain principal stocks has been good, but this has been the case only in a few instances.

Freight is dribbling in, and virtually all kinds of supplies have been received during the week, but not in sufficient quantity to be of much use. Some trucking has been resorted to, but the high rates charged are almost prohibitive. Most jobbers are refusing to pay prices asked.

Collections are slightly off. This is the direct result of failure to receive goods billed by jobbers. In a number of instances goods have been en route for six to seven weeks and contractors are holding jobbers' invoices waiting for the freight to be unscrambled.

Orders have fallen off and demand for new buildings is greatly reduced on account of scarcity of non-electrical building materials. Most of the work being done is on remodeling of old buildings.

Heating Appliances.—Manufacturers are expected to advance the prices of flatirons, toasters, etc., about May 15. The increase on irons will amount to about 6 per cent.

Flexible Armored Conductor.—Some stocks are arriving by truck, but the amounts are small. Some jobbers have advanced prices, although the majority are holding to $110 per 1,000 ft. for No. 14 double-strip in lots of 1,000 ft. or more.

Motors.—Stocks have vanished with small prospects of getting any motors for some months to come. There are some in the hands of used-material dealers, but even these are few and far between.

Lightning Arresters.—Heavy demands have reduced stocks to almost nothing, and although a few have been received the number has not been large enough to fill back orders.

Transformers.—Distribution transformer stocks, which have a quick turnover, are virtually out of the market. Usual demand with no new stock coming in has resulted in an acute shortage of all sizes.

Compensators.—There are no stocks of compensators anywhere. Not a single compensator is reported in the stock of any representative number of jobbers.

Wire.—Rubber-covered wire has been received during the week in sizes up to 400,000 circ.mil, with the exception of No. 14. One manufacturer has marked up weatherproof 1 cent a pound on account of cotton.

Push-Button Switches.—This line, which was advanced by four manufacturers several weeks ago, as announced in these columns, has been marked up since by another manufacturer. Former shipments received by boat have been stopped. Small shipments are received by truck, but in general deliveries are unsatisfactory.

CHICAGO

Chicago's long-continued period of slackness in the construction industry has reached a point where it has become the subject of comment in the daily papers. New construction is being undertaken at the rate of approximately $1,500,000 a week, against a ten-year average of more than $2,000,000 and an average for the spring seasons of the past ten years of $3,000,000. Taking into consideration the present high cost of construction, it is evident that the physical volume of building is this year only one-half normal.

Production and transportation difficulties have been such that manufacturers and jobbers are having great difficulty in supplying even this reduced demand. The claim is made that railroad service is 80 per cent normal; if true, most of the shortage must be given to the electrical trade, for shipments are almost impossible of movement. Jobbers report that not a pound of freight has been received from various important producing points for more than five weeks. All manner of plans are being tried for securing goods, vast quantities being shipped in solid cars to Hammond, Ind., or other nearby points and trucked on into the city. The expense on such work is figured at one dollar or more per truck-mile and is adding materially to the jobber's financial burden.

Local factories, through scant raw material and coal supplies, are showing lessened production. This combination of circumstances is delaying the day when back-order files will return to normal and dealers' and jobbers' stocks hold a reasonable amount of goods.

Collections are a little tight. Slow deliveries have thrown a heavy financial burden on the jobber, and general tightness in money has rendered his situation more difficult. Reports show collections ranging from forty-one to fifty-two days, with those interests which favor the use of trade acceptances making the better record.

Lamps.—Stocks here are in a deplorable condition, solely on account of transportation troubles. Receipts for the last six weeks have been negligible and stocks already low have evaporated. Emergency needs are being handled by trucking goods into Chicago from points outside the city where freight is stalled. Demand is normal except from railroads, which are placing unusually heavy orders.

Fans.—Local supply is low, only certain types being available, while new orders continue to be placed in large volume. Deliveries on goods from factory range from four to twelve weeks.

Wire.—As in all other lines, stocks are getting low, but as yet prompt deliveries are being made on most kinds from jobbers' stock. Minor fluctuations in the price of electrolytic copper are causing some price confusion. Several makers have advanced one cent to a 29-cent base, while others are still using 28-cent base. On a 28-cent base No. 8 weatherproof is 31 cents and No. 8 bare is $26.25 per 100 lb., in 200-lb. lots.

Line Tools.—Mathias Klein & Sons have withdrawn quotations on all wireman's tools. Pliers, splicers and similar items are almost wholly out of stock and delivery promises range around six months. Some climbers are available, in limited quantities only. Shovels, spoons and pike poles are in fair supply.

Insulators.—Supply conditions on porcelain insulators are getting constantly worse, owing to raw-material conditions. Deliveries are slow and uncertain and a threatened shutdown of some factories promises no immediate improvement. Trade conditions in glass remain more nearly normal.

Poles.—Producing fields are being seriously harassed by a timberman's strike. Open shop companies were not affected at first, but intimidation caused many of their men to quit. Poles, being sixth-class freight, are receiving scant consideration from the railroads.

Washing Machines.—Most makers remain able to make prompt deliveries, although Chicago factories are seriously troubled in securing coal and supplies. Local sales campaigns are meeting with marked success.

Heating Devices. — Hollow-ware remains hard to get, stocks still being seriously low. Delivery dates are uncertain and prices show an upward tendency. New lists are anticipated from various manufacturers in the immediate future.

BOSTON

Trade continues extremely active, the chief handicap being delivery conditions. These show a slight improvement and some carload freight is moving into New England for electrical purposes. Outward shipments are a trifle better. Collections hold up well. Stocks are somewhat larger in wiring material, but iron conduit is very hard to get. Prices are a little unsteady. Flexible armored conductor is quoted easier. Motors are in great demand, and a shortage of fans threatens this district this summer. Lamp cord is a little more plentiful in the cotton-covered type. Building operations scheduled to May 6 total $115,693,000 for New England, compared with $43,193,000 in the same period of last year. Since 1900 this annual total to May 6 has never exceeded $67,000,000. Street-lighting extensions are being prepared in various places, and industrial-plant additions continue to occupy attention. Labor is on strike in important textile centers, but a threatened walkout on a considerable scale at the Lynn Works of the General Electric Company has been averted. Brass mills in Waterbury are hard hit by strikes.

Wire.—Mills at Ansonia, Conn., have resumed work, following the return of employees forced out by an unsuccessful strike of unskilled laborers. Rubber-covered No. 14 wire is firm at $11 per 1,000 ft. in 25,000-ft. lots. Weatherproof and bare copper are quoted on 28-cent and 24-cent bases. Finer sizes of wire used in instrument coils are scarce.

Commutator Bars.—Recent strikes in the Naugatuck Valley have impeded the output and delivery of commutator bars. Conditions are expected to improve soon.

Electric Starters.—Transportation difficulties have cut production in one representative Massachusetts factory from 800 to 400 sets per day. Raw material and finished-product movement has been slow.

Lamps.—Current requirements are being well handled, but no excess stocks are being built up, so far as can be learned. Prices are steady. Motor-truck shipments have been of great help.

Motors.—While prices are steady, stocks are virtually shot to pieces as regards smaller-sized motors. Fractional-horsepower motors are almost unobtainable, and up to 25 hp. alternating-current motors are very low in supply. Carload shipments of motors are on the way to Boston, but these will be quickly absorbed by the market.

Flexible Armored Conductor.—This material is easier at $110 per 1,000 ft., in single-strip, No. 14. Stocks have been much improved of late, in spite of the active demand.

Non-metallic Flexible Conduit.—Loom is now sufficiently plentiful to permit sales of 5,000-ft. lots in a fairly free market. The $\frac{7}{32}$-in. size in this quantity sells for $33.50 per 1,000 ft., and the $\frac{5}{16}$-in. size for $36.50. Wiring contractors are much relieved at the improved situation.

Lamp Cord.—Good stocks of cotton-covered cord are reported in Boston. This can now be had in 5,000-ft. lots at $28 per 1,000 ft., in No. 18 size.

Schedule Material.—Local jobbers are getting well stocked, and instructions to slow up shipments have been sent in some cases to the factories. Transportation difficulties caused the shutdown of a large Connecticut factory for a week, but conditions are slowly improving and it is believed that vigorous efforts to get in raw material will enable such plants to keep going henceforth. Socket prices show no change from last week.

ATLANTA

Despite unfavorable weather conditions, there has been no decrease in building or other commercial and industrial activities, although continued rains have so retarded spring planting as to cause a feeling of pessimism in the rural districts. This, however, has not yet been reflected in business conditions, and proposed construction both in the country and city districts is being announced daily. The threatened walkout of union labor in Atlanta failed to materialize and the prospects at present are that no concerted action will be taken. The striking tinners, painters and glaziers have been replaced; the plumbers' strike has failed to interfere materially with building operations.

Jobbers report that the embargoes on shipments from the East and Middle West are being acutely felt. Badly needed material held for shipment in the East cannot be started for lack of cars, and local stocks are showing the effect of this failure to receive shipments.

Bank collections continue to show a gain of 30 per cent to 45 per cent over the same period of last year, and collections in general are reported good.

Wire.—A slight advance is to be noted in the way of smaller discounts, but no change has been made in the base, which is quoted at 28 cents rubber-covered, 29 cents weatherproof. Rubber-covered stocks, with the exception of No. 12, are in fair condition, but one of the largest jobbers reports no weatherproof on hand. Shipments are quoted at from eight to ten weeks, and orders for No. 12 rubber-covered now three months old have not been filled.

Distribution Transformers.— These are being received slowly and local stocks are in bad shape. The popular sizes of 5, 10, 15 and 25 kva. are not available for immediate service and shipments are quoted at from three to four weeks. Much difficulty is experienced in serving new customers promptly because of this condition.

Non-metallic Flexible Conduit.—A slight betterment in this line is reported this week, one jobber having received a shipment of 25,000 ft. and promise of 50,000 ft. additional in the next ten days. The first shipment was absorbed by back orders, while the second shipment will fill only one-half of the orders on hand. Prices, lots of 250 ft. to 1,000 ft., $\frac{5}{16}$-in., $5.52 per 100 ft.; $\frac{7}{32}$-in., $5.06 per 100 ft.

Schedule Material.—No improvement in stocks is to be noted. Acute shortage exists in those articles requiring porcelain, also in knobs, cleats and rosettes. Good stocks of pull-chain sockets and fair stocks of key sockets are reported on hand.

Friction Tape.—A sufficient quantity is on hand to supply the present demand, although an increase of approximately 20 per cent in price has been made. Shipments are reported fair in the face of brisk demand.

Poles.—Difficulty is being experienced in obtaining shipment on any class of poles, owing to car shortage, and construction work is being badly delayed because of this fact. Manufacturers report stocks on hand sufficient for the demand but cannot obtain cars. Prices, 30 ft., 7-in. tops, Western red cedar, $12.80; white cedar, $7.50.

Safety Switches.—Local building activities have depleted stocks of this specialty, even in the face of fair deliveries. Prices are quoted as follows: Standard packages, two-pole, 30-amp., $1.76; three-pole, 30-amp., $2.64. Broken packages, two-pole, 30-amp., $2.04; three-pole, 30-amp., $3.06.

Flashlights.—Demand continues to hold up excellently and stocks have become rather spotty with shipments reported only fair. There are, however, sufficient supplies of batteries in the territory.

SEATTLE—PORTLAND

In spite of chaotic deliveries, shortage in stocks and fluctuating prices, there is no apparent decrease in the trade volumes in the Pacific Northwest from week to week. This condition is especially noticeable in Seattle, Tacoma and other Puget Sound cities where building is opening up on a scale in excess of the most optimistic expectations. Collections, generally speaking, are holding up well, those from out-of-town dealers being especially good for this time of the year. Weather conditions in this district during the past three weeks have been ideal from an agricultural standpoint. Lumber mills and logging camps are running full blast and the steel shipyards will resume work on recently awarded contracts as soon as steel from the East can be laid down. The labor situation in the Puget Sound country is easy, with plenty of common labor to be had. Business in general seems to remain relatively quiet. Credit is tightening, jobbers are watching particularly new organizations which have started during the last year or so and which have not yet become well established. Collections are noticeably poorer than they were. There is a great difference of opinion existing at the present time as to whether all these indications point toward the fact that the crest of the wave of high prices has been reached. There is an indication, however, that some badly needed improvements that have been delayed for a number of years in railroad circles are to be taken care of gradually. The labor situation is rather peculiar. Common laborers seem to be very difficult to secure. However, reports are that a large number of journeymen wiremen are available with no work to do.

Line Tools.—In the face of an increasingly active demand of recent date, stocks are in poor condition, especially along the line of smaller tools. Indications, however, are that the situation locally will be improved within the next two or three months. There is considerable line work progressing, the major portion being replacements and betterments to existing lines in rural districts.

Appliances.—Steady demand along practically every line is being inadequately met by insufficient and depleted stocks. Jobbers have practically abandoned hope of normal stocks or even sufficient stocks to meet demand for a year at earliest. Shipments from factories are poor and erratic.

Glassware.—Existing shortage in this section is becoming more acute owing to the increasing demand. Little or no hope is held out for immediate improvement within six months.

Flexible Armored Conductor.—There are no stocks worth mentioning in this district, and shipments are snapped up on arrival; this in the face of good demand.

SAN FRANCISCO

Exceedingly important electrical conventions are now in full swing in California, the month of May being marked by the Del Monte and Pasadena meetings. Building construction has dropped off within the last few days, and dealers are now principally busy with the completion of existing contracts. Comparatively few new ones of any size have been signed. Device business, too, is rather quiet, although this is partly caused by the absolute exhaustion of available stocks on certain lines.

Ironing Machines.—There are now few electrical dealers who do not display ironing machines on their floors, and in many cases excellent demonstrations have been placed. Sales have been a little slow recently. Stocks are fairly good with the demand concentrated on the 42-in. width roll.

Heating Material.—Renewed effort by certain companies to stimulate heating business has resulted in many orders. Orders are now being taken for Christmas deliveries, and many dealers, remembering the wild scramble during the fall of 1919, are protecting themselves by ordering early and often. Coast stocks are poor.

Vacuum Cleaners.—Except in the case of big department stores, there has been a recent tendency among dealers to concentrate upon one or two makes which has gradually meant the elimination of the half dozen or more models that were being carried during the fall of last year. Customers were often embarrassed by this multiplicity of makes and gradually reached the condition where they would not buy at all unless they tried out several types. Dealers now are concentrating on fewer types and find that it does not hurt their sales and, besides, increases the rate of their turnover

New Apparatus & Appliances

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Portable Wireless Set

The usual outside aërial, says the producer, can be eliminated by the use of a portable wireless set manufactured by the Winn Radio & Electric Manufacturing Company, Chicago. It is claimed that this set can be operated successfully from a loop aërial inside a house for a sending range of from 10 miles to 12 miles and for a receiving range of from 200 miles to 300 miles under favorable conditions. In the newly designed detector used on this instrument a glass dust-proof cylinder keeps the crystal clean and free from vibration. The interrupter is equipped with heavy platinum iridium points. By the use of sliders for regulating the tuning coil every strand of wire in the coil can be utilized. The instrument is cased in an 8-in. x 9-in. x 11-in. mahogany finished box and weighs complete about 15 lb.

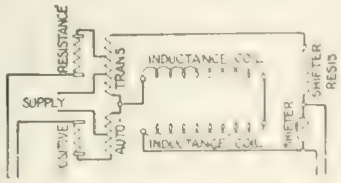
COMPLETE WIRELESS SET WEIGHS 15 LB.

Electrode Cooling Ring for Electric Furnace

In order to prevent the ignition of the hot gases escaping from the furnace roof, the Electric Furnace Construction Company, Philadelphia, Pa., has designed a cooling ring for the electrode. The roof portholes are kept cool, the electrode is kept reasonably so, and the gases are cooled down as they leave the furnace, says the manufacturer. The gases, after passing through the roof porthole around the electrode, pass through a clearance in the cooling ring and into a relatively larger chamber. Here they expand and give up considerable heat, which is absorbed by the water in the cooling ring. This process is repeated in a larger chamber, and a thin inclosing cover dissipates still more heat as the gases pass out to atmosphere, too cool, says the manufacturer, to ignite. The cover is made adjustable to allow for different working conditions with different electrodes. The standard form of the electrode economizer will have the bottom flat, but in cases where the roof is arched they can be made to conform to the curvature of the roof.

High Power-Factor Mercury Vapor Lamp

To overcome objections to low power factor encountered in the operation of mercury-vapor lamps on alternating-current supply, the Cooper Hewitt Electric Company, 95 River Street, Hoboken, N. J., has developed and is marketing its EC auxiliary for use with type F lamps. The new feature of this auxiliary is a positive low-resistance unit which takes the place of the former choke coils, and through its use the manufacturers say that the power factor of the lamp has been raised to 85 per cent from the former value of 52 per cent. In addition, the weight of the EC auxiliary has been reduced to 42 lb. net, a saving of 14 lb. over the old E. A. auxiliary. There is also an increase in allowable voltage variation, the present regulation being 25 per cent, while formerly it was 12 per cent. Present wattage is 430 watts so that the candlepower of the tube is increased 12 per cent. The tube will operate at 3.8 amp. direct-current normal through the tube. The weight of the auto-transformer is slightly reduced because of less current flowing through it.

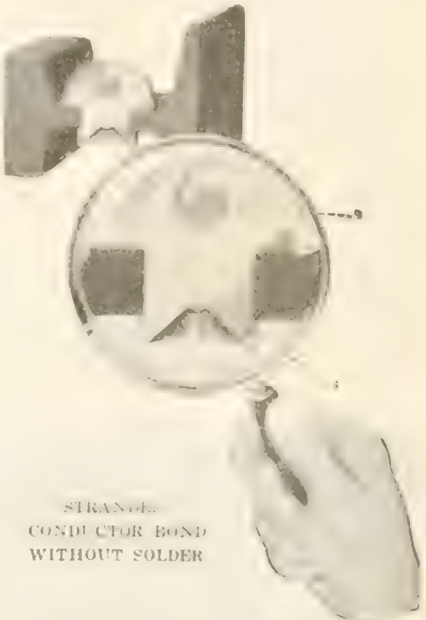


POWER FACTOR INCREASED TO 85 PER CENT

In the illustration the two leads at the left connect with the positive terminals of the tube, while those at the right connect with the negative terminal and the starting band of the tube. The lamp is adapted to alternating current circuits only and can be used only on its specified frequency and within its own voltage range.

Rail-Bond Terminal

A rail-bond terminal for use with stranded conductor has been developed by the American Mine Door Company, Canton, Ohio. The Canton bond is made of ductile metallic composition. The shank which goes through the rail supports a U-shaped head on broad shoulders. When the cable bond is inserted in the U-opening the ends of the U are pressed down over the cable, and one end, according to the design, is pressed into the strands to improve contact at all points. Soldering is not necessary. When pressed into the rail a shoulder is formed on the second side of the bond.



STRANDED CONDUCTOR BOND WITHOUT SOLDER

Notes on Recent Appliances

Valve Grinder

A worm-drive electric value grinder for internal-combustion engines has been developed by the Consolidated Machine Tool Company, Worcester, Mass.

Floor Surfacer

A motor-driven floor surfacing machine has been brought out by the G. M. Watters Manufacturing Works, Minneapolis, Minn.

Connector Plug

A connector plug designed to fit all heating appliances interchangeably has just been developed and is now being marketed by the Magnus Electric Company, 109 Broad Street, New York City.

Mining Locomotive

Developments in its electric gathering locomotives for mine use have been made by the General Electric Company.

Multiple Christmas-Tree Outfit

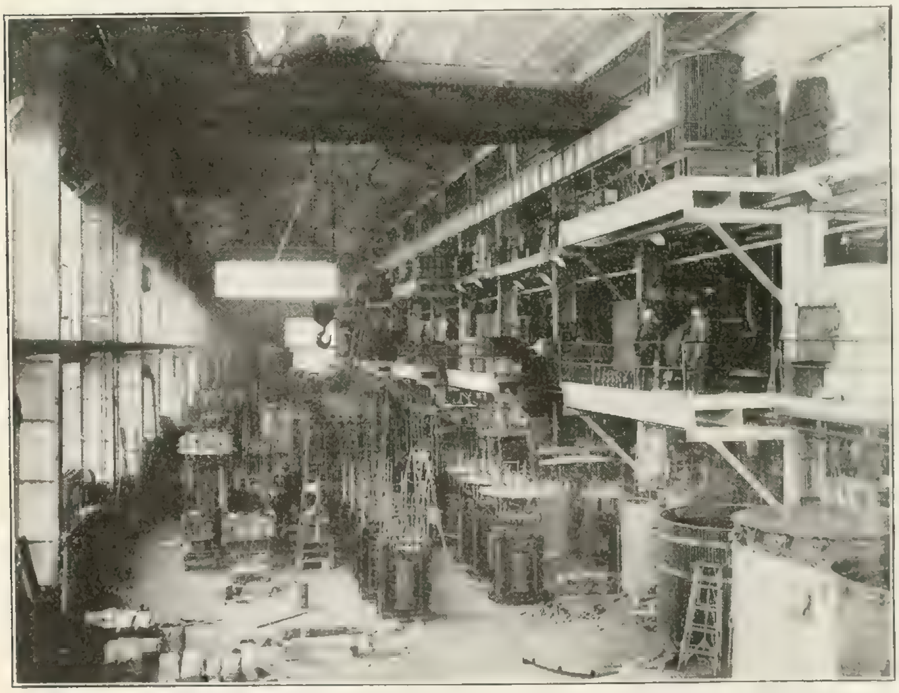
For use on 110-120 volts, the Betts & Betts Corporation, New York City, has developed a mulitple Christmas-tree lighting outfit

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

G. E. STOLTZ, general engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has been appointed engineer in charge of the steel-mill section of the engineering department. After graduation from the electrical engineering course of the Ohio State University in 1909, Mr. Stolz entered the apprenticeship course of the Westinghouse company, after which he became engaged in steel-mill work.

HALF A MILLION DOLLARS' WORTH OF TRANSFORMERS.—In the hoisting bay of the Pittsburgh Transformer Company more than $500,000 worth of transformers are shown in process of assembling In the center of the photograph is one bank of three 2,000-kva. self-cooled transformers without radiators or external cooling devices. The corrugated tank incasing this transformer is said to be large enough to take a 5,000-kva. unit. The tanks in the foreground are three of the company's vacuum and impregnating tanks. This erecting bay is in the Juanita plant of the Pittsburgh Transformer Company, which is one of its three factories, each of which occupies approximately 300 ft. x 120 ft.



HOISTING BAY IN PITTSBURGH TRANSFORMER COMPANY PLANT

THE WOLKE LEAD BATTERIES COMPANY, Louisville, Ky., successor to the Peerless Storage Battery Company of Louisville, has changed the trade name of its battery from "Peerless Red Cap" to "Wol-Kee Red Cap." No change has been made in the personnel and management of the company.

WALTER N. POLAKOW & COMPANY, INC., industrial management and power production engineers, announce the new location of their offices at 33 West Forty-second Street, New York City.

THE DAYTON FAN & MOTOR COMPANY, Dayton, Ohio, announces that Errest Boehme, Lee Warren James, Maurice D. Larkin and Louis Ruthenburg have acquired the controlling interest in its property and will assume active management at once

W. N. MATTHEWS & BROTHER, INC St. Louis, Mo., announces that the Chicago office is now at 29 South Desplaines Street, with Walter E. Bischoff in charge

L. BRANDENBURGER, Salt Lake City, Utah, formerly established in the Walker Bank Building, has taken over larger quarters at 59 West Broadway. Mr. Brandenburger was recently appointed sales representative for the Cutler-Hammer line of motor starting and control apparatus, magnetic clutches, brakes, lifting magnets, magnetic separator pulleys, etc., for the territory extending throughout the State of Utah, the western section of Wyoming and three-quarters of the State of Idaho.

JOHN C. DOLPH COMPANY, 168 Emmet Street, Newark, N. J., manufacturer of insulating varnishes and compounds, announces that the selling arrangement in effect with the Dolph Manufacturing Corporation has been discontinued and that sales will be handled direct from its factory.

L. W. HAIG has been appointed district sales manager of the Packard Electric Company at Buffalo, N. Y. After being graduated from Purdue University Mr. Haig became connected with several electrical concerns where he specialized on the design of transformers.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY, Chicago, has voted to increase its common stock from $4,000,000 to $8,000,000 and reduce the par value from $100 to $25, old stock to be exchanged in the ratio of four to one. Twenty thousand new shares will be sold to employees on terms to be fixed by directors.

THE PHILADELPHIA STORAGE BATTERY COMPANY has awarded contract for a two-story reinforced-concrete building, 40 ft. x 219 ft., to be erected on Ontario Street, west of C Street, to cost $142,600.

THE DELHI BATTERY & SUPPLY COMPANY, 2700 Locust Street, St. Louis, Mo., has completed plans for the construction of a two-story building, 80 ft. x 135 ft., to cost about $100,000.

THE LOCKE INSULATOR COMPANY, Victor, N. Y., has awarded contract for construction of its proposed plant at Baltimore, Md., to cost about $500,000.

THE NATIONAL ELECTRIC SUPPLY COMPANY, Washington, D. C., is planning improvements to its plant at 1328-30 New York Avenue, to cost about $100,000.

THE FEDERAL ELECTRIC COMPANY, Chicago, announces that it will move from its present quarters at Lake and Desplaines Streets to a new plant which it has erected at Eighty-seventh and State Streets. The company was incorporated in 1901 for the purpose of manufacturing and selling signs. It early realized that it could fill an urgent demand by renting signs. In 1905 the Federal Sign System (Electric) was incorporated for the purpose of carrying on the sign-renting business. Its principal function was to sell and rent signs made by the Federal Electric Company. The manufacturing of the vacuum cleaner was started in 1906, and in 1912 the first Federal washing machine was put on the market. The controlling interest of the Chicago Miniature Lamps Works was purchased in 1912. The growth of the Federal Electric Company is indicated by its sales. Eight years ago its annual washing-machine production was 1,000; today it is 24,000, and the sales are increasing so rapidly that only by the most strenuous efforts can production approach the sales. Eighteen years ago the company's annual sale of signs was $25,000; at the present time it is $1,000,000 and there are several hundred salesmen in the field. The vacuum-cleaner manufacturing department cannot keep abreast with the demand. Twenty-five thousand vacuum cleaners are produced annually and they are all sold within a radius of 50 miles from the plant. Eight commodities are sold, but each of the eight is sold by separate sales divsions headed by an assistant to the sales manager. Each division has the co-operation of the other divisions.

IRA CUSHING has resigned from the Boston office of the General Electric Company to become sales engineer with James C. Barr, dealer in power plant, railroad and electric railway supplies, with headquarters at 84 State Street, Boston. Mr. Cushing is past chairman and secretary of the Boston Section A. I. E. E., and is widely known in New England electrical circles. For some years he has been engaged in switchboard engineering and other special work in the Boston office of the General Electric Company.

HARRY M. GARDINER, who for ten years has been connected in an engineering capacity with various subsidiaries of the General Motors Corporation, has become manager of the Detroit office of the Industrial Controller Company, with headquarters at 708 Ford Building. During his experience in the engineering field Mr. Gardiner was from 1906 to 1908 assistant engineer of the Delray power station of the Detroit Edison Company; from 1908 to 1910 he was electrical engineer for the Navy Yard at Charleston, S. C., and from 1910 to 1916 he was electrical engineer for the Northway Motor & Manufacturing Company of Detroit; from 1916 to 1918 he was superintendent of power for the Cadillac Motor Car Company of Detroit; from 1918 to 1919 he was consulting electrical engineer for the General Motors Corporation at Detroit, and from 1919 to March 31, 1920, he was works engineer for the Olds Motor Works at Lansing, Mich.

CHARLES H. LEPPERT announces that after April 1 he will be at 550 Asylum St., Hartford, Conn.

THE CHICAGO FUSE MANUFACTURING COMPANY has removed its office and factory to Laflin and Fifteenth Streets, Chicago, where it will have larger quarters.

THE STATE ELECTRIC COMPANY, Canton, Ohio, contractors, has increased its capital stock from $50,000 to $250,000 for expansion purposes. The company also plans to handle suction sweepers and other electrical equipment for use in office buildings and shops.

THE PROMETHEUS ELECTRIC COMPANY, 571 West Forty-second Street, New York, manufacturer of heating apparatus, has increased its capital stock from $500,-[illegible] $850,000

THE ROME (N. Y.) WIRE COMPANY has taken over the plant and holdings of the Electric Rod Mill of Rome.

THE WOODFORD ELECTRIC COMPANY, 118 North La Salle Street, Chicago, Ill., contemplates the erection of a two-story building, 44 ft. x 120 ft., to cost about $12[illegible]

THE A. F. McCARTHY COMPANY, 10 High Street, Boston, Mass., will act as representative for several manufacturers of electrical materials and specialties in New England, including Edward & Company, Inc., New York, N. Y.; King Manufacturing Company, St. Joseph, Mo.; Beers Sales Company, New York, N. Y.; Dongan Electrical Manufacturing Company, Detroit, Mich.; Arts Electrical Company, Troy, N. Y., and the Ajax Electric Specialty Company, St. Louis, Mo. Mr. McCarthy has served in the electrical field continuously since 1900, when he entered the employ of the New York Edison Company. During the past twelve years he has represented the Westinghouse Electric & Manufacturing Company and several electrical supply jobbers in New England territory.

THE TURNBULL ELECTRIC MANUFACTURING COMPANY, Brooklyn, N. Y., recently incorporated to manufacture renewed lamps and to deal in all makes of lamps, has taken possession of its plant at 1237 Atlantic Avenue.

Supply Jobbers' Notes

THE GEORGE F. GRANT COMPANY, formerly at Binghamton, N. Y., has moved its office and warehouse to 140 West Thirty-fourth Street, New York City, where it will continue its business of jobbing electrical appliances and supplies.

THE CLEVELAND ELECTRICAL SUPPLY COMPANY, recently incorporated with a capital stock of $200,000 as successor to the Guttentag Light Company, at 504 Prospect Avenue, Cleveland, Ohio, will occupy a new four-story and basement building at 220-222 High Street, Cleveland. The new company will conduct a wholesale electrical jobbing business, having given up its retail store, and will cover Ohio and northern Pennsylvania.

THE PERRY-MANN ELECTRIC COMPANY, INC., Columbia, S. C., announces the election of W. L. Perry as secretary and treasurer, to succeed M. L. Mann, whose resignation became effective May 1. The Perry-Mann Electric Company will continue to improve its service to customers and aims to conduct its business in accordance with the strictest interpretation of the principles embodied in the Goodwin plan. The company will continue to handle its present line of electrical products.

Foreign Trade Notes

THE ATLAS MANUFACTURING COMPANY, 234 Cameron Street, Port Arthur, Ont., is negotiating for a building on Ambrose Street, which will be rebuilt and the ground floor used for manufacturing purposes. The company will manufacture electrical apparatus, including table lamps, electric call systems, etc.

THE CANADIAN WESTINGHOUSE COMPANY, Hamilton, Ont., Can., is planning an addition to its local plant, to cost about $25,000.

THE POWER SPECIALTY COMPANY, 111 Broadway, New York, manufacturer of coolers, heaters, superheaters, etc., is erecting a factory at St. Catharines, Ont., Can. A foundry will be built later.

RAILWAY ELECTRIFICATION IN BRAZIL.—Since the announcement of the Paulista railway electrification in Brazil was made in the April 24 issue of the ELECTRICAL WORLD, it has been learned that the Westinghouse Electric International Company has obtained contracts for a portion of the equipment therefor. Two of the four locomotives to be built by this company are for passenger service and two are for freight service. The passenger locomotives have a one-hour rating of 2,000 hp. and weigh 121 tons. They will be operated from a 3,000-volt direct-current overhead-trolley system and will be complete with regenerative control. They are designed for a maximum speed of 65 miles per hour and have a track gage of 5 ft. 3 in. The freight locomotives have a one-hour rating of 1,500 hp. and will weigh 87 tons. They are operated from the same voltage and have regenerative control. The speed is 40 miles per hour.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A merchant in Switzerland (No. 32,666) desires to secure the general agency for the sale of electric cooking and heating stoves.

A merchant in Palestine (No. 32,676) desires to secure an agency for the sale of electrical goods, etc.

A firm of general representatives of American exporters in Mexico (No. 32,694) desires to secure agencies for the sale of incandescent lamps.

A company in Sweden (No. 32,715) desires to get in touch with firms exporting 120-volt electric incubators complete with all necessary accessories.

A commercial agent in Italy (No. 32,681) desires to secure an agency for the sale of electrical machinery in general, including small and medium-size three-phase motors, electrically driven pumping machinery for water, etc.

An electric power company in Japan (No. 32,686) desires to purchase in very large quantities galvanized-iron wire of all sizes and measuring instruments, meters, etc., for use in electrical work.

A mining corporation in South Africa (No. 32,689) desires to purchase electrical furnaces for heat-treating drill steel, the furnace to be made of highly refractory material.

Electrical & Engineering Development, Ltd., 82 Victoria Street, London, S. W., 1, England, advises that it has been formed specifically to develop export trade to Europe, for the acquisition of the American patent rights on European electrical inventions and for the sale or disposition of European patent rights on American inventions. It has appointed engineers and representatives in the principal industrial countries and has laboratories equipped for testing and developing inventions.

Trade Publications

GENERATING SETS FOR MARINE USE.—A booklet issued by the Delco-Light Company, Dayton, Ohio, describes and illustrates the Delco-Light electric generating sets for commercial and pleasure craft.

RADIO APPARATUS.—The Wireless Improvement Company, 17 West Street, New York, N. Y., has issued a folder covering its radio apparatus, including marine, field and airplane types.

ELECTRIC RIVET HEATER.—The American Car & Foundry Company, 165 Broadway, New York, N. Y., has issued a booklet describing the Berwick electric rivet heater.

MARINE CONTROL APPARATUS.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has issued a booklet describing and illustrating the use of electrical marine apparatus.

CENTRIFUGAL CLARIFICATION.—The De Laval Separator Company, 165 Broadway, New York, N. Y., has recently issued bulletin No. 200, describing the De Laval method of centrifugal clarification of varnishes, japans and pigment goods.

COOKING BY ELECTRICITY.—The Estate Stove Company, Hamilton, Ohio, has issued a booklet entitled "Cooking by Time and Temperature," describing and illustrating its electric cooking stoves.

WIRES, CABLES AND CORDAGE.—The Belden Manufacturing Company, Chicago, Ill., is distributing catalog No. 8, giving prices and other data on electrical wire, cordage, cable, insulating materials, winding machines and other products manufactured by the company.

MAGNETIC CHUCKS.—The Heald Machine Company, Worcester, Mass., has issued bulletin No. 20-22A, describing the Heald grinding machines and magnetic chucks, and a booklet entitled "Heald Machines in Operation."

STEEL POLES.—The Bates Expanded Steel Truss Company, Chicago, has just published a 128-page 1921 edition of its steel-pole treatise.

ELECTRIC MOTOR CONTROL.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued circular 1608, in which it describes and illustrates the control of electric motors in industrial applications.

OUTDOOR SUBSTATIONS.—The Delta-Star Electric Company, Chicago, Ill., is issuing a special publication No. 92, describing a few forms of its unit-type high-tension outdoor substations.

WIRE—The Page Steel & Wire Company has just published a pamphlet describing the electrical and physical properties of American ingot iron ware.

PYROMETER—Apparatus for automatic temperature control in steel-hardening furnaces, drawing furnaces, japanning and enameling ovens, glass-annealing ovens, etc., is described in bulletin 857, recently issued by the Leeds & Northrup Company of Philadelphia, Pa.

New Incorporations

THE P. M. LAMP COMPANY, New York, N. Y., has been incorporated with a capital stock of $10,000 by I. M. [illegible], M. L. Rippe and J. Michael, 155 Gerard Street, Brooklyn, N. Y., to manufacture incandescent lamps.

THE MYLEY ELECTRICAL SUPPLY COMPANY, Brooklyn, N. Y., has been chartered with a capital stock of $10,000 by M. Schier, N. Cohan and M. Levy, 54 Lenox Avenue.

THE C. C. COGHLIN ELECTRIC COMPANY, Worcester, Mass., has been incorporated with a capital stock of $[illegible] to deal in electrical supplies and to do a general electrical contracting business. The incorporators are: Charles C. Coghlin, Edith Coghlin and James C. [illegible].

THE WOMELSDORF, MYERSTOWN & LITITZ TRANSIT COMPANY has filed articles of incorporation under the laws of Delaware with a capital stock of $1,700,000. The incorporators are: M. L. Horty, M. C. Kelly and S. L. Mackey, Wilmington, Del.

THE AEMILE BACHELET CORPORATION, Kingston, N. Y., has been incorporated by E. Bachelet, R. E. Smith and C. R. Cummings of Kingston. The company is capitalized at $150,000 and proposes to manufacture power generators, etc.

THE A. & R. LAMP COMPANY of Newark, N. J., has been incorporated by A. J. Rainaud, W. J. Rainaud and M. Rainaud of Newark, N. J. The company is capitalized at $125,000 and proposes to deal in lighting devices.

THE SERVICE ELECTRIC MANUFACTURING & SUPPLY COMPANY of Boston, Mass., has been incorporated with a capital stock of $50,000 to manufacture electrical supplies. The incorporators are John J. Donovan, James E. Cussen of Boston and Thomas [illegible] of [illegible].

THE CONTINENTAL RADIO & ELECTRIC CORPORATION of New York, N. Y., has been incorporated by G. E. [illegible], J. F. Grinan and F. di Blasi, 6 Warren Street. The company is capitalized at $30,000 and proposes to manufacture electric apparatus for wireless operations, etc.

THE GENERAL AUTO ELECTRIC COMPANY, 257 Halsey Street, Newark, N. J., has been incorporated by William F. Hencke, Daniel E. Lenthe and Frederick E. Draiss. The company is capitalized at $50,000 and proposes to manufacture electric specialties.

THE EVANS STORAGE BATTERY COMPANY, [illegible], N. J., has been incorporated with a capital stock of $250,000 to manufacture storage batteries. The incorporators are Frank S. Muzzey, Joseph P. Murray and F. Stanley [illegible].

BOWERS & BARTLETT, INC., Riverdale, Md., has been incorporated by Claude C. Bowen, Harry O. Barlett and Charles C. [illegible]. The company is capitalized at $200,000 and proposes to manufacture washing-machine equipment and ironers.

THE VICTORY STORAGE BATTERY COMPANY, Maryland Casualty Building, Baltimore, Md., has been incorporated by A. J. Thompson, Edward B. Masterson and Henry Stockbridge. The company is capitalized at $[illegible] and proposes to manufacture batteries.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

MANCHESTER, N. H.—Extensive additions to the street-lighting system are being planned.

BOSTON, MASS.—Graphic Arts Printing Corporation, 516 Atlantic Avenue, plans to build a ten story office building, to cost about $3,000,000. Lockwood Greene Company, State Street, are engineers.

CHESTER, MASS.—At a recent fire district meeting it was voted that the town assume control of the plant of the Chester Electric Light Company.

CLINTON, MASS.—The hydro-electric power plant of the Metropolitan Water Works at the Wachusett Dam has been damaged to the extent of $12,000, caused by the bursting of a turbine.

PITTSFIELD, MASS.—The Pittsfield Electric Company has been granted permission by the Public Utilities Board to issue $125,000 additional capital stock for additions to its plant.

HARTFORD, CONN.—Bids will soon be received for the construction of an addition to the Brown school on Talcott Street, to cost about $600,000. I. A. Allen, Jr., Inc., 904 Main Street, is architect.

NEW HAVEN, CONN.—Bids will be received by James P. Manning, superintendent of Charities and Correction, Room 2, City Hall, until May 18, for wiring the Springside Home and Farm and installing electrical equipment. Specifications may be obtained at the office of the Building Inspector, Room 3, City Hall.

NEW HAVEN, CONN.—The United Illuminating Company, 84 Temple Street, has awarded contract to C. W. Murdock, Inc., 185 Church Street, for construction of turbine room and to Westcott & Mapes, Inc., 207 Orange Street, for boiler room. Cost is estimated at $65,000.

Middle Atlantic States

ALBANY, N. Y.—The State Hospital Commission has awarded contract to the General Electric Engineering Company, New York, N. Y., for the installation of a fire-alarm system in the Central Islip Hospital, to cost $12,150.

BROOKLYN, N. Y.—The Commissioner of Public Works, Borough Hall, is having plans prepared by McKenzie, Voorhees & Gmelin, 1123 Broadway, New York City, engineers, for the construction of a municipal building, to cost about $5,000,000.

BROOKLYN, N. Y.—The Brooklyn Edison Company is having preliminary plans prepared for the erection of a substation on Grand Street, to cost about $100,000. William Whitehill, 55 Duane Street, New York, N. Y., is engineer.

BUFFALO, N. Y.—John Dunlop's Sons, 22 Fay Street, plans to erect a transformer station to cost about $5,000.

COHOES, N. Y.—Bonds to the amount of $45,000 have been authorized for electrifying and making other improvements to the local waterworks.

GLENS FALLS, N. Y.—The Adirondack Electric Power Corporation has applied to the Public Service Commission for permission to purchase the properties of the Glens Falls Gas & Electric Light Company, the Consolidated Light & Power Company and the United Gas, Electric Light & Fuel Company, with the view of increasing and extending its service.

MILLBROOK, N. Y.—Public Service Commission has granted the Hudson Gas & Electric Company a franchise to operate in Millbrook and the town of Washington. The installation of a new electric street-lighting system in Millbrook is contemplated.

NEW YORK, N. Y.—Contract has been awarded by the New York Telephone Company, to John I. Downey, 410 West Thirty-fourth Street, for the construction of a telephone exchange on Thirtieth Street and Second Avenue, to cost about $1,000,000.

NEW YORK, N. Y.—Contract has been awarded to the Turner Construction Company, 244 Madison Avenue, by the Western Electric Company, for the construction of a factory and warehouse, to cost about $2,700,000. McKenzie, Voorhees & Gmelin, 1123 Broadway, are engineers.

ALLENTOWN, N. J.—Bids will be received by the Borough Council, Borough Hall, Allentown, N. J., until May 24, for additions to the borough power plant as follows: producer, gas engine, generator, switchboard, piping, etc. Specifications may be seen at the above address.

TONAWANDA, N. Y.—The Tonawanda Power Company plans additions to its plant equipment, to cost about $150,000.

BAYONNE, N. J.—The installation of a street-lighting system, "white way" type, on Broadway north from Twenty-sixth Street, is contemplated. The Uptown Improvement Association, 718 Broadway, is interested.

BAYONNE, N. J.—The International Nickel Company is planning to rebuild its steam plant with the purpose of increasing efficiency.

HOBOKEN, N. J.—The White Metal Manufacturing Company is contemplating the construction of a power house, to cost about $60,000. J. C. Schaeffer, 40 West Thirty-second St., New York, N. Y., is engineer.

JERSEY CITY, N. J.—The Central Railroad of New Jersey, 143 Liberty Street, New York, N. Y., is planning the construction of a 4,000-kw. electric power plant in connection with the new Greenville district terminal now under construction. Considerable electric equipment, including a 30-ton electric-operated gantry crane, will be required.

NEWARK, N. J.—The Foster Engineering Company plans to install an additional 100-hp. boiler and a 60-kw. generator.

NEWARK, N. J.—The Public Service Corporation, Terminal Building, contemplates the erection of a power plant, to have an ultimate capacity of 200,000 kva. The project calls for an expenditure of about $15,000,000.

BEAVER FALLS, PA.—Extensions to the street-lighting system is under consideration. The service is furnished by the Beaver County Light Company.

ELVERSON, PA.—Extension of the electric light and power system to Summit Level is under consideration.

LATROBE, PA.—Work will soon be started on the construction of a power plant at the St. Vincent's Arch Abbey, to supply light and power service to its entire group of buildings.

PHILADELPHIA, PA.—Plans have been prepared by the Rockford Knitting Company, Randolph and Jefferson Sts., for improvements to its factory power plant.

PITTSBURGH, PA.—Bids will be received by George W. Gerwig, secretary, 725 Fulton Building, until May 20, for installation of electrical equipment in the Duquesne, Bellefield, Crescent, Harwood, Jefferson, Minersville, O'Hara, Schiller and Springfield schools.

BALTIMORE, MD.—The Bailey Building Company has awarded contract to Norton, Bird & Whitman, 616 Munsey Building, for the construction of an office building, to cost $2,500,000. Ten electric elevators will be installed.

BALTIMORE, MD.—Plans are being prepared by Lockwood, Greene & Company, 101 Park Avenue, New York, N. Y., architects, for the construction of a shirt factory, to cost about $500,000. Considerable electric equipment will be required.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company has prepared plans for the construction of a building at Kleman St. and the Western Maryland Railroad, to cost about $46,000.

CATONSVILLE, MD.—Plans are being prepared by C. L. Reeder, Park Avenue and Sartoga Street, Baltimore, for the installation of an electric generator, switchboards, etc., to cost about $100,000, in the Spring Grove State Hospital.

HAGERSTOWN, MD.—Bonds to the amount of $300,000 have been voted for the construction of a new municipal electric plant. A. B. Grubmyer, 21 East Franklin Street, is engineer.

SOUTH CHARLESTON, W. VA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 19, for electrical equipment for main substation, furnishing and installing switchboards, oil switches and barriers, buses and connections, storage-battery motor-generator set, transformers, disconnecting motor starters and other electrical equipment furnished by the government, and for making the necessary connections for a complete indoor substation ready for operation at the naval ordnance plant. Drawings and specifications may be obtained on application at the Bureau of Yards and Docks or inspector of ordnance in charge of plant named. Cost is estimated at about $195,000.

WASHINGTON, D. C.—Bids will soon be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the following: Kuahua, T. H., Schedule 4185—high-pressure air line. Loiza, P. R., Schedule 4194—radio building, towers and service connections.

WASHINGTON, D. C.—G. H. Rettew, 2357 Rhode Island Avenue, N. E., is in the market for three 75-kva. or three 100-kva., 25-cycle, single-phase transformers, outside type, 6,600/460 volts.

North Central States

BATTLE CREEK, MICH.—Plans are under way for the installation of an ornamental street-lighting system on Lake Avenue.

DETROIT, MICH.—Bids will be received by Louis Scisorek and A. Malkin, 225 Farwell Building, architects, for the construction of a battery service station for the Clements Battery Service Company, to cost about $35,000.

DETROIT, MICH.—Contract has been awarded to Joseph F. Dayton, 979 McKinley Avenue, by the Scheiwe Coal & Coke Company, 630 Mack Avenue, for the erection of a coal storage and conveyor buildings, 200 ft. x 200 ft. Motors will be installed to operate conveyors.

DETROIT, MICH.—The Board of Fire Commissioners has awarded contract to the Bryant & Detwiler Company, Dime Bank Building, for the erection of a central fire-alarm station at Macomb and Antoine Streets, at a cost of $162,937, and is in the market for automatic equipment for alarm system.

IRONWOOD, MICH.—Bids will soon be received by Alvord & Burdick, 8 South Dearborn Street, Chicago, Ill., engineers, for extensions to the waterworks system and installation of electrical pumping equipment, to cost about $300,000.

MARYSVILLE, MICH.—Plans are being prepared for the proposed waterworks system, including a pumping station and filtration plant, to cost about $200,000. The equipment consists of electrically driven centrifugal units. Robert Gordon is engineer.

MOUNT CLEMENS, MICH.—Contract has been awarded by the S. S. Kresge Company, Kresge Building, to George A. Fuller Company, 540 Penobscot Building, Detroit, for the construction of a pottery plant, 120 ft. x 823 ft. Electrical equipment, to include miscellaneous power motors, will be required.

AKRON, OHIO.—An ordinance providing for the erection of a municipal electric power plant has been introduced by Councilman Kasch for approval.

CLEVELAND, OHIO.—The Electric Vacuum Cleaner Company, Ivanhoe Road, East Cleveland, contemplates the erection of a larger shop and the installation of direct motor drive.

COLUMBUS, OHIO.—The Public Utilities Commission has authorized the Cleveland Electric Illuminating Company to issue $1,150,000 in bonds for improvements.

EAST PALESTINE, OHIO.—The City Council has authorized the employment of engineers to make a survey of the power situation, anticipating the grant of a franchise.

LINWORTH, OHIO.—Linworth Mutual Light & Power Company plans to erect a high-tension transmission line to Worthington and Dublin, at an estimated cost of [illegible]

TOLEDO, OHIO.—The erection of a substation at the Terminal Railway is contemplated by the Toledo Railways & Light Company, to cost about $225,000. The station will have a capacity of 10,000 kw. with space for future additions.

NORWALK, OHIO.—The City Council is considering the installation of an additional 1,000-kw. turbine in the municipal power station.

YOUNGSTOWN, OHIO.—The First National Bank is having plans prepared by Walker & Weeks, 1900 Euclid Avenue, Cleveland, architects, for the construction of a bank and office building, to cost about $2,000,000. Considerable electrical equipment will be required.

NEWPORT, KY.—The St. Joseph Orphanage plans to construct a reservoir to be equipped with electrically driven centrifugal pumps, at a cost of $20,000 George Horning, 512 Fairfield Avenue, Bellevue, Ky., is engineer

PADUCAH, KY.—The Paducah Electric Company contemplates extensive improvements to its plant at Second and Monroe Streets. The company recently purchased a new city franchise.

BARGERSVILLE, IND. Bids, it is understood, will soon be asked for the construction of a transmission line from Bargersville to Whiteland

BATESVILLE, IND -The Batesville Telephone Company has been purchased by John K. Johnson for $75,000. Additional equipment will be installed.

CHICAGO, ILL.—The Columbian Colortype Company has awarded contract to R. C| Wiekoldt, 1534 Van Buren Street, for the erection of a printing plant to cost about $650,000. The plant will be equipped for electrical operation.

LINCOLN, ILL.—The Lincoln Water & Light Company plans to expend $60,000 for improvements, to include the installation of a General Electric turbo-generator, also an addition of a switchboard and boiler, not yet contracted for.

PEORIA, ILL.—The installation of an ornamental street-lighting system on Madison Avenue is under consideration by the City Council.

SPRINGFIELD, ILL.—Contract has been awarded for the new power plant to be installed in the St. Nicholas Hotel, Washington and Jefferson Sts., to cost about $25,000 The equipment will include two 250-hp. Springfield boilers, two Illinois automatic stokers made in Alton, etc.

DES MOINES, IOWA.—The Des Moines Electric Company is contemplating the installation of new equipment, to cost about $1,000,000. The company has recently contracted for a 10,000-kw. turbine.

LETTS, IOWA.—The local electric plant is reported to have been destroyed by fire. A new plant will be erected

MASON CITY, IOWA.—Miller Hotel Company is having plans prepared by Proudfoot, Bird & Rawson, 810 Hubbell Building, Des Moines, Iowa, architects, for the construction of a hotel to cost about $800,000.

ROCKHAM, IOWA.—The installation of an electric power plant is under consideration by the City Council.

CARTHAGE, MO.—At an election held April 8 the proposal to issue $100,000 in bonds for improvements to the municipal electric light plants and waterworks system was defeated.

ST. LOUIS, MO.—Improvements to the pumping station at the city sanitarium call for one 220-hp., horizontal, single-side crank engine, direct-connected to a 200-kw. generator now in place.

ST. LOUIS, MO.—The Joseph Greenspon Sons Iron & Steel Company, 3130 Hall Street, is in the market for two 1,000-hp. cross-compound condensing Corliss engines with direct-connected generators, 440-volt, alternating current.

VERSAILLES, MO.—H. Moser, owner of the Versailles flour mill, ice plant and power plant, contemplates increasing the electric plant this fall by about 130 hp. Mr. Moser took over the municipal electric plant last fall, which was practically rebuilt and the system changed from direct to alternating current.

GRAND FORKS, N. D.—Bids will be received by the Industrial Commission of North Dakota, Bismarck, until May 29, for construction of power plant, reservoir and filter plant, to include boiler, stokers, etc. C. L. Pillsbury, Metropolitan Life Building, Minneapolis, Minn., is engineer

JOHNSON, NEB.—Bonds to the amount of $13,750 have been voted for the erection of transmission lines in Johnson and from that town to Auburn. The Intermountain Railway, Light & Power Company of Colorado Springs, Colo., will supply the electric energy.

BENOIT, MISS.—The local electric light plant has been sold. The new owner plans extensive improvements.

AMERICUS, KAN.—An issue of $18,000 in bonds has been voted for the establishment of a lighting system Plans include the erection of a transmission line to Emporia to obtain energy for the proposed system

HAVEN, KAN.—Bids will be received by George H. Thorp, city clerk, until May 20 for the establishment of [illegible] system in Haven [illegible] 14-mile transmission line to Burton, to cost about $25,000

OSAWATOMIE, KAN. — Improvements to the municipal electric light and water plants, including the installation of a generating unit, construction of a dam, etc., to cost about $100,000, are under consideration.

Southern States

JELLICO, TENN The Consolidated Fuel Company of Pittsburgh, Pa., has purchased the property and mines of the Smoot Creek Coal & Coke Company of Jellico. Extensive improvements, it is said, will be made by the new owner, including the installation of new machinery, equipping the mines for electrical operation and installing electric lamps in all employees' homes.

MOSS POINT, MISS.—Bonds to the amount of $10,000 have ben authorized for the purchase of an electric light system. C. M. Fairley is city clerk.

MINDEN, LA.—At an election to be held soon the proposal to issue $60,000 in bonds for improvements to the electric light and water plant will be submitted to the voters.

PAWNEE, OKLA. — Bonds to the amount of $100,000 have been voted for improvements to the municipal electric light and water plant.

ALBANY, TEX. — The erection and operation of electric light plant is reported to be under consideration

DALLAS, TEX.—The Security National Bank has had plans prepared by Herbert M. Greene Company, North Texas Building, for remodeling the Southland Hotel into a twelve-story building, to cost about $1,000,000. Plans include an electric alarm system.

DALLAS, TEX.—T. Dees, Guaranty Bank & Trust Company, Commonwealth Building, is having plans prepared for the erection of a twelve-story office building to cost about $1,700,000. A power generating plant will be installed

FORT WORTH, TEX Bids will soon be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the construction of a one-story wood-frame cylinder storage building, including industrial railway, drainage and electric lighting systems, etc., at the United States helium production plant. A deposit of $10 will be required for plans and specifications.

WACO, TEX.—The Central Texas Railway Company has awarded contract to the Central Texas Engineering & Construction Company, Amicable Life Building, for the construction of the first unit of its proposed railway to Temple. Gasoline motor cars will be used until a power house and transmission lines are erected

Pacific and Mountain States

BLAINE, WASH.—The British Columbia Electric Railway Company, it is reported, contemplates extensions to its transmission lines in this vicinity

OLYMPIA WASH Contract has been awarded to the Westers Construction Company, Seaboard Building, Seattle, for the erection of a power house for the State Capitol group of buildings to cost about $100,000

ALBANY ORE Work will soon be started by the Mountain States Power Company on its new 11,000-volt transmission line from Albany to Corvallis. The company is also planning extensive improvements to its plant and equipment.

SALEM, ORE—Application has been made by Lyman Griswold of Portland to the state engineer for permission to divert water from the Santiam Creek, Whiskey Creek and Puzzle Creek to be stored in Marion Lake reservoir for power purposes. Mr. Griswold has also applied to construct the Clear Lake reservoir for storage of water from the McKenzie River

BRAWLEY, CAL.—[illegible] by the [illegible] of [illegible] to secure a municipal electric light plant, to cost $10,000.

LOS ANGELES, CAL.—The Southern California Edison Company has applied to the California Railroad Commission for permission to issue $5,000,000 in bonds to finance hydro-electric developments on the Kern and San Joaquin Rivers, and to make additions to its transmission and distribution lines.

MARE ISLAND, CAL.—Bids will be received at the Navy Yard, Mare Island, until May 19, for electrification of the railroad track on the Vallejo-Mare Island [illegible] Navy Yard, to include a 3,300-volt, single-phase, alternating-current overhead system of the catenary type. A deposit of $10 will be required for plans and Specification 4188, which may be obtained on application to E. L. Beach, Commandant, Navy Yard, Mare Island.

SAN FRANCISCO, CAL.—Contemplated improvements in the Divisadero district include placing electric lines underground, to cost about $150,000.

SUSANVILLE, CAL.—The Red River Lumber Company is negotiating for control of the properties of the Lassen Electric Company of Lassen, and also contemplates the construction of a transmission line between Westwood and Susanville.

FARMINGTON, UTAH.—The construction of a hydro-electric plant to develop 10,000 hp. for irrigation purposes is contemplated A. F. Parker, [illegible] Twenty-eighth Street, is engineer.

DOUGLAS, ARIZ.—Farmers of the Sulphur Springs Valley are considering the construction of a power plant at Douglas, to cost about [illegible]. It is planned to eliminate gasoline pumping plants and substitute an electrical capacity of [illegible]

JEROME ARIZ. The power plant of the United Verde Mine was recently damaged by an explosion.

CASPER, WYO Contract has been awarded to the Gamewell Fire Alarm Company, Hastings Falls, Mass., for fire-alarm and police call system, at a cost of $17,072.

LOVELOCKS, NEV.—The Nevada Valleys Power Company has applied for extension of its service to points in Lander and other counties to the east.

Canada

LAKEFIELD, ONT.—The local electric plant, it is reported, was recently destroyed by fire causing a loss of about $7,000

NEW TORONTO, ONT Additions to the waterworks system, to include a new electrically driven pump and feeder main, to cost about $35,000, will be made.

NIAGARA FALLS, ONT A by-law to [illegible] has been passed by the City Council for improvements to be made by the Hydro-Electric Commission.

OTTAWA, ONT.—A survey of Nepean Township has been made by the Hydro-Electric Commission engineers, to ascertain whether a plan of electric light and power distribution is feasible

OTTAWA, ONT.—Bids will soon be received by Stevens & Lee, [illegible] College Street Toronto, engineers, for the construction of a hospital, to cost about $2,500,000. Electrical equipment, including electric elevators and electrical signal system, will be required.

PORT CREDIT, ONT.—E. A. James Company, 36 Toronto Street, Toronto, engineers, have been appointed to make report on the proposed waterworks system, to cost about [illegible] include pump house, electrically driven centrifugal pumps, turbine, three stage, about 600 Imp. G. P. M. Electric energy will be furnished by the Hydro-Electric Commission of Ontario

WROXETER, ONT.—The Town Council is having plans prepared for the erection of a new hydro-electric power plant, to cost about $15,000. Mr. Flint, Hydro Building, Toronto, Ont., is engineer.

MONTREAL HARBOR, QUE.—Bids will soon be received by F. W. Cowie, engineer, care of Montreal Harbor Commissioners, for superstructure of a power house, to cost about [illegible]

Record of Electrical Patents

Notes on United States Patents

(Issued April 20, 1920)

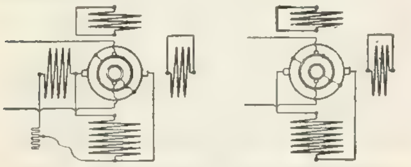
14,842 (Reissue). **Electrical Starting and Ignition System**; James K. Delano, Yonkers, N. Y. App. filed Feb. 10, 1920. Prevents battery from discharging through armature or through ignition circuit.

14,846 (Reissue). **Two-Wire Party-Line Lock-Out Telephone System**; Talbot G. Martin, Chicago, Ill. App. filed Jan. 14, 1919. Lock-out systems, especially those for calling automatically or semi-automatically.

1,337,648. **Synchronous Alternating-Current Motor**; Valere A. Fynn, St. Louis, Mo. App. filed May 9, 1916. Self-excited motors in which the revolving member receives energy from the supply while the stationary member carries the winding producing the unidirectional magnetization.

1,337,710. **Machine-Switching Telephone-Exchange System**; Alben E. Lundell, New York, N. Y. App. filed June 7, 1915. Transfers call from a manual office to a semi-automatic office.

1,337,711. **Telephone-Exchange System**; Alben E. Lundell, New York, N. Y. App. filed Aug. 16, 1916. Subscriber informed of mistake if he either mistakes number of desired line or operates his dial inaccurately.



1,337,648 Synchronous Alternating-Current Motor

1,337,712. **Telephone System**; Alben E. Lundell, New York, N. Y. App. filed Oct. 10, 1917. Releases set of indicator lamps as soon as trunk has been plugged into jack of called line.

1,337,713. **Telephone System**; James L. McQuarrie, Montclair, N. J. App. filed Dec. 30, 1916. Setting movement of line finder directs separate connector switch.

1,337,714. **Automatic Telephone Exchange System**; James L. McQuarrie, Montclair, N. J. App. filed July 2, 1917. Train of automatic switches controlled by a single auxiliary controlling switch.

1,337,715. **Telephone System**; James L. McQuarrie, Montclair, N. J. App. filed April 13, 1918. Automatic switches controlled by currents of different frequencies.

1,337,718. **Cleansing of Ferrous and Non-Ferrous Metals**; Sumner R. Mason, Wilmette, Ill. App. filed Sept. 3, 1918. Parts submerged in electrolyte of cyanide, hydrate and an organic agent and are made terminals for a source of alternating current.

1,337,724. **Electrolyzing Apparatus**; Claus N. Riber, Trondhjem, Norway. App. filed March 27, 1919. For alkaline chlorides.

1,337,725. **Electric Heating Unit**; Edwin A. Rutenber, Marion, Ind. App. filed April 22, 1918. Heat from entire surface of coil is reflected.

1,337,732. **Magnetic Gearing**; Hugh M. Stoller, New York, N. Y. App. filed Nov. 7, 1916. Eliminates mechanical contact and friction between transmission members and produces a noiseless gearing.

1,337,736. **Telephone-Exchange System**; Tudor Van Amstel, New York, N. Y. App. filed Feb. 3, 1919. Indicating devices controlled by small step-by-step switches over metallic circuit.

1,337,737. **Producing Currents of Desired Wave Form**; Hendrik J. Van Der Bijd, New York, N. Y. App. filed Sept. 30, 1918. Radiant-energy sensitive devices such as selenium produce currents of desired frequency and wave form

1,337,739. **Electric Generator**; Fred J. Whitcomb, Cleveland, Ohio. App. filed April [illegible], 1919. Improved mounting for permanent magnets of magnetos.

1,337,740. **Telephone-Exchange System**; Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed Jan. 25, 1919. Automatically informs operator of number and class of service of calling line.

1,337,741. **Telephone Receiver**; James A. Wotton, Montclair, N. J. App. filed Nov. 3, 1917. Auxiliary receivers used when lines are noisy.

1,337,748. **Telegraph System**; John H. Bell, South Orange, N. J. App. filed Nov. 21, 1917. Overcomes phenomenon known as "wandering zero" in line conductors having high electrostatic capacity.

1,337,752. **Telephone System**; Louis W. Carroll, Riverside, Ill. App. filed Nov. 24, 1916. Signaling mechanism economizes space.

1,337,753. **Supervisory System**; Henry P. Clausen, Mount Vernon, N. Y. App. filed Nov. 27, 1916. Conveys information to special operator if switch fails at any stage of its operation.

1,337,754. **Telephone-Exchange System**; Henry P. Clausen, Mount Vernon, N. Y. App. filed Aug. 1, 1917. Cords and plugs for link circuits.

1,337,755. **Telephone-Exchange System**; Henry P. Clausen, Mount Vernon, N. Y. App. filed Sept. 14, 1917. Signaling means for central-energy telephone systems.

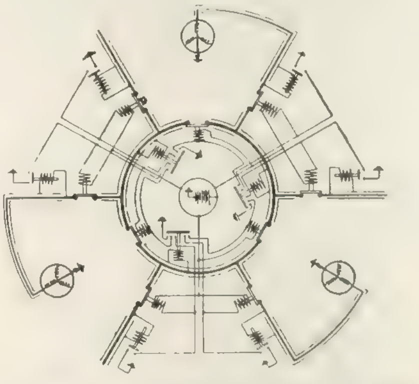
1,337,761. **Telephone-Exchange System**; William L. Dodge, Maplewood, N. J. App. filed Aug. 7, 1918. Trunk circuits for completing connections between telephone lines terminating at different central offices.

1,337,779. **Electric Heating Resistance Element**; Leslie V. Leonard, Richmond, Victoria, Australia. App. filed April 5, 1919. High and low resistances wound on a continuous helical form.

1,337,782. **Telephone-Exchange System**; Alben E. Lundell, New York, N. Y. App. filed May 17, 1918. Simplifies apparatus and circuit arrangement of connections between calling and called lines.

1,337,783. **Signaling Mechanism**; Fred R. McMurry, Westwood, N. J. App. filed Feb. 8, 1918. Intercommunicating printing-telegraph systems.

1,337,784. **Automatic Switch**; James L. McQuarrie, Montclair, N. J. App. filed April 16, 1917. Electromagnetically controlled step-by-step switching device for use either as a selector or a connector.



1,337,866 System for Protecting Electric Cables

1,337,794. **Automatic Switch**; John N. Reynolds, Greenwich, Conn. App. filed Aug. 29, 1917. Saving in number of contact sets.

1,337,797. **Relay System**; Harry O. Rugh, Chicago, Ill. App. filed May 12, 1919. Breaks local energizing circuit of a telegraph sounder after a predetermined length of time.

1,337,811. **Method of Molding Semi-solid Substances**; Bernard J. Allen, Stoke-Upon-Trent, England. App. filed Aug. 14, 1917. Obtains a deposit of clay plumbago by electrodeposition upon a mold.

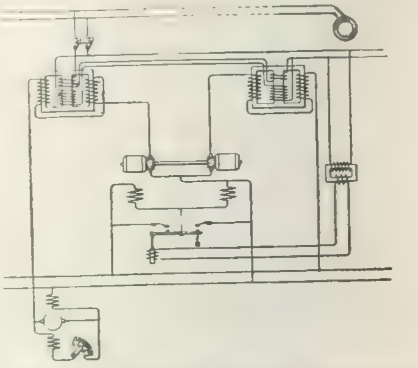
1,337,826. **Rheostat**; Homer L. Dodge, Iowa City, Iowa. App. filed Aug. 23, 1917. Prevents loss due to unnecessary or undesirable heating.

1,337,[illegible]9. **Electrically Heated Melting Furnace**, Leonard C. Harvey, Malden, Eng. App. filed Nov. 11, 1919. Protects the whole of the melting-chamber lining from local overheating.

1,337,853. **Spark-Gap-Controlling Device**, George H. Taber, Binghamton, N. Y. App. filed March 8, 1919. Gaps increased or diminished at will.

1,337,854. **Regulating System for Alternating-Current Circuits**; Louis W. Thompson, Schenectady, N. Y. App. filed July 10, 1910. Regulation of an alternating-current circuit accomplished without interruption of power currents and without use of heavy moving parts.

1,337,855. **Regulating System for Alternating-Current Circuits**; Louis W. Thompson, Schenectady, N. Y. App. filed July 10 1918. Prevents excessive voltages and excessive currents in primary windings of transformers and in a regulating system.



1,337,942 Regulating System for Alternating Current System

1,337,858. **Telephone-Booth Controller**; George E. Thum and Max Theimer, Elizabeth, N. J. App. filed Jan. 19, 1918. Holding customer as a prisoner in event of failure or refusal to pay charges.

1,337,866. **System for Protecting Electric Cables**; Frederick B. Whitaker, Rugby, Eng. App. filed Sept. 27, 1917. Systems which are grounded either direct or through a resistance or impedance at one or more points.

1,337,875. **Regulating System for Alternating-Current Circuits**; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Oct. 17, 1918. Regulates voltage of an alternating-current circuit by transformer provided with winding to space apart points on which are connected reactors, the inductances of which are varied so as to regulate effect of transformer upon alternating-current circuit.

1,337,885. **X-Ray Transformer**; William D. Collidge, Schenectady, N. Y. App. filed June 27, 1919. Compact arrangement of parts.

1,337,892. **Telephone Receiver and Receiver Switch**; Arthur Engelberg, Oakland, Cal. App. filed Jan. 27, 1919. Receiver short and light.

1,337,894. **Electrode**; James K. Forshee, Chicago, Ill. App. filed March 18, 1920. Performs all functions of vacuum electrode.

1,337,904. **X-Ray Tube Stand and Table**; Ernest E. Greville, London, Eng. App. filed April 1, 1918. Fluoroscopy and X-ray photography.

1,337,915. **High-Voltage Transformer**; Svend E. Johannesen, Pittsfield, Mass. App. filed July 15, 1918. Adequate insulation and ventilation provided without barriers, the windings being supported independently of core.

1,337,933. **Electric Oscillator**; George M. J. Mackay, Schenectady, N. Y. App. filed Jan. 27, 1916. Generate high-frequency waves substantially free from harmonics and of relatively large power.

1,337,942. **Regulating System for Alternating-Current Circuits**; Edwin J. Murphy and Louis W. Thompson, Schenectady, N. Y. App. filed July 10, 1918. Regulation of alternating-current circuit accomplished without interruption of power currents and without use of heavy moving parts.

1,337,973. **Engine-Starting Apparatus**; J[illegible] Bijur, New York, N. Y. App filed Nov. 16, 1916. For internal-combustion engines convenient in control and whose action is automatic.

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician
Published by McGraw-Hill Company, Inc.

W. H. ONKEN, Jr., Editor D. H. BRAYMER, Managing Editor
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Volume 75 New York, Saturday, May 22, 1920 *Number* 21

The Keynote of the Convention

AT PASADENA this week a realization of what Pacific Coast electrical men have for so long been speaking of was brought home to Eastern delegates by personal contact with the conditions of which they have heard so much. It did not need the hospitality and the enthusiasm for which the Far West is famous, forthcoming though these were, to put the delegates' minds in a receptive mood for the practical lessons that Nature's bounty and human enterprise combined to spread before them. The paramount importance of water-power development was the prevailing note of the convention. Legislation and finance were its dominant topics. Happily the needed law is now all but a certainty before the sitting Congress adjourns; the needed capital must and will be forthcoming. President Ballard's figure of $750,000,000 for national electrical development right now is a huge one. How the Pacific Coast purposes to do its share is indicated by the program announced by John A. Britton, as reported elsewhere in this issue—a program which involves the expenditure of $123,000,000 in eleven years by one company alone. The glimpse into these and other convention discussions given this week is an inspiring one. Since, however, the convention is still in session as this issue goes to press, our full report with abstracts and discussions will appear next week.

"Frozen Credit" and Public Utility Securities

WITH a nation-wide freight blockade of unprecedented dimensions due in large part to a lack of the rolling stock necessary to move the accumulated merchandise, with public utilities everywhere confronting opportunities for greatly enlarged service of which they are unable to take advantage because the necessary funds are not available, and with a widespread disposition on the part of non-speculative capital to seek seclusion behind the combination locks of safe-deposit vaults, the term "frozen credit," of recent coinage, is both apt and thought-provoking. No industrial crop can be reaped when the fertilizing rills of investment are congealed at their sources, and this is the condition that exists where public utility securities are concerned. While under competent commission regulation these securities have a permanent stability approaching that of state and municipal bonds, they cannot compete with government issues in the favor of timid investors and administrators of trust funds, and when they enter the field against industrial securities they are handicapped by the smallness of the profit they are permitted to earn. Yet midway between these two opportunities for investment there should be an inviting field of public utility finance which careful capitalists, both big and little, neither seeking a gambler's profit nor yet content with little more than a savings-bank return, could enter confidently. Their entrance would speedily bring the utilities to the physical and financial condition in which it is so obviously to the interest of the public to have them. All that is needed is a new public viewpoint on permitted earnings, which, once brought about, would speedily be reflected in legislative enactment.

Inadequate Depreciation Reserve Is Costly

THOSE public utilities laying aside a depreciation reserve at a rate sufficient only to pay off their bonds are running the risk of being forced to replace the equipment before the entire bond issue is liquidated. This condition has occurred in some of the cases where theoretical rates of depreciation have been employed. One precaution which presents possibilities for co-operative work on the part of central-station engineers is the compilation of accurate life data for all plant equipment and the standardization of the degree of maintenance which should be kept up. Deferred maintenance is very costly because any equipment which is allowed to run down has a shorter useful life than if it is kept in good condition all the time.

Expediting Commission Procedure

BY CUTTING away from the formal practice of the courts many public utility commissions have shortened their own labors to the mutual benefit of themselves and the regulated companies. Inquiries into the merits of cases at other times than during open hearings have helped to achieve this result, and the growing practice of relying upon operating executives and engineers to represent utilities during public investigations is also responsible for much direct action. Legal counsel have their place as advisers in these proceedings, but the broader the contact between the public, the commissioners and the officials who operate properties in their daily work, the more direct the whole problem of regulation becomes. It is a good omen when the hand of the engineer is observed in the preparation and conduct of cases involving the issue of new securities as well as in rate inquiries. Commissions can proceed legally and expeditiously without adopting the methods of courts, and companies seeking prompt action in both disputed and non-disputed cases can facilitate decisions greatly by adopting what we may call engineering methods of presentation in preference to confining themselves chiefly to the routine practices of the legal fraternity.

Material and Labor Costs

IN POINTING out before the Electric Power Club recently that electrical manufacturers need to study more closely than ever before the economics of the industry and make available more definite information on production costs, S. L. Nicholson, chairman of the club's foreign trade committee, placed his finger on one of the needs of all industry. Material and labor costs have soared to such heights, with no indication of an early descent to anything like pre-war scales, that production of the future must for some time be predicated on a new basis of costs, and if quality is to be maintained and price increases limited under increasing production costs, recourse for the manufacturers lies only in increase of the productivity of processes and labor. The uncertainty of prices is the present worry of both the buyer and the seller, with relief looked for in intelligent and careful buying and a hope for an early speeding up of production in raw and finished products to equal the demand. Just now a new experiment is being conducted by the retail merchants in large cities throughout the country, following the lead of John Wanamaker, in competing in advertising price reductions with the idea of helping along the operation of the law of supply and demand through the psychological effect of arbitrarily reducing prices 20 per cent or more. The final results will be interesting to all lines of trade, since the same elements of present high material and labor costs are involved. This situation suggests the question: Will the creation of a demand at a reduced price necessarily create also a continued supply?

The Power Situation in California

IN SPITE of the brilliant success which has characterized the history of power transmission in the State of California, only about one-fifth of the better primary sites are yet utilized. There is a reserve of more than 3,000,000 hp. capable of economic development. Broadly, as pointed out by Frank C. Baum in an article of this issue, the great power sites lie on the western slope of the Sierras and the Cascades. These respective ranges differ widely in character, for the Sierras are piles of granite, while the Cascades to the northward are in general lava masses. Curiously enough, the latter fact attains high importance from the standpoint of hydroelectric development. Northeastern California was originally an area of low elevation, and the subsequent formation of the Cascade range produced a sort of dam between the Coast Range and the Sierras, lava dams being thrown across many of the branch streams. The precipitation on this great lava plateau finds subterranean storage and emerges in great springs, producing, for instance, something like 80 per cent of the low-water flow of the Sacramento River. The same condition holds elsewhere in this particular region; for example, hard on to 500,000 hp. is available on the Pitt River, an amount which could be made fairly constant, since there is plenty of storage area in the broken country. Down to the north fork of the Feather River the same general hydraulic condition prevails.

Southward one passes into the Sierras, granite-bound, with little ground storage and comparatively few first-class reservoir sites. In fact, the available proportion of the total precipitation will here depend largely on skillful use of storage lasting roughly over half of the year. In the northern Sierra territory there is at least 500,000 hp. within comfortable reach of San Francisco. On the east side of the Sierras 100,000 hp. more could be put into service which would be from its location peculiarly available for railway electrification. Further south an even larger amount of undeveloped power exists with somewhat better chance for storage than in the northern Sierras. In the long run much of the power from the southern Sierra territory must find its way into the great and growing southern portion of the state. The Southern California Edison Company has already made a good beginning on this work of development. Ultimately Mr. Baum thinks that the transmission of power must be for a trunk line of over 200,000 volts to take care of the extreme distances, with synchronous-condenser regulating stations and steam reserve at the working terminals. From the southern Sierra stations the distance to the San Francisco region, the natural outlet, is more moderate and perhaps 100,000 volts may be adequate. For the longer stretch to the Cascades the higher voltage is likely to prove desirable, and all these power supplies will be effectively interconnected. Such interconnection in fact exists today, but thus far it is of secondary rather than primary importance.

From long experience with the high-voltage transmission systems of California, Mr. Baum is fixed in the belief that no serious difficulty will be met in transmission at 220,000 volts. With circuits as large as 500,000 circ.mils to avoid coronal loss there would be a capacity of close to 200,000 kw. per circuit. It is Mr. Baum's judgment that the use of shields to lower the electrical stress on the insulators, improvement in insulator porcelain, and particularly the ultimate use of porcelain in compression rather than tension, should greatly increase the security of the lines. Concerning regulation no fears need now be held, since synchronous condensers or their equivalent in other synchronous apparatus can take care of the situation with entire success. From the large industrial viewpoint the main thing is that water-power development must come in order to build up industry. There is every reason why the utilization of surplus power should be encouraged. There is an immense possibility in the electrification of railways all along the Pacific Coast as well as in the growth of general manufacturing industries, which, attracted by available power supply, will find the best conditions for economic production. Surely the energy which has produced the present splendid developments of electrical power in the Far West will not stop until the other four-fifths of the potential water power is put at the service of man.

The Value of Cheerful Service

THE work of a public utility implies very much more than keeping on tap, so to speak, gas, water, electricity or transportation which the public can in a way and at a price get at. For vigorously calling attention to the great importance of good service to the central-station business the paper by S. M. Kennedy presented at the Pasadena convention this week deserves hearty commendation. Friendly relations with the public, the sympathetic understanding on the part of the public of the central station's problems, and good will in all things—these are the factors that make for lasting success. Nobody, however good-natured, likes to do business with a man who carries a grouch or harbors ill-concealed distrust. It is neither polite nor discreet to throw goods at a customer's head, or before his face to bite the change he passes over to make sure that it is not counterfeit. The greatest change which has come over the central-station business in the last twenty years has been not in methods of distribution nor even in apparatus, but in the mutual attitude of company and public. It does not take a long memory to go back to the time when these relations were frankly predatory, when the company looked on the public and its representatives as perpetually trying to get the better of it and the public looked on the company as an ill-natured gouger.

It is the building up of a sound and friendly understanding that has done more to bring the great industry of distributing electricity to its present place than anything in the way of physical improvement, and the key to the situation is found in the way Mr. Kennedy well sets forth—in service not only by supply of energy but in the care of all the details of the business as between producer and consumer. The public's impression of a public utility is gained wholly from the attitude of the company's employees. If service is actually inefficient in the sense of inadequate and improper supply, that, too, is charged up to the personnel of the operating company, and generally with some justice. For electrical supply depends on organized attention, which in turn is based upon the thoroughly planned co-operation of active and willing men. Every company must expect complaints, just and unjust in an indeterminate proportion, and it is quite as important to deal with the latter amiably and courteously as it is with the former. Another phase of the matter has to do with petty details of the organization of the business. It is possible in meter reading, billing, installations and lamp renewals to preserve general good nature on the part of the customers or to exasperate them almost beyond measure. The little things of business in the long run count heavily. Every public service corporation can meet the emergencies of service or business successfully about in the proportion in which it enjoys the confidence of the community, so that the building up of public good will is the best insurance against the time of trouble.

Accurate Electrical Fire Records

RECENT announcements such as the one on page 1209 of this issue by the National Fire Protection Association of an increase in property loss due to electrical causes from $16,559,433 in 1916 to $25,000,000 in 1919 do not justify the conclusion that electrical hazards in the home have increased 55 per cent in that period, for a study of increases in building costs will show that the 1916 real property loss is equal to if not more than the electrical loss of 1919. When the rate at which electrical service has been introduced into the home in the past three years is considered, dollars property loss due to electrical fires is no true measure of electrical hazards. The activity of the National Fire Protective Association in its attempt to educate the public to the importance of proper installation of wiring and use of labor-saving devices is to be commended, but in this propaganda that association is obligated to be equally cautious that the public is properly informed on the safety of electric service when its standards of installation are maintained. Too many mysterious fires are still wrongfully accredited to electric wiring. This will always be so until steps are taken to make compulsory a careful investigation and accurate report on all fires. Placing the blame for a fire is the job of local inspectors of insurance companies, police forces and electrical inspection organizations. The opinions of those men can be accurate or inaccurate only as proper methods of education are applied to the men themselves. Hence those responsible for the opinion of the public concerning electric service in each locality would do well to formulate a plan that will assure a reasonably accurate analysis of the causes of fires. That this is not an impossible thing has been proved by experience in certain cities, notably Dayton, Ohio, where the operation of such a plan has reduced the record of electrical fires to a figure surprisingly low in comparison with averages for the country at large.

Inductive Interference Grows in Importance

IN THE report of the committee on inductive interference which was presented this week at the Pasadena convention of the National Electric Light Association attention was called to the importance of the subject to the power companies, the telephone companies and the public, which is served by both. A plea is made for the more general and comprehensive study of the subject by the power companies, with a view to joint action by both the power and light and the communication interests.

It is manifestly inevitable that the opportunities for interference between power systems and communication systems will multiply as time goes on. More wires and longer wires are going to appear on the highways every year. There are going to be more electric railway and power distribution systems. There are also going to be more telegraph and telephone systems. Where these systems come into proximity there will be opportunities for interference. From a physical point of view the interference is all one way—the strong-current systems interfere with the weak-current or communication systems—but from the point of view of litigation the interference is all the other way. The complaints all come from the weak-current systems, even when they themselves intrude into the district occupied by the strong-current systems.

Inductive interference as a problem, therefore, has pushed its way to first importance in the transmission and distribution field. Much important work, notably the study in California, has been done in the development of specific methods of mitigation. It is unfortunate that the published data are so largely confined to those things that can be done with generating, transforming and transmitting equipment to mitigate interference. The two industries principally affected are vital factors in the development of modern industrial life, and it is of the utmost importance that both be allowed to develop with the least possible hindrance. Any solution of the inductive interference problem undoubtedly must be based on methods that will permit of the least total cost of service from both industries to the public. It may be that this result would be best accomplished by a study based on the assumption that both industries are controlled by one head. Such a study would naturally seek the solution that would least hinder the development of either class of service, produce results at the least cost, and utilize the full possibilities of mitigation within the plants of both industries. The thing most needed at the moment is a full and forceful presentation of the problem from the standpoint of the light and power industry, and it is to be hoped that the representatives of that industry will soon become much more active in the study than they have been in the past.

William LeRoy Emmet

Recipient of the Edison medal this week for inventions and developments of electrical apparatus and prime movers, pioneer in the design of electric propulsion for ships and inventor of switches and insulating materials.

DURING the last twenty years William LeRoy Emmet, consulting engineer of the General Electric Company, has been intimately associated with the developments in steam turbines. For the success of the Curtis turbine Mr. Emmet is largely responsible through his untiring work and experimentation. For years he stood practically alone and unsupported in his conception of the application of the turbo-generator and motors to the propulsion of ships. Not until seven years ago was he able to demonstrate his principle, but after the electrical equipment of the U. S. collier Jupiter he succeeded in two brief years in converting the most skeptical and brought about the adoption of electric drive for the largest and most powerful battleship the United States Navy has ever built, the U. S. S. California, and similar men-of-war at a marked saving in cost of construction. For this work it is particularly fitting that the American Institute of Electrical Engineers should honor him this week by awarding the Edison medal to him for inventions and developments of electrical apparatus and prime movers. However, this is only a part of Mr. Emmet's contribution to the electrical industry, with which he has been intimately connected since 1887. In the fall of that year he became associated with the Sprague Electric Railway & Motor Company. He next served as electrical engineer for the Buffalo (N. Y.) Railway Company and later as district engineer for the Chicago district of the Edison General Electric Company. Since 1892 he has been continuously engaged with the General Electric Company except for a time in 1898 when he served as navigator on the U. S. S. Justin during the Spanish-American War.

During the early part of this period of thirty-three years he did much original work in alternating-current distribution, inventing switching and control devices, including the first types of oil switches and air-blast transformers. He was chiefly responsible for developing the use of Copal gums and oils with cambric for insulation of high-voltage apparatus. Mr. Emmet was born at Pelham, N. Y., July 10, 1859, and was graduated from the United States Naval Academy in 1881. During the war he was appointed a member of the Naval Advisory Board. He is also a member of the A. I. E. E., the A. S. M. E., the Society of Naval Architects and Marine Engineers and the American Philosophical Society.

California Greeting to N. E. L. A. Typical of the West

Twenty-three Hundred Delegates Gathered This Week at Pasadena for the National Convention, the Principal and Underlying Theme of Which Was the Development and Financing of the National Water-Power Resources of the Nation

Convention Headquarters, Hotel Huntington, Pasadena, Cal.

TYPICAL of the West in every respect was the opening of the National Electric Light Association convention this week at Pasadena. The smiles and the hearty greetings of the Western hosts, together with the sunny southern California climate, removed every trace of formality and gave the delegates a close-up vision of the vastness of the possibilities in the West and the enthusiasm of its inhabitants. The formal opening of the convention at the president's reception on Tuesday night gave a glimpse of the lavishness of the entertainment program. On the front lawn of the Huntington Hotel an outdoor stage was arranged, and, with the tropical trees for a setting and a huge electrical banner with the initials "N. E. L. A." for a curtain, a group of singers and dancers gave an interpretation of playtime in California. A display of electrical effects and fireworks followed the dancing.

Each day auto trips were provided to many points of interest. On Wednesday evening a celebrated mission play was arranged as a special feature of the entertainment, and on Friday night "La Fiesta de Electra" fulfilled all expectation. Spanish dancers and dazzling scenes portrayed the pioneer days of the West. Nor did the entertainment committee relax even during mealtime, when Spanish dancers and singers gave a touch of local color. Approximately 2,300 delegates were registered. At the time of going to press the convention was still in progress. A full and complete report with abstracts of papers will be found in next week's issue.

Development of the natural water-power resources of the nation and their financing was the principal theme of the convention. Since the electrical industry has perhaps a greater importance than any other, it was recognized that most earnest support must be given to financing if the industry is to continue to expand. Commission regulation and the work of the committees on public policy and public information also attracted intense interest. A sound public policy and the dissemination of accurate detailed information on the operation and financial conditions of power companies were considered the greatest factors in stabilizing the industry and in furthering the public confidence so necessary to enable the tremendous financing plans to be carried out successfully.

The coal and fuel-oil supply, the cost of all other materials and the supply of labor were discussed extensively both in the meetings and wherever operating engineers and executives gathered. After the official welcome to California, President R. H. Ballard introduced Governor Stephens, who extended to the delegates the felicitations and good wishes of the West. The Governor stated that the West was looking to the electrical industry to maintain the prosperity now only started.

Following the address of President Ballard, which is abstracted on the following page, M. H. Aylesworth, executive manager of the association, briefly outlined plans which are being made for increasing the usefulness of the association by the enlargement of various departments, particularly the engineering section. This section has obtained the services of W. J. Canada, formerly of the Bureau of Standards, who will work under the direction of E. J. Fowler of the Commonwealth Edison Company.

The publicity department will assist the regulatory commissions and place before the public information regarding the operations and financial conditions of the industry. During the past two months more than 500 inquiries from member companies have been answered by the Company Service Bureau, all within forty-eight hours from the time of receipt. The Accounting Service Bureau will give assistance on the subject of uniform classification of accounts, co-ordinating this work with that of the Rate Research Bureau.

With one or two exceptions all of the state associations have now become affiliated with the geographic divisions of the association.

Increased revenues must be provided for more extensive operations, according to the report of H. C. Abell, treasurer. It is expected that at the close of the fiscal year a balance of approximately $87,000 will remain.

A committee, consisting of H. C. Abell, I. E. Moultrop and Guy Talbott, was appointed to consider the constitutional changes which were outlined in the May 8 issue of the ELECTRICAL WORLD.

In order to effect a better organization, F. W. Herbert has been placed in direct charge of the Bureau on Rate Research, with a staff equipped for giving assistance to commissions and member companies in matters of rates, Alex Dow, chairman of the committee on rate research, reported. It is believed that the reorganized staff will facilitate the conduct of the affairs of the bureau.

Difficulty has been experienced owing to the lack of an accepted definition of power factor and unbalanced load, and at the present time a committee of the American Institute of Electrical Engineers is preparing to submit definitions of these which will then be considered by the rate research committee. It was recommended to the committee that an unreasonably low power factor and a bad state of unbalance should be considered as a menace to good service and should be prohibited by all companies.

In speaking of the estimate of developed and undeveloped water powers made by the ELECTRICAL WORLD as of January 1920, Franklin T. Griffith, chairman of the water-power committee, took occasion to compliment the technical press on the monumental task which had been so ably accomplished. He stated that the technical press of the electrical industry is doing a wonderful work in forwarding the best interests of that industry and asked the hearty co-operation of the national association with this press. Mr. Griffith stated that 94 per cent of the potential hydro horsepower of the United States depended upon federal permits, and that the water-power committee would do its utmost to co-operate with the federal government in working out the details of the water-power bill when it shall become law.

W. W. Freeman of Cincinnati offered a resolution, seconded by S. Z. Mitchell of New York, suggesting that the present water-power committee be retained throughout the coming year to assist the federal government in the carrying out of the pending water-power bill, which in the form given it by the Congressional conference committee has been passed by the House of Representatives and is expected to come before the Senate very soon.

The use of fuel oil in California to generate electric power is similar to the pouring of gold into a bottomless abyss by a maniac, said John Britton. Whereas the increase in hydro development in that state in the past five years had only been 2 per cent, the increase in steam had been more than 400 per cent. Congress has been responsible for this, and since two-thirds of the hydro power waiting to be developed is on the public domain the men of the East should use all the influence they can bring to bear upon Congress to insure the passage of the water-power bill.

The interests and problems of California are those of the industries there, and the people must be made to realize that they themselves will benefit by the greatest development of the industry, said A. Emory Wishon in touching on his "self-interest" plea. William C. L. Eglin suggested that the raising of capital could be taken care of to a large degree by the sale of securities to consumers and that the commercial men who have already won the confidence of the consumer by assisting them are undoubtedly the right men to support this movement.

The conservation work of the insurance bureau has saved the central stations many millions of dollars, said W. H. Blood, Jr., insurance expert. The most important task accomplished has been the watching of the court decisions on damage by fire, Mr. Blood asserted, and the work done by him as representing the National Electric Light Association in the National Fire Protection Association.

President Ballard Puts Credit Situation First

Reviews the Financial Situation, Discusses the Problems of the Industry, Outlines Association's Plans and Appeals for Co-operation

IN THE address of President R. H. Ballard, delivered before the National Electric Light Association convention on Wednesday, May 19, the retiring executive emphasized the imperative need of the central stations for the funds which restricted returns make it so hard to obtain in the existing financial conditions and discussed the other important problems now before the industry, closing with an appeal for closer co-operation between all its branches. After an optimistic allusion to the progress that has been made in electrical development and the increase of public appreciation, he turned to the problems and issues of immediate importance, saying in part:

"The credit situation is a matter of concern to every public utility. We face the fact that at present our industry must have at its command about twice as much money as heretofore to handle even a normal volume of business. But the present strain on the money market has made it manifest that there is not enough money to go around—not enough, that is, to finance the production of necessities in sufficient volume to meet pressing demands and at the same time finance a great number of speculative and non-essential activities.

"The industry needs approximately $750,000,000 of new capital right now to care for the expanded requirements of the country, and the ability of the utilities to raise this large sum of money hinges on the earning power of the investment, the economic soundness of proposed development, support of public utility commissions, favorable opinion of the public at large and the extent to which our securities are forced to compete for favor in the general money market.

"Utilities like ours are among the greatest factors in the country's commercial life and to cripple or handicap them would be a national calamity. It is true that commission regulation is an element of security, but none the less there is one weakness in our system of regulation—its elasticity.

"The business must be profitable if production is to be adequate to the economic demands, and it is expedient that properties be developed to a state of efficiency commensurate with the natural growth and evolution of the country. The same sound principle which prohibits regulated monopolies from earning at any time more than a fair return on their capital investment demands that at no time shall the earnings be less than such fair return.

"The kind of public ownership which brings results is ownership by the public at large in the stocks and bonds of their local regulated utility companies. This forms a partnership which leads to complete understanding and co-operative effort in development and retains in the management and operation of the utilities those trained by long experience to perform the task. In our own industry the economic necessity for very large generating stations and interconnecting transmission lines, traversing many counties under one operating system, relegates to the past serious consideration of independent municipal systems necessarily confined to the area of single cities.

"The future of the industry depends in great measure on the constructive attitude of commissions possessing regulatory and rate-making power; on the efficient management of the properties and on ability to raise adequate funds to handle the ever-increasing demands for our service. It is to be assumed that the commission will accord fair treatment when all the facts are fairly and firmly laid before them, and it is certainly within the realm of reason to expect owners and managers of properties to handle them efficiently. The immediate problem, therefore, which all utility executives are facing, is the marketing of their securities.

"The economic growth of the electric utility business lies in larger and more efficient units of production and in their interconnection. We are accustomed to the transmission of electrical energy from water powers for long distances, but as yet the possibilities resulting from the transmission of energy from steam power produced directly in the coal fields have not been realized; nor are the advantages resulting from the generation of such steam power and undeveloped water power fully appreciated.

"The development of large steam and water-power plants and the improvements made in the transmission of power have raised new problems as to the most economical methods of operation. New power projects must hereafter be considered and studied in combination with existing power plants, because interconnection of power systems is the order of the day in all sections of the country.

"Moreover, the ultimate development of our water powers will involve interconnection of existing systems if maximum use is to be made of them and the developments are to be profitable. Both for the conservation of the fuel supply and the economic advantages resulting from the use of power in our industries, development of all possible water powers and their interconnection with existing systems should be encouraged.

"Trunk-line electrification has its greatest argument in the future, for with the rapidly increasing cost of fuel and traffic the ultimate return on any amount now invested in electrification will be more than generous compared with the return on the accumulated amount which might be spent over a long period in patching up the systems. Aside from the greater comfort in travel and the purely operating economies obtainable, enormous savings in coal are possible through electrical operation of the railroads.

"It is not my purpose to discuss with any detail the water-power situation, since the committee on that subject will go into the matter at great length. Both Congress and the executive departments have recognized for years the inadequacy of existing laws; and although developments subject to revocable permits have been and are being made on the public domain, no development on navigable streams has been authorized by Congress since 1912. Thus three-quarters of the country's hydro-electric resources are either locked up or are so involved as to discourage development.

R. H. BALLARD
President N.E.L.A.
Vice-President and General Manager
Southern California Edison Company

"The problems and conditions confronting our electrical industry are such as to require a strong, aggressive and thoroughly representative organization. To that end plans have been made to strengthen state and geographic sections and to co-ordinate their activities with those of the national body. Moreover, much of the work formerly done by the national association will be delegated to the geographic sections, where regional questions can be better discussed and where national policies can be interpreted and modified to meet conditions. Already interest in the geographic section work has been quickened to such an extent that all of the country west of the Mississippi River and south of the Virginia line has been organized into geographical divisions, together with New England and Canada. Work on other sections is well under way, and it is reasonable to expect that within the year the entire country will be organized along geographic lines.

"At headquarters, under the direction of an efficient and energetic executive manager, the organization has been divided into five departments for constructive assistance to the membership. It is proposed also to divide the work of the association among four national sections—public relations, technical, commercial and accounting. The last three are already functioning. The public relations section is entirely new."

Greater Publicity Advocated

JOHN A. BRITTON

Chairman Public Policy Committee

IN PRESENTING the report of the public policy committee, Chairman John A. Britton alluded to the unprecedented conditions that have followed the armistice—the inflation of money values, the high pay and extravagance of workingmen, the prevalent spirit of unrest and public hysteria. He urged that the public policies adopted by the convention be acted upon by those who compose the industry and not allowed to become a dead letter as the enthusiasm aroused by the gathering subsides. Regulation, he said, had caused a realization of the fundamentals of self-interest and service, and by service he meant not only the service rendered to those the industry serves but also service to those who serve the industry.

Mr. Britton recapitulated the topics affecting public policy grouped in the preamble to the constitution of the association—commission relationship, welfare work, employees' benefit funds, profit sharing, stock ownership by employees and customers, accident prevention, and in general the whole range of social and economic questions that are in the forefront of modern thought. Some of these topics had been assigned to individual members of the committee, and their reports were appended to the chairman's more general observations.

Turning to the ever-recurring demand from certain of the people for municipal ownership of electric lighting plants, Mr. Britton said that reports from municipalities owning such plants were misleading, and for that reason it was impossible to contrast their service with that rendered by private plants.

NEED FOR GREATER PUBLICITY

Not enough had been accomplished, Mr. Britton held, in informing the public concerning public utility operation. The association should be frank and open in the declaration of its principles. The public can be brought to see the necessity for the expenditure of huge sums in electrical development and to realize how the development of natural resources will follow.

A continuation of the policy of fair rates to utilities, rates that will meet all operating costs and money costs and leave a margin of safety, is essential, Mr. Britton said. He commended the policy of offering stock issues to employees, consumers and the general public. The attitude of the Railroad Commission of California, as embodied in a recent decision in which the dependence of that state on electrical development was emphasized, came in for Mr. Britton's hearty commendation, and in conclusion he urged the importance of welfare work and of embuing employees with an interest in the achievements and the problems of the companies.

Abstracts of reports by individual members of the public policy committee follow:

The Construction Problem.—Henry G. Bradlee, dealing with this subject, said that it should be the duty of the members to seize every proper occasion and to use all proper means to bring before the public and all regulating bodies the fact that further extensions cannot be made and the public cannot be adequately served unless new capital can be obtained through the sale of securities, and that this can be accomplished only through permitting the utility to charge reasonable and adequate rates. The credit of all public utilities has suffered during the war period through the inertia and delays incident to obtaining reasonable increases in rates to offset increases in cost of labor and materials. This injury to credit is serious and can be remedied only through prompt and liberal action in the future where further increases are reasonably needed and through a liberal policy in permitting utilities to continue the higher rates established during the war until the general costs of labor and material are reduced sufficiently to permit a corresponding reduction in rates. The question of presenting this situation clearly to the public is, therefore, one of prime importance in connection with future development and the furnishing of adequate service. If by delaying the extension its cost may be reduced, the amount necessary for a reasonable return and for the replacement of the property will be less and rates for service may be lower.

Relation of Manufacturers to the Association.—J. B. McCall held that the central station has a duty to perform to the public in the matter of reducing the high cost of living. Everything possible that can be done to control the tide of rising prices should be done, and in this particular the manufacturer can be of great assistance. The cost of the electrical appliances which have become so necessary for the health and happiness of the home has unfortunately kept in step with the rising prices of other commodities. It should be the duty of the entire electrical industry to do everything possible to check this tendency to rising costs and prices.

Alliance with Other Utilities.—Herbert A. Wagner thought that in the general conduct of the electric and gas businesses there is much in common that involves a duplication of operating expense when undertaken separately. Consequently very material reductions in combined expenses can be effected by combination. Duplication of investment in the exploitation of business can also be avoided to a greater extent.

National Relations.—John W. Lieb alluded to the work of the National Committee on Gas and Electric Service, organized as a war service committee with headquarters in Washington, and to the appreciation it won from various departments of the government. The stress and anxieties of the war period having passed, it was found that there was still work for the committee to do during the periods of reconstruction and resumption, and it would appear further that in certain directions important and useful service may still be rendered in maintaining close contact between the utilities and the agencies of government even in times of peace. The problems of continuity of fuel supply, water-power development, provision of ample supplies of power for transportation and industrial application, and the conservation of natural resources and elimination of waste and inefficiency through the maximum utilization of investment and interconnection of generating and transmitting systems, are all economic problems of national importance.

Co-operation.—W. W. Freeman referred to the way in which in the last few years various companies have been selling their securities direct to their consumers, usually on an installment basis if desired, and in this way have established a new relationship with many consumers which cannot be otherwise than desirable. The extension of this idea as rapidly as is practicable will prove a splendid exemplification of co-operation, but whether the average citizen is a stockholder in his public utility company or not, he should realize that much of the stability and growth of his community depends upon the financial integrity of such company and that so long as its operations are conducted, under public regulation, with due regard to serving the interests of the public, it is entitled to the co-operative support of the community in both thought and action.

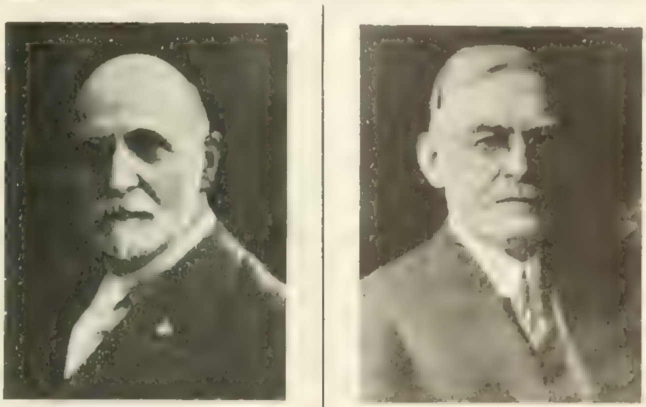
General Policies of Relations to Commissions.—Walton Clark, pointing out that regulatory commissions are a fact, urged cordial co-operation with them by the public utilities. In order to lessen the labors incident to the performance of the arduous and delicate duties of the commissions, he suggested that all claims and requests submitted to a commission be not only just and reasonable but also, if susceptible of proof, be supported by plainly stated and unquestionable evidence, and that where speculation enters into the discussion the companies' claim be frankly stated and accompanied by such evidence of probability as has convinced the companies of the correctness of their claim.

Water-Power Development Still Waits on Legislation

FRANKLIN T. GRIFFITH

Chairman Water-Power Development Committee

BECAUSE of the peculiar setting of the convention at Pasadena, the water-power development committee, of which Franklin T. Griffith is chairman, brought out in its report more especially the water-power development west of the Rockies, giving instances near at hand for verification, however, rather than setting up the individuality of Western problems. There is a great need for development in the West, where there is a power shortage such as, of course, also exists to a lesser degree in the East. In fact, the trend of labor and transportation conditions makes imperative the utmost co-ordinated development and application of water power wherever available. The saving of fuel for heating purposes follows water-power development. Replies from prominent central-station men in answer to a questionnaire reflect the present economic conditions affecting such developments. These replies are presented in full in "Appendix A," which forms a part of the committee's report. The general trend of these replies emphasizes lack of suitable legislation and the establishment of a fixed policy on the part of the federal government in the granting of permits for the development of water power on federal reserve lands and on navigable streams. The report then goes on to review the legal aspects of priority of navigation rights, power development on public lands, state laws of navigable streams and diversity of state legislation.



ALEX DOW
President and General Manager
Detroit Edison Company

JOHN A. BRITTON
Vice-Pres. and Gen. Mgr.
Pacific Gas & Electric Co.

FRANKLIN T. GRIFFITH
President Portland Railway, Light & Power Company

M. S. SLOAN
President
Brooklyn Edison Company, Inc.

Mr. Dow is chairman research committee; Mr. Britton, chairman public policy committee; Mr. Griffith, chairman water-power development committee; Mr. Sloan, chairman electrical resources of nation committee.

The national water-power bill is touched on briefly, and the essential features of the bill as amended by the Senate are pointed out.

Co-operation between the Federal Power Commission to be established and the electrical industry is urged, and also the committee recommends that a permanent committee be appointed to represent the entire electrical industry in its relations with this commission.

Figures on water-power development compiled by the Geological Survey and also by the ELECTRICAL WORLD as its Jan. 1, 1920, estimate are presented, and the latter are taken as a basis for the discussion in the remainder of the report.

From these figures an analysis of the development in the Western States is made. The committee at this point, however, points out that these estimates do not include the unknown factor of storage, which is hardly susceptible of estimation. The committee states that it has been roughly approximated that something like 200,000,000 hp. would represent the possible maximum potential horsepower with maximum storage facilities developed and utilized, as compared with 60,000,000 hp. when storage is not considered. About 75 per cent of the generated power of the West is hydro-electric and the remaining 25 per cent steam. With the program of water-power construction now under way and planned for the next decade steam generation will become still more a minor factor in the West, except for stand-by purposes. The report contains some interesting comparisons relative to the power consumption, cost, revenue, etc., per capita in various sections of the country. The States of Idaho, Montana, California, Washington and Oregon represent 61 per cent of the total maximum water-horsepower of the country, with a total of 36,210,000 hp. Developments in the Eastern States include over 1,000,000 hp. in the States of Alabama, North Carolina, Georgia and Maryland. The electrification of the trunk-line railroads of the Western section will amply justify local development. A questionnaire to all of the fifty-two power companies of the Far West brought forth that 1,776,260 kw. is the expected development in this section in the next ten years. This represents a future expenditure of something like $710,510,000. The value of the "self-interest" appeal in this financing was emphasized.

The present and prospective water-power applications, including electrochemical possibilities and agricultural load, are briefly touched on. Attention is also drawn to the value of pooling of power resources.

The committee further advocates that the policy of trunk-line transmission of 220,000 volts and over be advanced as economic possibility.

Electrical Resources of the Nation

M. S. Sloan

Chairman Committee on Electrical Resources of Nation

FOUR separate and distinct divisions are made in the report of the committee on electrical resources of the nation, of which M. S. Sloan is chairman: (1) The status of municipal plant operation throughout the country; (2) recommendations for commission control over municipal as well as private plants; (3) need for collecting certain statistics, and (4) the state of the electrical resources of the nation.

The municipal plant in almost every case studied by the committee was less efficient in energy production, narrower in its application and distribution and higher in actual average selling prices than the private utility. Most of these plants are small and in thinly populated places.

The investigation showed actual competition existing between private and municipal plants in comparatively few instances. The active fighting type of competition exists in about seventy-four cities, of which only fifty have a population of more than 5,000.

It appears in the general evolution of the business that the number of the larger municipal plants will decrease from the operation of the fundamental laws of real depreciation and neglected maintenance and the growth of demand for power in large amounts with the development of large and growing power systems.

It was recommended by the committee that the control of public utility commissions be extended over municipal plants where such control does not now exist. It was also recommended that definite action be started by the N. E. L. A. whereby a policy and program could be outlined.

Commissions have control over both municipal and private plants in sixteen states, with varying or optional control over a few matters pertaining to municipal plants in eight others. In nineteen states commissions have complete control over private plants and none over municipal plants, and in eleven states no control is exercised over either class. In states where commission control has been wise and helpful over both municipal and private interests, both classes of service have prospered.

The commissions are almost unanimous in the opinion that the municipalities should be under supervision as to rates, service and accounts. The trend of court decisions in cases of municipal competition is toward the theory that where a municipality goes into business it must submit to the same laws and hazards as a private utility.

Attention was drawn to the necessity for statistics on operating capacity of power plants, output of such plants, their reserve capacity, their transmission and distribution facilities, demand on their plants, either present or estimated for the future, and the preparations being made to meet future demands. To gather and disseminate these statistics the committee recommended that the N. E. L. A. establish a permanent agency. In this connection the association has been offered the co-operation of the interdepartmental board of the Council of National Defense.

Present capacity of generating machinery is defined as the electrical resources of the nation. The latent power of the country is taken at 54,000,000 hp. in water power and 3,000,000,000 tons of coal. The available central-station operating capacity is almost 11,000,000 kw. It is estimated that two to three million kilowatts in capacity, if installed, could be absorbed by our present needs by 1922, with almost as much more needed soon thereafter.

The state must meet its share of the problem and permit some scale of return to be provided which will allow the industry to obtain the funds necessary under conditions fair to the public itself.

"The mere raising of fixed rates," the committee concludes, "over a period of high costs is not the best economic or individual answer to the problem. What is really necessary is a rate of return adjustable to changing conditions and establishing securely for the future the principle of an increased reward for improved and more economical methods of manufacture sufficient to furnish the required inducement for the investment of money. This might be accomplished by the establishment of proper base rates sufficient to include the accumulation of reserves, and by allowing the utilities to receive, in addition to these rates, a fair share of the earnings over the base rate, secured by the improved methods proposed by the industry."

Obligations and Results of Good Service

S. M. Kennedy

Vice-president Southern California Edison Company

IN A PAPER entitled "Service" S. M. Kennedy, Southern California Edison Company, discussed in detail the service functions of the central station in all its departments. He touched upon the following topics: Physical conditions, rate schedules, meter reading and billing, service applications, educational responsibilities, complaints and troubles, contact with customers, courtesy and conciliation. The following are excerpts:

It goes without saying that there should be an ample supply, close frequency, proper voltage and assured continuity. To be able to meet such ideals there is an obligation on the central-station company to install the best type of equipment and maintain it in the highest condition of efficiency, from the penstock on its hydroelectric system and the fuel reservoirs of its steam generating plants to the premises of its customers.

For the ordinary man—the smaller consumer—complicated schedules are mystifying and confusing and tend to create the impression that they are framed to conceal the cost rather than to reveal it. All employees of a central-station company who receive applications or sell the service should thoroughly understand the rate schedule. They should know why rates differ for different classes of service. They should be able to point out the various factors which make rates vary. Hours of use, quantity, "on peak" and "off peak," seasonal characteristics, load factor and other elements should be intelligently explained when necessary.

Meter readers and billing clerks do not command the highest pay in a central-station organization, but their work demands that there shall be punctuality, accuracy and courtesy; otherwise good service is withheld. It is easy for a company to lose more in good will than it will save in salaries by using a class of men for meter reading who are either incompetent or do not have a proper appreciation of the importance of their work.

When applications for service are received it is a fitting time for the creation of an atmosphere that will convince prospective consumers that their money is not all the company wants and that the selling of energy is not its only desire. On the contrary, it should be made evident that the chief aim is to supply a service that in every reasonable way will not only satisfy but also please the consumer. Perhaps the most practical education to begin with is to instruct consumers regarding the economical use of the service already supplied. An industrial plant using power service may be wasting energy every hour of operation. It is good service on the part of the company to point out this waste and at the same time indicate the best means to correct it. Such methods start consumers investigating and thinking electrically. The best service yet devised cannot prevent local disturbances, such as transformer difficulties, fuse troubles, lamp burn-outs and appliance breakages. The quality of the service depends upon how these complaints are disposed of. Troublemen should not be ordinary men—there should be men of extraordinary worth on trouble duty at all times. The men who go out to look after the troubles in connection with the tangible service can do much to help the company while attending to their duties. Complaints about bills and inattention or discourtesy on the part of employees cannot be too carefully handled or too closely investigated. No attempt should be made to stifle complaints or head them off. On the other hand, they should be encouraged, listened to with attention, and the customer should feel that what he complains of is entirely reasonable and that the company is thankful for the information and glad of an opportunity to remedy any unsatisfactory condition. What company employees need more than technical knowledge is a deeper human understanding, so that they may endeavor to see this question of service through the customer's eyes rather than through their own.

S. M. KENNEDY
Vice-Pres. and Gen. Agent
Southern California Edison Co.

W. H. BLOOD, JR.
Electrical Engineer
Stone & Webster

EDWIN O. EDGERTON
President
California Railroad Commission

M. H. AYLESWORTH
Executive Manager National
Electric Light Association

Mr. Kennedy, author of paper on "Service"; Mr. Blood, N. E. L. A. insurance expert; Mr. Edgerton, author of paper on "Rewards for Efficiency"; Mr. Aylesworth, in charge of executive work at N. E. L. A. headquarters.

The fruits of good service, Mr. Kennedy pointed out, are these: Increased earnings, public good will, financial advantages, prosperity of territory served and unlimited possibilities for improving service. In discussing these results he emphasized among other things, the following points:

In the central-station service business where there is good service no chances are taken as to the character of the results which will accrue. There will be an ever-increasing number of consumers to serve, and existing consumers will make ever-increasing demands for more service. Such a condition not only means a growing volume of new business each year but greater earning from present investment. Good service stimulates business to a high degree, and no chances are taken as to the results which will accrue.

It must not be overlooked that in any business it takes two—the server and the served—to produce good service. When a central-station company asks its consumers to assist the company by means of information, criticisms and suggestions to improve their service, and when consumers realize that such suggestions are thankfully received and adopted if practicable, then something happens, and that public sentiment is being formed which will be useful to the company later on. Every public utility company must have money to carry on its business, and no company subject to regulation can finance its requirements out of earnings. Consequently each company needing money must find a market for its securities, either at home in its own territory or abroad in the great money markets of the land. In either case the local standing of a company is closely scrutinized. A utility company that supplies good service, including all these words properly imply, cannot proceed on its career entirely unnoticed. Its policies and methods are known to the banker and broker in the money centers and through them to individual investors, and locally such a company is well known to its consumers and the public. It is not luck when that company meets with success in disposing of its stocks and bonds.

The company which, through its representatives, has pictured the advantages to be derived from the uses of electricity, has invited and solicited business, and has built up a load based upon promises of service, has assumed a tremendous responsibility. The greater the company's responsibility, the greater and better should be the company's service in all its details. If that service fails, in either its tangible or its untangible qualities, for any controllable reason, then that utility company becomes a delinquent and may be branded as unfaithful to its trust.

Much Unfair Legislation Forestalled

W. H. Blood, Jr.
N. E. L. A. Insurance Expert

THE insurance expert, W. H. Blood, Jr., told in his report of the duties of his office in preventing legislation unjust to the electrical industry both in civil courts and by the National Board of Fire Underwriters and the Bureau of Standards. Mr. Blood went on to say that a judgment involving only a few hundred dollars against the smallest company may readily be as serious a matetr for the industry as one involving hundreds of thousands of dollars against one of the larger companies. Up to a few years ago the industry suffered considerably because no one in particular followed up this matter. Of late years the reverse has been true.

As a rule the cases are of such a nature that the local attorneys run across them hardly once in a lifetime and consequently are unfamiliar with established precedents with the special technique of the case. These circumstances render the insurance expert's service of special value because of his familiarity with all the important cases, as he has personally participated in many of them and has knowledge of the technical questions involved. Of particular value in these cases is the insurance expert's intimate acquaintance with the National Electrical Code (known as the Underwriters' code). His knowledge of the National Electrical Safety Code of the Bureau of Standards is also helpful.

In every revision of the code in the past changes have been proposed, which if they had been adopted, would have largely increased installation costs and would have tended to discourage the use of electricity. It has been the duty of the insurance expert to watch for these and to point out to the committee the undesirability of such changes unless they were warranted by experience.

The insurance expert would respectfully suggest that individuals and the association should co-operate with the National Board of Fire Underwriters in its efforts to secure compulsory education along fire preventive lines.

Rewards for Efficiency

E. O. Edgerton
President of Railroad Commission of California

UNDER the title "Rewards for Efficiency," E. O. Edgerton, president of the Railroad Commission of California, read a paper in which he declared that a vital need of the people of the United States is the generation and distribution of electrical energy in sufficient quantity for their needs and at the lowest possible cost. It is evident, Mr. Edgerton said, that failure to meet the pressing demands of the public for energy will result in widespread loss and discomfort. Effort and real thought therefore must be devoted to methods of improving service and increasing the supply available, and every inducement should be held out to those engaged in this business to work and think at the highest efficiency.

Commission regulation has been criticised, Mr. Edgerton said, because the limitation of utilities to a fixed rate of return has a tendency to create a fixed level of service and provides no stimulus to the companies for progress, inasmuch as the companies can gain little benefit from enterprise so long as increased net earnings are reflected only in reduced rates to consumers. If regulation in the past has had this tendency, the Commissioner asserted, a change should be brought about, so that the company shall be rewarded for improved service or for efficiency resulting in the supply of good service at lower cost. There is, however, a tendency on the part of managers of public utilities and investors in them to think that they only deserve such a return and to overlook the fact that to get the desired results every member of a public utility organization must participate in the rewards accorded and every individual must feel that his loyalty, attention to duty, progressive thinking and proper attitude to the public will find appreciation. A manager, however great his ability, will not succeed in the conduct of his business unless he is loyally supported by the individuals composing his organization. If regulating bodies are to hold out a definite assurance of reward to public utility companies for efficiency and economy, it is the task of the management to work out a scheme whereby employees will enjoy individual rewards for their part in the betterment of conditions. These rewards need not be confined to increases in pay, but should include appreciation of work well done and promotion on merit, influence or "pull" being excluded from consideration.

Fluctuating Valuation Has Nothing to Recommend It

Carl D. Jackson
Chairman Railroad Commission of Wisconsin

FUTURE central-station development is beyond the scope of governmental management, Carl D. Jackson, chairman of the Railroad Commission of Wisconsin, asserted in the opening of his address on "Trend of Regulation." In other words, municipalities and government divisions are not prepared for undertakings of the magnitude and scope which the activity must take if the full results of efficiency and economy are to be given to the people.

Regulation, besides assuring the public good service, safety and reasonable rates, must encourage and reward to a reasonable degree those supplying the energy, enterprise and capital. The very present problem has been to meet the conditions which have grown out of the war. Extraordinary interest rates for public utility securities are a great handicap to extension and absolutely necessary development.

The conception of fair value has assumed increased importance recently because of the great and rapid change in all unit construction costs. Undue emphasis on value without considering investment will unquestionably tend to establish fluctuating values or rate-making bases, which ought to be stabilized.

The assignment of constantly fluctuating value to property devoted to a public use has nothing to recommend it. A rule which tends to protect public utility investments when prices are declining must recognize investment when costs are inflated. Most present public utility property will be renewed or replaced with units the additional cost of which will be reflected in investment account, and such additional costs are clearly to be recognized as capital expenditures in proper accounting. This is so even though the new unit be identical with the old except as to cost. The cutting down of the earning base below the actual reasonable investment actually in the plant can lead only to decreasing returns, discouragement and failures. Yet such a result is likely to come from the establishment of valuation based wholly on highly fluctuating elements.

Reserves set aside must somewhere be represented by interest-bearing assets. In fixing the amount to be set aside each year for accrued depreciation this interest must be considered. This is a strong ground for the proper use of a curved line in figuring depreciation and depreciation reserves.

If satisfactory earnings can be maintained, it is reasonable to assume that with the return of more stable conditions money which is now attracted to other fields will be attracted in larger measure to sound, conservative public utilities. In the meantime the increased cost of new capital invested must be recognized as a necessary element of the cost of service bearing on the return allowed.

Indeterminate permits are much more desirable than short-term franchises. The former do away with the necessity for amortization of capital account in a limited number of years; investment will not be subject to unreasonable hazard at stated intervals.

Regulation of public utilities is an established institution, which, if replaced at all, will be replaced by government ownership, although the tendency is not strong in that direction. Regulation is worthy of the best thought and ability and should be removed as far as possible from the active political field. Mutual confidence and enlightened policies on the part of all concerned are essential factors. If the public knows it is getting a square deal, it in turn will give the utilities a square deal.

I. E. MOULTROP
Assistant Superintendent Construction Bureau, Edison Electric Illuminating Co., Boston

JOHN G. LEARNED
Assistant to Vice President Public Service Company of Northern Illinois

GEORGE B. FOSTER
Assistant to Vice-President Commonwealth Edison Co.

R. W SYMES
General Accountant Detroit Edison Company

Mr Moultrop, chairman Technical and Hydro-Electric Section; Mr. Learned, chairman Commercial Section; Mr. Foster, chairman Electric Vehicle Section, and Mr. Symes, chairman Accounting Section.

Vehicle Future Depends on Garaging

George B. Foster

Chairman Electric Vehicle Section

IN POINT of view of sales, the past year, George B. Foster, chairman of the Electric Vehicle Section, brought out in his address, has proved the most prosperous one the electric vehicle trade has ever experienced. The country, however, is relatively worse off for public garage service than it was five years ago.

Today the electric vehicle business is about confined to a very few of the largest cities, largely because of poor garage service.

There is a noticeable tendency, Mr. Foster stated, for firms contemplating installations of fleets to public garaging at first, and later to their own garage.

"The rapid development of the electric vehicle business" Mr. Foster said, "depends largely on adequate garage facilities."

The central stations recently have not helped to introduce the electric vehicle, it was pointed out, to the extent their interest seems to warrant. The central station should keep an electric vehicle cost record.

A review of some thirty reports from central stations shows an average daily mileage per truck of from 10.4 to 21. Even greater differences can be shown by comparing the figures available from one of the very large users of electric vehicles engaged in the transportation business. Taking their cost for a basis as 100 per cent, the average cost reported by six of the large central stations is 318 per cent, while one large fleet shows an operating expense of 720 per cent.

The report contained maps showing the garaging facilities of New York and Chicago.

Technical Section Problems

I. E. Moultrop

Chairman Technical and Hydro-Electric Section

THE largest piece of work to be handled by the industrial interference committee is to obtain unity of action among the member companies of the association, said I. E. Moultrop, chairman of the Technical and Hydro-Electric Section, in his address before the general session of the convention. Location, character of the territories served and the finances vary in the different parts of the country, and a solution of the industrial interference problem which might be satisfactory to a company in the East might be far from satisfactory to a similar company in the West.

In discussing the great need for a research by the association the speaker stated that it was not the desire to parallel the research work being done by other organizations, but to carry out only that which was required by the central-station industry. In this connection the overhead systems committee and the underground systems committee have been carrying on a certain amount of work of this character on high-tension line insulators and insulation material used on underground cables.

A number of the points brought out in the interference committee's report were emphasized to call attention to the growing seriousness of this problem. Attention was called to the fact that the member companies did not appreciate the problem until they came in contact with trouble from this source. Mr. Moultrop stated that in his opinion the technical work of the association in the past has been done in an awkward and inefficient way in respect to the work of the committees. At the present time it has been the custom to appoint these committees late in the summer or early in the fall, and the committees therefore have little time to do more than organize and lay out their work before the busy season of the year prohibits any further thought being given to it. The work is resumed in the spring as soon as the holiday load is over. It is thought that a better scheme would be to appoint these committeemen before the beginning of the administrative year, so that the work of the former committee could be continued without any break. In this way the work could be spread over nine or ten months of the year, and, particularly in the case of the industrial interference committee, the continuity of the work would increase the value of the committee's efforts.

Commercial Side of Central Station Management Increasing in Importance

JOHN G. LEARNED
Chairman Commercial Section

THE work of the various bureaus and committees of the Commercial Section during the past year and the development of the commercial side of central-station management formed the main topic of the address of the chairman of the Commercial Section, John G. Learned. In describing the work of the section this year Mr. Learned said that two new bureaus had been established, the Advertising and Publicity Bureau and the Merchandise Sales Bureau, and these bureaus, together with the Lighting Sales and Power Sales Bureaus, now cover the main parts of the field.

The national executive committee has authorized the sale of educational courses and other publications to non-members. New booklets, circulars, etc., have been compiled and are available to member companies.

Central-station development is growing rapidly owing to increases in the application of electricity in the reduction of copper, zinc and aluminum, in manufacturing nitrates and chlorine and in making steel. Ice making, electric signs, electric cooking for hotels, clubs, etc., and the widespread use of electrical appliances in the home are other reasons for the increased demand for central station power. This demand, which is increasing in volume and in variety of loads, is calling more than ever for central-station executives of commercial ability. The industry is now changed from the stage when technical problems were the most numerous and difficult to the present stage, when commercial problems are equally large and important. Companies doing a retail business must recognize the necessity of organization along commercial lines, and companies engaged exclusively in a wholesale business in order to be successful must be operated by men who are essentially commercial.

Activities of Accounting Section Resumed

R. W. SYMES
Chairman Accounting Section

IN A GENERAL survey of the activities of the Accounting Section, R. W. Symes, chairman, in his address before the section pointed out that in order to co-ordinate the work of the committees of the Accounting Section with the committee work of the Commercial Section, wherever there was a possibility of committee work being duplicated, the plan of interlocking committees was adopted through the appointment of a chairman of an Accounting Section committee as a member of the corresponding Commercial Section committee and by likewise having the Commercial Section represented on certain Accounting Section committees. He stated that the publication of an Accounting Section handbook for distribution to its members had been recommended.

In the plan of reorganization it is proposed to combine the work of the Accounting Section education committee for next year with a proposed standing committee of the national body.

California Hydro-Electric Development Dependent on East

NECESSITY for bringing the California self-interest appeal to the attention of the East and dependence of California on the East in her hydro-electric development were the principal themes of the convention of the Pacific Coast Section, N. E. L. A., held at Pasadena on Monday. The success of the California Electrical Co-operative Campaign also came up for considerable attention. A. Emory Wishon, in his presidential address, summed up the events that had made this year the most successful in the history of the section.

The aim of the engineering committee in the past year has been the development of insulators to a point where confidence may be placed in them when working under extreme high voltages. Committee Chairman P. M. Downing, Pacific Gas & Electric Company, stated that Professor Ryan of Leland Stanford Junior University would continue experiments along this line in co-operation with the insulator committee. A number of new schemes of relay protection have been put into operation in the West under conditions different from those in other parts of the country. These methods will be followed with interest.

The problem of basing rates on power factor came up for considerable discussion. There was a divergence of views as to whether tests should be made on individual installations and rates fixed accordingly or whether the power companies or the consumers should install static or synchronous condensers for the correction of power factor and unbalanced load, charging the interest and maintenance against the consumer.

As the price of fuel oil has increased from 60 cents to $1.81 per barrel in the last few years, California companies, it was brought out in the discussion, are facing the absolute necessity of eliminating as far as possible the use of steam generation. A number of companies have indefinitely postponed plans for steam-turbine installations.

Lee H. Newbert, Pacific Gas & Electric Company, was elected president of the section for the ensuing year.

Progress of Power Industry in Far West

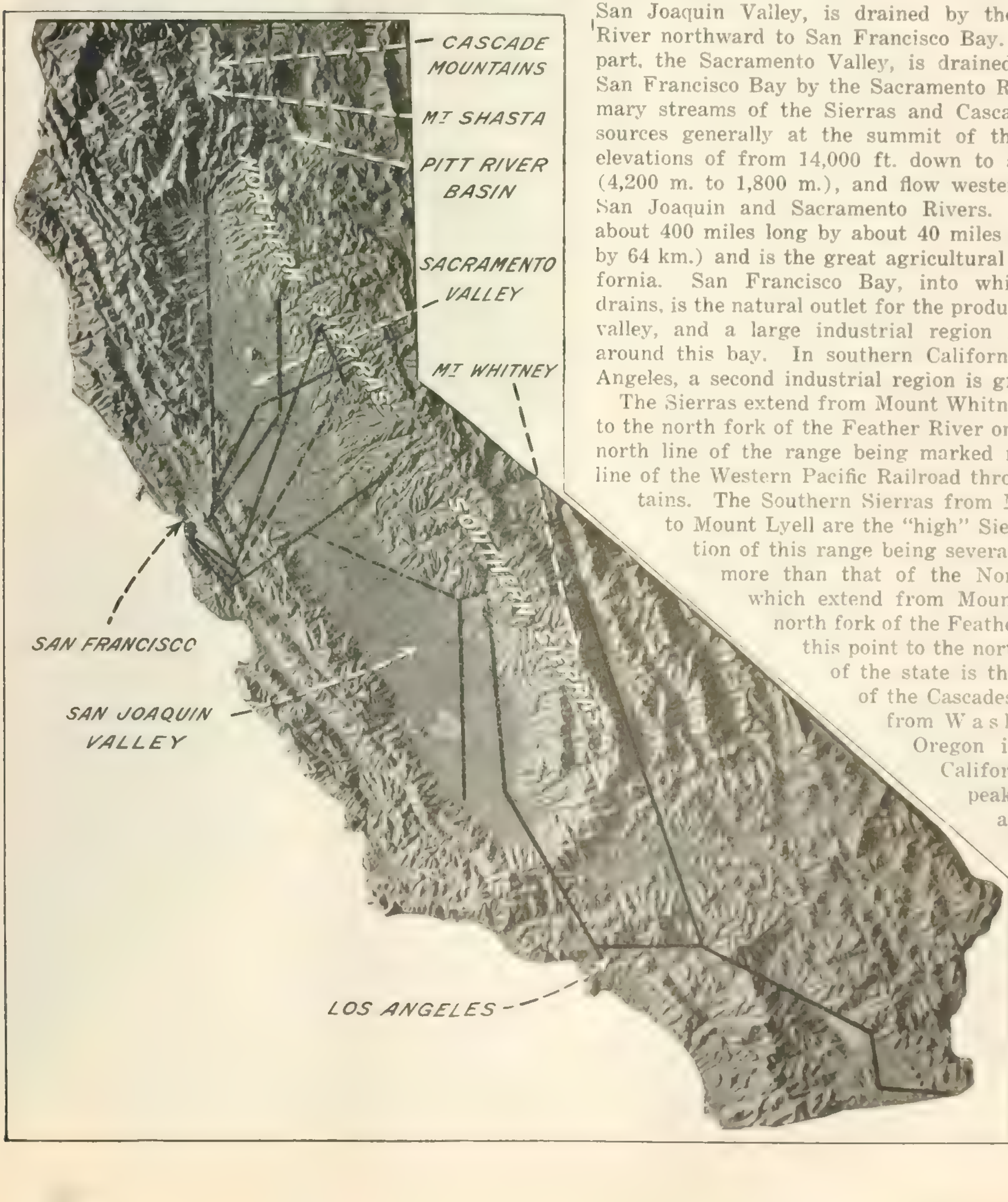
Location and Storage Characteristics of Undeveloped Primary Water-Power Sites in California Totaling 3,000,000 Hp. Plans for Future Development of These Sites, Covering Engineering Features and Need of Favorable Legislation

By FRANK G. BAUM
Consulting Hydro-Electric Engineer, San Francisco, Cal.

A STUDY of the potential water power in California shows the existence of primary sites of more than 3,000,000 hp. that may be economically developed. In other words only 20 per cent of the better primary sites are now developed. To emphasize what the feasible development would mean in actual figures, the number of barrels of oil per year equivalent in a good steam plant to the power derived from these primary sites would be 50,000,000. This is about half the present production of oil in California.

In order to make clear the water-power conditions in California it is necessary to give a brief description of the general topographic and geologic features on which water power depends. The outstanding geologic feature of California is the Sierra Nevada Mountains, which, with the Southern Cascades, extend almost continuously along the eastern boundary, about 150 miles (240 km.) from the coast. Along the coast is the Coast Range, which is much lower than the Sierras and Cascades and has no great possibilities of development. This is also true of the mountains of southern California south of the Techachapi Mountains. Between the Coast Range and the Sierras and Cascades is the great interior valley, the southern part of which, called the San Joaquin Valley, is drained by the San Joaquin River northward to San Francisco Bay. The northern part, the Sacramento Valley, is drained southward to San Francisco Bay by the Sacramento River. The primary streams of the Sierras and Cascades have their sources generally at the summit of these ranges, at elevations of from 14,000 ft. down to about 6,000 ft. (4,200 m. to 1,800 m.), and flow westerly to join the San Joaquin and Sacramento Rivers. The valley is about 400 miles long by about 40 miles wide (640 km. by 64 km.) and is the great agricultural region of California. San Francisco Bay, into which this valley drains, is the natural outlet for the products of the great valley, and a large industrial region is growing up around this bay. In southern California, around Los Angeles, a second industrial region is growing rapidly.

The Sierras extend from Mount Whitney on the south to the north fork of the Feather River on the north, the north line of the range being marked roughly by the line of the Western Pacific Railroad through the mountains. The Southern Sierras from Mount Whitney to Mount Lyell are the "high" Sierras, the elevation of this range being several thousand feet more than that of the Northern Sierras, which extend from Mount Lyell to the north fork of the Feather River. From this point to the northern boundary of the state is the southern end of the Cascades, which extend from Washington and Oregon into northern California. The high peaks of this range are Mount Shasta, 14,380



CONSTRUCTED AND PROBABLE FUTURE TRANSMISSION LINES OF CALIFORNIA

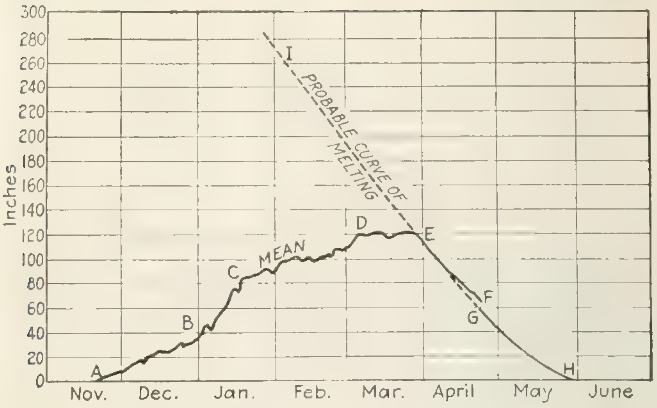


FIG. 1—NORMAL DEPTH OF SNOW AT SUMMIT, CAL.

ft. (4,300 m.), and Lassen Peak, 10,600 ft. (3,100 m.). The Sierras are a granite range, while the Cascades are generally lava. This and other remarkable geologic features make the Cascades of very great value from a water-power standpoint. According to geologists, the northeastern part of California was an area of low elevation (an extension of the Sacramento Valley) after the Coast Range and the Sierras were formed. Then the Cascade Range was formed, making a dam between the Coast Range and the Sierras and inclosing the Pitt River Basin, which covers an area of about 5,000 sq. miles (1,295,000 hectares). Similar lava dams have been formed across several of the branch streams of the Pitt River, namely, Fall River, Rising River, Crystal Lake and Burney Creek. The precipitation on this immense lava plateau sinks in large measure through the lava and is stored in lava-covered basins, emerging in very large springs, almost perfectly regulated. Such is roughly the explanation of the remarkable water conditions of the Pitt River basin, on which about 80 per cent of the low flow of the Sacramento River at Red Bluff depends.

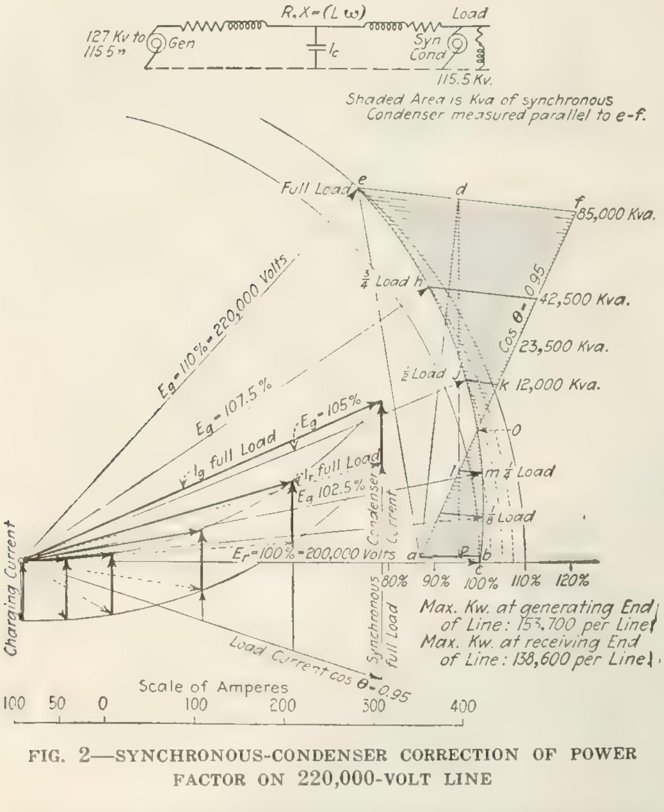


FIG. 2—SYNCHRONOUS-CONDENSER CORRECTION OF POWER FACTOR ON 220,000-VOLT LINE

Line is 200 miles long. Shaded area shows size of condenser needed to correct power factor when generator pressure is varied from 100 per cent at no load to 110 per cent at full load by adjustment of potential by voltage regulator. Receiver pressure maintained constant by voltage regulator at 100 per cent. Power factor of load corrected locally by steam plants to 95 per cent. Synchronous condenser maintains variable pressure drop automatically from 0 per cent at no load to 10 per cent at full load by varying power factor of receiver through variation in load. Synchronous-condenser maximum capacity is 85,000 kva. per line. Synchronous condenser kva. required at no load (23,500 kva.) will regulate from no load to approximately 0.6 load. If two condensers are installed per line, each of 42,500 kva. capacity, then one condenser will regulate from no load to three-quarters load and two condensers will regulate from three-quarters load to full load. Length of line, 200 miles. Conductor, 500,000-circ.-mil copper, spaced 15 ft. vertically. Resistance pressure including transformers is 10,000 volts; reactance pressure 90,249 volts. Transformers have 0.5 per cent resistance and 10 per cent reactance. Full-load current at unity power-factor load is 400 amp. Charging current is 136 amp.

This damming by lava flows is illustrated in a small way by the waterfall of Burney Creek. A lava flow lifted the old stream bed of this creek more than 100 ft. (30 m.), forming Burney Falls. At the falls a spring of about 160 second-feet (4.4 cu.m. per second) flows out of the lava layers, an amount of water more than that used by all the San Francisco Bay cities combined. The damming of this stream probably formed a large lake which has since been filled in by lava débris. The underground storage basin thus formed gives an almost perfectly regulated stream.

In the Pitt River basin about 8 miles (12.8 km.) east of Burney Falls, there is a similar spring at Crystal Lake, near Cassel, giving about the same quantity of water as Burney Spring. At Rising River, about 3 miles (4.8 km.) above Crystal Lake, is another spring of about 350 second-feet (9.8 cu.m.), and Fall River, the most remarkable river formed by springs, gives an almost perfectly regulated flow of close to 1,500 second-feet (42 cu.m.). These and other springs in the basin raise the total for the Pitt River above Peck's Bridge to about 2,500 second-feet (70 cu.m.). The total head available is over 2,000 ft. (600 m.), and there are therefore possible dependable and constant power developments on the Pitt River close to 500,000 hp. The power output could be made practically constant, as storage sites are available to make up the summer deficiency of about 10 per cent due to irrigation and evaporation. This stream also furnishes more than 1,000,000 acre-ft. (1,230,000,000 cu.m.) per year of irrigation water for the Sacramento Valley lands. South of the Pitt and to the north fork of the Feather River there are numerous small lava streams, though with few storage sites, on which a number of developments have been made, and a few fair power sites still exist undeveloped. The north fork of the Feather River also has a spring source of about one-fourth of the Pitt flow, and fortunately on this stream there is probably the best artificial reservoir site in California (not considering Lake Tahoe, which discharges into Nevada), having a storage capacity of about 300,000 acre-feet (369,000,000 cu.m.), but unfortunately in years of very deficient precipitation the reservoir does not fill.

On the Pitt River and its branches and the small streams to the north fork of the Feather River, and on the north fork of the Feather River, there can be developed about 1,000,000 hp. to 1,300,000 hp. The actual development cost of this power will be generally from $25 to $50 per kilowatt less than in the Sierras, and sometimes the difference may run as high as $100. The writer has advocated the development of the Pitt River territory for a number of years, especially the development of Hat Creek and Fall River as a first step to the larger developments. The distance of transmission from the Pitt River to San Francisco Bay will be about 200 miles (320 km.) and the distance from the other power will be 150 miles to 175 miles (240 km. to 280 km.). This power should go to the San Francisco Bay region after supplying the territory of northern California.

Near the northern boundary of the state the Klamath, a good power stream, is found, but because of the distance to San Francisco Bay this power should be used largely for the Southern Pacific Railroad Siskiyou electrification and for industries on the coast. Some surplus may finally go to San Francisco Bay, and some power is now being transmitted to the Pacific Gas & Electric Company from this river.

WATER-POWER CONDITIONS IN THE SIERRAS

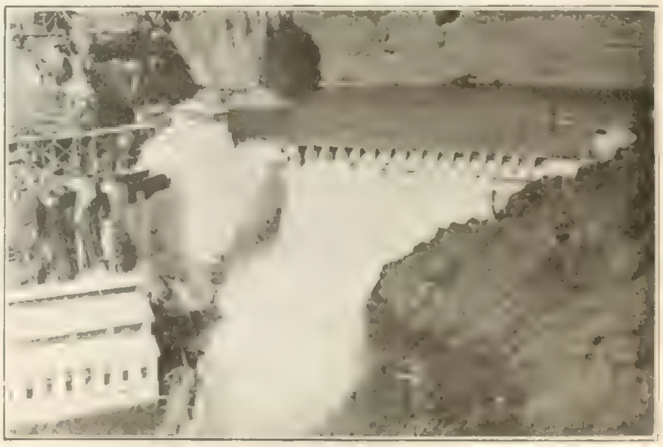
Immediately south from the north fork of the Feather River the water power conditions entirely change. This is due to the granite formation, in which generally little ground storage exists, and the water supply from the rain and snow must be supplemented by water storage. Unfortunately there are not many reservoir sites of 50,000 acre-ft. to 100,000 acre-ft. (61,500,000 cu.m. to 123,000,000 cu.m.). The mean precipitation varies from about 30 in. to 50 in. (75 cm. to 125 cm.), depending on the altitude and also on increases from south to north. In the higher elevations of the Sierras the precipitation is largely in the form of snow, which gives high stream flows until midsummer. After this time the streams fall off rapidly, and during the late summer and fall the flow is only a small percentage of the mean. Fig. 1, for which acknowledgment is due to Professor LeConte, shows the mean snow depth at Summit at an elevation of 7,100 ft. (2,130 m.). About 75 per cent of the normal run-off is usually provided for in development. Owing to the water conditions, the power possibilities cannot be safely determined from the mean precipitation or the mean stream flow, but the measure of dependable and economic power is almost altogether determined by the capacity of available reservoir sites and their location as regards favorable head. For safety, storage must be usually available for the entire flow for 150 to 200 days, and generally close to 200 days' storage is advisable. Because of these conditions there is less high-class dependable primary water power in California than is usually estimated. The figures given usually run from 3,000,000 hp. to 6,000,000 hp. The lower figure is high enough for economical power, although in time much more may be ultimately developed as secondary power or by more expensive storage.

A WELL-KEPT SUBSTATION OF THE SOUTHERN CALIFORNIA EDISON COMPANY

CAPISTRANO SUBSTATION, WHERE THE SAN DIEGO GAS & ELECTRIC COMPANY IS CONNECTED TO THE SOUTHERN CALIFORNIA EDISON COMPANY

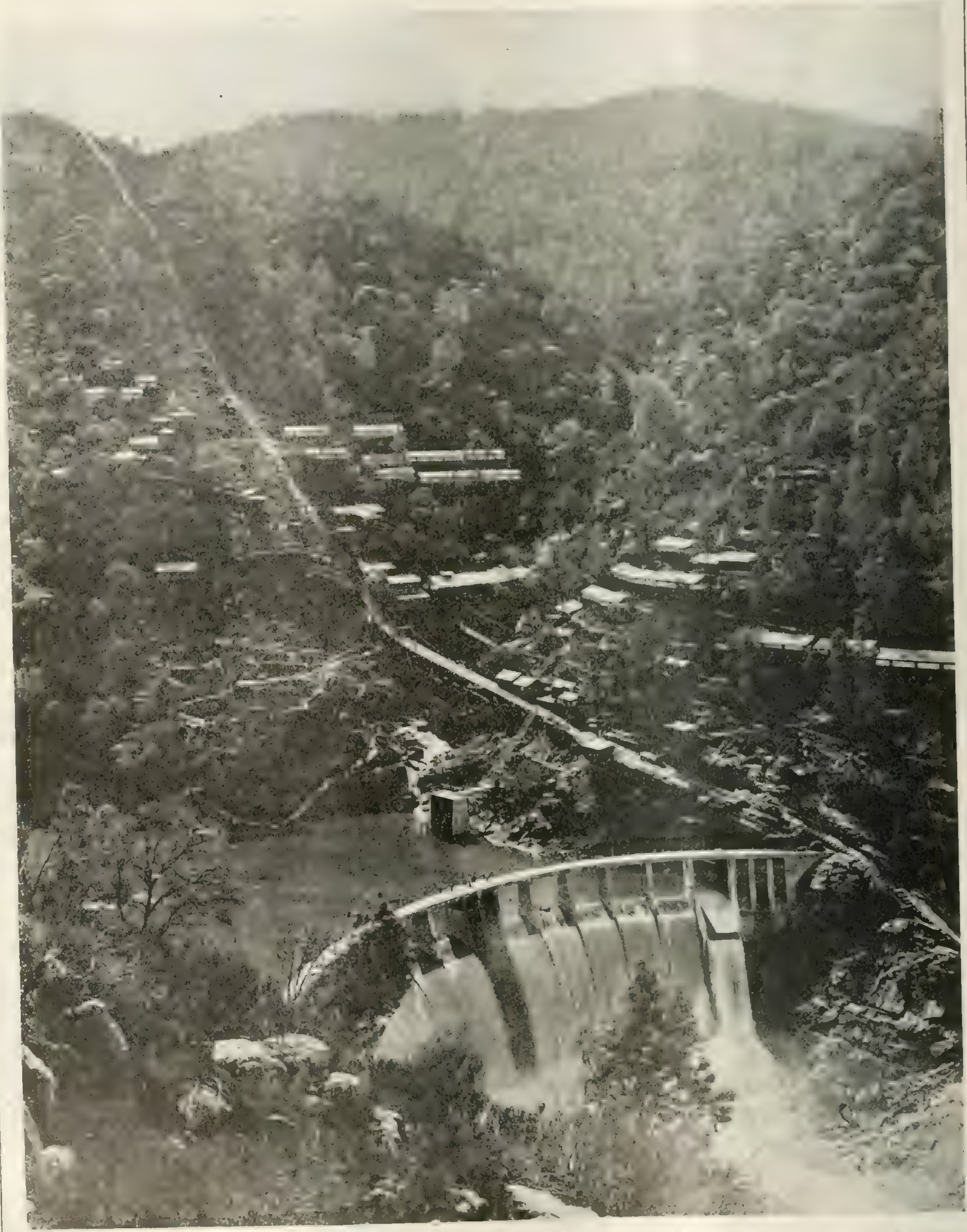
In the Northern Sierras the north fork of the Yuba has a good low flow, about 200 second-feet (5.6 cu.m. per second), from gravel storage, but no good storage sites. On the middle fork and south fork of the Yuba the conditions are, however, reversed, for there is very little gravel storage but a number of good reservoir sites and power sites still undeveloped. The middle and south forks of the American River have also good storage sites and power sites yet undeveloped. The Stanislaus is a good power stream only partially developed. The Mukolumne and Tuolumne are not good power streams. The Merced has one good reservoir site and several good power sites, but most of these are wholly or partially in the Yosemite National Park. Therefore, eliminating the Merced, there are in the Northern Sierras only three really good power streams, the Yuba, the American and the Stanislaus. From these streams there can be developed 500,000 hp. to 750,000 hp., probably a surplus of about 500,000 hp. over the future requirements of the central part of the great valley. This surplus power should be transmitted around the south end of San Francisco Bay to San Francisco and the peninsula.

On the east side of the Northern Sierras about 100,000 hp. can be developed on the Truckee, Carson and



12,500-KVA. COPCO POWER PLANT OF THE CALIFORNIA-OREGON POWER COMPANY

New Dam for Kerckhoff Hydro-Electric Development on San Joaquin River



The new Kerckhoff hydro-electric development of the San Joaquin Light & Power Company is located on the main San Joaquin River near Auberry, about 40 miles northeast of Fresno. A dam is located below power house No. 1 of the company and backs up water as high as is safe. This dam is at the bottom of a narrow box canyon, making it necessary to lower all material for construction down an incline about 1,100 ft. higher than the dam. This is shown in the background of the illustration. A tunnel 16,950 ft. long connects the dam with the Kerckhoff power house, which has a rating of 30,000 kw. and is situated lower down on the San Joaquin River. The transmission line to connect this power house to the present transmission system will be about 130 miles long.

Walker Rivers, and because of its location this power should be used for the Southern Pacific Railroad electrification east of the Summit and in Nevada.

WATER POWER OF THE SOUTHERN SIERRAS

In the Southern Sierras the San Joaquin River has a number of good reservoirs and power sites, and the same is true of the Kings River. Many of these sites are far in the mountains, and, on account of the very rough country, railroads are generally required for transportation, putting a heavy burden on the power companies, especially for the initial developments. The San Joaquin is partially developed by the Southern California Edison Company and the San Joaquin Light & Power Company, and developments are contemplated by the San Joaquin Light & Power Company on the Kings. The Kern River has no good storage sites, and hence its power output must vary widely during the year, but the nearness to Los Angeles is of advantage.

On these three streams there can be developed about 500,000 hp. to 750,000 hp., probably a surplus, over the requirements of the lower San Joaquin Valley, of about 500,000 hp. Part of this will be required for the Southern Pacific Railroad electrification of the Techachapi Mountain and the remainder should go to the industrial market of southern California, the largest load being at Los Angeles. Some power can be developed on the Kawea and Tule, but these plants must be small and should go to supply the local demands of the immediate territory.

On the east side of the Southern Sierras there are a number of good power sites, some of which are already developed by the Southern Sierras Power Company for transmission to southern California and to the Imperial Valley and Yuma, making probably the longest transmission line in existence today.

On the accompanying topographic map of California the main transmission lines as built and the contemplated future lines are shown. The power from the Southern Sierras should ultimately go to southern California at 220,000 volts. As the lines from the Northern Sierras must be more or less radial from the south end of the bay to the widely separated power sources, and because of the fogs near San Francisco Bay, it may prove best to operate these lines at about 110,000 volts. The power from the Cascades should come to the bay at 150,000 volts to 220,000 volts, and that from the Pitt at 220,000 volts, because of the large volume of power to be transmitted. The power from the Northern Sierras for central California, the Sacramento Valley and San Joaquin Valley transmission, as well as for a connection between the Northern Sierras and the Southern Sierras lines, will probably be at 110,000 volts. There appears to be no adequate reason at the present time for connecting these high-voltage systems at a voltage greater than that named above.

12,500-KVA. WISE POWER HOUSE OF THE PACIFIC GAS & ELECTRIC COMPANY

Power plants require practically a continuous supply of water throughout the year, while requirements for irrigation are greater in the spring and summer than in the fall. The spring and summer demands for the two industries can be met without any appreciable divergence of interests, as the excess run-off in the early spring months is usually enough to supply the needs of irrigation and fill the mountain reservoirs besides. The storage required for the operation of power plants during the fall until the beginning of the next season's stream flow from precipitation must be controlled practically for power purposes only.

TYPES OF DAM

Four types of dam have been developed in California: (1) The rock fill with timber or concrete face; (2) the hydraulic fill; (3) the multiple arch; (4) the constant-angle arch. These, together with the ordinary gravity type, are found on various developments in the West. The constant-angle arch for high dams in V-shaped canyons and the multiple arch for dams up to about 150 ft. (45 m.) for U-shaped canyons are logical and are now

Two of California's Largest Hydro-Electric Plants

Big Creek Power House No. 1 of the Southern California Edison Company, in the top picture, is designed for 32,000-kva. output. Below is the largest water-power plant in California, the 75,000-hp. Big Bend Generating Station of the Great Western Power Company.

generally used in California. J. S. Eastwood deserves in large degree the credit for developing the multiple-arch type and L. Jorgensen the credit for the constant angle type.

REGULATION OF TRANSMISSION LINES

On San Francisco Bay and at Los Angeles there will be synchronous-condenser stations and steam-reserve stations. The regulating diagram for a 200-mile (320-km.), 220,000-volt, 300,000-kw. transmission system is shown in Fig. 2. For transmission at 220,000 volts a conductor of about 0.95 in. (2.37 cm.) in diameter is required to prevent corona, which means an area of about 700,000 circ.mil. If some corona loss be allowed for, this size can be reduced perhaps to 500,000 cir.mil. For copper this indicates a capacity for a single circuit of about 150,000 kw. to 200,000 kw. For aluminum or aluminum-steel the capacity can be reduced. In the writer's belief the use of shields to reduce the electrical stress on the insulators near the line and the improvement of the porcelain insulator as to mechanical strength, moisture absorption and temperature cracks will make the step from 150,000 volts to 220,000 volts easy. The porcelain must ultimately be used in compression.

STANISLAUS POWER PLANT OF THE SIERRA & SAN FRANCISCO POWER COMPANY DESIGNED FOR 34,000 KVA.

The power loss at full load over the line used for the chart is 10 per cent, including step-up and step-down transformer losses. The regulation as shown can be made virtually perfect from no load to full load. The synchronous condenser required for this purpose from no load to about three-quarters load has about one-fourth the kva. rating of the generators. From three-quarters load to full load another synchronous condenser of the same rating must be added. By placing the regulating capacity largely at the receiver end of the transmission line the size of generator required is reduced, as are also the extreme fluctuations of voltage. The synchronous condensers, therefore, not only improve regulation but prevent overvoltage stresses on transformers, insulators and other machines.

WATER-POWER DEVELOPMENT MUST COME FIRST

The development of the water power must precede the industrial development of the state, and therefore all those interested in industrial growth should encourage the development of water power as rapidly as the growth demands. If power is not available when required, the development of industries must lag. The water power now developed is only about 20 per cent of the possible development in California, considering only the better primary power sites as herein outlined.

PAST AND FUTURE OF POWER INDUSTRY

The development of what may be called the power industry began about twenty-five years ago with the installation of water-power units of a few hundred to a few thousand horsepower (the first plant installed on San Antonio Creek in California) for transmission at about 10,000 volts to 11,000 volts to nearby communities. Then followed the second stage of development where units of 2,000 hp. to 10,000 hp. were installed, and larger amounts of power were transmitted from 50 miles to 150 miles (80 km. to 240 km.) at voltages of about 50,000 to 60,000. After this came the third stage, which is now about at its maximum with units of 10,000 hp. to 40,000 hp. for transmission distances of 100 miles to 250 miles (160 km. to 400 km.) at 100,000 volts to 150,000 volts. Now the fourth stage is approaching, in which units of 20,000 hp. to 100,000 hp. are planned to be used for transmission at about 220,000 volts over distances of 200 miles to 300 miles (320 km. to 480 km.).

In considering and planning the larger power development and transmission systems of the future one must recognize the difference between this business and that of the railroads. The railroads carry traffic both ways; the transmission lines will carry business only one way. A railroad may build one trunk line through a region and all traffic must come to it; the transmission lines must deliver the power to each consumer. Hence the power lines will require a transmission system along different lines from that of the railroads. The large systems will grow from the present systems as a natural economic development, and certain small companies must ultimately be eliminated; but the change should be gradual and natural.

The writer cannot see any step in the development of the power and transmission business that cannot be solved by private interests better than by political methods. If the present privately owned public utilities cannot meet the needs of the growth of the industry, then circumstances will no doubt bring about some other solution. The responsibility, therefore, on those at present directing the policies of power companies is very great. The power companies should study their possible future requirements and logical developments to meet the demands of the future.

The lack of water-power legislation has been a handicap, and the present proposed legislation, while offering some relief, is too cumbersome. What the public wants is development and a bill providing for regulation of service and rates which can be put on one sheet of paper. During the period of growth in the next few years the commissions should be especially liberal in the earnings allowed the companies in order to promote development. In the development period of any business greater earnings are required to attract the money for construction than after the development period. An allowable earning of 10 per cent to encourage development of water instead of steam power, would, in the writer's opinion give the impetus needed at this time.

The problem, because of its magnitude for the next five or ten years, requires the co-operation of the power companies, the oil companies and the railroads. These three big interests should be able to solve it with the help of the railroad commissions and the co-operation and backing of the general public.

Three Years of Engineering Council Accomplishment

An Outline of the Work Undertaken in the Interest of the Public Where Engineering Entered and of the Public Interest of the Engineer

IN VIEW of the organizing conference of engineering societies called for June 3 and 4 at Washington, D. C., for the purpose of forming a comprehensive organization for the public interest where engineering matters are involved, and also to consider matters of common interest to technical engineers, the ELECTRICAL WORLD is taking this opportunity to tell briefly the story of the Engineering Council, which was formed almost three years ago to function along the same general lines.

Recognition of the need for such an organization is not new. Seven years ago at the annual convention of the American Institute of Electrical Engineers, at Cooperstown, N. Y., on June 24, 1913, Dr. William McClellan presented a suggestion to form a national body representative in its membership of all non-commercial national engineering societies. From the seed thus sown the Engineering Council came into being four years later as a department of the United Engineering Society. Five representatives from each of the four founder societies, the American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Society of Civil Engineers and American Institute of Mining and Metallurgical Engineers, and four representatives of the United Engineering Society then composed the Engineering Council.

The entrance of the United States into the war undoubtedly served to bring this national body of engineering societies into being long before this might otherwise have taken place. On June 27, 1917, the first meeting of the Engineering Council was called and the following officers were elected: Chairman, Dr. I. N. Hollis, then president of the American Society of Mechanical Engineers; vice-chairmen, Harold W. Buck, then president of the American Institute of Electrical Engineers, and George F. Swain, past-president American Society of Civil Engineers; secretary, Calvert Townley (president this year of the A. I. E. E.); executive committee, J. Parke Channing, past-vice-president American Institute of Mining and Metallurgical Engineers, and D. S. Jacobus, past-president American Society of Mechanical Engineers, and the four officers.

The first annual meeting was held Feb. 21, 1918, at which time J. Parke Channing was elected chairman and Alfred D. Flinn secretary, the vice-chairmen remaining the same. Mr. Channing has continued as chairman of the Engineering Council since that time.

The Engineering Council derives its funds from the member societies approximately on the basis of enrolled membership in the society. Last year, however, it was found necessary to supplement these limited funds by popular subscription.

Provision is made in the by-laws for election to membership of additional national engineering societies, and since the formation of the council the American Society for Testing Materials and American Railway Engineering Association have been elected to membership.

Work of the Engineering Council for the most part is done through committees, of which there are a large number. During the first year committees on finance, rules, public affairs and American engineering service and the war committee of technical societies were appointed. These committees were later supplemented by a number of others. The accomplishment of each of these committees has been briefly as follows:

Public Affairs—Assisted United States Chamber of Commerce in water-power bill referendum; made recommendations relative to land reclamation on a large scale; initiated committees on patents and on licensing engineers.

American Engineering Service—Made classified record of thousands of engineers, from which it supplied the government with 4,000 carefully selected names of engineers; helped the government in other ways to get in touch with engineers.

War Committee of Technical Societies—This committee, associated with the Naval Consulting Board and the Inventions Section of the army General Staff, aided the army and navy in examination of 135,000 inventions for war devices.

Fuel Conservation Committee—Has collaborated with the Bureau of Mines and the Fuel Administration; recommended federal appropriation for super-power zone survey.

Patents Committee—Appointed so that the Engineering Council might have a share in endeavors to improve patent law practice and the organization of the Patent Office.

Water Conservation Committee—Created to deal with questions concerning the utilization and control of water for various purposes in all parts of the country; has correspondents in approximately thirty states collecting information; is assisting Maine Water Power Commission on questions of policy.

License Committee—Has presented a report, accompanied by a recommended uniform registration law, to regulate the practice of professional engineering, architecture and land surveying.

Americanization Committee—Report written summarizing the present status of Americanization activities.

Industrial Affairs Committee—At instance of National Industrial Conference Board opposed "anti-efficiency legislation."

Military Aid Committee—Reported on proposed schemes for aiding engineers in service and on suggested insignia for non-uniformed war service.

Employment Bureau—Following the armistice, has registered more than 5,000 engineers, the majority of whom were in the service, and aided a large proportion to find positions.

Reconstruction Committee—Formed largely to work out details of organization and personnel of national service committee.

National Service Committee—Has permanent representative and office in Washington; has taken up a number of subjects with Congressional committees and the departments, including land reclamation and the proposed national Public Works Department.

Classification and Compensation of Engineers—Works in three sections, dealing with engineers in the employment of (1) the federal government, (2) railways, (3) cities and states; has made a report containing standard tentative classification of engineers (for purposes of compensation) and a suggested tentative schedule of salaries for government engineers.

Committee on Types of Government Contracts—Only recently appointed.

Committee on Military Affairs—Only recently appointed.

Committee on Co-operation with the American Institute of Architects—Only recently appointed; working on a draft of bill for regulating architectural engineers and land surveyors and upon relations of engineers and architects in professional work.

Committee on Co-operation with Association of Russian Engineers of America—Only recently appointed.

Besides the committee work the Engineering Council has participated in a number of other activities.

It was in response to a communication from the Engineering Council that President Wilson caused a Board of Surveys and Maps to be appointed to expedite completion of topographical maps of the United States.

Assistance was given to the Reconstruction Commission of New York State in the preparation of its reports.

By public hearing the Engineering Council aided in the reinstatement of 350 engineers unfairly dismissed by the city of New York. Later it assisted in securing better salaries for these engineers.

The council took part in organizing a national Board for Jurisdictional Awards in Building Industries and appointed a member thereon.

On invitation delegates were sent to testify before a special congressional committee on a national budget system.

Assistance was given to the War Department Claims Board in securing technical experts.

The council has become a member of the United States Chamber of Commerce.

The council called together representatives of seventy-four technical organizations having 105,000 members to discuss an effort to secure a national Department of Public Works. Out of this grew the National Public Works Department Association.

The Engineering Council took an active part in obtaining an order from the War Department permitting students of draft age to complete their courses before being called to the colors.

Numerous other subjects have been discussed from time to time, including engineering school curricula, airplane production, maintenance of technical education, alien enemy members of engineering societies, merchant marine, war memorial to engineers, Pan-American engineering organization, pillaging of industries by the Germans and relation of engineering colleges to the federal government.

Interesting and important as are the specific items of work done, briefly described above, after all the important accomplishment of Engineering Council has been the demonstration that the engineering societies of America can work together constructively for the benefit of the profession and the community through a carefully chosen representative organization.

[NOTE—Other details of the work of the Engineering Council have been outlined in the ELECTRICAL WORLD as follows:

Council of American Engineering Societies, ELECTRICAL WORLD, Feb. 17, 1917, page 329.

Scope and Aims of Engineering Council, ELECTRICAL WORLD, Sept. 1, 1917, page 446.

Work of the Engineering Council, ELECTRICAL WORLD, July 13, 1918, page 55.

National Service Committee of Engineering Council, ELECTRICAL WORLD, Jan. 25, 1919, page 186.]

Connecting Ground Wire to Pipe

FOR making a solid connection between a ground wire and a pipe driven in the ground a mixture of lead and antimony which expands on cooling from the molten state is employed by the Southern California Edison Company. In using this method the ground wire is placed inside the pipe and the molten metal is poured in around the wire. On cooling, the metal expands and forms a junction which is not only very rigid but is also of a satisfactorily low resistance. Before pouring the metal the pipe must be plugged a few inches from the end to prevent the metal from running down the pipe. It has been found that the best proportions for mixing the metals are 25 per cent of antimony and 75 per cent of lead.

The place to prepare the mixture is in the shop, after which it is supplied to the installation crew in small pieces, which may be melted with a common blow torch. This method overcomes one of the chief difficulties encountered in the use of driven-pipe grounds, that is, making a good connection between the ground wire and the pipe.

Readers' Views and Comments

Training the Electrician's Helper

To the Editor of the ELECTRICAL WORLD:

Sir: I have read your editorial in the May 1 issue, page 987, and heartily agree with you that there should be some better means for the electrician's helper to gain a knowledge of the electrical trade. I also maintain that the greatest majority of journeymen electricians are very deficient in their knowledge of electrical theory. In fact, the downright ignorance of some men having the nerve to draw a journeyman's pay is deplorable and very discouraging to a man who has spent some time and effort getting more knowledge and is by no means an encouragement to an apprentice who is unfortunate enough to be working with them. G. W. SPENCER.

Worcester, Mass.

Hazards of Electric Switches When Placed on Washing Machines

To the Editor of the ELECTRICAL WORLD:

SIR: I should like to draw the attention of manufacturers of electric washing machines to the hazard to life that is being introduced through the placing of snap switches on washing machines. This is a somewhat recent development, but any competent electrical man will, I am sure, agree with me that it is a wrong departure. Not only is the mere presence of a switch, necessarily exposed to dampness in such a location as a washing machine is operated in, likely to be the means of causing shocks, but the manufacturers in attempting to wire up these switches have produced additional danger in that the safety factor of the heavy reinforced cord is affected through the cutting away of the outer covering to admit connecting in a single-pole switch. In some cases a splice has been made in the cord, while in others, where a flush type of switch is used, the unbroken conductor is stowed away in a metal box. Another manufacturer brings both sides of the cord to the motor, connecting one wire to one terminal, jumps a single wire to the other terminal but does not connect to it, but, by means of another section of the cord, runs up to the switch and back to the motor. This, of course, covers cases where motors having exposed live terminals are used—another instance of insufficient appreciation of what is involved.

Inspectors of wiring have for years striven to deal with the brass-socket menace in basements and damp places, as well as in bathrooms, but there is in the development above outlined a far more risky condition and one that I contend there is no excuse for. While it is true that many alternating-current secondary distribution systems are more or less effectively grounded, many systems are not so protected, and, even if this protection were universally provided, I hold that there is no necessity to expose women and children to the danger of even a low-voltage shock through the use of a switch on such an appliance. F. A. CAMBRIDGE,

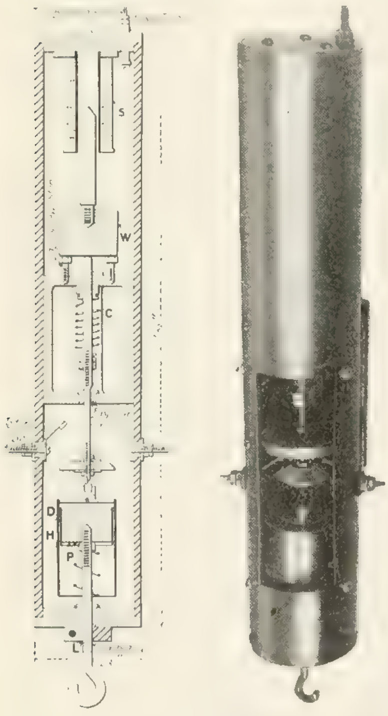
Winnipeg, Manitoba. City Electrician.

Station and Operating Practice

A Department Devoted to Problems of Installation,
Operation and Maintenance of Equipment for Economical Generation and
Distribution of Electrical Energy

Home-Made Relay Has Accurate Timing Mechanism

A RELAY with absolutely definite time limit, which is independent of temperature changes or amount of power, has been perfected for use on the system of the Southern California Edison Company. The principle of the relay involves an air dashpot, *D*, which is actuated by a spring, *C*, when released by the lifting of a weight, *W*. The operation of the relay is as follows: Upon the occurrence of an overload in a circuit or switch which has installed in it a contact-closing instantaneous overload relay, the solenoid in the upper chamber of this relay is energized and lifts the brass weight *W*. The lifting of the weight releases the coil spring *C*, and this spring in turn lifts the rod and cylinder *D* of the dashpot. When the dashpot has been lifted until the holes *H* in the cylinder reach the top of the stationary piston, *P*, the cylinder and attachments increase in velocity and thereby the contacts are made quick-closing.



AIR DASHPOT ASSURES ACCURATE TIMING

The time setting of the relay is changed by adjusting the height of the piston. This may be done by loosening the setscrews in the collar around the lower shaft at *L* and raising or lowering the piston. The range of calibration of this relay is from one-tenth second to approximately ten seconds.

One advantage of the relay is that its setting may be changed from normal to instantaneous very easily and returned to the former setting without the necessity of testing or calibration. This is accomplished by hanging on the hook at the bottom a weight sufficiently great to compress the spring which is between the piston and the bottom of the container and thereby lower the piston with reference to the cylinder and so uncover the portholes in the walls of the cylinder. This removes the time element of the dashpot, and as soon as the upper solenoid is energized and the weight lifted the cylinder rises rapidly and the contacts are closed.

The temperature correction is effected by the construction of the piston and cylinder of the dashpot. The body of the piston, *P*, is constructed of cold-rolled steel with a brass sleeve and the cylinder is composed of brass, *D*.

The expansion of the various parts was very carefully calculated so that as the temperature increases and the viscosity of the air decreases the cross-sectional area of the annular space between the piston and the cylinder also decreases, thereby maintaining a practically zero temperature coefficient. The whole mechanism of the relay is inclosed in a section of pipe with close-fitting ends and covers, so that the relay is dustproof. Three of these relays have been installed outdoors for a year and a half and have given no difficulty whatever as regards collection of dust or moisture within the cases.

The cost of the relays has been found to approximate $20 each when made in quantities of one dozen at a time.

San Francisco, Cal. J. E. ARMSTRONG.

Arc-Lamp Troubles Stopped by Eliminating Ground Return

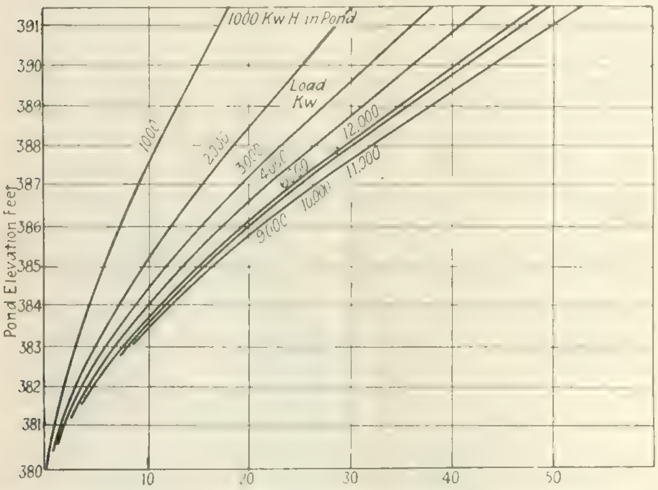
THE elimination of the ground return on two long arc-lighting circuits of the Scranton (Pa.) Electric Company by connecting the extremities of the circuits through a tube transformer put an end to much trouble. As these two circuits were rather long, 25 miles and 7 miles (40 km. and 11 km.) respectively, it was thought advisable in the original plans to use the grounded neutral of the company's 4,000-volt distribution system as a return for the arc circuits. However, as the number of lamps increased on each of these circuits to about a hundred, the difference in potential between the outgoing line and the ground return reached approximately 8,000 volts. This frequently caused insulators to break down and lamps often burned out when the ground was near the station as the arc transformers could not regulate for the very few lamps between the grounded insulator and the station. It was not unusual on a rainy night for the insulation between the arc lamp and the mast arm to break down or for an insulator to leak sufficiently to burn or char a pole so badly that it had to be replaced.

To get rid of this trouble lines were run from the ends of each circuit, which were not far apart, to a new substation near by. One of the arc transformers was removed from the old station to the new station, and the ends of both circuits were connected to this transformer. By this arrangement a complete metallic circuit was obtained, eliminating the grounded return and consequently avoiding the high-potention difference across the insulators. Since this change the trouble on these two circuits has been reduced to virtually nothing.

Scranton, Pa. C. F. NAGLE.

Chart Gives Energy in Pond for Different Elevations

TO SHOW instantly the amount of energy available in the station No. 5 storage pond of the Rochester Gas & Electric Corporation the chart shown here has been prepared. With this chart, if the level of the water in the pond is known, the value in kilowatt-hours of the water may be easily determined. On account of different efficiencies of the turbines with different loads several curves were plotted, corresponding to several loads. Taking for instance a pond elevation of 388 ft. (116 m.), if the plant is running under a load of 10,000 kw. the energy in the pond amounts to about 32,000 kw.-hr.



CURVES SHOW KILOWATT-HOURS IN POND FOR DIFFERENT ELEVATIONS

Available energy varies with load on station.

On the other hand, with the same elevation, if the plant is carrying a load of 3,000 kw., there is available at this rate only 23,000 kw.-hr. It will be noticed that when the plant carries over 10,000 kw. the amount of energy available decreases for the same elevation on account of the generation efficiency falling off with loads above full load.

These curves, in addition to giving the amount of available pondage, are used to determine the amount of river flow into the pond expressed in kilowatts. In determining the proper curves to use in calculating river flow the kilowatt-hour generation for the period is used to obtain the average load. When the load is steady hourly readings of the meter are used, but if the load is varying, readings should be taken more often.

To simplify the calculation of these curves certain assumptions had to be made. For instance, although the head under which the turbines operate affects their efficiency, a constant head was assumed. The power factor was also assumed to be constant for similar reasons, and the hydraulic gradient or slope of the pond was neglected.

In making the chart use was made of another curve showing the amount of water in the pond at different elevations. That curve was originally made for surveys conducted when the pond was built. It was found, however, that the curve was in error due mainly to a partial filling up of the pond by mud and rubbish which reduced the storage capacity materially. After consideration of the probable amount of filling and an analysis of operating data, a new pond-capacity curve was drawn, and from this curve the chart shown here was worked out. The results from this new curve agree closely with observed operating data.

Rochester, N. Y. NORMAN H. DAVIDSON.

Relation Between Line Regulation Load and Size of Conductor

THE relation between line regulation, load transmitted and size of conductor can quickly be determined by means of the chart shown herewith. By use of a movable straight edge the chart is freed from diagonal lines and consequently simplified. To use the chart in determining the size of conductor required, for instance, to transmit 150 kw. at 85 per cent power factor, two miles, at 2,200 volts, three-phase, one would proceed as follows: From the conditions kw. multiplied by miles equals 300. Taking the point 300 on the horizontal base to the right of 2,200 volts, follow up to the intersection of the ordinate showing 10 per cent regulation.

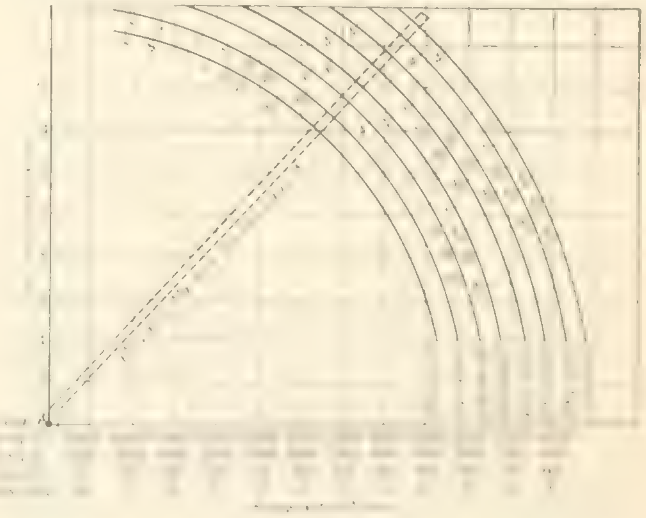
SPACING BASED ON THREE-PHASE, 60-CYCLE CIRCUIT USING COPPER CONDUCTORS*

Voltage	Effective Spacing, Ft.
110—220—2,200	1.5
22,000	5.0
60,000	7.8

*No account is taken of line capacity.

After setting the pointer on this intersection follow up the pointer until it strikes the curved line marked at its extremity 2,200-85 P.F. This pointer strikes this curve between 2 and 4 on the curve. The wire size, therefore, is between No. 2 and No. 4, and the former must be used unless a voltage drop of 11.5 per cent is allowable, when No. 4 is large enough. This chart is plotted here for limited ranges, but it may be extended to apply to any particular needs. A similar chart may be prepared covering per cent power loss instead of voltage regulation. A. M. MCCABE.

Raleigh, N. C.



LINE REGULATION CHART

Set marker on intersection of kilowatt-miles and regulation and read size of wire required on curve of proper voltage and power factor. For single phase use twice the number of kilowatt-miles.

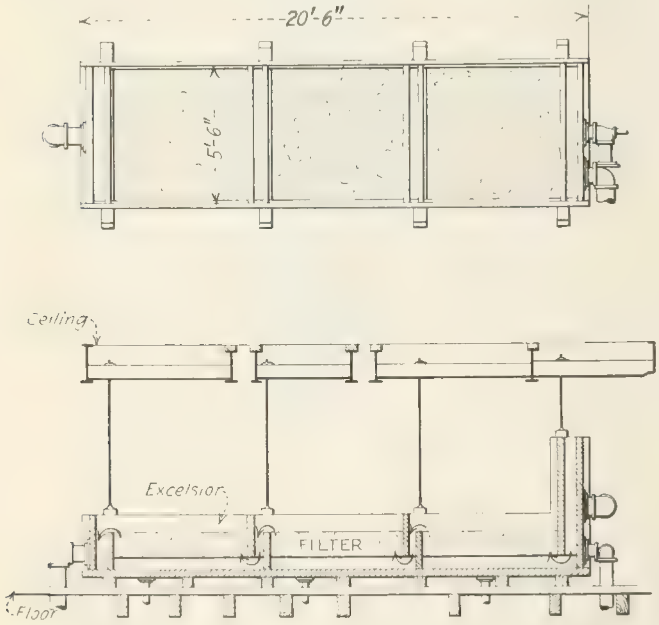
Insulator Life Less the Greater the Span

MECHANICAL stress is one of the main factors in determining the life of insulators according to recent analysis of failures which shows that where ten insulators fail in 200-ft. spans, sixteen fail on 200-ft. to 400-ft. spans, thirty-two on 600-ft. to 800-ft. spans, and twenty-four on 800-ft. to 1,000-ft. spans. The maximum pull found practicable is about 2,000 lb., or 0.2 of the ultimate strength. Any attempt to change the design to get greater ultimate strength is offset by increased trouble from temperature changes. To relieve the mechanical stress different expedients have been tried, such as the use of paraffin between cement and porcelain, paint or cork on top of the insulator and a cork washer on the end of the pin; but no large number of definite results have been reported. Attempts have with some success been made to relieve the electrical stresses across certain parts of the insulators by grading or placing rings around the top disk of the insulator. O. C. Traver.

Schenectady, N. Y.

Home-Made Oil Filter Saves Boiler Tubes

HOME-MADE oil filters in a Michigan mining company's plant have greatly reduced the replacement of boiler tubes. Although the exhaust steam passes through oil separators before entering the mixed-pressure auxiliary turbines, considerable oil from the condensate was found deposited on the lower tubes nearest the fire, necessitating frequent replacement of tubes. The number of tubes replaced per year in the twenty-two 500-hp. boilers has been reduced to eighteen by these filters. Two similar filters were built each for 350,000 lb. (159,000 kg.) of water per hour. Each measures outside about 20 ft. x 6 ft. x 2.5 ft. (6 m. x 1.8 m. x 0.8 m.). The water passes upward through three 12-in. (30-cm.) layers of excelsior, going from one layer to the next down through a 4-in. (10-cm.) slot and leaving oil floating on the top of each compartment. The tanks are cleaned and the excelsior is renewed about every four days. At a cost of $40 per year for excelsior, besides the installation costs, these filters have greatly reduced the expense of replacements and shut-downs, with the consequent overloaded operation of other boilers. Aarvid Baalack.



CONDENSATE PASSES SUCCESSIVELY THROUGH THREE BEDS OF EXCELSIOR

Synchronous Condenser Operated Without an Attendant

AN INDUSTRIAL substation supplying energy for the General Motors Company at Saginaw, Mich., from the lines of the Consumers' Power Company is designed to operate without an attendant, although it contains a synchronous condenser. The most interesting feature of the installation is this 2,000-kva. synchronous unit, which was installed as a voltage regulator for the 2,500-volt bus in preference to the familiar induction type, as it not only holds the voltage on the bus within the limit of its capacity but improves the power factor of the station as well, which is equivalent to increasing the transformer capacity for the same kilowatt station load. This unit, which consists of the motor proper with a pilot generator and an exciter mounted on the same shaft, is protected from overload by induction-type relays and a low-voltage-release coil. In addition, each bearing is fitted with a relay which opens the low-voltage trip coil in case the bearing temperature reaches 95 deg. C. In the event of shut-down the motor or feeder switches, which are also equipped with induction-type relays, will not automatically reset but must be closed by some one sent from the General Motors Company. To give notice of such a shut-down alarm circuits are carried from the substation to the chief electrician's office in the main building.

The voltage of the synchronous motor, and through this the power factor of the station, is controlled by a K-2 Tirrill regulator, equipped with a field-regulating rheostat. Additional automatic protective devices are installed to take care of extremes of transmission-line voltage under peak and light load. Without these devices, if the regulator was set to give 2,400 volts on the bus, the motor would operate to hold this voltage, even if the transmission voltage fell so low that the rating of 462 amp. was exceeded. This overload would operate the relays to shut the unit down. Therefore, to obviate these shut-downs, which would be of frequent occurrence, auxiliary rheostats, contactors and relays are so arranged that the exciter voltage is reduced when either the synchronous-motor field current or the armature current rises to full load.

The station is of sheet-iron construction and contains a low-tension bus, switchboard and oil switches. Current is obtained at 22,000 volts from Zilwaukee, Mich., and is stepped down to the station bus voltage by three delta-connected 1,000-kva. radiator-type transformers in the yard outside the building. The lightning arresters and the 22,000-volt switch form a combined unit which is installed on a steal-tower structure directly over the transformers. The low-tension disconnect switches are installed on pipe framework. The whole outdoor structure is laid out so that the apparatus is easily accessible for inspection and repairs.

The maximum load on the station is approximately 1,500 kw., and, with the motor fully excited, the station power factor is raised to approximately 97.7 per cent, which is exceptionally high for a load consisting almost entirely of induction motors. C. C. Steck.

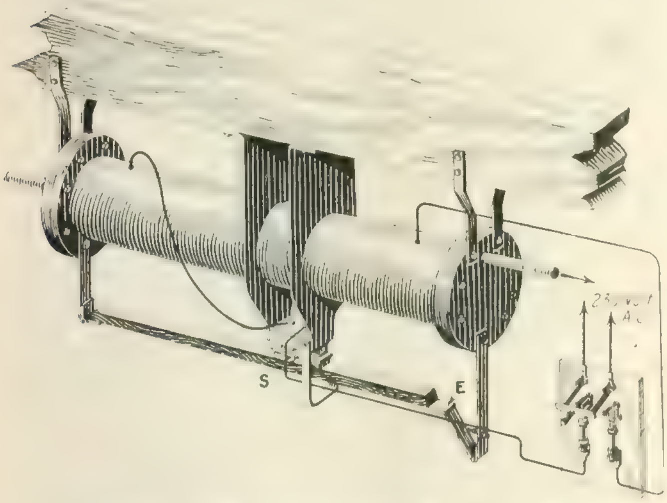
Saginaw, Mich.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

Home-Made Electric Water Heater

TO FURNISH hot water for washing purposes to its forty employees an Eastern manufacturing plant recently made an electric heater from an iron pipe and other common materials. This 6-in. (15-cm.) by 6-ft. (2-m.) pipe was flanged at each end, and after two outside plates were bolted to these flanges the pipe was insulated and wound with No. 11 asbestos-covered wire. For insulation two layers of scrap mica were shellacked on, followed by a layer of asbestos tape. After this, 360 turns of the wire were wound, leaving about ⅛ in. (3 mm.) between turns. After winding, the ends were tied down with asbestos tape and brought back about 6 in. (15 cm.) to prevent any mechanical strain on the winding. The whole was then plastered with a mixture of fireclay and a small amount of magnesia pipe covering, broken up finely. This was wrapped with another layer of 4-in. (10-cm.) asbestos tape.



ELECTRIC WATER HEATER MADE FROM IRON PIPE

Expansion of pipe causes switch (*S*) to open circuit and thereby prevent overheating.

TEST ON HOME-MADE WATER-HEATER
Room Temperature, 26 Deg. C

Volts	Amp.	Kw.	Water Temp., Deg. C.	Time Min.
210	51.3	10.2	21.5	0
211	47.5	9.6	30.0	3
212	46.2	9.4	40.0	6
211	44.8	9.16	47.0	9
213	44.3	9.06	55.0	12
215	43.8	9.0	65.0	15
216	43.3	9.0	71.0	18
216	42.4	8.88	78.0	21
217	42.0	8.78	85.0	24
217	41.3	8.6	91.5	27
Water boiling				30

To prevent damage in case the power switch should be left on, the expansion of the drum was utilized to open the circuit. An oil-treated maple bar about 1½ in x 2 in. (2 cm. x 2.5 cm.) was hinged to the drum as shown in the sketch, one end having a steel plate which rests on an adjustable steel edge (*E*) supported from the end of the pipe. Attached to the bar is a copper plate and supported from the ceiling above it is a small switchboard with two spring contacts into which the copper bar fits. When the bar is held up the circuit is completed through this bar. When the drum expands the bar drops and breaks the circuit. A stop is provided, as shown in the sketch, to prevent the bar from dropping too far.

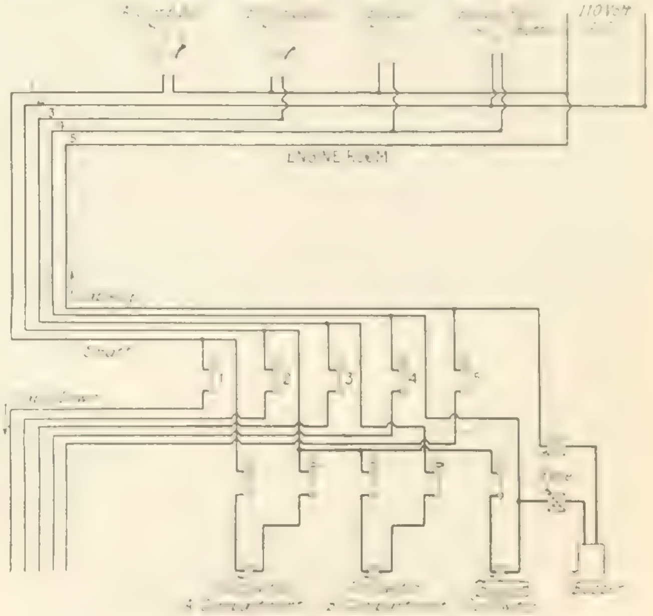
This switch acts only as a safety valve and not as an energy saver. It is found that because of the hot water rising to the top the drum tends to bend and so the actual linear expansion is much smaller than was expected. A test made on the heater before it was installed showed that it heated water from 21.5 deg. C. to boiling in thirty minutes (see table) and that the efficiency is approximately 83 per cent and the power factor 94.7 per cent.

This heater has been in service for some time now and has given excellent results. EUSTACE C. SOARES.

Ampere, N. J.

Deep-Mine Signal System Which Permits Easy Location of Troubles

ELECTRIC signals for hoisting in deep metal mines must be rugged and reliable, easy to operate and so installed that trouble can be quickly located. A system having these qualifications has been in use for five years in a two-compartment shaft of the Butte & Superior (Mont.) Mining Company. In this system a signal bell



LOOP-THROUGH BOXES FACILITATE TROUBLE SHOOTING for each hoisting compartment is located upon the engineer's stand together with a buzzer push-button. Pull switches as shown in the drawing are placed at each level and in skip pockets within easy reach of the cage tenders. This switch is of a type developed in the Butte district and is very reliable and rugged. The bells are of a quick-acting core-and-plunger type, as this type gives one stroke when power is applied. The buzzers are used for signaling the cage man, or in case a bell signal is misunderstood by the engineer he presses his buzzer button and the signal is repeated.

From the accompanying diagram of wiring it is seen that the bell system has a common wire No. 2 and one wire for each hoisting compartment, Nos. 1 and 3. As a buzzer and a buzzer switch are placed on each level two more wires Nos. 4 and 5 are necessary, but in actual practice for a two-compartment shaft a six-wire cable is run to allow a spare conductor in case of trouble.

In order to facilitate finding trouble the cable is looped into a junction box at each level. In this box each wire may be disconnected by a baby knife switch from all lower levels of the mine, and by another switch it may be disconnected from the circuits in the same level. In place of knife switches fuses are connected on each side of the buzzer to disconnect automatically the buzzer in case of trouble without disturbing the rest of the system. This system of looping the cable at each level is costly, but its advantages from the operating and maintenance standpoints overbalance the cost.

Arizona Hercules Copper Co., Kelvin, Ariz. — **E. W. FREDELL**, Chief Engineer.

Home-Made Transformer for Locating Motor Troubles

FOR locating short-circuited coils in induction motors and for testing small direct-current motors the home-made testing transformer shown here has proved successful in a New York repair shop. For use on a 110-volt, 60-cycle circuit this transformer is wound with 150 turns of No. 10 B. & S. gage (5.26 sq.mm.) square double-cotton-covered magnet wire. For 220 volts, 60 cycles, 300 turns of No. 13 (2.6 sq.mm.) is used and for 110 volts, 25 cycles, 356 turns of No. 14 (2.08 sq. mm.). The core is of H-shaped laminations measuring 5 in. x 6 in. (12.5 cm. x 15 cm.) over all. These are built up to a depth of 3½ in. (9 cm.) and are held together by ¼-in. (6-mm.) bolts which are insulated from the laminations by paper or tape bushings and washers. In making the core, blank laminations 5 in. x 6 in. may be bolted together after the holes are drilled and the whole core may be milled to shape in one operation. After milling, all burrs should be removed with a file.

In winding the coil a fiber or bakelite sleeve should be put around the core. After each layer is wound it is painted with bakelite and baked. When the winding is completed the coil is bound with friction tape or a band of ⅛-in. (3-mm.) cord. A snap-or-push switch in the connecting cord facilitates shifting the transformer when testing large motors.

When testing with this transformer for short-circuited coils of induction-motor stators, the transformer is used as in Fig. 2 in conjunction with a steel feeler which is a thin piece of steel or iron about ½ in. x 5 in. (1.2 cm. x 12.5 cm.). When the transformer is applied over a leg of a short-circuited coil, the feeler is pulled to the core by magnetism when it is laid across the slot containing the coil. To locate a short circuit in a two-layer winding as shown in Fig. 2 if the feeler vibrates when bridging a certain slot, then one of the coils in that slot is short-circuited. The other side of the grounded coil may be found by testing the slots on each side at a distance away equal to the pitch of the coil. For example, in Fig. 2 after the feeler vibrates at slot No. 7, then if it vibrates also at No. 1, the bad coil is located at *c*. In case of a motor whose core is less than the length of the transformer, 3½ in. (8.5 cm.), across *k*, the feeler must be applied to the slot one coil pitch away, as at *b*, rather than *a*. The best method for testing is to pass the transformer around the stator, slot by slot, marking with chalk each slot at which the feeler vibrates. After this is done all the defective coils are located.

For testing small direct-current armatures about 2 in. to 4 in. (5 cm. to 10 cm.) in diameter the transformer is placed on a bench and the armature is placed in between the poles as in Fig. 3. Short circuits may be located with the feeler placed on the top of the motor directly above its center in the same way as they are located on alternating-current stators already described. For locating reversed leads and open coils as well as short circuits, a bar-to-bar test is made, revolving the motor between the poles. For this test a telephone receiver or a flashlamp is used connected to two points of a testing fork which spans one commutator mica segment. This fork is always kept within two or three bars of the top of the commutator while the armature is revolved a step at a time. Any change in the tone of the telephone or in brightness of the lamp indicates that a coil is defective. The practice of the writer is to make the feeler test before soldering the commutator leads.

Bronx, N. Y. — C. A. JOHNSON.

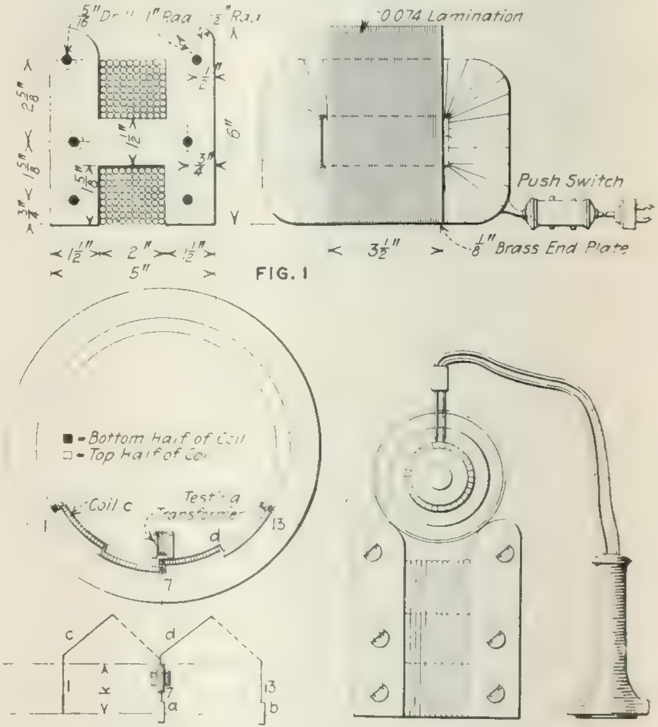


FIG. 1

FIG. 2

FIG. 3

FIGS. 1, 2 AND 3—LOCATING TROUBLES IN ALTERNATING-CURRENT AND DIRECT-CURRENT MOTORS

Fig. 1 Construction details of testing transformer. Fig. 2—Method for locating short circuits in an alternating-current stator. Fig. 3—Test for small direct-current armature to locate short circuits, reversed coils and open circuits.

Electric Hoist with Electrolytic Controller

IN AN electric hoist driven by alternating current with a capacity of 180 tons per hour, operating in a 720-ft. (220-m.) shaft, recently installed at Kilton Collieries, England, an electrolytic controller, an overspeed device and an overwind switch are among the interesting features. The winder was built to replace a beam-type engine with overhead drum. The new winder house is built immediately behind the old engine house so that the transference of the ropes to the new drum was greatly facilitated, while no alterations to the head sheaves were necessary. In order that the winding cycle may be equalized a conical drum is to be used.

The drum brakes are operated by means of a compressed-air engine. In the event of operation of any emergency trips, a solenoid-released trigger causes the main brakes to act and to remain "on" until operation is started again. The air compressor for the brake engine is driven by a 10-hp. motor supplied from a three-phase, 440-volt transformer, which also supplies the solenoid and controller pump motor.

SPECIFICATION FOR HOIST LIFTING 180 TONS PER HOUR FROM 720-FT. SHAFT

Depth of shaft, ft	720
Net load of stone, tons	3.5
Weight of cage and chains, tons	3
Decks per cage	1
Tubs per cage	2
Weight of one tub, tons	65
Output per hour (ironstone), tons	180
Time of winding, seconds	45
Decking interval, seconds	15
Total time each wind, seconds	60
Drum, cylindro-conical, diameter, ft	11 to 15
Turns on small diameter	*6
Turns on scroll	4
Turns on large diameter	9.7
Drum speed, r.p.m.	27.6
Rope, circumference, in	4½
Maximum rope speed, ft. per minute	1,300
Motor rating, hp	370
Motor peak, hp	440
Motor, speed, r.p.m.	255
Ratio of gearing	9.25 to 1

Supply, three-phase, 40 cycles, 2,750 volts; auxiliaries, three-phase, 40 cycles, 440 volts.

*Three dead.

The motor is controlled by a liquid controller of the weir type, fitted with oil-immersed reversing switches. During the time the controller is in circuit a continuous flow of electrolyte is pumped into the upper tank, returning over a sluicegate into a lower tank. The operating lever raises the gate, causing the level of the liquid in the upper tank to be raised, thus decreasing the resistance between the electrodes. As the resistance liquid cannot follow the raised sluicegate faster than the pump can deliver the liquid into the upper tank, a certain minimum accelerating period is obtained. The acceleration period is adjustable within limits by means of a stop valve in the delivery pipe of the pump.

The reversing oil switches are fitted with safety interlocks so arranged that the oil containers may not be removed without tripping the main oil switch. Overspeeding is prevented by a direct-current series-wound generator, chain-driven from the motor shaft, and arranged to send current through a relay and a bank of resistors. These resistors limit the current through the relay so that at normal speed the relay does not trip.

At a speed above normal the current increases enough to trip the relay. The resistors are so connected mechanically with the main controller that they are varied during acceleration or deceleration and prevent overspeeding at any instant during these operations.

The overwind switch is of the friction-driven type fitted with a flexible steel rope drive working in a grooved pulley mounted on the switch spindle. The rope is attached to a lever which is struck, when an overwind occurs, by tappets on the depth indicator. The flexible cord pulls the switch open and shuts down the winder, but as the drive is by friction only, the switch may be reset by hand. Should the winder be started in the wrong direction following an overwind, no risk is incurred, as the switch will always shut down the winder when the cage has moved less than one foot upward. MARK MEREDITH.

Liverpool, England.

Mounting on Boring Machine Adjustable for Different Motors

BY MEANS of the bracket in the illustration, motors of different sizes and types may be mounted on a 42-in. (106-cm.) Bullard boring machine in the shops of the Chapman Valve Manufacturing Company, Indian Orchard, Mass. The bracket shown holding a 10-hp. motor is of two arms held on one end by a horizontal 1¾-in. (3.5 cm.) rod running in bearings on the tool frame.

SWINGING ARMS MAY BE SPREAD ON ROD FOR LARGER MOTOR

These arms may be swung up and down on this rod or spread horizontally along it to adjust for motors with different bases. These arms are supported by a 1¼-in. (3-cm.) diagonal brace rod 31 in. (78 cm.) long, the lower end having a nut which may be adjusted to change the height of the bracket through small limits.

W. B. ATCHINSON,
Electrical Engineer.

Chapman Valve Manufacturing Company,
Indian Orchard, Mass.

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

Utility Will Train Non-Technical Men as Junior Engineers

A COURSE for junior engineers has been started by the Consumers' Power Company of Jackson, Mich., for technically trained and other desirable men who wish to add practical experience to the theoretical knowledge received at college or elsewhere. The men will be expected to work under the same conditions as the regular employees, but the junior engineers will be transferred from one department to another as agreed upon between the employee and the superintendent of the personnel department from time to time.

The company does not ask the men to sign any rigid contract or to complete any specified course; it agrees, however, to pay the men $90 a month for three months. Then the rate is increased to $100 per month for those who continue on the company's payroll. Further salary increases depend entirely upon the man himself. He may continue changing from one department to another, or may settle in one department immediately if he thinks it best.

The junior engineers are started in such positions as electrical repairmen, substation operators, hydroelectric plant operators, steam-plant operators, combustion men and statisticians. Later they will be eligible for the positions of local managers, superintendents, chief engineers, combustion engineers, mechanical engineers, load dispatchers, chief operators, electrical inspectors, leaders and specialists in one department or another of the many branches that go to make up the organization. Opportunity and encouragement will also be given to eligible men who desire to become connected with any of the allied properties of the company.

Intensive Training of Metermen Found Valuable

WHEN the metermen's short course was inaugurated by the engineering extension department of Iowa State College last year a large percentage of the students attended at their own expense. However, the central stations profited so much by what the men learned that nearly all of the fifty-eight men, representing some thirty companies, who registered for the course this year were sent by and at the expense of the utility companies.

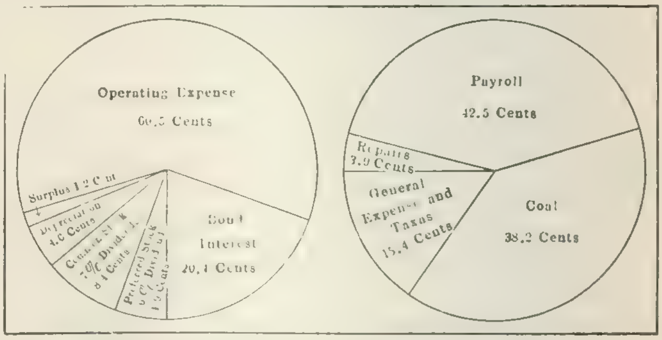
The course takes four days and consists in the main of one-hour lectures followed immediately by consultations, discussions and demonstrations. The work is divided into a study of single-phase and polyphase meter problems. About two-thirds of the students took the single-phase course, and a number of the men who attended last year returned and took the three-phase course.

The instruction was in charge of Frank D. Paine, professor of electrical engineering of Iowa State College, and he was assisted by A. B. Campbell of the engineering experimental department of the university; E. G. Nichols, Iowa Railway & Light Company, Cedar Rapids; S. M. Cox, Des Moines Electric Company, Des Moines; H. L. Jepson, Des Moines Electric Company, Des Moines, and C. A. Steele, Sioux City Gas & Electric Company, Sioux City.

The students were addressed each evening by representatives of the Duncan Electric Company, the Electric Appliance Company, the General Electric Company, the Sangamo Electric Company and the Westinghouse Electric & Manufacturing Company. The instructors and students at last year's meeting formed the Iowa Association of Electric Metermen. This organization held its second annual meeting during the course this year and re-elected Frank D. Paine of Ames president. George T. Gibson, Des Moines, was elected vice-president, and A. B. Campbell of Ames secretary and treasurer. The universities of Illinois and Wisconsin are preparing to give similar courses this summer.

How a Public Utility's Gross Revenue Is Spent

HOW each dollar of the gross revenue of the Public Service Company of Northern Illinois was spent during 1919 is clearly explained by the accompanying charts appearing in the April number of the *Public Service Lumen.* The revenue—operating and other income—was $9,325,913.23, operating expense was $5,646,340.19. The disk on the left represents any dollar of the gross revenue received. The first expenditure out of this typical dollar was 60.5 cents to pay the operating costs. The next segment, 20.4 cents, paid the bond and note interest—$1,902,706.25. Then came a smaller piece of the dollar worth 4.9 cents, which made $455,280, or 6 per cent on the preferred stock. Another piece of each dollar—8.4 cents—aggregating $781,191.25 was used to pay 7 per cent dividends on the common stock. After 4.6 cents had been taken to make up the item of $430,660, set aside for depreciation, only 1.2 cents re-



CHARTS SHOWING DISTRIBUTION OF REVENUE OF THE PUBLIC SERVICE COMPANY OF NORTHERN ILLINOIS mained, amounting to $109,735.28, which was carried to the reserve.

On the right the disk represents any one of the $5,646,340.16 dollars paid out for operating expenses. To meet the payroll, which totaled $2,397,996.78, a section worth 42.5 cents came out of each dollar, 38.2 cents went toward purchasing $2,157,749.99 worth of coal, 15.4 cents was required to pay taxes and general expenses amounting to $868,088.25, and the remaining 3.9 cents was applied to the payment of $222,505.17 for supplies and repairs.

Study Courses Conducted by Employees of Southern California Company

BY M. MCNEAL

CORRESPONDENCE courses in practical electricity, commercial engineering, elementary accounting and advanced accounting offered by the National Electric Light Association are being conducted with marked success by the Southern California Edison Company and its subsidiary companies, the Mount Whitney Power & Electric Company and the Santa Barbara Electric Company. After a plan approved by R. H. Ballard, first vice-president of the Southern California Edison Company and president of the National Electric Light Association, the facts relating to the benefits of these correspondence courses were advertised throughout the organization during the fall of 1919. Department heads were called in conference, at which time they were asked to suggest a plan that would result in the greatest benefit to all concerned. Fred B. Lewis, superintendent of the Los Angeles district, who has served as superintendent of instruction, suggested and has executed the following plan: (1) To establish district classes at central locations throughout the company's system; (2) to appoint district instructors; (3) to adopt a definite schedule of study with class leaders.

At the end of six weeks after the adoption of this plan there was an enrollment of 272 students—250 in practical electricity, ten in commercial engineering and twelve in elementary accounting. One student enrolled in the combined accounting course. These students are grouped into geographical district classes and definite places determined upon for class meetings. At the first district class meeting class instructors are appointed by the superintendent of instruction and a definite date and time schedule arranged for the meetings.

The following plan of study has been adopted and is producing satisfactory results: (1) Discussion and study of the last lesson issued; (2) new lesson issued with complete instructions; (3) answers to last studied lessons are written up between class meetings and forwarded to the N. E. L. A. headquarters.

Class meetings are held every two weeks. The students enrolled include district agents, district superintendents, salesmen, bookkeepers, machinists, meter readers, substation operators, truck drivers, linemen, apprentices, groundmen, gang foremen, cable splicers, battery tenders, test men, general repair men, clerks, storekeepers, troublemen, cashiers, inspectors, patrolmen, power engineers, estimators and construction men.

The beneficial results from these classes in promoting harmony and efficiency in the company clearly indicate that the correspondence courses of the N. E. L. A., indorsed and supported by the public utilities, are a direct contribution to the personnel of the latter.

Employees' Beneficial Association a Factor in Good Service

IN MAINTAINING a high standard of service the beneficial association of the Philadelphia Electric Company plays an important part. The management of the company believes that the fidelity and efficiency of its employees depends to a great extent upon their physical and mental well-being. A sound body, vitalized by outdoor exercises in pleasant surroundings, maintained in health by prompt medical attention, are the aims of the beneficial association.

The work of the association may be considered threefold—the payment of disability benefits, the provision of life insurance and the provision for health-building recreation.

The disability benefits provide for wage payment during absence on account of sickness or accident. A special sickness benefit feature recently added provides for the payment of full normal wages for a period of one year to a member who may have contracted tuberculosis while in service. The association has disbursed for disability benefits $237,855.

The life insurance feature provides a payment upon the member's death to his beneficiaries of $750 from the date of membership until the completion of five years, when it is automatically increased to $1,000, with a further increase of $100 for each additional year until the maximum benefit of $1,500 is attained. During the past thirteen years the cost of the death benefit insurance paid to members has averaged the deceased member only $1.47 per $1,000 insurance per year. The sum of $194,443 has been paid for death benefits.

The association has broadened its plan by providing for the payment of a funeral benefit of $150 to the member in the event of the death of the member's wife or husband, as the case may be, and a burial benefit of $75 to the member on the death of a dependent child.

In an effort to encourage outdoor recreation as a means to promote good health, the beneficial association has been working along both preventive and remedial lines by contributing for some years to the maintenance expense of the club house and grounds of the athletic association of the employees, containing about twenty-five acres. There is plentiful provision for every department of sport, a playground for children and a club house with dining-room accommodations.

Last year these grounds were dedicated as a memorial to the employees of the company who sacrificed their lives in the war and were named "the Howard C. McCall Athletic Field."

Cost of Money to a Massachusetts Central Station

THE cost of money borrowed on short-time notes by a Massachusetts central station in the latter half of 1919 is indicated by an analysis of thirty-five such notes recently tabulated. The notes totaled $1,205,000, the borrowings ranging from July to December last, inclusive, and the dates payable ranging from January to September inclusive in the present year. The individual notes ranged from $10,000 to $65,000. Sixteen of the notes were placed at 5½ per cent, ten at 5¼ per cent, four at 6 per cent, three at 5 per cent and two at 5¾ per cent. The company's credit is excellent and its business expanding rapidly.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Single-Phase Commutator-Motors Developed by Siemens-Schuckert.—M. SCHENKEL.—This article gives descriptions of various types of repulsion motors and series motors for single-phase supply which have been developed during the last few years by the Siemens-Schuckertwerke. For small amounts of power—pumps, ventilators, etc.—repulsion motors of ordinary form were built, having one movable brush per pole and all brushes directly shorted. For larger amounts of power the Déri type of repulsion motor has been built in considerable numbers. This motor has two sets of brushes per pole, one fixed and one movable. The fixed brush of one pole is directly connected with the movable one of the next. The Déri motor has come into considerable use for elevator service and also for purposes of traction in mills and mines. In elevator motors of this type all operation is accomplished by moving the movable brushes, either directly by means of a control cable or by a small controller-motor operated by press buttons. In smaller elevator motors both sets of brushes are sometimes set at a fixed position, and reversal of the motor is obtained by connecting one or the other of two auxiliary displaced stator windings in series with the main stator winding. A special type of repulsion motor has been designed for use in cotton mills, where its high efficiency and economic speed control are desirable features. In connection with the development work on single-phase series motors for heavy traction some interest has been devoted to the design of series motors of medium sizes for hoists and small mine locomotives. A great number of photographs and diagrams are exhibited, which illustrate the operational characteristics and design of these motor types.—*Elektrotechnische Zeitschrift*, Jan. 8, 1920.

Lamps and Lighting

Effect of Color of Walls and Ceilings on Resultant Illumination.—A. L. POWELL.—The author outlines briefly some color schemes for walls, ceilings and fixtures that have been found to give good results in industrial plants, offices, schools, stores, and residences. Some interesting information is given on the reflecting power of several different kinds of paint, both when new and after aging one year, the data being as follows:

Paint	Coefficient of Reflection New	Coefficient of Reflection After Aging One Year
White lead and oil	0.85	0.67
Lithopone	0.77	0.72
Calcimine type	0.74	0.67
Flat enamel (magnesia bearing)	0.76	0.73
Gloss enamel	0.75	0.75

Some suggestions as to the best methods of applying paint to secure satisfactory reflections are also offered, and a method is described for determining the coefficient of reflection of any surface.—*Transactions I. E. S.*, Feb. 10, 1920.

Factory Lighting—A Central-Station Problem.—O. R. HOGUE and J. J. KIRK.—It is pointed out that there are great possibilities of improving industrial lighting and that the central-station engineers are in the best position to foster this development, particularly considering the increased revenues of the central stations.—*Transactions I. E. S.*, Feb. 10, 1920.

Generation, Transmission and Distribution

Possibilities of Canadian Water-Power Development.—LEO G. DENNIS.—It is said that of the total electric central-stations installation of 2,107,743 hp., 1,806,618 hp., or 85 per cent, is in hydro-electric stations. The large size of these stations is shown by the fact that 40 per cent of the installed capacity is in plants of 100,000 horsepower or over and another 42 per cent in plants between 10,000 hp. and 100,000 hp. Recent data on water-power installations in Canada reveal the following total horsepower for the various provinces: Ontario, 1,000,000; Quebec, 900,000; British Columbia, 310,000; Manitoba, 78,600; Alberta, 32,500; Nova Scotia, 30,000; New Brunswick, 17,000; Yukon, 13,400; Prince Edward Island, 1,700, Saskatchewan, 40. With regard to Canada's potential water-power possibilities, recent estimates place them at 18,832,000 hp., divided among the various provinces as follows: Quebec, 6,000,000; Ontario, 5,800,000; British Columbia, 3,000,000; Manitoba, 2,797,000; Alberta, 462,000; New Brunswick, 300,000; Saskatchewan, 220,000; Nova Scotia, 100,000; Yukon, 100,000; Northwest Territories, 50,000; Prince Edward Island, 3,000.—London *Engineer*, April 9, 1920.

Water-Power Development for Small Plants.—CHARLES H. TALLANT.—It is pointed out that much has been written concerning the proper selection of units for a large hydro-electric plant, but that little information is available concerning the small isolated plant. The writer gives an outline for the study of water flow and size of units for the designing of small plants.—*Journal of Electricity*, April 1, 1920.

Traction

Electric Freight Locomotives for the Bernina Railroad.—Some rather peculiar problems were encountered in designing these freight locomotives for the railroad between Tirano in Italy and St. Moritz in Switzerland. The total ascent from Tirano to Bernina being 1,827 m. (6,000 ft.), it was necessary to provide a draw-bar pull of no less than 8 tons on a 100-ton train. Direct current at 750 volts is chosen for the supply, and the locomotives are each provided with four motors, divided on two bogies, which give a total one-hour average output of 800 hp. The electric equipment is described in some detail in the article, which ends with an interesting table giving comparative data for six high-powered locomotive types built for roads in the Alps.—*L'Industrie Electrique*, Dec. 25, 1919.

Modern Practice in the Construction and Maintenance of Rail Joints and Bonds in Electric Railways.—E. R. SHEPARD.—This revised edition of a paper already published on the subject contains an appendix with descriptions of recent improvements in the field of rail bonds and joints not contained in the former article.—*Technologic Paper No. 62, U. S. Bureau of Standards,* Feb. 9, 1920.

Units, Measurements and Instruments

Testing of High-Tension Cables on Constant Potential.—M. WEISET.—In testing long pieces of high-tension cable with the ordinary alternating-current testing outfit the large charging current of the cable often is very troublesome, causing an unusual strain on the generator and distorting the wave form. The author therefore has made a systematic comparison between the results of testing with alternating voltage and with a continuous voltage derived from the high-tension transformer by means of a Delon rectifier, consisting of synchronously driven contact-making arms. By this rectifier a buffer condenser was charged to a continuous potential of about $\sqrt{2}$ times the r.m.s. transformer voltage. Certain voltage losses arise from drop in the contact-making sparks of the rectifier, and a special study was made of the performance of the rectifier during testing of cables of high capacity. The results of these investigations are shown by diagrams and oscillograms. It was found that the rectifier gave enough power to permit the burning out of punctures so that a subsequent determination of the position of the fault could be easily made by a bridge method. With very small deviations, the breakdown voltages of ordinary high-tension cables with impregnated paper dielectric were found to be on the average 2.46 times higher on a continuous voltage test than in ordinary alternating voltage testing at 50 cycles. Approximately the same ratio was observed in tests on cables with one conductor, as in tests of three-conductor cables in various modes of connection; but for samples of impregnated paper of a similar kind to that used in constructing the cables, and tested between circular electrodes 2 in. (5.1 cm.) in diameter, an average ratio of 2.64 was obtained.—*Elektrotechnische Zeitschrift,* Jan. 15 and 22, 1920.

Electrophysics and Magnetism

Self-Inductance of Multi-Layer Coils.—A. ESAU.—In radio engineering it is often of importance, in order to lower the distributed capacity of inductance coils, to wind them with considerable spacing between wires. The ordinary formulas for self-inductance, which are based on the assumption of homogeneous current distribution over the entire cross-section of the winding space, are not applicable. After some rather laborious mathematics, the author arrives at a formula which is claimed to give exact values even when the turns are spaced far apart and when the layer spacing is different from the turn spacing.—*Jahrbuch der Drahtlosen Tel. und Tel.,* January, 1920.

Ultra-Violet and Visible Transmission of Variously Colored Glasses.—K. S. GIBSON, E. P. T. TYNDALL and H. J. MCNICHOLAS.—Special transmission curves for eighty-seven samples of glass representing more than fifty different kinds, mostly colored, are given in this paper. These curves extend from 710 millimicrons throughout the visible and ultra-violet as far as the specimens show any appreciable transmission. Most of these glasses are of American manufacture, but a comparison is afforded with some samples of Jena glass obtained before the war. Various practical uses to which these glasses are put are indicated, such as ultra-violet signaling, railway signaling, improvement of visibility both for visual and photographic work, protection of the eyes and selective ray filters. Of special value is their use as filters, to obtain monochromatic light from the mercury, helium or hydrogen lamps.—*Technologic Paper No. 148, U. S. Bureau of Standards,* March 19, 1920.

Systems, Installations and Appliances

Electric Motors for Coal Mining.—FRANK BROADBENT.—In this article the author deals with means of increasing the output of the coal face. He points out that this involves increased handling and transport facilities and a general speeding up of all other operations, including pumping, ventilating, hauling, winding, picking, screening, etc., and for all these purposes electricity is not only the most convenient but also the most economical method of driving.—*Beama,* January, 1920.

Electrically Driven Hoists—FRASER JEFFERY.—Unbalanced single-drum hoisting and the more efficient balanced hoist employing a second cage or a counterweight are considered. The character of load imposed by different types of hoist and different hoisting depths is shown by means of curves. It is said that the slip-ring induction motor is usually applied to this service. Details of electric braking and a comparison of full magnetic and liquid control are included.—*Power,* Feb. 24, 1920.

Telegraphy, Telephony and Signals

Radio Telegraphic Station at Rome.—B. MICCHIARDI, G. PESSION and G. VALLAURI.—The station at San Paolo near Rome is described in detail, including its antennas, down-leads, ground, arcs, controls and receiving apparatus. The determination of the most desirable antenna construction is considered, and experimental means of measuring effective antenna height are given. The methods of simplex and duplex operation are discussed. The reception from four high-power American stations is described, and detailed reception data are given.—*Proceedings Institute of Radio Engineers.* April, 1920.

The Latour System for Protecting Telephone Lines Against Disturbances from Power Transmission Lines.—A. COSTABEL.—The system consists in amplifying the telephone currents immediately upon their leaving the microphone transmitter to such an amplitude that the power-line disturbances become relatively insignificant. A vacuum-tube amplifier is used in each end of the line. The signals are reduced to normal strength at the receiving end by connecting high resistance in series with the receiver or by using a non-inductive shunt. Several modes of connecting the amplifiers in applying this system are discussed by the author, who concludes, on the basis of results obtained during certain tests on the line from Perpignan to Prades, which follows a single-phase electric railroad—16.7 cycles, 12,500 volts—that perfectly satisfactory protection may be obtained by this system, even when the telephone line runs along a single-phase railroad without balancing return feeder, or when it is carried on the same poles as is a high-tension transmission line.—*Revue Générale d'Electricité.* Jan. 3, 1920.

DEMAND for electrical supplies and apparatus is holding up well, but billings are falling off. Materials are moving in small amounts, just enough to take the edge off famine conditions existing in the industry. At the same time collections are being watched very closely and are far from satisfactory. It is getting more difficult to finance goods held up in shipment. Reports state that the Interstate Commerce Commission is taking steps to control freight movement, giving priorities to perishables and necessities.

FROM several sections comes the report that supplies of fans at present available are not expected to do more than cover requirements of the first hot spell. Several carloads are en route, however.

ONE OF the largest electrical manufacturers, one who is particularly interested in retail sales, is backing the direct sales policy strongly.

A LAY-OFF of about 2,000 men in the Lynn works of the General Electric Company has brought home to the industry the seriousness of the transportation tie-up and the shortage of materials. This curtailment of output, however, is expected to be temporary only; receipt of materials, it is reported, will be the signal for resumption of work. Although curtailment in the industry is getting to be more general, few reports have been received giving news of specific lay-offs.

THE REPORT of the lamp committee of the N. E. L. A. shows increases in candlepower and efficiency of tungsten lamps during 1919, although the total number of large lamps sold during that year was 3,000,000 less than the previous year's total of 186,000,000 lamps.

A REVISION of the war-time rates of the Athol Gas & Electric Company has been ordered by the Massachusetts Department of Public Utilities. This will bring a reduction in lighting rates and a readjustment in rates for power.

A STATEMENT defining its principles under the new plan for serving the electrical industry has been issued by the Conference Club.

TEN MILLIONS of twenty-year first and refunding mortgage gold bonds have been placed on the market by the Detroit Edison Company.

CURRENT report says that the Radio Corporation of America is about to erect near Port Jefferson, Long Island, the greatest wireless plant in the world.

FIRES from electrical causes resulted in a loss of $25,000,000 last year, according to the National Fire Protection Association.

GOVERNOR SMITH of New York has vetoed a bill permitting private development of boundary waters of the state.

ASSERTING that the Wisconsin Railroad Commission is delaying unduly its task of fixing reasonable utility rates, the Wisconsin-Minnesota Light & Power Company has appealed to the federal courts against the Wisconsin statute that forces it to charge the old rates till the new ones are determined.

News in Brief

Summary of Market Conditions and of Recent and Approaching Happenings of Importance to the Industry

EXPENDITURE of $123,000,000 in the next eleven years is involved in the program of the Pacific Gas & Electric Company as outlined by John A. Britton before the California Railroad Commission.

A REDUCTION of 1 cent a kilowatt-hour has been made in the lighting rates of the Edison Electric Illuminating Company of Brockton, Mass.

WATER powers of the Canadian province of New Brunswick are to be developed under the control of the provincial government.

THE TENTATIVE program for the White Sulphur Springs convention of the A. I. E. E., to be held from June 29 to July 2, has been issued.

A CUT OF four or five million dollars has been made in the expansion program of the Detroit Edison Company, which, as originally prepared, involved the expenditure on new plants, substations and other improvements of $12,000,000 in the near future.

STRONG opposition to the abandonment of the policy of permitting central stations to initiate rate changes, subject to review by commission in case of dispute, arose during the consideration of this question by the Massachusetts Legislature. A commission inquiry seems probable.

TRADE-UNION methods in the engineering profession were strongly condemned by the American Association of Engineers at its recent St. Louis meeting.

OBLIGATIONS incurred by the United States as a creditor nation were discussed at the foreign trade convention held in San Francisco, May 12 to 15. Two hundred members of a staff of "trade advisers" held individual conferences with delegates.

TO PROVIDE for capital expenditures the Northern Ohio Traction & Light Company has sold $2,000,000 six-year 5 per cent gold bonds secured by $2,500,000 of the company's mortgage bonds.

WATER-POWER development through the exercise of eminent domain under direction of the Massachusetts Department of Public Works received a setback as the result of an adverse committee report recommending legislation to authorize co-operative development by the department in conjunction with the federal government. Massachusetts and Maine viewpoints differ radically on this question.

WITH the help of the St. Louis Electrical Board of Trade and the Associated Engineering Societies of St. Louis a bond issue for $4,000,000 has been carried in that city. Of this $1,000,000 is for extending and improving the electric street lighting of the city.

AS STEPS in the restoration of public utility credit the board of governors of the Investment Bankers' Association advocates indeterminate franchises and state commissions instead of local regulation.

THAT THE market price of utility securities is everywhere less than the original cost of the properties is the belief of Harold L. Stuart, expressed before a hearing of the Illinois Public Utilities Commission.

AN APPEAL is being made for subscriptions to the endowment fund of the Engineering Foundation which will bring the total to $1,000,000, Ambrose Swasey having given $300,000 to this object.

HONORARY membership in the Société Française des Electriciens has been bestowed upon Dr. C. O. Mailloux of New York, president of the International Electrotechnical Commission.

AN IMPORTANT meeting of the general standards committee of the Associated Manufacturers of Electrical Supplies will be held during the meeting of that association at Eastern Point, New London, Conn., from June 28 to June 30.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Pacific Gas & Electric to Spend $123,000,000 in Next Eleven Years

JOHN A. BRITTON, testifying before the California Railroad Commission last week, announced that the Pacific Gas & Electric Company is to spend $123,000,000 on construction in the next eleven years, $63,000,000 on the development on Pit River and $60,000,000 on substations and transmission lines. During this time the company expects to increase the number of its consumers by 450,000. So far the company has spent $1,200,000 on the purchase of Pit River water rights. Work has been started on the first two units of 12,500 kw. each on Hatch Creek, and will be completed by November of this year. The 1921 schedule of development is 60,000 hp.; 1923, 44,000 hp.; 1925, 60,000 hp.; 1927, 57,000 hp., and 1930, 79,000 hp.

Detroit Edison in Long-Term Financing

TEN millions of first and refunding mortgage gold bonds of the Detroit Edison Company are placed on the market this week at 89, which will yield the investor more than 7 per cent. These bonds are due July 1, 1940. The gross earnings have increased annually from $5,546,587 in 1913 to $16,498,391, and the net earnings in the same period from $1,814,361 to $4,278,318.

Plans Largest Radio Station in the World

THE Radio Corporation of America, according to current report, has purchased 6,000 acres (2,400 hectares) of land near Port Jefferson, Long Island, for the erection of what will be, when completed, the largest radio plant in the world. The largest plant at the present time is that at Nauen, Germany, but this will be completely surpassed by the new Long Island plant, with ultimately about seventy-two towers, as stated in the report.

It is said that the Alexanderson system is to be used with high-frequency alternators for the power supply and the multiple antenna arrangement, requiring a relatively small generating plant and towers of only moderate height—400 ft. (120 m.). The report indicated that communication was to be established with South America, Germany, France, Italy and Poland, and that each unit would have a speed of 100 words per minute, thus permitting sending 500 words and simultaneously receiving 500 words per minute.

When asked about the matter at the office of the Radio Corporation, officials of the company said that these reports were premature and declared that statements which had been attributed to Edward J. Nally, president of the corporation, could not be confirmed.

Conference Club Issues Statement Defining Principles

TWO statements, one a history and a statement of possibilities and the other a definition of principles, have just been issued by the Conference Club. In each of these statements the new idea in the Conference Club—its dedication to the entire industry, as a thought forum—is clearly brought to the fore and fully expounded. Furthermore, emphasis is placed on the value of industry united as to principle and ideal.

The Conference Club is not put forward as a panacea for the ills of the industry, but rather that it may offer some mechanism for diagnosis and the statement of these ills, for their discussion in order that remedies may be decided upon and applied.

The background of the Conference Club movement is the belief that the scientific method which is responsible for the marvelous development of the industry on its technical side must now be applied to obtain a sound and healthy development on the commercial side. To apply this method a laboratory must be provided, and the old Conference Club conceived it to be possible that the club might be converted into such a medium for research and study.

Among the benefits that flow from co-operative effort the club sets down the following:

Increased income, due to decreased cost, increased production and elimination of false competition.

Enhanced personal power, position and self-respect, due to the creation of and ability to take a part in a well-ordered industry.

Increased energy of the craft, due to the increase in the energy of the units working harmoniously and according to the common law of the industry.

Benefits accruing to the industry arising from research work done on a large scale by the craft for the craft.

Enhanced power and respect accruing to an industry whose constant energies are devoted to increasing production at lower costs, because thereby the public is well served and the units of the industry are better served.

Increased influence on legislation when wielded by a united industry.

Enhanced power arising from the uses of publicity for educating the public in all matters electrical.

Hazards of Domestic Electrical Devices

FIRES from electrical causes, according to an estimate by the National Fire Protection Association, resulted in a loss in 1919 of $25,000,000, compared with a loss of $16,559,433 in 1916 and $20,780,307 in 1918 from the same cause. These figures are contained in a bulletin entitled "Hazards of Domestic Electric Devices," of which the association is seeking to obtain broadcast distribution.

The bulletin goes on to say that "one of the chief causes of the rapid increase in the number of dwelling fires is the multiplication of domestic devices, and especially of irons."

The National Board of Fire Underwriters, which has been tabulating the causes of fire, investigated the electrical fires during a typical week recently, the bulletin states, and found that of 540 fires 252 were caused by flatirons and 82 by defective cords, while 206 came from miscellaneous causes. Of the miscellaneous fires seventy-six were in attics and basements, showing, according to the report, the effects of tampering with the wires in efforts to make extensions.

Dr. Mailloux Honorary Member French Society of Electricians

ANNOUNCEMENT has been received in this country of the unanimous election of Dr. C. O. Mailloux, past-president of the American Institute of Electrical Engineers, to the Société Française des Electriciens. Dr. Mailloux was proposed for this honor by Prof. André Blondel and other prominent French electrical men soon after his election last October to the presidency of the International Electrotechnical Commission.

The official *Journal* of the society for December, 1919, the publication of which was delayed several months by the printers' strike and which has only recently arrived here, contains the official announcement of the election. The general secretary of the society, in moving the resolution, at the request of the president, recalled "the valued services of all kinds rendered to the cause of France by Dr. Mailloux, who, by reason of his election to the presidency of the International Electrotechnical Commission, was entitled to a place among the honorary members of the Société Française des Electriciens."

Obligations of Creditor Nation Discussed by Foreign Trade Convention

THE SEVENTH national foreign trade convention, held in the Civic Auditorium, San Francisco, May 12 to 15, was the most successful in the history of the body. Twenty-five hundred delegates were in attendance. The general theme of the convention was "The Effect of Being a Creditor Nation." The final report of the general committee urges that as a creditor nation the United States should afford other nations every fair and reasonable opportunity to sell their products to us, especially raw materials. The full employment of manufacturing facilities was urged so that production may be increased to the maximum in order to restore normal conditions in the United States of employment and also of living.

The final declaration of the convention favors supplemental legislation to the Webb-Penrose act, reversion of the Merchant Marine to private ownership as soon as practicable, allocation of more passenger vessels to South American and transpacific trade, building of ships for export, establishment of foreign trade zones at ports of entry, extension of international parcel post facilities, federal incorporation of American firms in China, additional cable facilities and the extension of radio service.

The meeting was called to order by James A. Farrell, president United States Steel Corporation and chairman of the National Foreign Trade Council. The chairman of the meeting was Alba B. Johnson, former president Baldwin Locomotive Works, and O. K. Davis was secretary. Fifteen group sessions considered various phases of world trade. Representatives of forty foreign countries were present as guests of delegates. A luncheon of the American Manufacturers' Export Association was held in the Palace Hotel, May 13, in connection with the convention. The banquet in the Civic Auditorium, May 14, was one of the largest ever held in San Francisco.

In a group session on "Foreign Trade and the Press," a paper by James H. McGraw, president of the McGraw-Hill Company, on the service of the business press was read. A trade adviser service with a staff of 200 gave individual conferences to delegates. Among the advisers were E. Wilholmi Drooston, of the Robbins & Myers Company, and M. A. Oudin, vice-president of the International General Electric Company, who gave advice on the exportation of electrical goods. W. W. Nichols, of the Allis-Chalmers Company, spoke on the reorganization of the government service of trade promotion and information.

At the conclusion of the convention on Saturday many delegates remained on the Pacific Coast to visit the scenic regions and also to investigate the industrial resources of the West.

Detroit Edison Company Makes Big Cut in Expansion Program

FROM a program involving the expenditure of $12,000,000 on new plants, substations and other improvements the Detroit Edison Company has struck items totaling $4,000,000 or $5,000,000. This big reduction in its budget is attributable, according to an announcement made a few days ago by Alex Dow, president of the company, to the difficulty of financing such projects, inability to get the material needed and the unrest in the building trades.

Mr. Dow explained, however, that all improvements needed to keep pace with service demands are being pushed to completion.

"The curtailment of our plans for immediate expansion was just a matter of abandoning an effort to get a year or two ahead of the game—to prepare for demands that probably will not be made until late in 1921 or 1922," said the president of the company.

"We are going ahead with work on the plant at Marysville, but are now using only a day shift on the job. All preliminary work on the Trenton Channel plant, such as laying of railroad tracks and installing a drainage system, has been finished. At this point we have suspended operations until such time as conditions are more favorable or until the need for the plant is more imperative.

"Every improvement we have promised power consumers is to be provided; some that we had planned, but had not heralded widely, will be delayed. Of three large turbines needed, one already has been installed and is in operation at Delray; the second is now being placed at Conner's Creek; the manufacturers have notified us that they will be from two to three months late in delivering the third, but we expect to have this in operation for the winter.

"Work that we have suspended, in addition to the Trenton Channel project, includes office and warehouse improvements amounting to about $200,000, a substation at Mount Clemens, a new coal-elevating system at Delray, and innumerable small 'jobs.'"

Missouri Association of Public Utilities to Meet at State Capital

JEFFERSON CITY, Mo., has been selected as the meeting place of the Missouri Association of Public Utilities on June 3, 4 and 5. H. M. Aylesworth, executive manager of the National Electric Light Association, is to discuss "Public Relations." Other papers of interest to electrical men will be one on "Merchandising of Electrical Appliances," by C. E. Michel of the Union Electric Light & Power Company, St. Louis; one on "Water-Power Development in Missouri," by P. G. Sergeant, Joplin, Mo., and one on "How to Build Up the Revenue of Small Electric Plants by Manufacture of Raw-Water Ice." Chairman Busby of the Missouri Public Service Commission will address the convention. An attractive program for the entertainment of the delegates has been arranged.

War-Time Central Station Rates Ordered Revised at Orange, Mass.

RATE-MAKING as affected by war conditions and by recent industrial developments is discussed in a decision of the Massachusetts Department of Public Utilities upon a complaint of the Selectmen of Orange against the price of electricity on the system of the Athol Gas & Electric Company. On Jan. 1, 1918, an increase of 2 cents per kilowatt-hour was made in all lighting rates and from 1 cent to 7 mills on all power rates on the regular schedules. This brought the maximum lighting rate to 16 cents net per kilowatt-hour. A coal clause was added which yielded about 6.5 mills per kilowatt-hour in 1919, and on Oct. 1, 1918, a surcharge of 20 per cent was imposed on all power rates with the exception of those charged the Northern Massachusetts Street Railway. The complainants held that $40,000 might well have been returned to customers in the form of decreased rates, in view of the increase in net operating income from $74,868 in 1918 to $103,082 in 1919.

The commission found that the desired reduction and readjustment of income would actually require about $70,000, leaving a balance of net earnings inadequate to make any proper provision for depreciation. The commission declared that a fear that depreciation allowance will be dissipated in dividends is not a ground for denying a utility earnings reasonably adequate for its needs.

The increases in rates in 1918, the board states, were made when large increases in the amount and cost of coal used and in wages and taxes had to be met under circumstances making accurate predictions of their effect difficult. It is apparent in the case of this company that the resulting increase in income has exceeded the increase in expense. More than 80 per cent of the customers of the Athol company pay the maximum rate of 16 cents per kilowatt-hour. It may be conceded, the commission remarks, that some of these customers are unprofitable, but the commission is not convinced that the lighting business as a whole is done at a loss. The commission is therefore of the opinion that the company should restore its 15-cent maximum rate for electricity for any use, and that if because of longer use by business places the company deems it proper to offer lower rates for lighting, this should be done by secondary rates for the amounts consumed in excess of the present 25 kw.-hr. per month to which the maximum rate now applies.

The commission states that the objections to the existing power rates doubtless were caused by special power contracts at rates not included in the published schedules, and also by the company's failure to make any increase in the street railway rate for electrical supply when the increases were made to all other power customers. Criticism was also directed to the high rates in the earlier steps of the schedule, which ranged from 11 to 7 cents per kilowatt-hour down to 750 kw.-hr., and finally ran to a minimum of 2.4 cents net for over 40,000 kw.-hr.

Indeed a careful examination of the special contracts with very large industrial concerns makes these objections less convincing to the commission. There was insufficient evidence to show that any business was being taken at rates tending to throw a burden on other consumers; on the contrary, it appeared that if this business had not been secured, the company would have had to make greater increases in its rates than was the case and would have less future ability to make reductions either in its maximum or in its other rates.

In conclusion, the commission emphasizes the importance of the company's standardizing its special contract rates into a regular published schedule, points out the need for taking into account power factor of large customers and recommends the reduction of the surcharge and the assumption by the street railway of such surcharge as may be retained.

Private Diversion of New York Boundary Waters Opposed by Governor

THE bill permitting diversion for private development of waters of Lake Erie, the Niagara River and other state boundary waters was vetoed by Governor Smith of New York on Tuesday. The Governor said that while favoring state water-power development he was opposed to development by individuals or corporations. Furthermore, he stated that he was opposed to the extension to private interests of any greater rights in the development of the state's water-power than they now possess by law.

"I am credibly informed," the Governor said, "that there are in existence some corporations practically defunct, but which have never been legally terminated, which were incorporated for the purpose of taking water from these boundary waters for purposes far remote from that of developing hydraulic or hydro-electric power. This act, if it became law, would, in my opinion, so vitalize such practically defunct corporations as to permit them to exercise the right to take water for hydraulic or hydro-electric power purposes where they now have only the right to take it for entirely different purposes.

"There is throughout the state a widespread public demand for the enactment of laws which will give to the people themselves the benefits that come from the great natural resources owned by them. Not only would they be dissatisfied with anything short of the adoption of that policy, but I am reasonably certain that they would severely condemn any attempt to make possible further private development, on the ground that private development benefits only the individuals who are fortunate enough to secure the grants or franchises."

Flat Rate for Ontario Hydro-Electric Energy Finds Advocates

DISSATISFACTION with the rates charged for electrical energy by the Hydro-Electric Power Commission of Ontario has been rife of late, and this dissatisfaction culminated recently in a resolution passed by the Legislature of the province, on motion of John G. Lethbridge, a member of the farmers' organization that now controls the government. This resolution reads:

That in view of the evident necessity for more equitable distribution of hydro-electric power throughout the province, and further, in view of the fact that the prices at present paid for power discriminate against those living at a distance from the source of power and tend to centralize action in large centers, especially those near the source of supply, this House is of the opinion that the government should at this session appoint a committee of five members of the house to go into the whole question with the Hydro-Electric committee during the recess and endeavor to devise some more equitable system of distribution for the province and a more uniform price throughout the different portions thereof, and report to the government as soon as convenient.

Mr. Lethbridge disclaimed the advocacy of a flat rate, but that was the general interpretation put upon the resolution, and in consenting to the appointment of the committee the Premier asserted that the government did not necessarily indorse such a rate. To impose one, he said, would involve a very big undertaking—the entire reorganization of the Hydro-Electric system, which he could not conceive to be possible. The government's attitude, he said, was one of entire friendliness to the development of the water powers for the use of the people, but it might be necessary to proceed cautiously because of the financial and other conditions that prevail. The Premier also pointed out the difficulties presented by the dual municipal and provincial control, saying that the province might ultimately assume responsibility for the whole project.

Investment Bankers Suggest Steps to Restore Utility Credit

INDETERMINATE franchises to supersede term franchises, state commission instead of local regulation and the appointment rather than election of state commissions are held by the board of governors of the Investment Bankers' Association to be steps in the restoration of the credit of public utilities. In this connection the following resolution was passed by the board at its meeting on May 8:

Whereas investment bankers are expected to purchase and distribute the securities of public utility companies, which must be sold if utilities are adequately to supply the demands upon them for local transportation, light, heat, power and the transmission of messages; and

Whereas the credit of many of the public utility companies will not permit the sale and distribution of such securities, thus interfering with the development of many commercial enterprises, the welfare of many communities and the comfort and convenience of a great many people; and

Whereas the credit of the public utilities is largely dependent upon the attitude of the public as expressed through the various governing and regulatory bodies;

It is hereby resolved by the board of governors of the Investment Bankers' Association of America that as steps in the restoration of the credit of the public utilities:

(1) Term franchises should be superseded by indeterminate permits securing the right to operate under proper regulation during good behavior, with provisions for equitable adjustment of rates from time to time, as tending to eliminate controversies which inevitably impair the public service, the credit of the companies involved and the value of their securities.

(2) The power of regulation and control of public utilities should be vested in state commissions as tending toward standardization of regulation, which is not possible under local regulation.

(3) Members of state commissions should be appointed. If commissioners are elected, they are frequently embarrassed by political policies and platforms in the consideration of questions which should be decided only on sound economic and financial principles.

A. A. E. Condemns Unionism in Engineering Profession

UNIONISM in the engineering profession was strongly condemned by the American Association of Engineers at its sixth annual convention at St. Louis, May 10 and 11, in a resolution indorsing a statement issued by the board of directors of the association and reading in part as follows: "We believe in organized representation for the correction of wrong, the advancement of the engineering profession and service to the public, but are opposed to methods inconsistent with the dignity of the profession and which would lessen public confidence in engineers. The American Association of Engineers, recognizing the many fundamental differences between the principles and objectives of the trade union and an organization of professional men, expresses the opinion that an engineer cannot subscribe to the tenets of both."

The resolution recommended the expulsion from the association of engineers who advocate strikes or similar methods of securing their ends.

Consumers and Employees Main Sources of Capital, Says W. S. Barstow

IN THE financing of public utilities, which is especially difficult at the present time because of the impossibility of successfully bidding for capital against non-regulated enterprises, W. S. Barstow, president of the General Gas & Electric Company, said to a representative of the ELECTRICAL WORLD that the main avenue open today is through the sale of securities to employees and consumers.

"This is particularly desirable," said Mr. Barstow, "as a means of bringing together the interest of the public and the company. The bankers at the present time will not undertake public utility financing except where it is necessary to protect their continuing interest in the enterprise.

"When the leading railroads of the country are obliged to bid 7.5 per cent and the leading industrial companies over 8 per cent for money, the public utility, owing to the uncertainty of commission decisions on rates, is obliged to do a 'hand-to-mouth' and expensive financing in any way it can. It is a fact that many public utility commissions do not yet realize that the relation between earnings and cash saved therefrom (which latter determines the rate of return on investment) is dependent wholly on the ability to finance the demand for increased working capital of a growing business and for necessary additions to property to take care of the growth of the community.

"The ready ability of a public service company to finance at all times is the only means of having its earnings represented in cash. A company which can preserve one-half of its earnings applicable to dividends in cash to pay return on its investment is doing well. It is not the amount of earnings that determines the return on capital, but the cash preserved therefrom, and the commissions in confusing earnings with return on investment have gone far in upsetting the confidence of the financial world in public utility securities."

Organizing Conference of Technical Societies to Be Largely Attended

DELEGATES, representing a membership of more than 90,000 engineers, will attend the Organizing Conference of technical societies to be held in Washington, D. C., June 3 and 4, according to a statement given out May 15 by the joint conference committee, which has just announced a tentative program for the meeting. Thirty-one societies, on May 15, had advised the committee that delegates had been named or would be appointed forthwith. Among them are the following:

American Society of Civil Engineers.
American Institute of Mining and Metallurgical Engineers.
American Society of Mechanical Engineers.
American Institute of Electrical Engineers.
American Society for Testing Materials.
American Electric Railway Engineering Association.
American Association of Petroleum Geologists.
American Ceramic Society.
American Society of Safety Engineers.
American Association of Engineers.
Cleveland Engineering Society.
Engineers' Club of Philadelphia.
Florida Engineering Society.
Illinois Society of Engineers.
Kansas Engineering Society.
Mohawk Valley Engineers' Club.
Portland (Ore.) Technical Council.
Trenton Engineers' Club.
Vermont Society of Engineers.
Washington Society of Engineers.

Richard L. Humphrey, chairman of the joint conference committee, will call the conference to order at 10 a.m., June 3, in the New Willard Hotel. Following the election of a temporary chairman and the appointment of committees there will be fifteen-minute addresses on the general subject of the engineer in public affairs by Arthur P. Davis, president A. S. C. E.; Philip N. Moore, past-president A. I. M. E.; William F. Durand, chairman, San Francisco section, A. S. M. E., and Le Roy K. Sherman, president A. A. E.

At a round-table luncheon, June 3, James H. McGraw, president McGraw-Hill Company, Inc., will speak on "The Value of Publicity for Engineers." The afternoon session will be devoted to committee reports and ten-minute discussion on licensing of engineers by T. L. Condron, F. H. Snow and D. W. Brunton. Homer L. Ferguson, past-president Chamber of Commerce, will talk on "Co-operation of the Business Man and the Engineer in Public Affairs."

A business session will occupy the morning of June 4. Prof. F. H. Newell will be the speaker at luncheon, while in the afternoon, at the Cosmos Club, the general subject will be co-operation of engineers in local affairs. A number of addresses are on the program for the evening session. The speakers include Robert S. Woodward, president Carnegie Institute; George Otis Smith, director, U. S. Geological Survey, and James R. Angell, chairman National Research Council.

Tentative Program for White Sulphur Springs Convention of A. I. E. E.

THE opening session of the White Sulphur Springs (W. Va.) convention of the American Institute of Electrical Engineers will be held on Tuesday, June 29, at the Greenbrier Hotel, when Calvert Townley will deliver the president's address and the technical committees will report. The tentative program for the remaining days has been drawn up as follows, this program superseding the preliminary draft printed in the ELECTRICAL WORLD for April 25:

WEDNESDAY, JUNE 30

Electrical Machinery Session.—"Classification of Large Steam Turbo-Generator Failures," by Philip Torchio; "Ventilation and Temperature Problems in Large Turbo-Generators," by B. G. Lamme; "Temperatures in Large Alternating-Current Generators," by W. G. Foster; "Some Practical Experience with Embedded Temperature Detectors in Large Generators," by C. J. Fechheimer and F. D. Newbury; "Eddy Current Losses in Armature Conductors," by R. E. Gilman.

Miscellaneous Session.—"The Corona Voltmeter and the Electric Strength of Air," by J. B. Whitehead and T. Isshiki; "Reactive Power and Magnetic Energy," by Joseph Slepian; "Theory of Speed and Power-Factor Control of Large Induction Motors by Neutralized Polyphase Alternating-Current Commutator Machines," by John I. Hull; "High-Tension Insulator Porcelain," by W. D. A. Peaslee.

THURSDAY, JULY 1

Protective Devices Session.—"The Use of Reactors on Large Central-Station Systems," by R. F. Schuchardt; "Stability of High-Power Generating Stations," by C. P. Steinmetz; "Voltage Stresses in Reactors in Service," by F. H. Kiersted and Royal Meeker; "Calculation of Magnetic Force on Disconnecting Switches," by H. B. Dwight; "Stresses in Conductor Carrying Heavy Currents," by I. W. Gross.

Electric Welding Session.—"Design of Constant-Current Generators for Arc Welding," by K. L. Hansen; "Automatic Arc-Welding Apparatus," by S. R. Bergman and H. L. Unland; "Arc-Welding Machines of the Wilson Welder & Metals Company," by Alexander Churchward; "Characteristics and Performances of Arc-Welding Machinery," by A. M. Candy; "Arc-Welding Machinery of the United States Light & Heat Corporation," by W. H. Turbayne; "Recent Developments in Electro-Percussive Welding," by D. F. Miner.

Power-Factor Session.—Report of joint committee on polyphase power factor, by F. C. Holtz; "Power-Factor Improvement Dependent Upon Adequate Metering," by Will Brown; "Power Factor in Polyphase Systems," by F. B. Silsbee; "Power Factor and Unbalance on a Polyphase System," by C. J. Fechheimer; "Polyphase Power Factor," by H. L. Wallau; "Polyphase Power Factor," by P. M. Lincoln; "Polyphase Power Representation by Means of Symmetrical Co-ordinates," by C. L. Fortescue; "Measurement of Power Factor on Unbalanced Polyphase Circuits," by R. D. Evans; "Polyphase Power Factors and Unbalanced Loads," by Philip Torchio; "Power Factor in Polyphase Circuits," by W. H. Pratt.

FRIDAY, JULY 2

Excitation Session.—"Considerations Which Determine the Selection and General Design of an Exciter System," by J. T. Barron and A. E. Bauhan; "Factors in Excitation Systems of Large Central-Station Steam Plants," by A. A. Meyer and J. W. Parker; "Exciters and Systems of Excitation," by H. R. Summerhayes; "The Application of Direct-Current Generators to Exciter Service," by C. A. Boddie and F. L. Moon; "Exciter Practice in the Northwest," by J. D. Ross; "Generator Excitation Practice in the Hydro-Electric Plants of the Southern California Edison Company," by H. H. Cox and H. Michener.

Engineering Foundation Seeks to Build Up Endowment

BASING his appeal on the generous gifts of Ambrose Swasey to the Engineering Foundation, amounting to $300,000, Chairman Charles F. Rand is actively seeking additions to the endowment fund which will swell the total to at least $1,000,000 in the near future. The Foundation does not plan to build laboratories and conduct research work directly, but rather to stimulate, co-ordinate and support research work in existing scientific and industrial laboratories, co-operating in so far as it may prove advantageous with the National Research Council.

Government Control for New Brunswick's Water Powers

PENDING legislation for hydro-electric development in the Canadian province of New Brunswick provides for three power districts, to be supplied from three central sources, with a combined capacity of 16,039 hp. on a ten-hour service or 6,683 hp. on continuous service. The New Brunswick Water Powers Commission is to be called into being with three members appointed by the government and removable at its pleasure. One of these members is to be a member of the government, which will have entire control, passing upon all the recommendations of the commission regarding the purchase and development of water-power rights.

Material-Handling Manufacturers Appoint Committees

TWELVE committees of the Material-Handling Machinery Manufacturers' Association were appointed at a special meeting of the board of governors held on May 3 in New York. With F. W. Hall, commercial manager Sprague Electric Works, as chairman, the main engineering committee will be composed of the chairman and one additional member of each of the six sub-committees which are to be representative of the six divisions of the material-handling industry, as follows: (1) Cranes, hoists and winches, (2) gravity and power conveyors, (3) elevators, (4) industrial trucks, (5) bulk-handling machinery, (6) miscellaneous equipment. As far as practicable, each of the sub-committees is to be one unit of the total membership in each division of the industry so that there will be one representative from each member company on some one of the sub-committees.

The remaining eleven committees appointed and the chairman of each are as follows: Membership, E. Logan Hill, Heyl & Patterson, Inc.; finance, Lucian C. Brown, Elwell-Parker Electric Company; meetings, Charles A. Rohr, General Electric Company; co-operation with technical societies, James A. Shepard, Shepard Electric Crane & Hoist Company; co-operation with trade associations and industries, J. H. Flynn, Blaw-Knox Company, Pittsburgh, Pa.; co-operation with marine terminal commissions, C. A. Luster, Clyde Iron Works; co-operation with railroads and railroad commissions, Francis L. Stuart, International Conveyor Company; co-operation with civic associations and governmental bodies, F. S. Chavannes, Chesapeake Iron Works; special crane committee, W. B. Clarke, Manning, Maxwell & Moore, Inc.; standardized containers, Calvin Tomkins; publicity (advertising council), A. J. Barnes, Shepard Electric Crane & Hoist Company.

Large Merger of Pennsylvania Power Companies Planned

STEPS are now under way for the merger into a new corporation, to be called the Pennsylvania Power & Light Company, of the Lehigh Valley Light & Power Company, the Harwood Electric Company, the Schuylkill Gas & Electric Company, the Northumberland County Gas & Electric Company, the Northern Central Gas Company, and the Columbia & Montour Electric Company, all subsidiaries of the Lehigh Power Securities Corporation, as well as the Pennsylvania Lighting Company, now controlled by the Securities Corporation General of Philadelphia.

Consolidation of the above companies will bring about an interconnected transmission system more than 125 miles (200 km.) in length. At the present time most of these concerns are under one control but are operating under separate charters. The new plan will merge them into the new corporation under one title with a common capitalization.

Wisconsin Public Utility Law Questioned

THROUGH its Wisconsin operating subsidiaries the American Public Utilities Company, Grand Rapids, Mich., is seeking to overthrow the scheme of public utility regulation in effect in Wisconsin, according to a statement issued by the Railroad Commission of that state, on May 8. The commission's statement sets forth that the Wisconsin-Minnesota Light & Power Company has filed complaint in the federal court asking that the commission and the Attorney-General be restrained from carrying into effect the orders of the commission establishing rates to be charged by the company in the various municipalities served by it in the state. These rate increases affect both gas and electric properties.

Joseph H. Brewer, president of the company, stated to a representative of ELECTRICAL WORLD that it is not the intention of the company to overthrow any fundamental part of the scheme of rate regulation by state commissions. On the contrary, he stated, the company in its bill of complaint in the United States district court at Madison expressly offers to provide for a refund to its customers of any amount which it may collect in excess of a reasonable rate when a reasonable rate shall have been fixed by the commission and its validity established.

The real complaint of the Wisconsin-Minnesota Light & Power Company, it was pointed out, is that by reason of certain provisions of the Wisconsin public utilities act the company is unable to obtain any substantial relief and has been compelled to continue doing business at a loss for nearly two years while the commission is proceeding with great deliberation to determine what are reasonable rates. Up to the day of the filing of the bill of complaint in the federal court on May 7 the company had been unable to obtain any relief on electric service and only a single increase in gas rates—at Chippewa Falls, where increased rates were granted by the commission May 1.

Under the provisions of the Wisconsin public utility law it is an offense punishable by a fine of not less than $100 or more than $1,000 for any public utility to collect or attempt to collect a rate different from that shown in its published tariffs. The suit which has been commenced by the Wisconsin-Minnesota Light & Power Company is based upon the contention that these provisions of the Wisconsin statute operate to deprive the utility of its property without due process of law in violation of the provisions of the Constitution of the United States.

The company does not ask or expect to obtain, according to Mr. Brewer, a decree denying the right of the commission to regulate rates. All that it asks, Mr. Brewer said, is that the provisions of the Wisconsin statutes requiring the utility to accept present rates until the Railroad Commission of Wisconsin can determine what are reasonable rates shall be set aside and that the utility shall be permitted to put into effect such rates as it considers reasonable under present conditions subject to the condition that it will refund any overcharges if the reasonable rates as finally established by the Railroad Commission of Wisconsin shall be lower than the rates the utility puts into effect.

Efficiency Engineers Told Relation of Lighting to Output

HOW manufacturers are losing production because of improper factory lighting was demonstrated by Ward Harrison of the National Lamp Works before the meeting of the Taylor Society held in Rochester, May 6, 7 and 8, under the auspices of the Industrial Management Council and the Manufacturers' Council of the Chamber of Commerce. In a paper on "The Necessity for Standards of the Relation Between Illumination and Output," he pointed out that tests in factories had shown that many manufacturers are saving one dollar in improved lighting and wasting ten dollars in production. Increased production amounting to from 10 to 20 per cent has followed lighting betterments. He said that night shifts were inefficient partly because of poor lighting. In plants averaging 100 sq. ft. of floor space per employee the cost of good artificial lighting per foot-candle supplied is usually not more than 0.1 per cent of employee's pay during the period. In discussing this paper, W. H. Leffingwell, of the Leffingwell-Ream Company, showed charts which plot lighting intensities on every square foot of an office or factory by different colors.

Market Price of Utility Securities Not Equal to Original Cost

"I DO NOT believe there is a utility in the United States the present market price of whose securities is equal to the original cost of the properties," said Harold L. Stuart, of Halsey, Stuart & Company, investment bankers, at the recent utility credit hearing conducted by the Illinois Public Utilities Commission. Some of those present at the hearing took issue with this statement, but were unable to produce evidence in rebuttal.

Continuing, Mr. Stuart said:

"The investment public does not seek utility securities, and those that are sold are only disposed of with difficulty. The commissions can control the investors whose money has been put in the property, but they cannot make new investors loan money to the properties unless the conditions are made more attractive. The great financial weakness of public utilities is that they have not been allowed to earn a sufficient net return to permit them to issue junior securities, and when companies have needed financial relief it has come so slowly that investments have been jeopardized."

In reply to a question by the commission, Mr. Stuart said that the utilities should be guaranteed a minimum rate of return for all time equal to the value of the money at the time it is invested plus a sufficiently large margin above all charges and expenses to make the payment of interest reasonably secure to the investor.

Brockton Utility Shares Prosperity with Customers by Reducing Rates

NINE cents net per kilowatt-hour is now charged by the Edison Electric Illuminating Company of Brockton, Mass., a reduction of 1 cent having become effective May 1, with a similar reduction in the secondary charges of the commercial lighting schedules. Theater service is also supplied at 1 cent per kilowatt-hour less. This reduction brings the rates back to the 1918 basis, and, according to a statement to the ELECTRICAL WORLD by the management expresses the company's desire to share its increasing prosperity with the community. About 100 old houses are being wired every month, and the company's power business has been intensively cultivated in relation to the shoe-manufacturing industry, which is the chief business of the Brockton district. At the East Bridgewater station two additional 600-hp. boilers with automatic stokers and automatic weighing equipment are being installed to provide more steam-generating capacity against next winter's load. A. F. Nelson is resident manager of the company, Stone & Webster, Boston, being general managers.

A 5,000-Ft. Span

THERE is shown here the 5,010-ft. transmission-line span across the Little Tennessee River installed by the Knoxville Power Company near the Tennessee-North Carolina state line. One of the towers supporting this span is about 1,100 ft. above the river. The normal sag is 216 ft. from the lower support. There are four conductors, each containing 500,000 circ.mils of aluminum around the steel core. The outside diameter of the cable is 1.175 in. The diameter of the steel core is ⅜ in. It consists of twenty-two aluminum strands of 0.150 in. each around thirty-seven steel strands of 0.125 in. each. This river crossing is part of a 24-mile single-circuit, three-phase, 150,000-volt line from Maryville.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Osaka Plans to Get Electricity from Garbage.—The city of Osaka, Japan, is planning to generate electricity at its garbage-incinerating plant, where a million pounds of refuse a day is consumed.

Municipal Plant for Tokyo.—The Municipal Assembly of Tokyo, Japan, is considering the establishment of a hydro-electric plant to generate about 10,000 kw. from the Tamagawa River. The plant would furnish power for lighting and electric railway service.

The Ill Health of Electric Light.—It is rather astonishing to learn that the housing and town planning committee of Dunfermline, the Scottish town where Andrew Carnegie first saw the light, has reported against electric lighting and that its finding has been adopted by the Town Council, one of the councilors gravely asserting that "the best sanitary authorities today said that gas lighting was much more healthy (*sic*) than electric light"!

Scheme to Transmit Energy from England to France.—A French engineer has proposed to the government authorities intrusted with industrial reconstruction that instead of importing coal from England France shall import electricity by submarine cable. It is pointed out that this would involve no new principle, since 50,000 kw. has been supplied by Sweden to Denmark in this way for several years at a transmission voltage of 25,000.

Round - the - World Wireless. — The Marconi Wireless Company is considering the construction of a wireless system from London to the Antipodes, with stations in Egypt, India, East Africa, South Africa, West Africa, Singapore and Australia, and also in Vancouver and Montreal. In return for a monopoly of service the Marconi company offers to construct, maintain and operate the system and to pay 25 per cent of the net profits of each station to the government concerned.

Railroad Electrification in England.—The Transport Ministry of the British government, of which Sir Eric Geddes, brother of the British Ambassador to the United States, is the head, has appointed a committee to consider the whole question of railroad electrification. This committee, said to be unusually representative in character, is to report on the following points: (1) Whether any regulation should be made for the purpose of insuring that the future electrification of railways in Great Britain is carried out to the best advantage, in regard to interchange of electric locomotives and rolling stock, uniformity of equipment, and (or) other matters. (2) If any such regulations are desirable, what matters should be dealt with and what regulations should be made. (3) How far it is desirable, if at all, that railways or sections of railways already electrified should be altered so that they may form parts of a unified system.

Copenhagen's New Central Station.—Copenhagen, the capital of Denmark, has recently put into service its new municipal electric generating station, named after the Danish scientist Hans Christian Oersted, from whose "Experiments on the Effect of a Current of Electricity on the Magnetic Needle," published just a hundred years ago, modern electrical development dates. The station is to have three steam units with a total capacity of 25,000 kw., of which one is at work, a second ready for installation and the third to be added in 1921. Provision for a greatly increased output in the future has also been made. Either coal or oil fuel can be used.

Jackson (Miss.) Company Defaults on Bonds.—The Jackson (Miss.) Light & Traction Company has defaulted in the payment of the interest on its first mortgage sinking-fund 5 per cent gold bonds. The company is going through a friendly receivership, has been reorganized and is now said to be earning twice the interest on its funded debt. A representative of the bondholders said that a new issue of bonds for $930,000 will be made within about a month's time to replace the original bonds issued. The new bonds will bear interest at the rate of 5 per cent for the first five years and 6 per cent for the succeeding twelve and one-half years. The April 1 coupons on the bonds will be payable in cash immediately upon issue. The property will continue to be operated by Kelsey, Brewer & Company as in the past.

Edison Makes a Speech.—The taciturnity of Thomas A. Edison on public occasions is well known, but a week or so ago he broke his rule by addressing 300 employees of the West Orange (N. J.) Edison plant who held a meeting under the auspices of the Herbert Hoover Club of the Oranges. Mr. Edison's speech is reported as follows by the New York *Times:* "I am for Hoover for President. Engineers are good propositions for the Presidency. I recall an engineer in American history who made good. That was George Washington. Today it is a question of economics and no longer a military problem. If it was the solving of war problems, I would vote for Wood. Hoover's record is strength and you all know what he has accomplished. There are many promises made by Presidential candidates that are soon forgotten when they reach the White House. Hoover will carry through his program without interference or there will be trouble. Every woman that I have spoken to believes he is the right man for President."

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., Boston Section.—At the May 3 meeting of this section, which was addressed by Major George F. Sever, the following officers were elected: Chairman, W. I. Middleton; vice-chairman, L. W. Abbott; secretary-treasurer, Ira Cushing; committee members, holding office for two years, Peter Junkersfeld, C. De Witt Jarvis and Arthur E. Pope.

American Society of Heating and Ventilating Engineers.—The semi-annual meeting of this society will be held at the Hotel Statler, St. Louis, next week on Wednesday, Thursday and Friday, May 26, 27 and 28. Among the papers to be presented is one on "Industrial Electric Heating" by Wirt S. Scott. Joint sessions will be held with the American Society of Refrigerating Engineers and the American Society of Mechanical Engineers.

Association of Iron and Steel Electrical Engineers.—The trip to inspect the works of the Trumbull Steel Company, Warren, Ohio, in which the Pittsburgh and Cleveland sections of the A. I. and S. E. E. were to join, has been postponed till some time in June on account of a shortage of coal at the Trumbull plant. Today, May 22, the Pittsburgh Section will meet at the Hotel Chatham, when a paper on "Lubrication of Electrical Equipment as Used in the Iron and Steel Industry," by T. O. Organ, consulting engineer of the Keystone Lubricating Company, Philadelphia, will be read. The Chicago Section will meet at the Great Northern Hotel on Friday, May 28. Robert Treat will present a paper on "The Grounded Neutral," and the election of officers will take place.

Montana Contractor-Dealers Form Association.—The electrical contractors and dealers of Montana met in Butte on April 25 and 26 to form an association and affiliate themselves with the National Association of Electrical Contractors and Dealers. The meeting was attended by thirty contractor-dealers from from all over the state, and after adopting a constitution and bylaws the following officers were elected: President, J. C. Curran of Helena; secretary-treasurer, E. Downing of Butte; board of directors, Joseph Olsen of Great Falls, Carl Miller of Kalispell, O. C. Langstadt of Butte and A. A. Nicholas of Billings. After the business session the electrical jobbers of Butte gave the members of the newly formed association a dinner. The next meeting of the association will be held in Great Falls in October, the day to be announced later.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Damming of Water That Injures Low-Lying Lands May Be Enjoined.—No person has the right to gather surface waters that would naturally flow in one direction by ditches or dams, divert them from their natural course and cast them on lower land to its injury, the Supreme Court of Florida holds, and where irreparable injury by such unlawful overflowing of lands is established an injunction may issue to prevent the injury. (83 S. 912.)

Procedure to Set Aside Decision of Commission. — Action having been taken by the Willapa (Wash.) Power Company against the Public Service Commission of Washington and the Willapa Electric Company to set aside an order alleged to favor the defendant company as against the complainant, the Supreme Court of the state has declared that a commission decision may not be questioned by an action to set aside but only by writ of review. (188 P. 464.)

Valuation in Abnormal Time Not Fair Basis for Rates.—The fair present value of the property of a public utility is the basis upon which a fair return should be paid, declared the New York Supreme Court in a gas-company rate case, and in arriving at this value the original cost of construction and the estimated reproduction cost must be taken into consideration, but a valuation based on cost of reproduction under abnormal conditions caused by war is not permissible. (180 N.Y.S. 570.)

State Boundaries as Affecting Workmen's Compensation Act.—That there may be liability under the workmen's compensation act if the employer and employee are both residents of the state, although the accident occur on the high seas, is the decision of the New York Supreme Court, and the act applies where the contract of employment is made in the state although it be performed without the state; but where the injured party is not a resident of the state and was not hired within the state and rendered no services within the state the act does not apply. (180 N.Y.S. 560.)

Responsibility for Injury from Electric Shock to Lineman Untangling Wires.—In a suit brought by a telephone lineman to recover damages for injury from improperly insulated electric wires owned by a city, the Kentucky Court of Appeals held that the question of lineman's contributory negligence was one for the jury, but that he had the right, while repairing and untangling telephone wires in proximity to the city's electric light wires, to assume that the city had exercised the highest practicable degree of care to have its wires properly insulated. The lineman was not charged with the duty of inspecting them. (219 S.W. 787.)

Powers of Oklahoma Industrial Commission.—The decision of the Industrial Commission of Oklahoma on matters of fact is final, the Supreme Court of that state has declared, and only questions of law are subject to judicial review. (188 P. 666.)

Oklahoma Corporation Commission.—That the Corporation Commission of Oklahoma has been vested with authority to make all valid and lawful orders prescribing rates which the state in the exercise of its sovereign capacity could make is the finding of the Supreme Court of that state. Unless the rate established by the commission is clearly oppressive or confiscatory, no question for judicial determination is presented. A gas company had protested against an order for a greater discount on its bills for prompt payment than had been in vogue. (188 P. 338.)

Improper Charges to Operating Expenses. — The New York Supreme Court, in Kings County [Gas] Lighting Company vs. Attorney-General, has enumerated the following expenditures as improper charges to operating expenses: (1) Legal costs incurred in suit to defeat rate law; (2) increased taxes on increased revenues from a rate higher than that prescribed by law; (3) a sum paid as a gratuity to a former officer without prior agreement; (4) increased cost of water-gas oil due to a three-year contract when contract could have been made from year to year; (5) a recording mortgage tax; (6) legal fees, money paid to a "general auditor" and items for "promotion management," in the absence of explanation as to their necessity; (7) commissions to a real estate agent for leasing lands. (180 N.Y.S. 570.)

Responsibility of Municipality for Death from Defectively Insulated Post.—The Court of Appeals of Georgia has affirmed a verdict against the city of Sandersville, which operates a municipal plant, in a case where a boy riding a bicycle came into collision with a "white way" post and died from electric shock, because of escaping current. Witnesses testified that the defective condition of the pole had been brought to the attention of the city authorities without action on their part following, and that there was a failure to respond promptly to a telephoned appeal to turn off the current after the accident occurred. The company contended that the boy had thrown a hoop over the pole and was killed in attempting to recover it, but the court held that a clear case of negligence had been established. (102 S.E. 552.)

Commission Rulings

[illegible] decisions of [illegible] bodies involving or affecting electric light and power utilities.

Debt Due from Municipality Not a Valid Reason for Refusal to Extend Service.—The fact that a municipality is delinquent in the payment for electric service is, in the opinion of the Illinois Public Service Commission, immaterial as affecting the question of the duty of the public utility company concerned to extend its service when there is nothing to indicate that the municipality will not eventually settle the account, and when the account is a realizable asset.

Inductive Interference.—In a complaint by the La Harpe Telephone Company against the Western Illinois Utilities Company because of interruptions to the service of the former from inductive interference, the Illinois Public Utilities Commission, finding that the companies' lines had not been constructed in accordance with the method prescribed by it, ordered them to file with it a joint plan and estimates of cost of such reconstruction as in their opinion would satisfactorily remove the electrical conditions complained of.

Colorado Board Authorizes Municipal Plant but Censures Town.—Finding that service furnished by the Farmers' Electric & Power Company has not been satisfactory, the Colorado Public Utilities Commission has granted the application of the town of Ault for permission to operate a municipal plant already constructed. In doing so, however, the commission took occasion severely to censure the town authorities, declaring that their refusal to apply previously for a certificate of approval had caused a needless delay of more than a year. The commission also announced that its approval of the application was not to constitute a precedent in similar cases.

Competition Injurious to Public in Long Run.—In denying to the Ausable Forks Electric Company the right to construct an electric generating plant which would enable the company to compete with the Northern Adirondack Power Company, the companies both having vested interests and being unable to reach an agreement to merge, the Public Service Commission for the Second District of New York has declared that "competition, while it works to the temporary advantage of the public, is in the long run disastrous to the public and to both companies." For the protection of the public as well as of the Northern Adirondack company, therefore, the application was denied, though without prejudice to the right of the Ausable Forks company to seek a limited franchise.

Fred Monteith has been appointed chief engineer of the Haverhill (Mass.) Electric Company, succeeding W. F. O'Regan.

W. F. O'Regan, chief engineer of the Haverhill (Mass.) Electric Company, resigned recently to accept appointment as superintendent of power for the Continental Paper Company, Hackensack, N. J. Upon leaving Haverhill Mr. O'Regan was presented with a gold watch as a token of regard by fellow-employees.

Major George F. Sever, formerly professor of electrical engineering in Columbia University and during the war actively at work in the army in connection with electric power conservation on the Pacific Coast and in the New England States, has joined the engineering staff of Jackson & Moreland, consulting engineers, Boston.

R. G. Carroll, manager of the Savannah (Ga.) Electric Company, has been transferred by Stone & Webster to its Galveston (Tex.) property as manager of the Galveston Electric Company. Mr. Carroll succeeds W. E. Wood, who has recently been made general manager of the Houston (Tex.) Electric Company and the Galveston-Houston Electric Railway Company.

R. C. Brooks, heretofore manager of the Pawtucket (R. I.) division of the Blackstone Valley Gas & Electric Company, has been made manager of the Savannah (Ga.) Electric Company, succeeding R. C. Carroll, who has been transferred to a similar position with the Galveston (Tex.) Electric Company by Stone & Webster, the general managers for all three properties. Mr. Brooks was formerly general superintendent of the Dallas (Tex.) Electric Company and previous to that manager of the Austin (Tex.) Light & Power Company.

W. E. Wood has resigned as general manager of the Galveston (Tex.) Electric Company to become general manager of the Houston Electric Company and the Galveston-Houston Electric Railway, with headquarters in Houston, Tex. All three companies are Stone & Webster properties and Mr. Wood will divide his time between Galveston and Houston. He succeeds E. L. Milliken, who has been transferred to the Boston office of Stone & Webster. Mr. Wood has been connected with the Stone & Webster organization since his graduation from the Georgia Institute of Technology in 1907. The year following he spent in the home office of Stone & Webster, in Boston, Mass. He was then transferred to the Jacksonville (Fla.) Traction Company, where he worked in several departments as a student. In 1912 he was made superintendent of the Jacksonville system, continuing to serve in that capacity until 1916, when he was transferred to Houston as general superintendent of the system there. He was subsequently appointed manager of the El Paso Electric Company and still later manager of the Galveston Electric Company.

Men of the Industry

Changes in Personnel and Position—
Biographical Notes

Dr. Ernest Fox Nichols, professor of physics at Yale University for the last four years, has resigned to join the staff of the National Lamp Works of the General Electric Company at Cleveland, Ohio. Dr. Nichols was formerly president of Dartmouth College, succeeding President William Jewett Tucker in 1909 after having served on the faculties of Dartmouth College, Hanover, N. H., and Columbia and Colgate Universities.

Lafayette Hanchett was elected president of the Utah Light & Power Company at a meeting of the board of directors on March 29. Mr. Hanchett is now identified with a long list of important industrial and commercial enterprises. He is president of the Intermountain Electric Company and holds the same position with the Dixie Power Company, which operates in southern Utah. He is also a director in the National Copper Bank and the Bankers' Trust Company of Salt Lake City. Mr. Hanchett was closely associated with D. C. Jackling, whom he succeeds as president of the Utah Light & Power Company, during the war, acting as his assistant at the government powder plant at Nitro, W. Va. The Utah company re-elected W. S. McCornick as senior vice-president, a position he has held ever since the company was formed; S. R. Inch as vice-president and general manager, and G. B. Thomas as secretary and treasurer. John C. Howard, president of the Utah Oil Refining Company, was named as a director of the Utah Light & Power Company.

LAFAYETTE HANCHETT

N. E. Dorsey, physicist in charge of the radium and X-ray section of the Bureau of Standards, has tendered his resignation to take effect at an early date, certainly not later than July 1. Dr. Dorsey has not perfected all of his plans definitely as yet, but he expects to open consulting offices during the latter part of the summer or early fall, specializing in the application of physics to medical practice, particularly as regards Roentgen ray and radium application.

Harry M. Gardiner, who for ten years has been connected in an engineering capacity with various subsidiaries of the General Motors Corporation, has accepted a situation as manager of the Detroit office of the Industrial Controller Company, with headquarters at 708 Ford Building. During his experience in the engineering field Mr. Gardiner was from 1906 to 1908 assistant engineer of the Delray power station of the Detroit Edison Company; from 1908 to 1910 he was electrical engineer for the navy yard at Charleston, S. C., and from 1910 to 1916 he was electrical engineer for the Northway Motor & Manufacturing Company of Detroit; from 1916 to 1918 he was power engineer of the Cadillac Motor Car Company of Detroit; from 1918 to 1919 he was consulting electrical engineer for the General Motors Corporation at Detroit, and from 1919 to March 31, 1920, he was works engineer for the motor works of the Olds company at Lansing, Mich.

Obituary

Ralph G. Hemingray, president of the Hemingray Glass Company, Muncie, Ind., died at Covington, Ky., May 11. Mr. Hemingray had many personal and business friends among electrical men.

Prof. August Raps, one of the directors of the Siemens & Halske company, Berlin, died on April 20, at the age of fifty-five. Dr. Raps had been for more than twenty-five years at the head of the Werner works of the Siemens & Halske company. He was a prominent engineer and scientist and a pupil of Helmholtz. He was largely responsible for the introduction of automatic telephony in Germany and elsewhere in Europe.

Jacob F. Mehren, chief of the electrical repair department of the city of Chicago and father of Edward J. Mehren, editor of the *Engineering News-Record,* published by the McGraw-Hill Company, died suddenly at his home in Chicago after suffering a heart stroke on May 4. Mr. Mehren was a native of Chicago, sixty-three years of age, and had been in the employ of the city electrical department for about forty-four years. During that time he invented several telegraphic devices, and he designed and installed the fire-alarm system in the old Chicago City Hall.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies Notes on Industrial Activities and Business Methods

Large Producer Champions Direct Sales Policy

A RECENT development in the wholesale distribution of electrical supplies is presented by one of the largest electrical manufacturers catering to the retail trade. This embraces the identical interests of the manufacturer and the jobber and the judging of sales organization by the number of points and degree of its contract with the field.

One of the great problems of the present-day manufacturer is to avoid peaks and valleys in production. In the case of the Ever-Ready products, for example, the demand has varied recently from 500,000 flashlight batteries at one date to 200,000 two weeks later and has again risen to 800,000 on order only a short time afterward. Such fluctuations in demand introduce baleful results upon economic production, the effect on manufacturing conditions being extremely trying.

To stabilize the demand and build up business a new policy of selling direct has been established. By this plan distributers' orders will be routed through the jobbers' organizations and the entire energies of a sales force of 250 and an advertising appropriation of $2,000,000 will be concentrated upon co-operative business building. Through local sales conventions this plan is being explained and set in motion. The plan provides for the taking of a quota of Ever-Ready products by each jobber in his particular territory, the jobber assuming the quota and ordering it in each case. The manufacturer undertakes to see that no new local distributers are added beyond those necessary for the proper marketing of the goods, and agrees to supply the quota ordered on satisfactory delivery basis. Advertising and sales effort are to be increased rather than diminished, the effort of the sales force, however, being directed upon dealers handling competitive lines. Shipments will be made smoother and on schedule.

The manufacturer's promotion work will be directed toward finding new markets and dealers, while jobbers have been urged to abandon the policy of trying to market every novelty in electrical products, rather concentrating upon fewer lines. The Ever-Ready interests are reducing the variety of types of dry cells and forms of flashlights to a more reasonable total.

Fan Trade Ready for Heavy Early Buying Season

MANUFACTURERS who were able to place their fan stocks in their distributers' hands before the railway strike became effective are in a fortunate way. The initial orders early this year were so far above those of previous years that it was not possible in all cases to get them started from the factories before the embargoes shut down. At the present time there are several carloads of fans that have been en route for some weeks, and from the outlook in transportation it can hardly be said that they are about to be delivered. On the other hand, it has been stated that unless the rail conditions materially improve in the next week or two certain distributers are liable to be caught with short supplies which might carry them over only the first hot spell, and then with lines not complete.

Other manufacturers have delivered sufficient stocks to cover any expected demand over the first hot spell. Virtually all initial orders are in, but few reorders have been reported to date. The 16-in. oscillating fan seems to have the biggest call again this year, the next jump being to the 8-in. and 9-in. sizes. In general, however, the trade is well prepared for an early buying season, while manufacturers expect that before the end of the season they will be called upon to supply more fans than they can produce, with all their increased capacity over last year.

Rubber-Covered Wire Bookings Show Slight Decline

AFTER the high volume of orders turned in for rubber-covered wire during the last week of March and the first two weeks of April, bookings dropped to less than half for No. 14 and to just above half for total code. Taken over the first eighteen weeks of the year, the weekly bookings of No. 14 have averaged about $320,000 per week, according to the closest estimates available. In the same way weekly bookings of total code have been averaging about $836,000 per week. At the same time, since the middle of April No. 14 bookings have not been above $240,000 per week and total code bookings have not been over $760,000 per week, estimated. It might be inferred from this that recent orders on total code and on No. 14 rubber-covered wire have been falling off somewhat.

Wire manufacturers are keenly feeling the pinch of curtailed transportation and factory outputs are being curtailed. Factory stocks of finished wire are in good shape, but stocks of rubber, cotton and copper are running low. Little material has come in within the past month, except by trucking and a car here and there. Refinery output is almost at a standstill. Jobbers' stocks of rubber-covered wire have been in good shape and are still holding up well.

Lay-Offs Threaten New England Electrical Factories

STRIKES in the transportation field, car shortages and inadequate rail facilities in the eastern part of the country are beginning to threaten the continuity of work in New England electrical factories. On Monday the General Electric Company was obliged at Lynn to lay off employees on a very moderate scale in the meter and instrument plants, and while this action was exaggerated in the Boston press, it was stated to a representative of the ELECTRICAL WORLD who called at the factory that unless transportation conditions improve lay-offs will have to be increased.

About fifty employees of this plant are in the field striving to hasten the shipment and transit of material to the factory. It is hoped to avert a general curtailment of work by recalling employees laid off as rapidly as conditions permit, and this can sometimes be done within a very short time of their temporarily enforced absence, in view of the fact that the arrival of a particular class of material or missing parts enables the completion of work in progress. A severe shortage in $\frac{1}{16}$-in. sheet iron of ordinary quality exists at the moment. The far-reaching adverse effects of strikes in other lines of work are beginning to be brought home to New England industrial workers. Press reports as to the cancellation of contracts are much overdrawn, although the upward rush of business noted earlier in the year appears to have subsided, at least in some plants.

Lighting Fixture Makers Flooded with Unfilled Orders

According to a representative lighting-fixture manufacturer, there appear to be more orders available for all kinds of lighting fixtures than the combined capacity of the manufacturers can take care of. In view of the uncertainty of the situation, he believes that a climax is rapidly approaching.

There is a feeling that material should not be purchased in expectation of a further advance, and several houses are refraining from placing orders for material at present prices for future delivery. The policy is being urged of buying only for immediate needs as one way to assist the readjustment of business conditions.

One method urged upon lighting-fixture manufacturers which would be to their advantage is the necessity of keeping in closer touch with the building market. At the present time a large volume of building operations are either stopped entirely or badly curtailed. The shortage of labor and the inability to move building materials of every kind have brought about this condition, and fixture manufacturers are curtailing their output because of the same reasons. Hardly any fixture manufacturer is getting enough material to keep going on anything like full time. In addition, the labor turnover is large. This latter item may improve, however, if manufacturers are forced to lay off help because of the increasing materials shortage.

Lamp Sales for 1919 Three Million Under Those for 1918

From the report of the lamp committee of the National Electric Light Association, presented at the Pasadena convention which has just closed, total sales of large lamps of all kinds in the United States for the year 1919 were 183,000,000, which is 3,000,000 less than the total for 1918. Sales of tungsten-filament types amounted to 170,000,000, an increase of 4,000,000, and of carbon and gem filament type 13,000,000, a decrease of 7,000,000. The percentage, however, of tungsten types to the total increased from 89 in 1918 to 93 in 1919, while the percentage of carbon and gem to the total dropped four points—from 11 per cent in 1918 to 7 per cent in 1919.

The candlepower of tungsten lamps increased during 1919, but at a lower rate than it did during the period of war industry activity. That of carbon lamps fell off, and at a higher rate than during this same war period. Each year there is recorded an increase in the average candlepower of lamps sold. This advance is due in part to the utilization of high-power gas-filled tungsten lamps in service formerly performed either by smaller electric lamps or by other illuminants and in part to the increasing illumination standards which are becoming more prevalent.

A mean horizontal candlepower of 53.2 was attained in 1919 as against 51.5 in 1918; a mean wattage of 51.5 was attained in 1919 as against 52.7 in 1918, and a mean efficiency of 10.5 was shown for 1919 as compared to 10.3 lumens per watt in 1918. The decrease in average watts was probably brought about by readjustment of war industries in which high-wattage units had been largely used.

Improvement in standardization toward the 110-volt to 125-volt service was shown, the proportion of lamps sold in 1919 for that range being 85 per cent of the total as compared with 82 per cent of the total for the year previous. The accompanying table shows the distribution by voltage ranges for the last two years:

	Per Cent	Lamp Sales
Voltage range	1918	1919
110-125 volts	82.1	85.1
220-250 volts....	7.6	5.1
Street series.....	1.3	1.4
Street railway...	3.8	3.3
30 and 60 volts	4.0	4.5
Miscellaneous...	1.2	0.6

Vacuum-type tungsten lamps increased in 1919 only 1,000,000, totaling 143,000,000, while the gas-filled type increased from 24,000,000 in 1918 to 27,000,000 last year, a 12½ per cent increase. While sales of these gas-filled lamps were 15.9 per cent of the total, they represented 42 per cent of the total candlepower of the 1919 lamp sales. The 40-watt lamp continues to be the most popular size, with the 25-watt a close second. The demand for the 50-watt size, vacuum, exceeds one-eighth of the combined demand of all sizes of vacuum lamps in the multiple group, and it is the only size of this group that showed in 1919 an increased demand over 1918 and has shown some slight gain in popularity each year. Third place in line is held by the 60-watt size. The following table shows the distribution of tungsten lamps by sizes and types:

PER CENT OF TOTAL TUNGSTEN LAMP SALES

Size:	1917	1918	1919
Multiple vacuum type:			
Sign lamps	6.4	4.9	4.3
15 watts	4.5	5.5	4.1
25 watts	23.7	22.4	21.0
40 watts	25.0	24.3	21.6
50 watts	7.0	8.4	9.7
60 watts	14.8	13.3	13.0
100 watts	2.7	2.0	1.3
Miscellaneous	0.5	1.7	0.5
Total all sizes	84.6	82.5	75.5
Multiple gas-filled types:			
50 watts (white Mazda)	....	....	1.9
75 watts	3.1	4.1	5.5
100 watts	3.9	4.7	5.5
150 watts	0.2	0.4	0.5
200 watts	1.5	1.9	2.2
300 watts	0.4	0.5	0.5
400-500 watts	0.4	0.5	0.4
750-1000 watts	0.2	0.3	0.1
Miscellaneous	0.2	0.3	0.2
Total all sizes	9.9	12.7	16.8
Miscellaneous types of Tungsten lamps.			
Total all sizes	5.5	4.9	7.7

Some Fundamental Conditions Which May Affect Tomorrow's Business

A number of conditions exist today which may reasonably be expected to have an important bearing on the electrical supply market of tomorrow. First, there is the inability of almost all of the larger central stations to take on any additional load. Already central stations in Chicago and Philadelphia have discouraged electrical shows this year because they do not want to be placed in the position of refusing any more business than they will have to do as it is. It is a fact that a number of central stations are no longer encouraging wiring of old houses.

Secondly, there has been a perceptible lull in new building in the past few weeks. This is not true of every section of the country, but is very evident in the Atlantic States, the Middle West and the Southwest.

There is still a growing stringency of money. Utilities are finding it less easy to finance construction, and as a result extension of systems is being very greatly curtailed. In this connection, therefore, there is not much hope for any large increase in new service. Home builders are feeling the cost of money, and this condition is in large measure responsible for the marked falling off in building. Furthermore, manufacturers and jobbers are finding that it is not so easy to carry stocks or finance orders as formerly owing to the increased cost of money.

Already there are reports of jobbers here and there with sufficient stocks of a number of lines of electrical building materials. There have been cancellations of orders for meters. While these might be isolated cases and therefore mean nothing at all, still they are interesting in the light of the above conditions.

Marine Wireless Suit Lost by Marconi Company

The Marconi Wireless Telegraph Company has lost a suit to the Kilbourne & Clark Manufacturing Company, Seattle, Wash., according to a decision just rendered by the United States Circuit Court of Appeals. Because of the many factors entering into the case the amount of the suit has not been determined, but it is understood that it will reach several millions of dollars.

Suit was brought by the Marconi company claiming that Kilbourne & Clark had infringed on their patent rights on transmitting and receiving apparatus in connection with wireless telegraphy for marine use. While it has been pending for several years, this suit involves fundamental circuit arrangements. Had the defendants lost, it is said that a heavy accounting would have been necessary for radio equipment on a large number of naval and merchant ships owned in the United States and abroad.

German G. E. Stock Purchased by American Banking Firm

PRIVATE interests, represented by the banking firm of Kuhn, Loeb & Company, together with the Guggenheim interests, were the purchasers of the 25,000,000-mark block of 100,000,000 mark stock of the German General Electric Company, according to a statement from the former company. The General Electric Company in America has stated that it has no connection with the above or any other German electrical company.

According to reports, the new capital is mainly for use in a closer consolidation of Felten & Guilleaume-Carlswerk, electrical engineers and manufacturers, and the German General Electric, and for use in purchasing copper in America. This, it is said, would give the company control of the materials required in the manufacture of electrical apparatus, with the exception of steel semi-finished products.

Metal Market Situation

WITH the virtual halt in rail freight traffic of many of the raw materials, the copper market is a bit softer than a week ago. While the larger producers are unwilling to shade 19 cents for so-called May delivery, some of the smaller producers have been interested in prices as much as ⅜ cent under 19 cents for small tonnage for nearby use. The demand is not very active, but some electrical manufacturers have availed themselves of the relatively low price offered by the outside market and have taken some for immediate delivery, where transportation has been at hand, at 18.62½ cents delivered. Small amounts of the metal have been offered as low as 18.35 cents at refinery.

The labor situation at the copper mines is very unsatisfactory, one mine having closed this week. Others are badly curtailed in their output, in some cases from one-half to one-third. The call of the farm is a big spring factor in the mine labor market and is making itself felt at this time.

In zinc the market is steady under little demand. It is not expected that the present stock will last the manufacturers long, although, because of curtailed output, it is dragging out pretty well. Prompt is quoted at about 8.10 cents.

Lead shows little activity, especially for June and July. Leading prices are 8.50 cents, New York, with the outside market asking 8.80 cents.

NEW YORK METAL MARKET PRICES

	May 12	May 19
Copper	£ s d	£ s d
London, standard spot	105 5 0	98 5 0
	Cents per Pound	Cents per Pound
Prime Lake	19.00	18.75
Electrolytic	19.00	19.00
Casting	18.37½	18.25
Wire base	22 50 23 00	22 50 23 00
Lead, trust price	8.50	8.50
Antimony	9.75	9.37½
Nickel, ingot	43 00	42 00
Sheet zinc, f.o.b. smelter	12.50	12.50
Zinc, spot	8.10	8.10
Tin	56.50	54.25
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.50 to 16.75	16.00 to 16.50
Brass, heavy	10.00 to 10.25	9.00 to 10.00
Brass, light	8.75 to 9.00	8.00 to 8.50
Lead, heavy	7.00 to 7.25	7.00 to 7.25
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

FALLING off of freight shipments for a period of more than two months is largely responsible for the slight decrease in volume of sales noted by jobbers in all sections of the country.

Demand is heavy for most electrical goods, with the result that jobbers dispose of a large amount of goods as soon as they are received, thus depending to a considerable extent on freight shipments for future business. With shipments greatly reduced sales naturally have fallen off.

Demand for electrical goods is not decreasing. If jobbers could get materials, sales would be probably more than double what they are at present. Building contracts for the first four months of 1920 for all sections of the United States are reported to be more than twice as great as for the first four months of 1919. Labor troubles have held up heavy building schedules in the larger cities, but in the suburban and rural districts there is considerable activity.

NEW YORK

DEMAND for conduit, armored conductor, wire and porcelain continues strong for use in suburban buildings, although calls for material in the city proper have dropped off to a considerable extent during the past week.

Differences between employers and employees in the building trades are expected to be adjusted satisfactorily during the week, and this should give a considerable impetus to building operations which have been held up for several months.

The small amount of freight received during the week has been partly responsible for the slight decrease in sales noticeable by most jobbers. Fans, heating appliances, armored conductor, metal-molding fittings, lamps, wire and some condulets have dribbled in, but not in sufficient quantity to be of much advantage. Most materials are reshipped at once, leaving jobbers' stocks bare.

Building materials, non-electrical, have caused some delay in large structural buildings, but these are now coming in at a better rate.

Jobbers are busy checking up credits and watching invoice returns.

Flexible Armored Conductor.—Jobbers report receipt of armored cable by truck in limited quantities. Prices vary, but No. 14 double-strip is quoted at from $120 to $125 in lots of 1,000 ft. There is very little stock in the city.

Non-Metallic Flexible Conduit.—This has been received in quantity from time to time, but few jobbers have any stock at all on which to quote. The 7/16-in. and ½-in. sizes are scarce.

Wire.—Weatherproof stocks are low in the power sizes. Factory shipments have been held up and but little wire has arrived of late. Good prices are being asked for stock now available. Rubber-covered wire has been coming in recently, and jobbers generally report plenty of No. 14 on hand. Quotations range from $12 to $14 per 1,000 ft. in lots of 5,000 ft.

Ovens.—Effective May 10, prices on Simplex bake ovens were advanced. The 56-loaf size is now listed at $400, the 90-loaf at $450, and the 150-loaf at $650. The new Edison heavy-duty list shows increases on small sizes, but the large size equipment is practically unchanged.

Ranges.—A new Hughes price list, No. 23, changes the price on the C. O. 17 range from $57 to $62 and on warming shelves from $10 to $12.50. New prices on auxiliary ovens are, for the No. 1015, $16; No. 01511, $26; No. 17, $26. These were formerly listed at $13.75, $21 and $21 respectively. Simplex line has increased its No. 27 cabinet type household range to $175 and has added a No. 25 apartment type at $145 and a No. 29 cabinet type at $235.

Irons.—Demand continues heavy. Few irons are being received, however, although deliveries are improving. Universal irons have been advanced from $7.50 to $8. The Hotpoint adjustable-voltage 3-lb. iron has been marked up to $7.75 from $7.25, the same price advance being effective on the Hotpoint 6-lb. domestic iron.

Meters.—Effective May 6, one manufacturer's entire line of alternating-current and direct-current watt-hour meters advanced in price. Discounts fell off ten points.

Pole-Line Material.—In one case hardware, cross-arms and insulator pins increased in varying amounts on May 10.

Street-Lighting Fixtures.—One line of street-lighting hoods, brackets and fixtures advanced May 10 on broken-package lots. Standard-package prices decreased slightly.

BOSTON

Sales are falling off somewhat owing to adverse transportation conditions. Orders received by jobbers continue in very large volume, but manufacturers report a diminution in demand for electrical machinery. Some improvement is noted in freight deliveries, but conditions are very bad and worse embargoes are threatened by the plight of the railways. Collections in this district are holding up well, in view of the foregoing considerations. One large jobber had 1,200 unfilled orders on hand recently. Stocks are spotty, running over-full in material made in New England and low on outside products. Industrial building work is expanding. Prices in the electrical field have not as yet shown much tendency to parallel downward movements noticeable here and there in the leather industry. Labor disturbances in the textile field continue, but no strikes of magnitude are on in the electrical trade at Boston.

Steam Turbines.—Deliveries range in general from six weeks to six months. Manufacturers are in better shape than for some time to handle this class of business.

Electric Ranges.—Factory stocks are practically cleaned out. Steel is short in supply. Output is engaged for many months to come.

Motors.—One agency reports that his motor sales in the first five months of 1920 will exceed those of any entire year in the past half-decade. New accounts on washing-machine motors tend to run into 1922 deliveries. In one company alone the demand totals 16,000 fractional-horsepower motors a week. The market is low on motors of less than 25-hp. rating.

Toasters.—Manufacturers are quoting deliveries on new accounts well on toward late fall. Prices are firmer on leading lines.

Fans.—Deferred warm weather has held down retail buying until now. The early hot spells will probably be well met by dealers, but there is some uncertainty as to the adequacy of the supply for late summer.

Wire.—Rubber-covered wire is firmer, No. 14 in 5,000-ft. lots being quoted at $11.75 per 1,000 ft. Stocks are large, one jobber having 1,000,000 ft. on hand Monday. Bare wire is steady at 24 cents base, with improved supply. Weatherproof wire, No. 6, triple-braid, sells for 34 cents per pound in real lots.

Magnet Wire.—Shortages are acute. Since Jan. 1 one manufacturer has refused $2,500,000 in orders. South Sea cotton for insulation is scarce.

Flexible Armored Conductor.—Stocks are spotty and prices steady. No. 14 single-strip brought $110 per 1,000 ft. in 1,000-ft. lots or over Monday. Some bins have none of this material, others moderate supplies.

Non-Metallic Flexible Conduit.—Orders are being filled satisfactorily. Prices are a trifle easier, the 7/32-in. size in 1,000-ft. lots or over being quoted around $35 per 1,000 ft. and the ¼-in. size around $38.50.

Metallic Flexible Conduit.—Boston jobbers recently doubled the manufacturers' lists. In coil lots a 45 per cent discount is quoted.

Knobs and Tubes.—Stocks are low. Nominal quotations, subject to price on delivery, are $31.50 per 1,000 in barrel lots on "Nail-it" knobs and $10 per 1,000, barrel lots, on 3-in. tubes.

Rigid Conduit.—Jobbers are hard hit as to supplies. There is practically no 2-in. pipe in the city, either white or black, but a little ½-in. pipe can be located now and then.

CHICAGO

The past week has seen but little change in general conditions in the electrical trade. Transportation troubles remain the outstanding feature, showing but slight improvement. In the last few days jobbers have been able to secure freight billing on considerable quantities of outbound consignments, but it is problematical how far the shipments have gone. Inbound shipments are working through slowly. The effect is to deplete further the scanty stocks without equivalent replacement. Manufacturers are getting a portion of their output off their loading docks but cannot replenish raw-material stocks. Moreover, coal is getting scarce and may get so low as to present a serious problem.

In this stringency the Chicago district seems to be fortunate in comparison with other points. Reports are to the effect that from 100,000 to 150,000 men have been forced out of employment in Detroit through fuel and material shortages, and various other cities are said to be similarly affected. No extensive reduction in working forces has been made here, though it is a fact that the combination of industrial stoppage in nearby cities combined with slackness in building construction has caused a notable increase in the number of men out of work.

Regardless of the fact that stocks are reduced to the famine point and many items wholly unobtainable, no case has been heard of where any jobber or dealer has attempted to profit by an undue increase in price. Orders for goods out of stock are being booked, goods to be furnished "as soon as possible" and at regular prices. The leading price feature was the advance of from 5 to 10 per cent on many heating appliances. Demand continues heavy in all lines, but it is hard to tell how much duplication of orders is being practiced in an effort to get prompt deliveries.

Construction, both residence and industrial, remains at a low level. Last week's permits in all classes totaled $1,300,000 and this week's $1,850,000. A great amount of alteration work is being done on which the electrical work will average a much higher percentage than in ordinary new construction.

Flexible Armored Conductor.—Jobbers' stocks are apparently exhausted, considerable quantities being reported on the way with delivery uncertain. No. 14 single-strip is quoted at $120 per 1,000 ft. in less than coils and $110 in coil lots.

Non-Metallic Flexible Conduit.—Only meager stocks of odd sizes are available. Prices are unchanged at $35 per 1,000 ft. for 7/32-in. in large quantities and $37 per 1,000 ft. for ¼-in. Short lengths are $55 and $60 respectively.

Motors.—Stock conditions in most makes could not be much worse. Local manufacturers are able to make some deliveries, but out-of-town shipments are uncertain.

Meters.—Only certain types and sizes are available for immediate delivery, factory orders requiring about six weeks for delivery. Slight advances were effective May 1, a 5-amp. alternating-current meter now being listed at $16.25.

Exhaust Fans.—Demand continues heavy with stocks badly broken. One factory requires from two to ten weeks for filling orders and shipment uncertain. Ventura fans, 32-in., are listed at $140, 37½-in. at $170 each.

Hollow Ware.—Deliveries from factory to jobber remain negligible. Numerous advances were noted last week. Edison Electric Appliance Company increased the list price on its lines of six-cup aluminum percolators 75 cents to $11.75, and their three-heat round grill $1.50 to $15. In the Landers, Frary & Clark list somewhat similar changes were made.

Flatirons.—Ample supplies of most makes are available.

ATLANTA

Weather conditions throughout the section continue unfavorable toward agricultural activity, and continued rains are interfering to a certain extent with building activities in the cities. Unless rains cease light crops will be the rule, and this will be reflected in poor business conditions throughout the section in the coming fall. The employers' association of Atlanta has come out flatly in favor of the open shop, thus supporting the master plumbers in their refusal to operate on a closed-shop basis, and as a result labor conditions are showing some improvement, although construction is still held up on account of the difficulty of installing plumbing and steam-heating fixtures.

All jobbers are still feeling the effect of the railroad strike and freight embargo, and little or no improvement in shipping conditions is to be noted over those of last week. Steel products, porcelain, glassware, hollow ware and motor stocks are in bad shape with little hope held out for immediate improvement in any of these lines.

In spite of these facts, a general spirit of optimism prevails throughout this section, and there is no indication of a material slackening in activities. Jobbers report collections somewhat improved over last month, though not up to the standard prevailing at the first of the year.

Outlet Boxes.—Stocks in the territory are small or nonexistent, while shipments, which are quoted at eight weeks, as a rule do not materialize. Brisk demand is absorbing such small allotments as are received.

Cartridge Fuses.—While certain sizes of cartridge fuses are on hand in fair quantities, the stocks as a rule are spotty, the more popular sizes of fuses being scarce. Plug fuses in the 10-amp. sizes are hard to obtain, though reasonable stocks of other sizes are on hand. The demand for both classes is good.

Cross-arms.—The shortage existent several weeks ago has been relieved by a shipment of Washington fir arms in assorted sizes, and this has served to fill out standing back orders and leaves fair stocks on hand. Prices: Lots of less than 1,000 linear feet, four-pin, 5-ft., $1.68; two-pin, 3-ft., $1.12.

Pins and Insulators.—As is true of all lines of pole material, the demand for these two items is brisk. Fair stocks are on hand, one jobber reporting the receipt last week of two cars of insulators and one of pins. Prices: Pins, lots of 100 to 500, 1¼-in. x 8-in., $2 per 100; 1½-in. x 9-in., $4.20 per 100. Glass insulators, barrel lots, $9.39 per 1,000.

Electric Ranges.—Demand continues to keep stocks in a depleted condition and poor shipments are the rule. Large quantities are being quoted at eight to twelve months.

Switches.—Stocks of switches are in poor shape, with the exception of fair quantities of certain types of snap switches. Poor shipments are depleting the holdings of this type; virtually no push-button switches are obtainable.

Vacuum Cleaners.—The late spring has caused a slackening in the demand for vacuum cleaners, though jobbers express the opinion that this condition is temporary. Stocks are in fair shape, while shipments are offered at three to four weeks.

Fans.—Two or three days of hot weather caused a tremendous increase in the movement of desk fans, which, however, has been stopped by the cold snap of the past week. Ceiling fans move phenomenally well, some jobbers having already reported an exhaustion of their stocks. Fear is expressed that there will not be sufficient desk fans to meet the summer requirements because of poor shipments in the past few weeks.

SEATTLE-PORTLAND

Jobbers and retailers' sales were maintained, generally speaking, although various difficulties, such as stock shortages and irregular deliveries, are becoming more pronounced. Jobbers report that they are receiving little or no materials from either the East or Middle West, and as a result all stocks are low and in many cases nearly exhausted. The business outlook is for continued activity, provided that jobbers can obtain materials in sufficient quantities and that pending labor difficulties are adjusted.

Retail business in Seattle and the Puget Sound district is reported to be satisfactory. Larger volumes than those noted in the month previous and larger than those of the same month last year are reported generally. The crop outlook is considerably brighter than it was a month ago.

The lateness of the spring, while it has retarded farming operations, has brought unexpected precipitation, and rains were general throughout the dry farming area. In Seattle thus far this year building permits, while not so numerous or of such high valuation as was predicted, represent a figure in excess of $5,000,000, exceeding last year's totals for the same period by more than $600,000.

Seattle faces the prospect of a general building strike, involving approximately 5,000 tradesmen, on June 1. Portland manufacturers report business about the same as it has been for the past three weeks. Freight embargoes in the East are proving very serious and will undoubtedly in the immediate future hamper business materially. It is impossible to get shipments out, and stocks are already in a very depleted condition in many lines.

There is no local embargo, however, and shipments out of Portland are unaffected, except for shortages of stock. The price of meters advanced approximately 10 per cent during the week. Reports indicate a very appreciable shortage in conduits of various sizes. Jobbers report that business is quiet at present. Collections are about the same as for the past month, somewhat slow but apparently getting no worse. Credits are being watched very carefully. Portland retailers also report business very quiet. In spite of warm weather, the demand for summer appliances has shown no particular movement.

Motors.—The demand for fractional sizes in Seattle Sound territory cannot be met. Demand for larger sizes and for heavy power apparatus is light and these stocks are practically nil.

Schedule Material.—Demand exceeds the supply by a considerable margin. The hope of building up stocks has been abandoned. The outlook, in face of sustained building in Puget Sound territory, is very dubious. Price fluctuations are immaterial.

SAN FRANCISCO

The labor situation in general is quiet, although the steel and ship strikes still drag along in San Francisco. The yardmen's strike is hampering railroad movement to a certain extent, which, however, is not very appreciable. The Eastern embargo is much more drastic in its effect and the stock shortage is being felt in many lines.

Motors.—The sale of motors for pumping plants is running high inasmuch as there is now water enough from the power companies' point of view although not from that of the farmers.

Household Appliances.—Stocks are still rather spotty, being good in this or that line but poor as a whole; new buying conditions are appreciable, small orders for Christmas heating material and winter ranges being vigorously booked. Household department managers of department stores report that they are being held down to a low budget in expectation of the long-expected break in buying prices.

Floodlights.—The opening of summer parks and resorts has caused a recrudescence of this line, stocks of which are high. There is no delivery difficulty.

Tools.—Small electricians' and linemen's tools are in high demand because of the great amount of power construction this year. Coast stocks are poor.

Insulating Material.—Prices remain very constant and stocks are good because of the heavy buying of last year, which caused accumulations of stocks on the coast. This business is running much lower than last year.

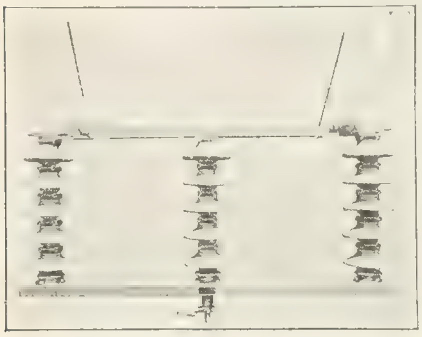
Ranges.—Although various reasons have brought about the abandonment of proposed range campaigns by the power companies, electrical dealers are producing orders in rather surprising volume. There is a much better showing, however, in the heavy duty or hotel devices, consisting of ranges and bake ovens.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

90,000-Volt Air-Break Switch with Separable Insulator Units

In order to obtain good flash-over characteristics and at the same time to take advantage of the unit type of insulator for building up a post type of insulator for high-voltage work, the Delta-Star Electric Company, 2433 Fulton Street, Chicago, is using a combination of Jeffrey-De Witt insulators of standard construction with its own 90,000-volt double-break-per-phase air-break switch. Each insulator is provided with a flange-type fitting for bolting to the other units, and all insulators are interchangeable.

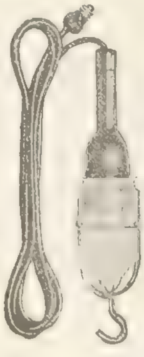


DOUBLE-BREAK SWITCH WITH UNIT-TYPE INSULATOR POSTS

Vapor-Proof Lamps

Two types of "Morse" vapor-proof hand lamps are being marketed by Frank W. Morse, 289 Congress Street, Boston. Style 12 takes the regular standard-base lamp bulb up to 60-watt, while style 26 takes foreign bayonet-base bulbs. The manufacturer states that both lamps have waterproof and vapor-proof sockets in the handle.

STYLE 26 FOR BAYONET BASE



STYLE 12 FOR EDISON BASE

Desk Lamp with Flexible Arm

The Aladdin Manufacturing Company, Muncie, Ind., is offering a new line of lamps to be known as "Desk-Flex." These lamps have an 11-in. flexible arm screwed into the back of the base and are equipped with Association sockets, Benjamin plug, mercerized cord and a patented swivel shade. The new boudoir lamps, or "Dressalamps," of the same company stand about 14 in. high and carry 8-in. shades of new shape. The base is made in two designs, each in three different finishes and colors. The bases of these lamps, instead of being tapered to the smallest point at the top, are "vase"-shaped.

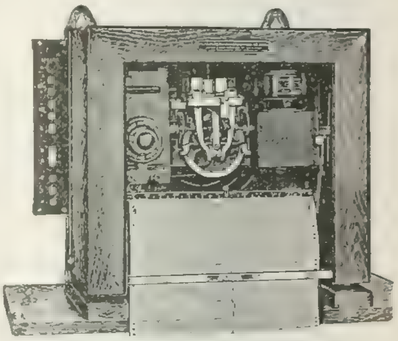
Portable Electric Drill and Hammer Stand

To permit the operation on the ceiling of an electric drill or an electric hammer controlled from the floor, the Hammerstand Manufacturing Company, 359 Jay Street, Brooklyn, N. Y., has developed a stand to the top of which is attached an electric drill or hammer. The upright of the stand is telescopic so that the height of the drill may be varied, and a hand lever, controlled from the floor, feeds the drill up into its work. The iron stand is built on four wheels which may be raised from the floor when the drill is in operation, allowing the stand to rest squarely on the floor. A special attachment offsets the drill for use in a corner.

Automatic Control for High Temperatures

For automatically controlling high, medium and low temperatures the Leeds & Northrup Company, Philadelphia, has developed an automatic recording controller, utilizing the devices and methods brought out in perfecting the potentiometer system of pyrometry. Slight changes of its former controller were required to enable the recording potentiometer to act as the initially governing member of a system of control, without changing its accuracy as a recording potentiometer. An autographic record of temperature is preserved. A thermocouple in the furnace, oven, etc., provides the change in emf. which in the last analysis is responsible for the opening and closing of a relay through which the power supplied to the furnace is controlled. The power which readjusts the potentiometer circuit, operates the pen and closes the relay circuit is supplied by a continuously running constant-speed motor. With suitable accessories the temperature at the thermocouple may be held virtually constant at the value for which the contacts are set.

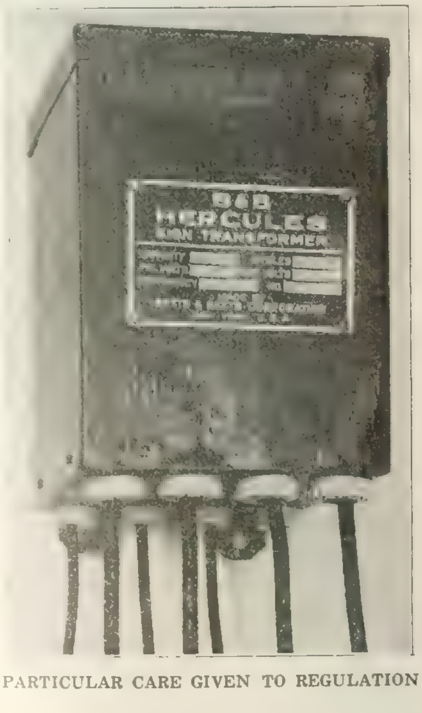
The time elapsing between the occurrence of a change in emf. of the couple and the appearance of a change on the record is given as two seconds. The pen may travel across the scale in fifty seconds if the emf. requires it to. The accuracy is given as one-half of 1 per cent of the range of the particular instrument. Sensitivity is given as one-quarter of 1 per cent. If desired, the recording controller can be arranged to operate a five-signal lamp system. A double recording controller is available to operate alternately from two couples and to control through two respective sets of relays.



THERMOCOUPLE CONTROLS SUPPLY OF FURNACE ENERGY

Sign Transformer

For the operation of signs the Betts & Betts Corporation, 511 West Forty-second Street, New York City, has developed a new "Hercules" sign transformer. Particular care has been taken to provide regulation in this transformer, the maker declares, and the core and copper losses are kept low by the use of high-grade materials.

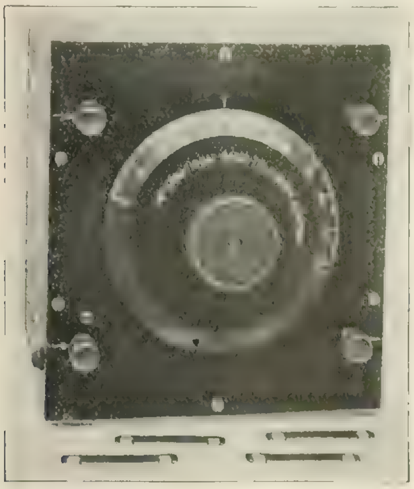


PARTICULAR CARE GIVEN TO REGULATION

The leads are brought out so that they may be connected for either 110 volts or 220 volts on the primary side and 11 volts or 22 volts on the secondary side. The coils are hand-wound on forms, insulated, vacuum-dried, impregnated and moisture-proof, while the core is made up of stampings of silicon alloy steel and insulated from the coils upon assembling. Leads are brought through the walls of the cast-iron case in porcelain bushings, and are embedded in solid insulating compound inside the case. The transformers are made in seven sizes from ½ kva. to 2 kva., and the weights vary from 10 lb. to 65 lb.

Linear Variable Condensers for Wireless Work

For comparison or measurement of capacities, using condensers for energy-storing units rather than for tuning, the International Radio Telegraph Company, 326 Broadway, New York City, is putting out Series RXC-100 linear variable condensers, using a type with simple semi-circular plate. In these the capacity changes directly with the angle of setting, says the manufacturer, and the effective value of the condenser in circuit is proportional to the scale divisions as shown on the dial on the front of the instrument. These condensers are made with two sizes of heavy punched aluminum plates which are mounted between bakelite dilecto plates on heavy brass shafts and supports. The dial is built to act as a shield to prevent effective capacity from changing when the operator's hand is on the knob. These linear variable condensers are built in three sizes, giving ranges between 0.00001 microfarad and 0.00206 microfarad, and the weights are 4, 4½ and 5½ lb.



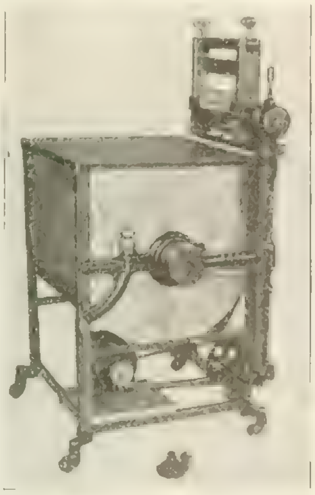
CAPACITY CHANGES DIRECTLY WITH ANGLE OF SETTING

Medical Reclining Cabinet

A reclining cabinet for office and institution work has been brought out by the Burdick Cabinet Company, Milton, Wis. It is distinctly a medical proposition, designed to meet the demand for a scientifically constructed light bath. It is built to inclose the body of the patient, with the exception of the head, in a reclining position, and all control is readily accessible to the operator. If desired, only the upper half or lower half of the body need be treated at a time, as the cabinet is divided by a partition.

Cylinder-Type Washing Machine

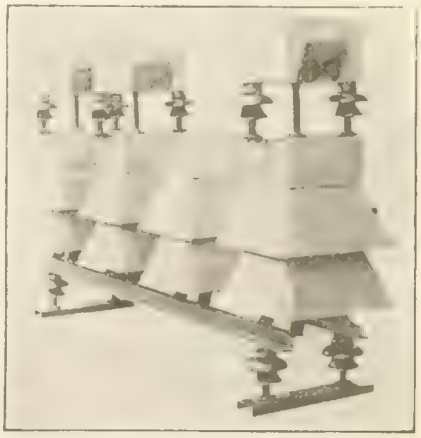
A feature of the new washing machine recently developed by the D. M. Sechler Implement & Carriage Company, Moline, Ill., is the inverted gear, which is made to give steady power and a soft cushion to every reversible motion of the cylinder. The cylinder is made of either metal or wood and makes one complete revolution and back. The frame of the machine is of angle steel. The wringer is equipped with a locking device for locking the wringer in any desired position and has a heavy steel cross support to hold the wringer in alignment. New sensitive bearings are non-adjustable and run in oil. Other specifications for the machine are bevel and spur cut gears, an endless flat driving belt and a standard ¼-hp. motor.



INVERTED GEAR DRIVE

Lightning Arrester for Use in Isolated Places

An oxide-film lightning arrester has been developed by the General Electric Company as the result of the demand for an arrester that would give the same amount of protection as the aluminum arrester without the necessity of daily charging. The construction of the arrester is simple, requiring no oil or electrolyte. It consists of a stack of cells, piled one on top of the other, connected to a sphere gap, the number of cells depending on the voltage of the circuit. In the outside type these cells and sphere gaps are thoroughly protected from the weather, which, says the manufacturer, insures a uniform spark potential under all climatic conditions. The cells themselves consist merely of two thin steel plates or electrodes spun on a porcelain ring, which acts as an insulator, the space between the plates, about half an inch, being filled with lead peroxide. The electrodes are further provided with an insulating film of varnish or some similar compound to give a uniform insulated surface.



ARRESTER DOES NOT HAVE TO BE CHARGED DAILY

Notes on Recent Appliances

Vacuum-Tube-Type Electrostatic Glow Meter

For the indication of potential and synchronism and to detect grounds, a vacuum-tube-type electrostatic glow meter has been manufactured by the Westinghouse Electric & Manufacturing Company.

High-Vacuum Pump

The Newark Engineering & Tool Company, Newark, N. J., has recently developed and is marketing a high-vacuum pump known as "the pump with the grip."

Atomizer

The Comfort Electric Atomizer Company, 959 First Avenue, New York City, is marketing an electric atomizer.

Washing Machine

A washing machine, the "Berkshire," with an electrically operated pump has been introduced by the Pittsfield Machine & Tool Company, Pittsfield, Mass.

Renewable Cartridge Fuse

The Kilo Instrument Company, Indianapolis, Ind., is marketing a renewable cartridge fuse.

Two-Piece Lighting Unit

A complete lighting unit of top and bottom bowls has been put out by the Sunlight Electric Company, Detroit.

Rotary Spark Gap

The Klitzen Radio Manufacturing Company, Racine, Wis., has placed on the market a rotary spark gap.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE GENERAL ELECTRIC COMPANY has acquired from the government the Bartlett-Hayward Company plant in Baltimore, Md., for use in the manufacture of switchboards.

RALPH D. MERSHON, consulting and electrical engineer, has removed his offices to 143 Liberty Street, New York City.

THE ELECTRICAL SECURITIES CORPORATION announces the removal of its offices from 71 Broadway to 165 Broadway, New York City.

THE COLLYER INSULATED WIRE COMPANY, North Main Street, Pawtucket, R. I., has awarded contract for two additions, one 25 ft. x 75 ft. and the other 20 ft. x 32 ft., to its plant.

THE HYGRADE LAMP COMPANY, Salem, Mass., has consolidated its shipping and sales departments. G. F. Gibney, fomerly Salem manager of the American Express Company, has been placed in charge of stock and shipments. He will also be responsible for all finished lamp stock inventories and as the business of the company expands will perform the duties of traffic manager.

THE AUTOMATIC ILLUMINATED ADVERTISING CORPORATION, 816 West North Avenue, Baltimore, Md., has been incorporated with a capital stock of $200,000 to manufacture outdoor electric displays and automatic machinery for advertising purposes. The incorporators are Lester G. Matthews, F. Allen White and Herman Norwood.

THE PHILLIPS INSULATED WIRE COMPANY, Pawtucket, R. I., has awarded contract for the erection of an addition, 45 ft. x 81 ft., to its plant on Winthrop Avenue, to cost about $13,000.

THE STANDARD ELECTRIC TIME COMPANY, Waterbury, Conn., has filed notice with the Secretary of State of an increase in capital stock from $100,000 to $200,000 for general business expansion.

LANDERS, FRARY & CLARK, New Britain, Conn., have appointed W. C. Sears sales manager of its motor-driven electric department, recently established.

BEYER & DEETCH, Cleveland, Ohio, manufacturers of lighting fixtures, have moved their plant from 3868 Hamilton Avenue to 2339 East Fourth Street, Cleveland.

THE POOLE MANUFACTURING COMPANY, Railroad and Union Avenues, Woodberry, Baltimore, Md., has recently been incorporated by interests connected with the Poole Engineering & Machine Company, Baltimore, to manufacture machinery, including washing machines. S. Proctor Brady is among the incorporators.

JOHN C. JONES, manager of the Salt Lake City (Utah) office of the Westinghouse Electric & Manufacturing Company, has been transferred to Los Angeles, Cal., to act as manager of the supply department of the company in that city. Before leaving Salt Lake City Mr. Jones was presented with a gold watch and chain by the employees of the Westinghouse Company and with a traveling bag by the Intermountain Electric Company. Mr. Jones has been in the Salt Lake office of the Westinghouse company for nine years. W. A. Mosher, formerly sales engineer for the company in Salt Lake City, will succeed Mr. Jones as manager of the Salt Lake office.

MAKING LAMPS IN THE HYGRADE FACTORY

THE ROLLER-SMITH COMPANY, 233 Broadway, New York, N. Y., announces the appointment of F. R. Ryan as district manager of its Chicago office, at 739-40 Monadnock Block. He has been connected with the Chicago office of the company since January, 1919, in the capacity of sales engineer and was recently made district manager. Mr. Ryan took his degree of electrical engineer at Notre Dame University in 1913 and he also attended the University of Illinois. In the past he has been connected with the Commonwealth Edison Company of Chicago as electrical testing engineer, with the Sanitary District of Chicago as electrical engineer, with the Krehbeil Company of Chicago as electrical engineer and with the Signal Corps of the United States Army as electrical inspector. Mr. Frankel, assistant sales manager, will continue to have his headquarters at the Chicago office.

HERMAN H. STICHT & COMPANY, 15 Park Row, New York, N. Y., announces that it has added a carbon-brush department to its business and is acting as Eastern agent for the Boxill-Bruell Carbon Brush Company, Indianapolis, Ind. The latter company does not manufacture a universal brush but rather a series to suit conditions.

THE DELTA-STAR ELECTRIC COMPANY'S New York office was removed from 100 Broadway to 25 Broad Street on May 6.

THE BLEADON-DUN COMPANY of Chicago, manufacturer of the "Violetta Violet Ray," is moving its works to its new factory at 213-217 South Peoria Street, where it will occupy the entire building.

THE MACK MOLDING COMPANY, Ordway Building, Newark, N. J., was recently organized by Frank M. Kirkner, formerly sales engineer of the Condensite Company of America, and Kenneth W. Macksey. The company has established a factory at Little Falls, N. J., where it will manufacture custom molding from condensite, bakelite and redmanol.

THE SAFETY ELECTRIC PRODUCTS CORPORATION, 1548 Central Avenue, Los Angeles, Cal., recently incorporated, is manufacturing switches, metal boxes, etc. Frank H. Trimble, formerly connected with the F. H. Trimble Manufacturing Company, now out of existence, is interested in the company.

F. W. SINRAM, president of the Van Dorn & Dutton Company, Cleveland, Ohio, was for the fourth time re-elected president of the American Gear Manufacturers' Association at the annual convention held in Detroit, Mich., April 29, 30 and May 1. The members of the association took advantage of this occasion to present Mr. Sinram with a gold watch and charm.

THE GENERAL MOTORS CORPORATION, Detroit, Mich., has announced that the armature-winding department, temporarily transferred to Munice, Ind., several months ago because of a shortage of labor, will be returned to the Remy electric plant at Anderson, Ind. Extensions are contemplated to the Remy plant.

THE NATIONAL ELECTRIC SERVICE COMPANY, Morgantown, W. Va., has been incorporated to conduct a general electrical business in this part of the state. The company will do a general electrical engineering business and will install electrical equipment in mines, factories and other industrial plants. Daniel A. Maurer is president, Dalton Van Fleet is vice-president, W. E. Watkins secretary, and John Campbell of Fairmount treasurer and general manager.

ARISON, GOODWIN & KNAPP, industrial engineers, has been organized with offices in the Webster Building, 327 South La Salle Street, Chicago, by Col. E. E. Arison, L. Reeves Goodwin and L. G. Knapp. Col. E. E. Arison has been connected with engineering work since 1891, having served two years with the Baltimore & Ohio Railroad Company, ten years with the Carborundum Company, Niagara Falls, N. Y., and five years with the Atchison, Topeka & Santa Fe Railroad. In 1908 he with three others formed the Emerson Company, counseling engineers, of which he was vice-president. L. Reeves Goodwin is a graduate of the University of Michigan, bachelor of science and chemical engineer. He has had seven years' experience as production engineer, one year in independent engineering practice, and was associated with the Emerson Company for four years, serving as secretary and Western manager. L. G. Knapp is a graduate of Cornell University, mechanical engineer. He has served with the Baltimore & Ohio Railroad and the Atchison, Topeka & Santa Fe Railroad, and was assistant to the chief electrician of the latter road. For seven years he was industrial and efficiency engineer for the Emerson Company.

JACK H. RISSER, manager of electric sales for the Globe Stove & Range Company, Kokomo, Ind., resigned from the company on April 30. Mr. Risser's plans for the future have not yet been announced.

EDWARD H. ROCKWELL and FRANK C. DOBLE announce the establishment of the engineering firm of Rockwell & Doble, with offices at 40 Central Street, Boston, Mass. The firm will handle a general engineering and construction business. Mr. Rockwell is a civil engineer, and is head of that department at Tufts College. He is a graduate of the Worcester Polytechnic Institute and has had a wide experience, including work for industrial clients, bridge builders, consultation service and special work for the United States government. Mr. Doble is a graduate in electrical engineering from Tufts College, class of 1911. His experience includes service in the electrified zone of the New York Central lines in the transmission department, in street-railway work and in a consulting capacity for several years.

THE PAGE STEEL & WIRE COMPANY announces the removal of its offices from 30 Church Street to the offices of the American Chain Company, Grand Central Terminal, New York City, with which the Page company has been consolidated. Removal was effective May 15.

THE BRYANT ELECTRIC COMPANY, Bridgeport, Conn., contemplates the construction of a new four-story building, 120 ft. x 150 ft., on Organ Street, to cost about $50,000.

THE PREST-O-LITE COMPANY, Indianapolis, Ind., contemplates the erection of a large manufacturing plant on Tulip Street, near Frankford Creek, Philadelphia, to cost with equipment about $3,000,000.

THE PHILADELPHIA INSULATED WIRE COMPANY, Third and Race Streets, Philadelphia, recently organized to take over the plant and holdings of the Alfred Moore estate, has made arrangements to issue about $1,100,000 in capital stock.

THE HUDSON WIRE COMPANY, Ossining, N. Y., is planning to build an addition to its plant, 80 ft. x 132 ft., one story, to cost about $35,000.

Supply Jobbers' Notes

THE TAFEL ELECTRIC COMPANY, 236 West Jefferson Street, Louisville, Ky., has purchased a large building in the heart of the wholesale district which it expects to occupy at some future time.

THE NORTHWESTERN ELECTRIC EQUIPMENT COMPANY, St. Paul, Minn., has moved its storage-battery department complete from the main building to a new store building at 173 West Fourth Street, where all orders for storage batteries will be handled. Additional space acquired in the new building has enabled the company to increase its battery repair department to a considerable extent.

THE MANN ELECTRIC SUPPLY COMPANY, Columbia, S. C., recently incorporated with a capital stock of $100,000 will distribute electrical supplies and appliances to the trade in South Carolina and adjoining states. M. L. Mann, after whom the concern takes its name, was formerly connected with the Perry-Mann Electric Company, Columbia, having served in the capacity of secretary and treasurer for seventeen years.

THE CARROLL ELECTRIC COMPANY, 714 Twelfth Street, N. W., Washington, D. C., which is now in its twentieth year, operates in the District of Columbia and the States of Maryland, Virginia, West Virginia, Delaware and North Carolina. In addition it has a small foreign business owing to its location in the national capital. The general offices and warehouses of the company are in Washington. The company has a branch office in Baltimore, where it expects shortly to carry a special stock. It is the Westinghouse agent-jobber in this locality and is also distributing agent for a number of manufacturers, including the Free-Westinghouse Company, the Geyser Electric Company, the American Ironing Machine Company and the P. A. Geier Company. At present its sales force is about 50 per cent normal, owing to the lack of materials and apparatus to sell. The force will be increased as the supply of commodities in which it deals becomes obtainable. Harry R. Carroll is general manager of the company, Louis D. Carroll is sales manager, and B. C. Clarke is purchasing agent.

Foreign Trade Notes

MARCHAND BROTHERS, Montreal, Canada, has been reorganized under the name of Marchand Electrical Works, Ltd. The new company is capitalized at $50,000 and will continue to manufacture electrical machinery.

THE PREST-O-LITE COMPANY, INC., St. Boniface, Manitoba, Canada, is planning to build an extension to its factory, to cost about $20,000.

THE CANADIAN GENERAL ELECTRIC COMPANY, Toronto, Canada, is planning to erect a large manufacturing building on Wallace Avenue, to cost about $500,000.

DEMAND FOR ELECTRIC HEATING AND COOKING DEVICES AND MOTORS INCREASING IN CHINA. The use of electricity for industrial and domestic purposes in China is steadily developing, increasing the demand for cooking and heating apparatus and motors.

THE WIGGETT'S BATTERY SUPPLY COMPANY, Sherbrooke, Quebec, Canada, has been reorganized under the name of the Electrical Repair & Supply Company, with a capital stock of $75,000. The company will manufacture all kinds of electrical supplies and also act as manufacturers' agents.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A merchant firm in Brazil (No. 32,737) desires to secure an agency on commission for the sale of electric supplies, etc.

An electric light and power company of a city in Ireland (No. 32,746) desires to purchase two dynamos and one booster.

A hardware company in Canada (No. 32,749) desires to purchase electric washing machines.

An American firm of export commission brokers with a representative member in Australia (No. 32,716) desires to be placed in touch with manufacturers of vacuum cleaners and household labor-saving devices, who will grant sole agencies for their products in that country.

A member of a firm who is an electrical engineer in Colombia (No. 32,769) desires to secure the agency for electric plants suitable for installation in homes and hotels.

A merchant in Belgrade (No. 32,779) desires to purchase a 6-hp. generator with installation for thirty incandescent lamps, 16-cp. to 50-cp., with 3,000 ft. of insulated wire, circuit breakers, tools and necessary apparatus.

Agents and firms in France (No. 32,728) desire to be placed in communication with manufacturers and exporters for the sale of electrical supplies and fixtures, etc.

The Ford Motor Company, Delaware, Mich., has a client in India for whom it desires to obtain quotations on gasoline or oil engine-driven, direct-connected, 125/250-volt, three-wire electric generating sets of 25-kw. to 30-kw. capacity, together with switchboard equipment.

H. S. Turner, 127 Apartado, Santiago, Cuba, would like to communicate with manufacturers of electrical equipment, including interior conduits and fittings, semi-indirect lighting systems, electric light switches and fittings for houses, ornamental electric lamp poles and globes for streets, underground electric light and telephone cables, etc.

Trade Publications

HOT PROCESS WATER SOFTENER.—A book recently issued by the H. S. B. W.-Cochrane Corporation, formerly the Harrison Safety Boiler Works of Philadelphia, describes the hot-process water softener and an improved type of a chemical feeder.

LIGHTING APPARATUS.—The Benjamin Electric Manufacturing Company, Chicago, Ill., is distributing catalog No. 22, dated April 20, 1920, covering all its products. The book is thumb-indexed and gives price lists and other data of its apparatus for industrial lighting, wiring devices, industrial signals, panelboards, etc. Bulletin 18, entitled "Better Lighting on the Farm," issued by the company, describes its special electric lighting devices for farm use.

ELECTRIC FANS.—The Sprague Electric Works of the General Electric Company, New York, N. Y., have issued a small booklet B-3552, giving price lists on its direct-current and alternating-current oscillating and non-oscillating fans and ventilating outfits.

METAL MOLDINGS AND FITTINGS.—The Appleton Electric Company, Chicago, has issued bulletin No. 13, giving a complete list of its "Pagrip" metal moldings and fittings.

REVERSING PLANER MOTOR—Bulletin No. 48,029 of the General Electric Company, Schenectady, N. Y., describes and illustrates reversing drive for planers, slotters, etc.

OIL COOLERS.—The Griscom-Russell Company, 90 West Street, New York, N. Y., has issued bulletin No. 902, describing its multiwhirl cooler for lubricating oils.

TRANSMISSION-LINE INSULATORS—CATALOG No. 19, recently issued by the R. Thomas & Sons Company, East Liverpool, Ohio, gives descriptions and illustrations of its transmission-line insulators and other insulating devices and material.

THEATER SWITCHBOARD—The Frank Adam Electric Company, St. Louis, Mo., [illegible]ing Effects," describing the "Major" switchboard and numerous "Major" installations.

ELECTRIC SOLDERING IRONS—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has issued booklet H, covering its electric soldering irons.

ELECTRICAL SUPPLIES—The Trumbull-Vanderpoel Electric Manufacturing Company, Bantam, Conn., is distributing its 128 page catalog No. 2, giving price lists and other data on electrical supplies manufactured by the company.

New Incorporations

GARDINER & LESIS, INC., New York, N. Y., has been incorporated with a capital stock of $200,000 by J. B. W. Gardiner, New York City, to manufacture insulating materials, wire and cloth fabrics, etc.

THE NATIONAL ELECTRIC WATER HEATER CORPORATION has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $2,000,000. The incorporators are: Robert A. Vanvooris, Jersey City, N. J.; Cornelius A. Cole, Hackensack, N. J., and Arthur R. Oakley, Pearl River, N. Y.

THE CHAIN SYSTEM BATTERY SUPPLIES COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $1,100,000, to act as selling agents. The incorporators are: T. L. Croteau, M. A. Bruce and S. E. Dill, Wilmington, Del.

THE FARMERS & MERCHANTS' ELECTRICAL POWER COMPANY, Sabin, Minn., has been incorporated with a capital stock of $25,000 by E. C. Shroeder, Moorhead, Minn., and others.

THE ELECTRICAL SUPPLY COMPANY, Williston, N. D., has been incorporated with a capital stock of $15,000 by T. S. Huff and others.

THE AURDAL (MINN.) ELECTRIC LIGHT & POWER COMPANY has been incorporated with a capital stock of $40,000 to generate and distribute electricity. John Boen, R. F. D. 4, Fergus Falls, is one of the incorporators. Post office address of the company is Fergus Falls.

THE BROCKET (N. D.) AUTO & ELECTRIC COMPANY has been incorporated with a capital stock of $25,000 by J. L. Trueblood and others

THE UNITED STATES SALES CORPORATION, Sedgwick, N. Y., has been incorporated with a capital stock of $25,000 to manufacture electrical welding products. The incorporators are: Robert A. Cummings, Bronxville, N. Y.; Royal F. Shepard, and Robert N. Chambers, Sedgwick. Sedgwick has not a post office.

THE HOLMES HILTON COMPANY, [illegible] Chancery Street, Trenton, N. J., has been incorporated by Frank Holmes, Jr., Ernest and Samuel Hilton. The company is capitalized at $50,000 and proposes to manufacture electric storage batteries.

THE HAUGHEY'S BURGLAR & FIRE ALARM SYSTEM, Atlantic City, N. J., has been incorporated with a capital stock of $100,000 by Charles C. McKeague, O. E. White and William M. Haughey. The company is capitalized at $100,000 and proposes to manufacture burglar and fire alarm systems.

THE DALYTE LAMP COMPANY, New York, N. Y., has been incorporated by P. J. Mee, M. Kiely and W. B. Boinset, 413 Greenwich Street, New York City. The company is capitalized at $50,000 and proposes to manufacture electric lamps, fixtures, etc.

EDWARD VERSTRAETI & SONS, 10 Railroad Place, Newark, N. J., has been organized by Edmond and Theodore J. Verstraeti, 615 Washington Avenue, Belleville, and others. The company proposes to manufacture electrical and mechanical devices.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

LEWISTON, ME.—Petitions, it is understood, are being circulated for the installation of a street-lighting system on Park Street.

ATKINSON, N. H.—The organization of an electric company to furnish electricity to the town is under consideration.

NORTH STRATFORD, N. H.—The Warner Sugar Refinery Company, 79 Wall Street, New York, N. Y., contemplates the construction of a one-story power plant at its local factory.

AUBURN, MASS.—The New England Power Company of Worcester has applied to the State Department of Public Utilities for permission to erect transmission lines in Auburn.

BOSTON, MASS.—The installation of a "white-way" type street-lighting system on Tremont Street, south of Dover Street to Roxbury Crossing, is under consideration.

BROCKTON, MASS.—Plans have been prepared for improvements to the local electric distribution line.

CHELSEA, MASS.—The W. J. Murdock Company is planning to build an electric specialties factory, to cost about $30,000. Electric light and power equipment will be required. S. S. Eisenberg, Exchange Building, is architect.

FALL RIVER, MASS.—Improvements to the street-lighting system are under consideration.

HOLDEN, MASS. — Extensions to the street-lighting system to remote parts of the town are under consideration.

HOLYOKE, MASS.—The State Legislature has denied the city of Holyoke permission to borrow $2,000,000 for extensions to the municipal electric light plant.

PROVIDENCE, R. I.—The Narragansett Electric Lighting Company plans to issue $1,700,000 in bonds for additions and improvements to its plant.

PROVIDENCE, R. I.—Plans have been prepared for the construction of a power house, 35 ft. x 35 ft., with turbine department, 52 ft. x 54 ft., at the Weybosset Mills of the American Woolen Company.

NEW BRITAIN, CONN.—Arrangements are being made by Landers, Frary & Clark, manufacturers of electrical appliances, for the installation of a new overhead carrier system in its foundry.

Middle Atlantic States

BROOKLYN, N. Y.—Bids will be received by the Department of Public Welfare, tenth floor, Municipal Building, Manhattan, until May 27, for general construction and electrical work for the erection and completion of the Cumberland Street Hospital, Brooklyn. Plans and specifications may be seen at the office of the architects, Ludlow & Peabody, 101 Park Avenue, Manhattan.

BROOKLYN, N. Y.—Stephen Ransom, Inc., 401 West Street, New York, has awarded contract to the Wharton Green Company, 37 West Thirty-ninth Street, New York, for the erection of a transformer building at Hamilton Street, South Brooklyn, to cost about $25,000.

BUFFALO, N. Y.—The Buffalo General Electric Company has petitioned the Public Service Commission for permission to issue $2,000,000 in debenture bonds and $2,000,000 in commercial stock. Proceeds are to be used for new construction work and equipment in 1920.

BUFFALO, N. Y.—Bids will be received by John F. Malone, commissioner of parks and buildings, until May 25, for furnishing wire, conduits, switchboards and other electrical equipment necessary to wire thirty-nine fire-engine houses in Buffalo. Former bids rejected.

BUFFALO, N. Y.—The Niagara & Erie Power Company is planning the erection of a new high-tension transmission system, estimated to cost about $250,000.

BUFFALO, N. Y.—The Niagara, Lockport & Ontario Power Company is preparing plans to double its cables between Lyons and Syracuse, to supply industrial demands. The cost is estimated at about $300,000.

ITHACA, N. Y.—The New York State Gas & Electric Corporation has made application to the Public Service Commission for authority to absorb the New York Electric Company of Ovid and the Standard Light, Heat & Power Company of Unadilla and also to mortgage and issue bonds to the amount of $2,600,000, for improvements to its plant.

MEDINA, N. Y.—The Public Service Commission has granted the Western New York Utilities, Inc., permission to construct new electric power plants at Kendall and Barre, N. Y., to cost about $260,000.

ROCKY POINT, L. I., N. Y.—Edward J. McNally, president of the Radio Corporation, Woolworth Building, New York, N. Y., has announced the purchase of 6,000 acres of land in connection with the construction of a wireless station extending for more than three miles, with seventy-two sets of antennas radiating from a central power house. The cost of the plant is estimated at about $10,000,000.

SCHENECTADY, N. Y.—According to Henry F. Peck, general manager, the Adirondack Power & Light Company is planning the construction of a steam power plant in the Mohawk Valley.

SODUS, N. Y.—The Wayne Power Company has been granted permission by the Public Service Commission for the construction of electric light plants in the towns of Fremont, Howard and Hornellsville, Steuben County, under franchises furnished by the towns.

BLOOMFIELD, N. J.—Plans have been filed by the American LaFrance Engine Company, Elmira, N. Y., for the erection of a power plant on Brookside Place, to cost about $75,000 and to be used in connection with the new local works now under construction.

DOVER, N. J.—The Board of Public Utility Commissioners has granted the New Jersey Power & Light Company permission to issue $152,000 in bonds and $100,000 in preferred stock, part of the proceeds to be used for expansion.

ELIZABETH, N. J.—The Union County Board of Freeholders is considering the proposal to issue $68,000 in bonds for the installation of new lighting, fire-alarm, heat and water systems at the Bonnie Burn Sanitarium.

NEWARK, N. J.—The American Hair Felt Company, 139 Lockwood Street, contemplates the erection of a new one-story power plant, to cost about $20,000.

NEWARK, N. J.—John Campbell & Company, 75 Hudson Street, New York, N. Y., has awarded contract to Joseph Jewkes & Sons, 676 Montgomery Street, Jersey City, N. J., for the erection of a one-story power plant in connection with its local works at Plum Point Lane and Avenue P.

PATERSON, N. J.—Contract has been awarded to the John W. Ferguson Company, 152 Market Street, by the Weiman Silk Dyeing Company, Fifth Avenue, for the construction of a power plant at its local works.

TRENTON, N. J.—The City Commission has awarded contract to Carr & Schultz, 301 Perry Street, for the installation of arc lights at Stacy Park, to cost $13,900.

CALUMET, PA.—The American Electric Manufacturing Company, Harrisburg, Pa., is having plans prepared for the construction of a large plant, including power house, on the old Calumet sewer pipe plant site, which covers 48 acres.

CATASAUQUA, PA.—The Town Council is considering the electrification of the municipal waterworks to replace steam motive power.

KANE, PA.—The City Council has voted to install a street-lighting system.

PENNSBURG, Pa. — Application has been made to incur an indebtedness of $15,000 for new and improved equipment for the borough electric light plant. H. H. Smith is town clerk.

PHILADELPHIA, PA.—The Philadelphia Electric Company has awarded contract to the John R. Wiggins Company, Otis Building, for the construction of an electric plant at 52-54 North Sixth Street, to cost $140,000.

PHILADELPHIA, PA.—Bids will be received by the Department of Public Works until May 28 for the erection of the new South Street bridge, which will be electrically operated. The cost is estimated at about $590,000.

PHILADELPHIA, PA.—Plans, it is understood, are under consideration by the Philadelphia & Reading Coal & Iron Company for the electrification of its various collieries.

MILFORD, DEL.—Bonds to the amount of $21,000 have been voted for improvements to the municipal light plant.

BALTIMORE, MD.—The Locke Insulator Company, Victor, N. Y., has awarded contract to J. Henry Miller, Inc., Eutaw and Franklin Streets, for construction of its proposed new plant, to cost about $500,000.

BALTIMORE, MD.—Plans have been prepared by the Reliable Furniture Company, 303 President Avenue, for the erection of a power plant to be used in connection with its new factory on Wilkens Avenue.

OXFORD, MD.—Commissioners of Oxford have been granted authority to maintain and operate a municipal electric light and power plant.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 26, for furnishing two 200-kw. turbo-alternators, one turbine-driven exciter, one motor-driven exciter and a switchboard, f.o.b. Mare Island, Cal., and service of engineer to supervise installation of same in the power plant at the naval station, Guam, M. I. Specification 4169 may be obtained on application to the Bureau or to the commandant, Navy Yard, Mare Island.

WASHINGTON, D. C.—Bids will be received at the office of the Chief of Engineers, U. S. Army, until May 27, for three switchboard panels.

WASHINGTON, D. C.—Bids will soon be received by Major Moeller, Construction Division, War Department, for erection of generator buildings and other construction work at the following forts, with estimated cost of each: Fort Barry, Cal., $63,000; Fort Nahant, Mass., $271,000; Fort Tilden, N. Y., $66,000; Fort Winfield Scott, Cal., $63,000; Fort Terry, N. Y., $61,000; Fort Andrews, Mass., $59,000, etc.

North Central States

DETROIT, MICH.—The Dodge Brothers Company contemplates the construction of a power house with equipment rated at 40,000 kw., alternating current, to cost about $2,000,000. Plans include the installation of four 12,000-hp. steam turbines, four 12,000-hp. boilers, complete turbo-generator sets, etc. Smith, Hinchman & Grylls, 710 Washington Arcade, are engineers.

DETROIT, MICH.—Sacred Heart Seminary is having plans prepared by Donaldson & Meier, 1314 Penobscot Building, for the construction of a proposed new seminary, to cost about $2,500,000. Considerable electric lighting equipment will be required. W. W. Walker, 155 McDougal Avenue, is chairman.

DETROIT, MICH.—Julius Stroh, 1676 Jefferson Avenue, contemplates the erection of an eighteen-story office building, 80 ft. x 100 ft. Considerable electrical equipment will be used.

SAGINAW, MICH.—Contract has been awarded for the construction of a power plant, to cost about $5,500,000. It is proposed to divert water from the Saginaw Bay, a distance of 25 miles. R. F. Johnson is commissioner of light, water and sewerage.

CINCINNATI, OHIO—The installation of a new street-lighting system is contemplated. William O. Klein is city electrician.

CLEVELAND, OHIO.—Bids will be received by the Cleveland Railway until May 27 for the construction of a substation at East Ninety-ninth Street and St. Clair Avenue, to cost about $100,000. Electrical equipment includes two 1,500-kw. rotary converters with blowers and generators. G. Radcliffe, Leader-News Building, is general manager of the company.

GALION, OHIO. — An expenditure of $75,000 has been authorized by the City Council for enlargement of the municipal electric light plant.

SCIOTO, OHIO.—Preliminary work has been started on the construction of a power plant for the Columbus, Delaware & Marion Electric Company, to cost about $1,000,000. Electrical equipment required will include two turbo-generators having a capacity of 7,500 kva. each, three 2,666-hp. boilers, etc. Sanderson & Porter, 52 William Street, New York, N. Y., are in charge of construction work.

BIRON, WIS. — Contract has been awarded by the Consolidated Water Power & Paper Company to L. A. DeGuere of Grand Rapids for the erection of an addition, 40 ft. x 60 ft., to its hydro-electric plant at Biron.

MENASKA, WIS.—The Board of Education has awarded contract to C. Meyers & Sons Company, 50 State Street, Oshkosh, for the construction of a high school addition and power house, to cost about $95,-000.

MILWAUKEE, WIS.—The Parry Products Company has awarded contract to the Burrell Engineering & Construction Company, 233 South La Salle Street, Chicago, Ill., for the erection of a grain elevator and warehouse, 50 ft. x 350 ft. Electrical equipment, including motors, will be required.

FOLEY, MINN.—Bids will be received by the Bradley Engineering Service, St. Cloud, Minn., engineers, until June 1, for one motor-driven, double-stroke deep-well pump.

DAVENPORT, IOWA. — In connection with the electrification of the proposed plant of the Western States Portland Cement Company, to be constructed on the Nutting Farm, east of Davenport, the People's Light Company of Moline, Kan., will erect an aërial cable from its plant, across the Mississippi River to Nutting Farm, at a cost of about $125,000. Energy up to 3,000 kw. will be supplied. Clark G. Anderson is general manager of the People's Light Company.

SIOUX CITY, IOWA.—The South Lighting Company, Sloan, Iowa, has petitioned the State Board of Railroad Commissioners for a franchise to establish a light, heat and power system in Sioux City.

BILLINGS, MO.—A corporation has been formed by the farmers along the road between Billings and Marionville and by Billings business men for the purpose of extending the White River power transmission line at Marionville, to supply electricity to Billings and homes along the line in that district.

JAMESTOWN, N. D.—The Jamestown-Medina High Line Company contemplates the erection of a 30-mile high-tension transmission line, to cost about $100,000.

MINOT, N. D.—At an election to be held on June 30 the proposal to erect a municipal electric light plant will be submitted to the voters.

BRISTOL, S. D.—The Mid-West Electric Company has been recently organized for the purpose of furnishing light and power to Bristol and the adjoining townships of Bradley, Butler, Lily and Crocker.

MITCHELL, S. D.—Improvements and additions to the local power plant, to cost about $200,000, are under consideration.

WATERTOWN, S. D.—The City Council is considering the construction of a municipal electric light plant, a distribution system and improvements and extensions to the street-lighting system.

Southern States

NEWLAND, N. C.—The Newland Light & Power Company, recently incorporated, contemplates the erection of an electric power plant and a 12 ft. dam, at a cost of about $15,000. The company also contemplates the erection of an 1,100-ft. transmission line.

WINSTON-SALEM, N. C. — Reynolds' Tobacco Company plans to erect a one-story electric power plant, to cost about $50,000.

ANDERSON, S. C.—Improvements to the electric light and waterworks systems in the Gluck Mills, to cost about $150,000, are being planned by the management. W. Z. McCue is in charge.

AUGUSTA, GA.—Construction of a hydro-electric plant in Augusta is proposed A. E. Parsons of Lockwood, Green Company of Atlanta is engineer.

SAFETY HARBOR, FLA.—Negotiations are being made for the Oldsmar Light & Ice Company to furnish electric light and power to Safety Harbor.

ST. PETERSBURG, FLA.—At an election to be held on June 18 a proposal to issue $28,000 in bonds will be submitted to the voters for the installation of a street-lighting system.

GADSDEN, ALA.—The Alabama Power Company of Birmingham will erect a transmission line to the state line, near Rome, Ga., to cost about $250,000.

EDWARDS, MISS.—Bonds to the amount of $7,500 have been voted for the construction of an electric light and power plant.

HATTIESBURG, MISS.—The construction of a $500,000 plant by the Hercules Powder Company of Wilmington, Del., will consist of sixteen buildings, including power house, boiler and retort houses, etc.

STEVENS, ARK.—The Board of Trade is considering the several applications made for franchise to install an electric light system in this locality.

TULSA, OKLA.—In connection with the high-tension transmission line to Skiatook, now under construction, a substation will be built north of Tulsa to boost electricity generated at Sand Springs to Turley and at Sperry to Skiatook.

BEEVILLE, TEX.—The municipal electric light plant has been sold to the Texas Gas & Electric Light Company. The new owner will remove the machinery to its plant and have it installed.

CLYDE, TEX.—The city plans to install new pump and power equipment at the municipal waterworks.

EASTLAND, TEX. — Preliminary work on the construction of a hydro-electric plant of the Oil Belt Power Company is well advanced. Plans include the construction of a dam across the Leon River, 4 miles south of Eastland, to impound more than 600,000,000 gal. of water as a source for generating electricity to be distributed by means of transmission lines. The company proposes to furnish electric energy for drilling and pumping oil wells in central west Texas fields. J. E. Lewis is general manager of the company.

FORT BLISS, TEX.—Bids will be received by constructing quartermaster, Fort Bliss, until May 31, for the erection of a 400-bed hospital. Plans include electric lighting, central heating plant, etc.

HOUSTON, TEX.—Petition has been filed by C. L. Brock, park superintendent, to change the lighting system in the public parks.

Pacific and Mountain States

MORTON, WASH.—J. B. Campbell of Springfield, Ill., has purchased the power plant and business of the Morton Electric Company.

OAKVILLE, WASH. — The Oakville Light & Power Company has been purchased by C. A. Bartin of Puyallup. Extensive improvements to the plant are planned.

PUGET SOUND, WASH.—Bids will soon be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing and installing surface condenser, wet vacuum pump, after-cooler, booster pump, new oil filter pump and appurtenances for a 6,500-c.f.m. reciprocating air compressor in the power plant of the Puget Sound Navy Yard. Drawings and Specification 4179 may be obtained at the Washington (D. C.) address or from the commandant, navy Yard, Puget Sound, Wash., upon deposit of $10.

ENTERPRISE, ORE. — The Enterprise Milling & Mercantile Company has applied to the state engineer for permission to divert 90 sec.-ft. of water for electric light, power and manufacturing purposes. Plans to include installation of turbine, erection of dam, etc.

PORTLAND, ORE. — The Public Dock Commission has authorized the installation of an additional lighting circuit at Pier 1 of Municipal Terminal 4, to furnish light to ships at pier in cases of emergency.

HAMMONTON, CAL. — The local substation of the Pacific Gas & Electric Company has been destroyed by fire, causing a loss of $2[illegible].

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Corporation, 645 South Hill Street, will issue bonds to the amount of $1,500,000 for additions to its plant.

LOS ANGELES, CAL.—The Southern California Edison Company has been granted permission to issue bonds to the amount of $5,000,000, to be expended for its hydro-electric developments, including construction of distribution and transmission lines.

OAKLAND, CAL.—The Town Council is planning for an appropriation of $50,000 for municipal lighting purposes.

PASADENA, CAL.—The city of Pasadena is negotiating for the purchase of the local electric light and power plant of the Southern California Edison Company, with the view of merging it with the municipal light and power system.

RICHMOND, CAL.—The lights committee of the Chamber of Commerce is investigating a new street-lighting system for the business section of Richmond.

SAN FRANCISCO, CAL.—An expenditure of $13,062,426 is planned by the Pacific Gas & Electric Company, 445 Sutter Street, for additions and betterments to its electrical generating and distributing system, including hydro-electric plants on the Pitt River, transmission lines, etc. John A. Britton is vice-president of the company.

SAN JOAQUIN, CAL. — Bonds to the amount of $1,000,000 have been voted for the construction of canals and laterals and for sinking eighty wells, to be equipped with modern force pumps, for irrigation purposes for the James Colony, owned by the San Joaquin Farm Lands Company.

LOGAN, UTAH—Improvements and additions to the municipal lighting plant, it is reported, are contemplated.

BILLINGS, MONT.—Bids will be received by E. H. Sackett, city clerk, until June 1, for furnishing and erecting 192 street-lighting posts in Lighting District 4.

Canada

KINCARDINE, ONT.—Plans will soon be prepared by Thomas Flint, Eugenia Falls, engineer, for the construction of a hydro-electric plant and the erection of a distribution system in this district, to cost about $45,000.

NEWMARKET, ONT.—Separate bids will be received by E. A. James, 36 Toronto Street, Toronto, engineers, until June 4, for improvements to the Industrial Home, to cost about $25,000. Plans include electric light wiring, two electric motors, radial brick chimney, ventilation system and fan, one 3-hp. electric motor and fan, etc.

NEWMARKET, ONT.—Bids will be received by E. A. James Company, 36 Toronto Street, Toronto, until May 25, for the erection of a sludge plant in connection with a sewage system, to include compressor building and the installation of two 200-c.f.m. electrically driven air compressors. The cost of the project is estimated at $65,000.

PORT CREDIT, ONT.—Bonds have been indorsed for the construction of a hydro radial from Port Credit through Hamilton to St. Catharines.

ST. CATHARINES, ONT.—The Power Specialty Company, 111 Broadway, New York, N. Y., plans the construction of a factory on two acres of land, recently purchased, for the manufacture of superheaters, etc.

TORONTO, ONT. — The erection of a steam power plant is planned by the Hydro-Electric Commission. The location has not been decided upon.

WINDSOR, ONT.—A civic building, to serve other adjoining municipalities, will be erected at a cost of about $1,500,000. F. L. Howell, 82 Caron Street, Windsor, is alderman.

WEEDON, QUE.—Bids will be received at the office of the engineer, Room 16, Whiting Block, Sherbrooke, for the construction of a dam and power house at Weedon. Plans and specifications may be seen at the above office.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer of the Panama Canal, Washington, D. C., until June 2 for furnishing duplex pump, copper cable, steel cable, copper wire, electric bells, carbons, condulets and covers, fuses, lighting switches, motors, plugs, transformers, etc., under Circular 1367.

Record of Electrical Patents

Notes on United States Patents

(Issued April 20, 1920)

1,337,311. Calling Device; John A. Hall, East Orange, N. J. App. filed July 12, 1917. Similar in appearance and manipulation to well-known commercial automatic telephone dial switch.

1,337,322. Impulse Starting Mechanism; Frederick D. Norman, Springfield, Mass. App. filed Sept. 21, 1917. Impelling spring arranged to be stressed upon relative angular displacement of the driving and driven devices.

1,337,324. Automatic Telephone System; Winfred T. Powell, East Orange, N. J. App. filed March 28, 1918. Automatic switches controlled by impulses produced by an impulse-transmitting device associated with a calling line.

1,337,325. Telephone-Exchange Apparatus; John N. Reynolds, Greenwich, Conn. App. filed Jan. 8, 1918. Switching apparatus employed in exchanges for extending or completing telephone connections.

1,337,331. Impulse Starting Mechanism; Wolfgang E. Schwarzmann, Springfield, Mass. App. filed Sept. 21, 1917. Driven device is given one or more impulses at a speed considerably higher than speed of driving device.

1,337,349. Method of and Apparatus for Producing X-Rays; Cornelius D. Ehret, Philadelphia, Pa. App. filed Nov. 13, 1918. Tube comprising an anti-cathode or target spaced in vacuo from a cathode which re-emits electrons or emits secondary electrons as a result of bombardment by primary electrons.

1,337,357. Fuse Indicator; William H. Holdorf, Minneapolis, Minn. App. filed Aug. 2, 1918. Fuse blows and releases spring which moves indicator.

1,337,363. System of Electrical Distribution and Control; Charles F. Kettering, Dayton, Ohio. App. filed Nov. 27, 1916. Batteries prevented from excessive overcharging.

1,337,364. System of Electrical Generation and Control; Charles F. Kettering, Dayton, Ohio. App. filed Dec. 16, 1916. Prevents operation when fuel supply reaches a predetermined low point.

1,337,366. Circuit Breaker; Thomas Midgley, Jr., Dayton, Ohio. App. filed Feb. 15, 1918. Controlled by a hydrostat controlled by condition of storage-battery electrolyte.

1,337,422. Electric Plug; Eli D. Whelpley and William E. Winters, Oneida, N. Y. App. filed April 15, 1918. Inserted in standard lamp sockets without turning plug.

1,337,457. Apparatus for Rivet Setting and Similar Operations; Simon Lake, Milford, Conn. App. filed Dec. 5, 1919. Device supports tools, cables, tubes, hose.

1,337,471. Telephone-Exchange System; William H. Harrison, Brooklyn, N. Y. App. filed May 9, 1918. Central office link circuit provided with relay which is energized upon each energization of link-circuit supervisory relay.

1,337,482. Electric Signaling System; Frank N. Reeves, Newark, N. J. App. filed Oct. 25, 1916. Variably operable signals selectively associated with controlling station.

1,337,505. Electrical Condenser; William C. Brinton, Jr., Kennett Square, Pa. App. filed Dec. 13, 1917. Covers lead with a strip of varnished paper, which prevents it from cutting dielectric material.

1.337,543. Metallic-Arc Welding; Jack Churchward, New York, N. Y. App. filed Jan. 14, 1920. Electrode for welding a railroad frog of manganese austenitic steel having approximately the same composition as the electrode.

1,337,549. Condenser; Robert J. Fitzgerald, N. Y. App. filed Nov. 4, 1919. Elements coated with a non-conducting film permanently deposited and enveloping the conductor.

1,337,573. Controlling Means for Electric Motors; Frank G. Warburton, Manchester, Eng. App. filed Nov. 27, 1916. Two shafts operated normally at uniform speed with regulator adjusted to counteract angular movement which may take place.

1,337,613. Electrical Control Mechanism for Automobiles and Other Vehicles and Machines; William J. P. Moore, New York, N. Y. App. field March 10, 1916. A twin electric drive jointly controlled.

1,337,633. Electrical Heating Element. Philip F. Apfel, Seattle, Wash. App. filed April 26, 1919. Double coil of wire eliminates danger of short circuit.

1,337,649. Starting and Ignition System for Internal-Combustion Engines; Valere A. Fynn, St. Louis, Mo. App. filed Mar. 7, 1918. Prevents wasting battery energy.

1,337,662. Electric Welding Appliance; Ralph P. La Porte, Schenectady, N. Y. App. filed Dec. 3, 1919. Position of weld properly located enabling operation by inexperienced help.

1,337,671. Telephone-Exchange System; Arthur B. Sperry, New York, N. Y. App. filed June 6, 1918. Connection whereby either party may cause complete release of switching means involved.

1,337,676. Telephone System; Ray S. Wilbur, Lyndhurst, N. J. App. filed Oct. 17, 1918. Limited number of trunk lines used to supply a large number of channels between various switchboards connected with trunk lines.

1,337,681. Telephone-Exchange System; Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed March 29, 1917. Power-driven switches in which line-finder switches are arranged to be controlled in group, subgroup and line selection.

1,337,686. Electric Motor; Solomon Boardman, Binghamton, N. Y. App. filed April 7, 1916. Power and speed adjusted without changing wire resistance in circuit in which machine is connected.

1,337,692. Telephone Set; Walter G. Crawford, New York, N. Y. App. filed April 24, 1917. Provides unit construction.

1,337,694. Telephone Amplifier; Henry C. Egerton, Passaic, N. J. App. filed June 7, 1916. Device for relaying telephonic currents.

1,337,699. Telephone System; Charles L. Goodrum, New York, N. Y. App. filed April 24, 1917. Combinations of fast and slow relays to control the setting and releasing movements of switches.

1,337,887. Starting Device for Internal-Combustion Engines; James K. Delano, New York, N. Y. App. filed April 17, 1915. Operable as motor for starting engine or as generator for storing up energy in storage battery.

1,337,976. Telephone System; John E. Hilbish, La Grange, Ill. App. filed July 16, 1915. Key plunger connects ringing current automatically to circuit connected with calling end of link circuit.

(Issued April 27, 1920)

14,848 (reissue). Telephone System; Ruben C. M. Hastings, Columbus, Ohio. App. filed April 11, 1912. Automatic ringing device energized by introduction of jack plug into a socket at the exchange.

14,849 (reissue). Process of Electrochemical Precipitation of Metals; Edward R. Holden, Los Angeles, Cal. App. filed June 11, 1918. Process for electrolytically treating solutions containing metallic substances and recovering metals from solutions.

1,338,020. Combination Faradic and Vibratory Massage Implement; Edward Masayoshi Kojima, Los Angeles, Cal. App. filed June 4, 1917. For producing therapeutic effects by vibration and heating means for stimulating circulation.

1,338,021. Method of Manufacturing Simultaneously Hydraulic Cement and Alkali from Alkaliferous Mineral Substances and Lime; Ernst W. Jungner, Kneippbaden, Sweden. App. filed July 31, 1918. Electrically generated heat for rinsing calcined raw mass from 600 deg. to about 1,450 deg. and for driving off and volatilizing alkali.

1.338,041. Device for Preventing Excessive Wear on Car-Lighting Dynamos; Harry D. Rohman, New York, N. Y. App. filed Aug. 19, 1919. Confines amount of belt slippage within predetermined limits.

1.338,088. Electric Heating System; John S. McWhirter, New York, N. Y. App. filed Nov. 15, 1917. Loss of current due to leaving heating system in operation through neglect is eliminated.

1,338,092. Commutator; John W. Pearson, Chicago, Ill. App. filed Sept. 6, 1918. Clamping arrangement for commutator bars.

1,338,093. Armature; John W. Pearson, Chicago, Ill. App. filed Sept. 12, 1918. Mechanical disposition of conductors on core and across ends of slot-wound drum armatures intended for high-speed operation.

1,338,103. Electric Iron-Ore-Smelting Furnace; James D. Shipton, Vancouver, B. C., Canada. App. filed Sept. 22, 1919. Uniform grade of metal obtained with an economical application of current.

1,338,130. Storage-Battery Terminal; Clarence W. Hazelett, Lakewood, Ohio. App. filed Nov. 3, 1916. Used with terminals of battery connected to flexible cables.

1,338,132. Magnet Steel; Kotaro Honda, Yonega-Fukuro, Sendai, Japan. App. filed Oct. 22, 1917. Manufacture of permanent magnets from alloys comprising carbon steel, cobalt and one or more metals of chromium family.

1,338,133. Magnet Steel; Kotaro Honda, Yonega-Fukuro, Sendai, Japan. App. filed Oct. 22, 1917. Strong residual magnetism and large coercive force.

1,338,134. Magnet Steel; Kotaro Honda, Yonega-Fukuro, Sendai, Japan. App. filed Oct. 22, 1917. Body of an alloy steel containing cobalt and molybdenum.

1,338,151. Detachable Magneto-Armature Heads and Core; Richard A. Golesby, South Bend, Ind. App. filed March 19, 1917. Detachable magneto armature heads and core.

1,338,170. Battery Indicator; William C. Carlon, Stockton, Cal. App. filed July 28, 1917. For motor vehicles.

1,388,180. Service and Meter-Test System and Associated Apparatus; Bryson D. Horton, Detroit, Mich. App. filed April 22, 1913. Prevent unauthorized tampering.

1,388,193. Trolley Head; Louis Sabo, Beaver Falls, Pa. App. filed Sept. 7, 1917. Pair of guard arms for a trolley wheel.

1,338,213. Lightning Arrester; Gerhard P. A. Damschen, Oconomowoc, Wis. App. filed April 27, 1918. Grounding electrical circuit after being struck by lightning.

1,338,222. Storage - Battery Lamp; Clarence W. Hazelett, Lakewood, Ohio. App. filed Aug. 7, 1916. Portable Lamp.

1,338,226. Attachment Plug; John J. Kenney, Pittsburgh, Pa. App. filed Aug. 7, 1916. Removes all strains on binding posts.

1,338,239. Searchlight Firearm; Joseph Matys, East Brimfield, Mass. App. filed July 20, 1917. Light rays directed toward target automatically.

1,338,269. Multiphase-Slow-Sine-Wave Producer; Reinhold H. Wappler, Yonkers, N. Y. App. filed Feb. 6, 1919. Control of faradic currents as employed in electro-therapeutics.

1,338,271. Process for Recovery of Metals from Their Ores; Harry V. Welch, Los Angeles, Cal. App. filed Aug. 11, 1917. Production of zinc by electrolytic action.

1,338,279. Composition of Matter and Process of Making the Same; Henry Blumenberg, Jr., Los Angeles, Cal. App. filed Feb. 23, 1917. Metal alloy with water, will generate either phosphin, arsin and stibin, or a mixture of any two.

1,338,294. Electrical-Heater Resistance Element; William E. Gardner, Pittsburgh, Pa. App. filed July 7, 1919. Made of pure coke carbon and white bone ash.

1,338,301. Arc-Current Regulator; Joseph Andrew Holifield, Mobile, Ala. App. filed June 18, 1919. Constant current for welding without dead resistances or power wasting devices.

1,338,309. Synchronizing-Clock; Clinton E. Larrabee, Binghamton, N. Y. App. filed July 10, 1919. Momentary current impulses transmitted from or by master clock effects same results as prolonged currents heretofore used.

1,338,318. Automatic Telephone System; Talbot G. Martin, Chicago, Ill. App. filed Dec. 15, 1916. Two-wire type in which the subscribers' lines are provided with individual line switches.

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician
Published by McGraw-Hill Company, Inc.

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Volume 75 New York, Saturday, May 29, 1920 *Number* 22

Western Spirit in N. E. L. A. Reports

TO THE central-station industry the Pasadena convention of the N. E. L. A. has contributed, among the other things that have always come from such meetings, one far-reaching influence. It has recorded and made available an interpretation of the spirit of the West in a language filled with evidences of opportunity and development which the engineer, the central-station executive and the financier interested in the welfare of the central-station business can understand. This year many of the vital reports have been compiled by Western engineers and commercial men, and in these reports they have not only painted the pictures of work done and to do but have given fundamental facts on which this work has been based and must in the future be based if electric service is to extend farther and farther into the fertile regions hardly explored in that great empire west of the Rockies. In the address of President Ballard and the reports of the public policy committee, the water-power development committee and others which were presented in the ELECTRICAL WORLD last week, and in the discussions on reports of some of the technical and commercial committees that are presented in this issue, there is a Western viewpoint that will be inspiring to central-station men in other sections of the country. S. M. Kennedy's ideals of service and A. Emory Wishon's self-interest plan applied to utility financing have made an indelible impression. A wide application of the principles involved will go a long way in helping the public to realize that the central station is a community builder as well as a public servant.

The Washington Conference

ONE hundred thousand engineers and forty-four engineering bodies are to be represented at the organizing conference of technical societies which will meet in Washington next week. Such widespread participation in the meeting is ample testimony to the potency of the idea that underlies it. That idea we take to be the very simple and human one that it is time for the engineer to assert himself in a way for which the technical associations do not provide. Class segregation is foreign to the spirit of American institutions, but none the less there exists a field of service —social, political, nationally constructive, broadly intellectual—in which an enlightened self-interest impels every considerable body of men to take a collective part. The engineers of America have long been a considerable body of men, but never yet have they taken such a part. If by the comparison of views and the thrashing out of differences the Washington conference can remodel any existing body—and there are two that afford the opportunity—or call into being a new one to meet the need, thus providing engineers both with a means for exercising a beneficent influence on the current of public opinion and with an aid to legitimate self-advancement, from it an epoch in the annals of engineering will date. Whether such a body shall be founded on the plan of individual, voluntary membership or on membership entailed automatically by the fact of belonging to a technical society is a non-essential which the conference or those whom it represents must work out. What is essential is that the new body, if it shall be born, shall have behind it a united army in which the wisdom of the veterans, the strength of the seasoned troops and the enthusiasm of the recruits shall combine to make an invincible esprit de corps, with unselfish public service the great object in view.

Electrical Price Policy

PRICE policies in the electrical industry have not kept pace with the growing importance of the electrical business among the fundamental industries of the country. No doubt this is partly due to the fact that every electrical man is imbued with the belief that electricity must always do things cheaply. This is not quite true. There are cases where cost is a secondary consideration and quality of results is primary. Moreover, in the electrical industry the men who make the prices are the salesmen of the business, who more often represent the point of view of their customers than the viewpoint of their own company. This has been one of the factors that have kept the electrical industry practically free from profiteers in the recent scramble to "boost" prices. To that extent the system is commendable. However, if business is now to enter on a period of narrower margins of profit, as many think it will, a change in methods of determining and quoting prices seems necessary so that the man who makes the sales will be able to maintain and stimulate a demand for goods of high quality.

Emmet as an Engineer

AS AN engineer William LeRoy Emmet, to whom the Edison medal was awarded last week for achievements in invention and developments in electrical apparatus and prime movers, as reported elsewhere in this issue, represents a rare type to whom the electrical industry owes much. For thirty-three years he has worked earnestly and enthusiastically toward one end, the mastery of the obstacles that lie between engineering theory and its practical application. In this work he has shown tenacity and fearlessness, his inward conviction of success and his practical knowledge of operating conditions enabling him to weather discouragement. Apparent failure in principle only led Emmet to study details, for in his fullness of knowledge of these details he has perfected the fundamentals. In the analysis of faults, mechanical and human, Mr. Emmet is a master worker. Although said to have been a dull student as a boy, he has through untiring energy and diligent application of his faculties not only overcome such a handicap, if it did exist, but injected into engineering thinking methods that will bear close study and extensive imitation. To offers of large salaries and positions of executive importance such as men of lesser ability have succumbed to Mr. Emmet turned a deaf ear, preferring to remain in the depths of unsounded engineering problems rather than assume the direction of more certain and better explored endeavors. Mr. Emmet has never been an investigator on paper, but as an observer and analyzer of deficiencies of design he has, like a great physician, diagnosed troubles where others have failed; and in this work he has never shown the slightest fear in departing from regular practice. His present work on the mercury-vapor turbine is an example which promises to revolutionize steam-electric plant practice with economies beyond the fondest dreams of his co-workers in this field.

Economies Through Standardization

THROUGH all the trying experiences of the last year or two central stations have maintained a remarkably high grade of service. This is, of course, the chief function of the utilities, and the character of service must be jealously guarded. Most of the companies, however, are facing a most serious problem in financing sorely needed additions and maintenance construction work. The danger lurking in this state of affairs is dwelt upon by the electrical apparatus committee of the National Electric Light Association, whose report is abstracted rather fully in this issue. The situation must be brought to the attention of regulatory commissions so forcefully that no one shall misunderstand the necessity for relief measures. In the meantime every effort should be made to guard the good name of central-station service.

The committee urges the importance of standardization of such a nature that it will not interfere with progress. This matter is of particular importance in these days of high prices, and the success which has already been attained by the elimination of unnecessary transformer ratings is worthy of careful consideration. Manufacturers say that transformer price increases would have been 30 to 40 per cent greater had the standards not been adopted.

Of timely interest is that part of the report devoted to automatic operation. While considerable information is available showing the economy of automatic operation in electric railway practice, central stations have not adopted it extensively. The cost of manual operation, however, has risen to such a degree that central stations should now consider fully the possibility of automatic and remote-control apparatus for their systems. The committee reports that 500-kw. automatic motor-generator substations are soon to be installed both in a three-wire direct-current system and in an industrial plant. Small automatic hydro-electric plants are also being built and data should soon be available concerning their operation. Details of some of these were presented in the Feb. 28 and April 10 issues of the ELECTRICAL WORLD, pages 477 and 827.

An important activity of the committee has been the consideration of the proposed National Safety Code in co-operation with the Bureau of Standards. Apparently there has not been full agreement in the matter of the fire hazard of oil-filled apparatus. There does not appear to be evidence that the hazard is great, but the subject needs further investigation in order that the operating companies shall not be unnecessarily hampered by drastic commission rules.

On the plan of subdividing its membership geographically, which was instituted this year, the committee reports favorably. This plan resulted in fuller participation in committee activities by the forty-five individual members.

Findings of N. E. L. A. Prime-Mover Committee

ONE of the technical events of the year now generally recognized among central-station engineers is the presentation of the report of the National Electric Light Association's committee on prime movers. No other committee keeps in better and closer touch with the developments of its subject or furnishes a greater volume of practical information. The work of the committee this year does not fall behind that of its predecessors. Its study of the steam turbine is perhaps the most important part of its task. As turbines have steadily increased in output they have gained in efficiency, but at the cost of constructional difficulties of no insignificant order. At the present moment the committee believes that about 30,000 kw. is the maximum size to be considered at all standard for single-shaft machines, although a single unit 50 per cent above this capacity is now in operation. For greater outputs practice is tending toward compound turbo-generators in which the total stages of expansion are divided between two or more mechanical units linked only electrically.

Just what the final economic relation is between such a combined unit and several single-shaft machines of the same aggregate output remains yet to be seen. The tests of some of the compound generators look remarkably well, but it is not yet clear whether in practical operation there is any real gain or whether the test conditions are equally favorable to the things compared. Whether, let us say, 60,000 kw. in one composite unit or two independent ones gives the better mechanical condition is still uncertain, for in fact it is the mechanical problems in these large outputs which really are grave matters for concern. There have been several serious failures in large units, due in the main to vibration of the wheel structure already worked at high stress and eventually yielding to fatigue. At the high speeds and stresses in use dynamic balancing becomes increasingly necessary and may have an important bearing on safe operation. Incidentally it is subject for congratulation that the engineering division of the National Research Council is taking up the matter of fatigue of metals to improve conditions in their use.

Another phase of the committee's investigations deals with the condenser. It is pointed out that the education of station operators in the proper handling of condensers and auxiliary apparatus and in the analysis of their performance is a matter too important to be overlooked. It is just here that care may actually determine the economical operation of the plant. There is a limit with any given turbine design to the vacuum which can be advantageously used, while up to this limit there is material gain, so that turbine and condenser cannot be considered apart but must be regarded as a thermodynamic unit. An interesting sidelight on condenser difficulties is shown in a brief report to the committee regarding the resistance of condenser tubes to corrosion, bearing particularly on the structure of the metal as related to its final endurance.

On the other side of the turbo-generator lie the boilers with economizers and superheaters, and at the extreme end of the line are the furnaces and their feeding apparatus. The tendency toward large boilers, long delayed in this country, has been rapidly increasing of late, so that units of 1,000 and 1,500 nominal horsepower or even larger are becoming common. Pressures, too, have increased, but since the last report there is little to add in the way of experimentation. It must be agreed that boilers and turbines can be developed for much higher pressures than those now in use. The limitation seems to come from final temperature rather than pressure, and this limit probably lies below 800 deg. Fahr. as the result of both pressure and temperature. The difficulties of the higher pressures lie perhaps more in the piping and auxiliaries than in the boilers and turbines, and how the effect of this limitation will bear on the distribution of temperature as between superheat and pressure is altogether indeterminate. At present the tendency seems not to be over 250 lb. and 300 lb. per square inch (17.5 kg. to 21 kg. per sq.cm.) as to pressures and to build up the rest of the safe temperature for superheating.

One important feature noted in the committee's report is that on the whole superheaters give a remarkably small amount of trouble, which is an encouragement to their more extensive use. The whole question of their employment is that of the most economical source for the heat necessary to push the feed water to its final temperature. At present practice varies widely, running all the way from depending wholly on available exhaust for feed-water heating to extensive use of economizers helped out by what exhaust may be available.

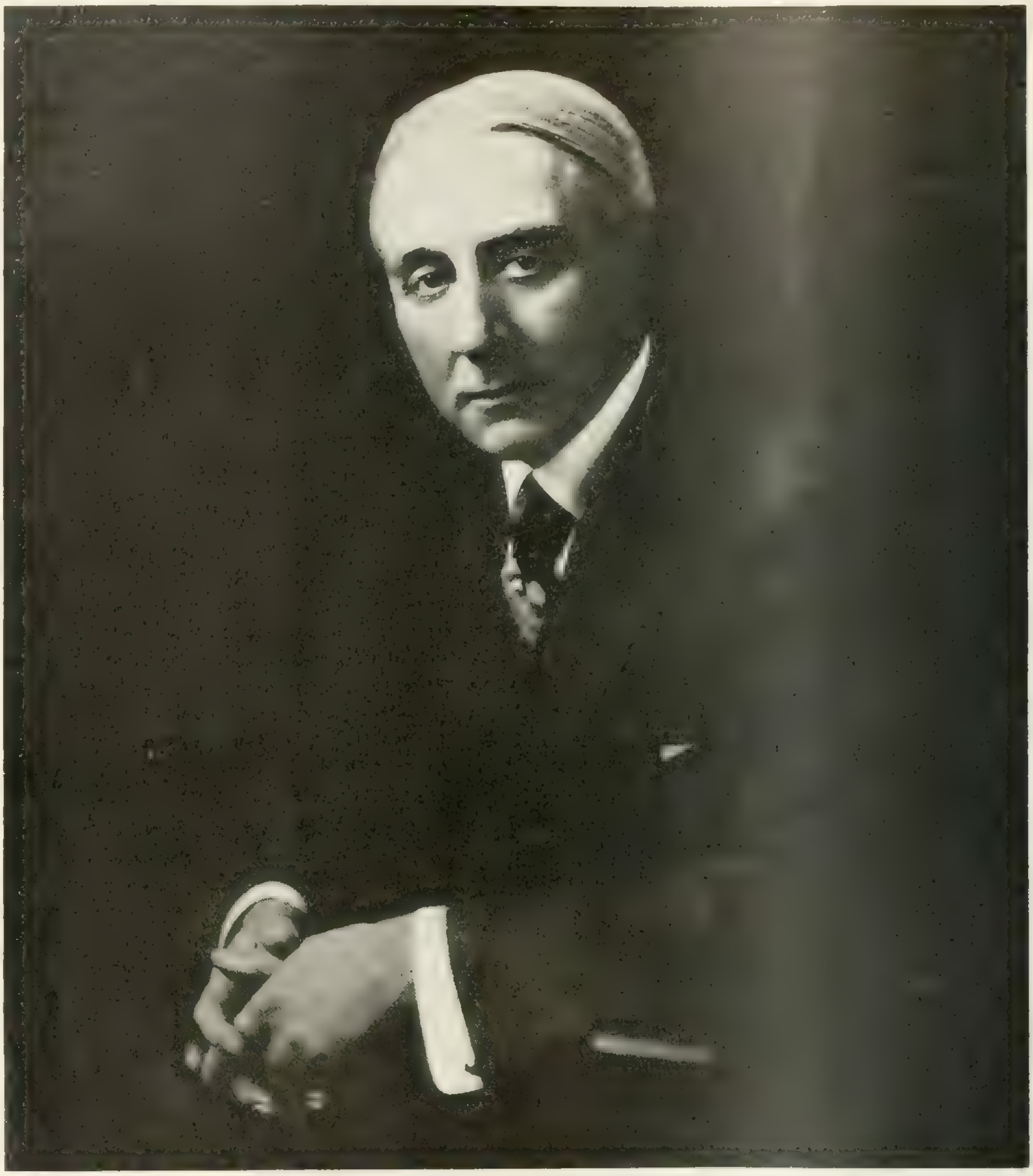
Returning to the furnaces, there has not been much to be added with respect to the ordinary stoking devices handling good fuel. There has been much progress, as we have often indicated in these columns, in the burning of low-grade coals and lignite. With proper furnaces and stokers, both chain-grate and underfeed, good boiler efficiencies have been maintained with a decidedly mean quality of fuel running between a little over 7,000 B.t.u. and a little over 9,000 B.t.u. per pound. In the present state of fuel supply these data are important. The day has passed when one can figure on the use of first-class steam coal as general practice. As a corollary to this subject the use of pulverized fuel is beginning to assume considerable importance. Powdered coal in quantity has been successfully piped a distance as great as 2,000 ft. (600 m.) from the powdering plant, but the present tendency is to powder on the spot. Where this is done the boiler plant is pushed fully up to its normal efficiency and the utilization of the fuel is excellent. Just how far the process can be made available will in the long run depend on its bearing on the use of low-grade fuel, a subject which has not yet been thoroughly worked out, although the outlook is somewhat favorable. At all events the furnaces for burning powdered coal are similar enough to those used for oil firing to make a change-over a far less serious matter than when using ordinary coal. As we have frequently intimated, the use of fuel oil is not a matter of engineering but of sheer commercialism. As a fuel it is excellent and easily applied, but the question of cost is an entirely different story, particularly when one looks a little to the future.

Finally, passing from these matters of combustion to the utilization of the "white coal" of which the supply is perpetually renewed, one of the very striking improvements of the last decade has been in the design and construction of large water turbines. Single waterwheels of 40,000 hp. capacity have already been installed, while bigger ones are under consideration. What is more, the efficiency obtained, due to size, care in design and fine finish of the working parts, has reached a point far beyond anything which could have been predicted at the beginning of the century. Hydraulic efficiencies from water to generator terminals very close to 90 per cent have already been recorded. Most of the advance has been made in turbines of the Francis type, which are now in use up to heads of many hundred feet. The impulse wheel, the mainstay of hydro-electric plants in their earlier development, has, however, not been left unimproved. It has been increased in size to a maximum of 15,000 hp. With these splendid possibilities in the use of large and efficient units in hydro-electric work, the possibilities of efficient development, particularly where long storage is necessary, are vastly increased.

Equalization of Load Factor

EQUALIZATION of load factor is a problem of such importance that every widespread power distribution system must of necessity seek its solution. In this issue it is discussed in an interesting way with reference to a plant at Pine Bluff, Ark. This plant is not a large one, the connected load being only a few thousand horsepower, with about 250 miles (400 km.) of distribution line operated at from 33,000 volts to 2,300 volts. A particularly striking feature of the system is that its situation and the industrial conditions of the territory it serves lend themselves readily to equalization of load throughout the year, gaining in a small territory in a limited way the objectives which must be sought whenever a widespread distribution from a large station is attempted.

It happens that in this part of Arkansas there is an irrigation pumping load for the rice fields through the spring and summer. In autumn and early winter this load is replaced by cotton ginning and the rest of the year by the cottonseed-oil mills, which furnish a ready market for power. These three loads, coming virtually in succession, enable the year's business to be kept at a fairly steady level, taken, of course, in connection with the miscellaneous power and lighting on the system. There are more than fifty motor-driven irrigation wells for this purpose, serving a total area of nearly 7,000 acres (2,800 hectares) of rice fields. As the pumping load falls off the cotton gins begin to come on, a 1,000-kw. connected load altogether, with an all-day call for power. As the cotton is ginned and this load diminishes the cottonseed mills start up, running from midnight Sunday to midnight Saturday, with an almost continuous and steady load. The sequence gives in a small region an extremely good opportunity to obtain efficient use of the generating plant. A widespread system diversity of load with respect to season can be sought on a larger scale and with similar good results in the yearly load factor.

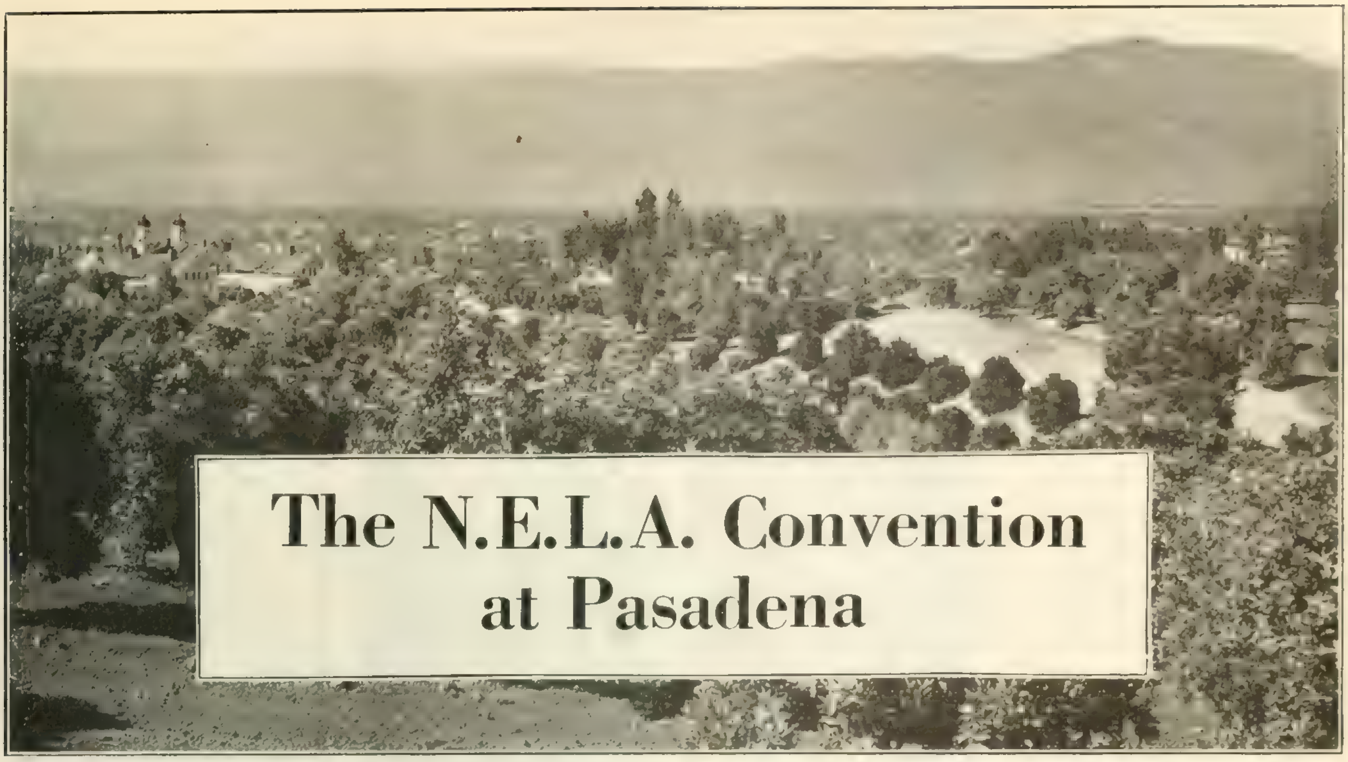


Martin J. Insull

who was elected president of the N. E. L. A. at Pasadena last week, is responsible for the administration of one of the most extensive utility investment and management organizations in this country

SINCE 1912 Martin J. Insull, as vice-president of the Middle West Utilities Company, has had executive charge of the management of public utility properties in sixteen states. While these properties extend from Maine to Oklahoma, the company's holdings are heaviest in the Mississippi Valley. Approximately five hundred communities are served by this far-spreading organization, which embraces no less than thirty-two subsidiary companies. Mr. Insull is one among not a few engineers or utility executives who, born in Europe, came to the United States early in the electrical era and grew up with the industry. He was born in Reading, England, on Sept. 18, 1869, and spent a few years in the telephone business before he left that country for America, which was in March, 1887. His brother, Samuel Insull, now president of the Commonwealth Edison Company, had preceded him by six years, and Martin Insull's first connection in this country was with the Edison Machine Works at Schenectady, N. Y., where his brother was secretary and treasurer and Mr. Edison's representative in charge of its general management. Martin Insull remained in Schenectady until 1889, resigning to enter Cornell University, where he took the course in mechanical engineering. Upon graduation in 1893 he became a partner of Sargent & Lundy, and five years later organized the Martin J. Insull Company to act as manufacturers' agents. About a year later, when this business was turned over to the General Incandescent Arc Light Company of New York, Mr. Insull became vice-president and general manager for that firm and for the New York Electric Equipment Company. In 1902, when the former company was acquired by the General Electric Company and the plant moved to Pittsfield, Mass., Mr. Insull became president. When the Stanley G. I. Manufacturing Company was formed, through the merger of the General Incandescent Arc Light Company with the Stanley Company, he was elected second vice-president in charge of its Middle West business, with headquarters in Chicago. In 1906 he resigned that position to take charge of the gas, electric lighting, water and railway properties in and around New Albany and Jeffersonville, Ind. These properties in 1912 were taken over by the Middle West Utilities Company and Mr. Insull was made its senior vice-president. He is also a director of the Public Service Company of Northern Illinois.

The N.E.L.A. Convention at Pasadena



Four sessions were devoted to general topics. President Ballard's address and some of the committee reports of the first two sessions were abstracted in last week's ELECTRICAL WORLD. The remaining reports are abstracted in the following pages:

Constitution and Bylaws, W. C. L. Eglin chairman.

Company Sections, F. A. Birch chairman.

Safety Rules, W. C. L. Eglin chairman.

Public Information, John F. Gilchrist chairman.

Co-operation in the Electrical Industry, Lee H. Newbert chairman.

Insurance, E. J. Fowler chairman.

Accident Prevention, Charles B. Scott chairman.

Sale of Company Securities, George R. Jones chairman.

Education, Fred R. Jenkins chairman.

Lamps, Frank W. Smith chairman.

Salesman's Handbook, I. Lungaard chairman.

Advertising and Publicity Bureau, L. D. Gibbs chairman.

THE forty-third convention of the National Electric Light Association, which was held at the Hotel Huntington, Pasadena, Cal., last week, will long be remembered by those who attended it for the lavish, varied and original entertainment provided. A precedent has been set which will be hard to surpass even at Hot Springs, Ark., where the convention is likely to be held next year.

Besides the technical and industrial application reports, which were unusually good this year, there were several subjects discussed that stood out above all others. These were water-power development, service, rewards for efficiency, trend of regulation, electrification of railroads, public policy, public information, co-operation in the industry and sale of company securities.

Considerable reorganization was recommended that will make the association still more useful. Chief among the changes were the constitutional amendments broadening the membership of committees, the formation of a Public Relations Section, a technical advisory committee and a hydro-electric prime movers committee, the nationalization of the Technical and Commercial Sections, making the Vehicle Section a division of the Commercial Section and placing the Accounting Section on a par with other sections, and establishing a Southwestern Geographic Section. Some of these changes await the final indorsement of the executive committee.

The Public Relations Section, which will be formed of company executives, will consider principally public utility finances, public information, co-operation in the industry and regulatory laws. The chairman is J. E. Davidson, Nebraska Power Company, Omaha. The other new section chairmen are: Technical Section, I. E. Moultrop; Commercial Section, M. S. Seelman, and Accounting Section, J. C. Van Duyne.

Prof. Elihu Thomson is chairman of the new technical advisory committee, to be assisted by Dr. E. A. Kennelly, professor of electrical engineering at Harvard and the Massachusetts Institute of Technology, and Prof. Charles H. Scott of Yale. To meet the needs of hydroelectric companies better subjects appertaining to them will be divorced from the prime movers committee and will be handled in the future by a hydro-electric prime movers committee, of which Markham Cheever, Utah Power & Light Company, has been asked to become chairman.

MARTIN J. INSULL ELECTED PRESIDENT

For the term 1920-1921 the following officers were elected: President, Martin J. Insull; first vice-president, M. R. Bump; second vice-president, F. W. Smith; third vice-president, Walter H. Johnson; fourth vice-president, F. T. Griffith; treasurer, H. C. Abell.

In last week's issue of the ELECTRICAL WORLD, besides a general summary of the convention proceedings, abstracts were printed of President Ballard's address and of the addresses of the retiring section chairmen, as well as of the reports of the committees on public policy, water power, and electrical resources of the nation. The papers of S. M. Kennedy on "Service," Commissioner Edgerton of California on "Rewards for Efficiency" and Commissioner Jackson of Wisconsin on "Trend of Regulation" were also summarized, as was the report of W. H. Blood, Jr., insurance expert.

The province of the Society for Electrical Development in popularizing the electrical industry and educating the public was emphasized by J. M. Wakeman, manager of the society, who pointed out the advantage of having a neutral organization to supervise a co-operative campaign.

CONSTITUTION REVISED TO HARMONIZE WITH NEW ORGANIZATION PLAN

Working with the special committee on organization, the committee on constitution and by-laws, William C. L. Eglin chairman, has rewritten the association constitution to agree with the reorganization plan. The new constitution and by-laws have been recommended to the executive committee for adoption and will be submitted to the convention. To finance the expense of the enlarged activities of the association a change in the dues has been made. Provision has been made for a technical advisory committee with which the technical committee may consult regarding research to be carried out.

A committee consisting of H. C. Abell, I. E. Moultrop and Guy Talbott was appointed to consider the proposed changes and suggestions and later reported as follows:

"In consideration of the water-power committee's report and bearing in mind present regulation, needed financial support of the industry and increased cost of conducting business, our study of the changes has led to the belief that to secure maximum service from the organization at the minimum expenditure of money and labor the revision should be adopted."

The motion was carried unanimously.

M. R. BUMP
Chief Engineer
Henry L. Doherty & Co.

FRANK W. SMITH
Vice-President and General Manager United Electric Light & Power Co.

WALTER H. JOHNSON
Vice-President
Philadelphia Electric Co.

FRANKLIN T. GRIFFITH
President Portland Railway, Light & Power Co.

The four vice-presidents of the N. E. L. A. elected at Pasadena, for 1920-21

COMPANY SECTIONS

Following the adoption at the last convention of the amendment to the constitution which provided more liberal membership conditions for the company sections, the company sections committee, F. A. Birch chairman, organized a number of sub-committees and immediately instituted a comprehensive campaign for the reorganization of those sections which had disbanded during the war period. The results of this campaign were somewhat disappointing. The former sections have not generally responded to the committee's solicitations. There are at present only twenty-three active company sections, an increase of only four in a year.

SAFETY RULES

The work of the committee on safety rules, W. C. L. Eglin chairman, involved a survey of the country. This is still under discussion. It was particularly urged that there be national action, and the hope was expressed that the Pacific Coast would participate fully in this work and not develop rules of its own.

STATE BUREAUS OF PUBLIC INFORMATION ESTABLISHED

In carrying out the work of the committee on public information, John F. Gilchrist chairman, it was deemed desirable that efforts should be conducted on broad lines in which all utilities could join on equal terms, each state selecting a committee to direct the plan, the chairman of which should be the public utility man in the state best fitted to conduct such work without regard to the particular utility with which he was connected. Visits were made to and correspondence carried on with utility men in the various states, with the result that committees have been formed in Indiana, Kentucky, Ohio and Nebraska and preliminary steps looking to such action have been taken in Iowa, Wisconsin and Texas. The work of the Illinois committee, formed in April, 1919, has proved very successful. In adopting its policy this committee recognized that, though in tendering a news service relating to public utilities to newspaper editors it might be looked upon with suspicion, yet if the matter was fair, had good news value and was informative and not argumentative, the newspapers could be depended upon to print a sufficient amount to warrant the effort. This expectation proved to be correct. In starting the issuance of the news matter a letter was sent out to all newspapers in the state, about 900 in number, advising them of the formation of the committee and its object. As a result of this work, which has been going on for a year, the committee has in its files clippings from about 300 papers, aggregating 21,000 column inches of matter. As only 300 of the 900 papers in the state were subscribed for by the committee, it is assumed that the total would exceed 60,000 column inches. To meet the expenses of this committee a subscription was asked from the larger utilities in the state, based upon one-two-hundredth per cent of their annual gross revenue. Four calls for this amount have been made, aggregating over $20,000.

CO-OPERATION IN THE INDUSTRY

In its report the committee on co-operation in the electrical industry, Lee H. Newbert chairman, summarized the various co-operative movements and included a detailed account of the work of the California Electrical Co-operative Campaign. Reference was made to the able work of the Society for Electrical Development and its staff, to the Jovian Order, to the National Association of Electrical Contractors and Dealers and to the Commercial Section of the N. E. L. A. In addition to these four national movements, the committee also recognized the co-operative promotion work done by the National Electrical Supply Jobbers' Association, the Conference Club, the various manufacturers' associations and others both nationally and locally. The work the California Electrical Co-operative Campaign has conducted since the plan was approved and launched by the executive committee of the N. E. L. A., Pacific Coast Section, at the Riverside convention in 1917 was outlined by the committee in great detail, mention being made that the fund subscribed annually to the movement has grown from $12,400 in 1918 to $27,000 in 1920.

Finally the committee stated as its opinion that to obtain the best results two things are needed—first, local organizations by states or groups of states as may best suit local conditions to carry on active field work; second, national co-ordination and co-operation.

In the discussion on the committee's report M. S. Seelman of the Brooklyn (N. Y.) Edison Company, pointed out that while the central station was the natural channel for appliance sales in early days, contractor-dealers have increased in number and improved their business methods so that they can be relied on almost entirely now. W. E. Robertson, Robertson Cataract Company, Buffalo, N. Y., said that the jobbers approved of nationalizing the California campaign. He suggested that such an organization could popularize utility securities and emphasize their stability. In this work he offered the co-operation of the jobbers' association and urged that some jobbers be appointed to the national association's committee on co-operation.

I. E. MOULTROP
Assistant Superintendent Construction Bureau Edison Elec. Illum. Co. of Boston

J. E. DAVIDSON
Vice-President and General Manager Nebraska Power Co.

M. S. SEELMAN
Assistant General Sales Agent Brooklyn Edison Co.

J. C. VAN DUYNE
Auditor Brooklyn Edison Co.

Section chairmen elected at Pasadena for 1920-21. Mr. Moultrop was re-elected chairman of Technical Section; Mr. Davidson, chairman of the new Public Relations Section; Mr. Seelman, chairman of Commercial Section, and Mr. Van Duyne, chairman of Accounting Section

Insurance Rates Too High

That premium rates on stations, substations and other property of the modern fireproof type of construction are very much higher than they should be is the conclusion drawn by the report of the committee on insurance, E. J. Fowler chairman. It is thought that this has been due to the fact that the reduction in premium rates has not kept pace with the rapid improvement in fire risks, and the committee recommends that all sub-committees of the various geographic sections of the National Electric Light Association should take up the matter of their rates with the various geographic insurance boards. The ratio of loss to the amount of insurance paid is about thirteen times as great for the small-city, group-utilities company as for the large city. This emphasizes the great opportunity that exists for reduction in the cost of insurance for those companies which have not yet replaced the old type of construction with the modern fireproof type.

Supplementing the report of the committee is a paper by J. G. Reese on "Does Insurance Receive the Attention It Deserves?" The author points out the extent to which this important financial feature has been neglected or at best has received half-hearted attention.

Accident Prevention

The committee on accident prevention, Charles B. Scott chairman, prepared detail reports on equipment for testing gloves, a list of rules for accident prevention, resuscitation, grounding, illumination, linemen's belts, testing and guarding high-tension equipment, placing of nameplates and other subjects. For some time the testing of rubber gloves has been studied, with the result that last year the committee put forward specifications for the purchase, testing and care of these articles. This year it presents a report on "a simple equipment for making voltage tests of rubber gloves" with a supplement on "additional glove-testing equipment used by some of the larger companies."

In a detail report a short set of general rules is presented dealing with the prevention of accidents. These can, with slight modification, be put into effect quite generally.

The committee has investigated for the past few years the method of changing insulators on high-tension lines while alive and, as a result of the investigation during the past year, wishes to put itself on record that it is not in position at this time to recommend definitely the use of any method of maintenance work on high-tension transmission lines while alive, but does recommend that whenever possible all such circuits be killed before any work is done on them.

Customer Ownership

In its report the committee on sale of company securities to customer and residential citizens, George R. Jones chairman, stated that upward of $100,000,000 has already been borrowed by central stations from their customers. Judging from statements that come from all sections of the country, the cost of obtaining new money under this plan is much less than under the underwriting plan. Universally good results have been realized from customer ownership of utility securities, and its working out brings, first, the immediate financial results and, second, indirect permanent benefits. Next to the financial aspects of the plan, the immediate effect upon the employees of the utilities is of great importance, especially in the latest development, where companies use their entire force to sell their securities to the public. Employees begin to learn about their company's affairs; things that had always baffled them seem to straighten out; they find that gross income is not net profit and that the boss is the same kind of a man they are.

Beneficial as are the immediate direct results of the customer ownership plan, the indirect lasting results are still better. People who have never cared whether the company prospered or not once they become stockholders will become interested in its welfare. If the company has been the object of attack and suspicion, it will find that a fuller appreciation of its problems will almost invariably result. As an outcome of the customer ownership policy the new attitude toward utilities is evidenced in the reduction of complaints, lessening of unscrupulous attacks, assistance given toward obtaining rights-of-way and co-operative endeavor to adjust rates fairly.

Another important lesson which the plan teaches is that if a community wants to be prosperous it must help its utilities to be prosperous, for one is dependent upon the other, and the people of the community can be made to see that the money they place at the disposal of the utility for new turbines and power lines will not only come back to them directly through the dividends which their money earns but also indirectly through the industries which the new turbines and power lines make possible.

Education

The committee on education, Fred R. Jenkins chairman, reported that notwithstanding generally increased costs the educational courses are still self-supporting, although the tuition fees remain the same. On Oct. 1, 1919, all restrictions were removed as to subscription to these courses, permitting their sale to all who desire to subscribe. During the past year all lessons in the commercial engineering course have been reprinted and the course in practical electricity is being revised.

The committee's advertising has been combined with that of the committee on education of the Accounting Section, covering the courses issued by both sections. It is recommended that for the coming year advertisements for these courses be inserted in selected trade papers, this method being now a practical one owing to the unrestricted sale of the courses.

The fullest success of the courses is contingent upon the following conditions: First—A full realization by the executives of member companies as to their proper value in training their employees; second—co-operation of each member company with its employees in the promotion of these courses; third—co-operation by member companies with their employees in financing the tuition fee for the courses; fourth—appointment of some one in each company to superintend actively the organization and conducting of classes; fifth—an immediate and active indorsement of these courses by every member company.

In the discussion on the report the plan of interesting employees in educational courses through the formation of classes and the direct supervision of work by the company officials was considered well worth serious attention at this time because of the high labor turnover.

New Era in Lighting

In its report the lamp committee, Frank W. Smith chairman, presented a brief exposition of the changes in the lamp situation. It was pointed out that a potent factor in the new lighting is the progress in the design and construction of reflectors, for a new era of artificial lighting is just beginning, which will do much to restore the lighting load to its old-time prestige.

While the committee made no attempt this year to resurvey central-station lamp practice, yet it may be stated that available information shows no considerable change to have taken place since the presentation of the last annual report. Although total sales of large lamps, excluding miniatures, amounted to 183,000,000 in 1919 as against 186,000,000 in 1918, sales of tungsten-filament types increased 4,000,000 to 170,000,000, while sales of carbon-filament type lamps fell off 7,000,000, to a total of 13,000,000.

Decrease in average watts was probably brought about by the readjustment of war industries in which high-wattage units had been used very largely. The trend of candlepower, watts and efficiency is shown by a curve in the report.

Of the 170,000,000 tungsten lamps sold in 1919, 143,000,000 were of the vacuum type compared with 142,000,000 in 1918, and 27,000,000 were of the gas-filled type compared with 24,000,000 in 1918. In number of lamps the multiple group represented 92 per cent of the total tungsten lamp sales in 1919. The 40-watt lamp continues to be the most popular size, with the 25-watt lamp a close second. The demand for the 50-watt size (vacuum) exceeds one-eighth of the combined demand of all sizes of vacuum lamps in the multiple group and is the only size of this group that showed in 1919 an increased demand over 1918 and has shown some slight gain in popularity each year. This 50-watt lamp is recommended to member companies as an excellent size for general lighting purposes. The 60-watt lamp continues to hold third place in popularity. In at least one very large company it is used almost exclusively for home lighting.

During 1919 the average candlepower of street series lamps was 155 compared with 157 in 1918, the slight reduction being due to the lesser proportion of 250-cp. and 400-cp. sizes used, excluding lamps of 250 cp. and higher, which are used largely in place of the old carbon arc lamps. The 6.6-amp. continues to be the most popular circuit.

More than 85 per cent of all lamps were of the 110-volt to 125-volt range. Nearly 79 per cent of these were of the three standard voltages, 110, 115 and 120, compared with less than 75 per cent in 1918.

JOHN W. LIEB
Vice-President
New York Edison Co.

W. C. L. EGLIN
Vice-President and Chief Engineer Philadelphia Electric Co.

JOHN F. GILCHRIST
Vice-President
Commonwealth Edison Co.

W. W. FREEMAN
President
Union Gas & Electric Co.

MORSE DELLPLAIN
Vice-President
Northern Indiana Gas & Electric Co.

E. A. EDKINS
General Manager of Electric Shops
Commonwealth Edison Co.

L. D. GIBBS
Superintendent of Advertising Edison Electric Illuminating Co. of Boston

LEE H. NEWBERT
Manager
Commercial Department
Pacific Gas & Electric Co.

Group of committee chairmen who presented reports at Pasadena convention: Mr. Lieb, committee on gas and electric service; Mr. Eglin, committee on safety rules; Mr. Gilchrist, committee on public information; Mr. Freeman, vice-chairman, public policy committee; Mr. DellPlain, division power sales bureau on electric development; Mr. Edkins, merchandise sales bureau; Mr. Gibbs, advertising and publicity bureau, and Mr. Newbert, committee on co-operation in the industry. Other chairmen of technical and commercial committees appear on page 1243.

The discussion emphasized the fact that good lighting makes good work easier, while poor lighting causes bad work. All of the power companies should obtain the best personnel and equipment for rendering better lighting service to their consumers. While it may not appear that this expense is justified in increased returns, yet the good will that will accrue will more than offset the expenditure.

RELATIONS WITH CUSTOMERS

Elimination of red tape in executing orders for connection and disconnection of service and methods of handling complaints were given particular attention in the report of the committee on commercial service and relations with customers, R. F. Bonsall chairman. The committee renews the suggestion made in its 1919 report, that member companies form a committee composed of the various departments serving the public to formulate and apply efficient methods of conducting relations with customers. It also recommends the preparation of a course in service relations with customers similar to the accounting and technical courses. A position of special importance in such a service sales organization is the telephone board, and only employees thoroughly trained for this work should operate it. It is becoming daily a more important link in the company's work through the increased use of the telephone by the public to transact its business with the utility.

In the issuance of service application and orders it is important that trained employees be used to prevent the loss of time by the operating departments because of incomplete or indefinite information on the orders. The service sales idea should also predominate in the obtaining of credit data. Customers' bookkeeping is also a part of such a service group, although it is in direct connection with the accounting department. In the same manner the meter readers form a definite part of such a group. This is also true in collections, where the exercise of proper judgment makes many friends for the company. The committee's report may be said to be a treatise on the development of "service sales" as a well-defined obligation of a public utility, having the value measured by an appraisal of what can be produced in results as compared with its cost.

Conversing with customers over the telephone is a very important factor in maintaining friendly relations, said S. F. D. Buer, Denver, in discussion. By taking a sympathetic stand a complaint department can often transform a dissatisfied customer into a friend.

PLANS TO SYSTEMATIZE AND EXTEND

In reviewing results and progress of the first year's work of the Advertising and Publicity Service Bureau of the Commercial Section in separate reports of the eight divisions of the bureau, Chairman L. D. Gibbs made the following suggestions: (1) There should be a textbook on advertising, either a printed and bound volume or a loose-leaf hint book; (2) plans might well be made for an exhibit at next year's convention of the service rendered by the advertising agencies; (3) street-car advertising service has been requested by several central stations; (4) a request this last year for advertising material in connection with a safety first campaign brought out the fact that there was almost no available material; (5) a speakers' bureau is in great demand; (6) other associations interested in sales and promotion work might well be asked to appoint representatives to membership of each of the eight divisions.

Co-ordinate Advertising and Sales Campaigns.—Merchandising and lighting schedules as a basis for planning advertising and sales campaigns have this year been put into effect by the co-ordinate advertising and sales campaigns division, Henry Harris chairman. The schedules agreed upon are as follows: Merchandising schedules—January, clearance sale; February, heating pads; March, vacuum cleaners; April, sewing machines and sewing-machine motors; May, grills; June, irons; July, fans; August, clearance sale; September, washing machines; October, radiant heaters; November, toasters; December, electrical Christmas gifts. Lighting Schedule—January, better lighting; February, outdoor lighting (tennis courts, playgrounds, etc.); March, stores and windows; April, residence lighting; May, electrical advertising; June, public buildings; July, industrial; August, stores and windows; September, electrical advertising; October, residences; November, better lighting (with emphasis on office buildings); December, industrial.

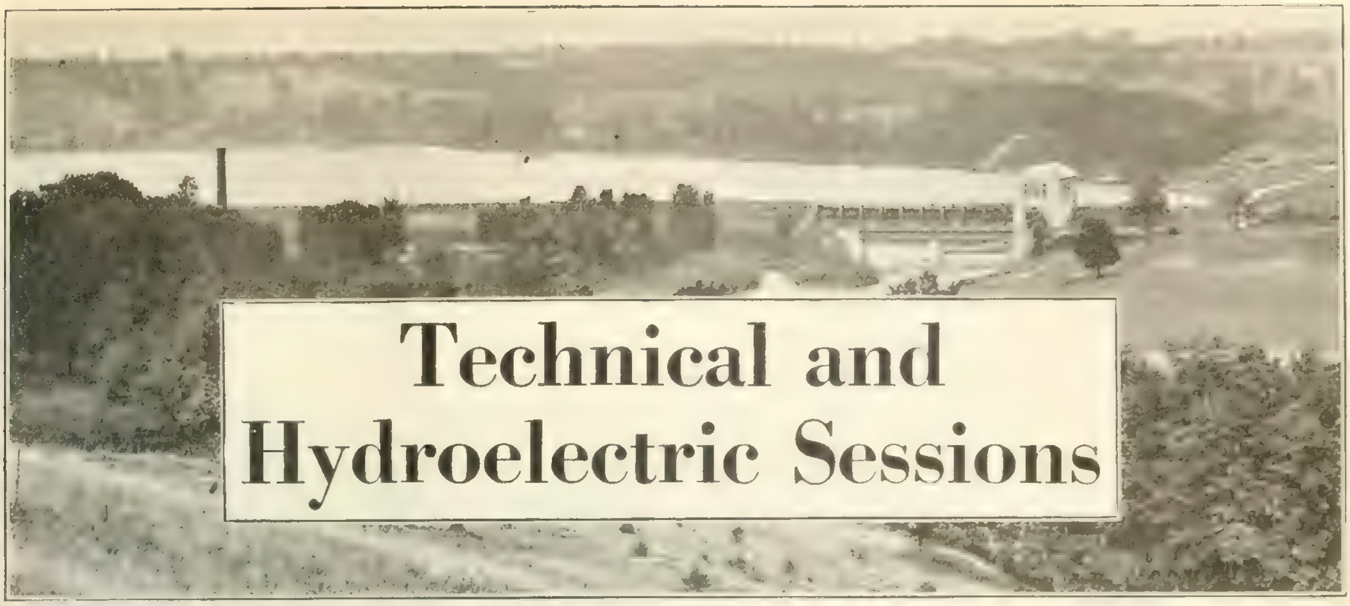
Motion Picture Advertising to Be Studied.—Convinced that cinematographic presentation has developed so rapidly that it must now be recognized as second only to the printed page as a means of communicating thought, the motion-picture films division, headed by Charles H. Peirson, emphasized the importance of using this powerful medium of contact with American people.

Reaching Public Through Popular Periodicals.—The news syndicate and magazine writers' division, Frank B. Rae chairman, has endeavored to accomplish three things: (1) To devise a method or plan whereby newspaper and magazine writers, editors of newspapers, newspaper syndicates and magazines, and others of value in disseminating public information, may be kept in touch with electrical developments of popular interest; (2) to familiarize men of authority and responsibility in our own industry with the objects and methods of legitimate publicity, as distinguished both from paid advertising and mere puffery; (3) to initiate a syndicate newspaper service devoted to popular electrical subjects, and especially to the use of home appliances, said service to be comparable in form to fashion, household, recipe and similar newspaper "departments" commonly published in the daily press.

General Commodity Advertising to Show Electrical Goods in Background.—The national commodity advertisers' division, Earl E. Whitehouse chairman, was established this year for the pupose of exerting an influence on the advertisers of general commodities to feature electrical appliances in the background of their advertising display.

Non-Technical Handbook on Illumination.—The newly organized division for non-technical applications of illuminating engineering, of which P. B. Zimmerman is chairman, has determined to publish two pieces of literature, the first to be an outline of a promotional sales campaign in the industrial field and the second a handbook on the subject of industrial lighting—a non-technical book that can be considered a complete encyclopedia on the subject.

ELECTRICAL CURTAIN FOR OUTDOOR ENTERTAINMENT STAGE AT PRESIDENT'S RECEPTION ON LAWN OF HUNTINGTON HOTEL



Technical and Hydroelectric Sessions

At the two sessions of the Technical and Hydro-Electric Section reports were presented by committees on the following subjects:

Meters, F. V. Magalhaes chairman.
Electrical Apparatus, R. F. Schuchardt chairman.
Overhead Systems, W. K. Vanderpoel chairman.
Prime Movers, N. A. Carle chairman.
Inductive Interference, A. E. Silver [illegible].
Underground Systems, F. E. Rickett chairman.

CHAIRMAN I. E. MOULTROP in his address to the Technical and Hydro-Electric Section outlined the work of committees and explained that the new organization of the association provides the machinery for technical committees in geographic divisions and state associations. It will be the duty of the national section to keep in touch with the geographic divisions and give them needed assistance, so that instead of having technical committees of their own the needs of the geographic divisions will be satisfied by representation on the national section committees. The speakers covered the main points of the work of the electrical apparatus committee, committee on inductive interference, committee on meters, overhead systems committee, committee on prime movers, and committee on underground systems.

Plant Equipment and Practice

The report of the prime movers committee appears in abstract on page 1257. Owing to the short time available for discussion of this report only five sections were brought up for consideration, namely, turbines, water power, condensers, oil burning and pulverized-fuel burning.

The manufacturers' viewpoint on turbines was touched upon by E. E. Gilbert of the General Electric Company, E. Sniffin of the Westinghouse Electric & Manufacturing Company and F. L. Webster of the Allis-Chalmers Manufacturing Company. Mr. Gilbert said that economy can be sacrificed for reliability. While Mr. Sniffin agreed with the committee regarding the present advisable limits to turbine ratings, he expressed the belief that larger units can be operated with safety if the design is modified. Instead of an oil outlet temperature of 140 deg. he recommended 160 deg., since this is safe and permits use of oil of higher viscosity. With an oil of the same viscosity as for 140 deg. the higher temperature will reduce the drag on the turbine. Bearings have worked satisfactorily with oil outlet temperatures as high as 200 deg., he said. Since piping to turbine must be laid out to allow movement in all directions, there is great opportunity for improvement in piping arrangements, Mr. Sniffin contended. Mr. Webster pointed out how his company meets operating requirements in the construction of turbines.

R. J. C. Wood, Southern California Edison Company, Los Angeles, voiced a general need for information on reliability of turbines, differentiating between trouble with operation and inherent design. N. A. Carle pointed out that the Edison association is investigating this subject.

S. J. Lisberger, Pacific Gas & Electric Company, San Francisco, is investigating the practicability of refrigeration in connection with bearings and condensers. L. M. Klauber, San Diego (Cal.) Consolidated Gas & Electric Company, announced that he is using sea water to cool turbine bearings. Steadying devices have to be used on the turbine governors to permit paralleling generators with those of the Southern California Edison Company, he declared.

WATER-POWER TENDENCIES

In discussing water power, consideration was given chiefly to tendencies in size and type of plants, the performance of a new type of runner, the advisability of outdoor stations and automatic plants, the measurement of precipitation in the mountains and methods of operating hydro-electric plants.

There is a tendency to larger and larger hydro-electric plants, said E. C. Hutchinson, Pelton Water Wheel Company, but medium-size powers are also being developed extensively, probably to avoid too great an investment before the market can absorb the power. While he contended that the Nagler runner had poor regulating characteristics and a short high-efficiency period, F. L. Webster contended that with low heads, such as are obtained in the Middle West, the regulating characteristics, efficiency and stability are all that can be desired.

Where there are low heads and no large amount of water to be impounded, as in the Middle West, there is an excellent field for automatic hydro-electric plants, declared E. W. Allen, General Electric Company. However, H. A. Barre, Southern California Edison Company, Los Angeles, contended that the tendency to automatic operation is becoming a fad like outdoor stations and should be carefully considered first to determine the advisability of such practice in view of the relatively low labor expenses compared with capital charges in hydro-electric plants. Regarding outdoor stations, Mr. Barre said that unless an inclosure is provided in which to repair and overhaul equipment operators are very liable to neglect maintenance.

OPERATING HYDRO-ELECTRIC PLANTS

Discussing some of the operating problems of his company, Mr. Barre referred to the arrangements which have been made for operating some generators at either of two frequencies (50 cycles and 60 cycles), depending on whether his own company or a purchasing company requires the surplus power. Details of this plan were published in the ELECTRICAL WORLD for July 19, 1919.

When operating the 50-cycle generator at 60 cycles there is a reduction in efficiency of 9.2 per cent, but this is less than with a frequency changer. However, to the surprise of the company, it was possible to obtain larger outputs from the generators at the higher frequency. In general, the Southern California Edison Company operates its stream-flow and reservoir water-power plants on the base load when there is plenty of water, the steam plants carrying the fluctuations. During dry weather the base load is carried on steam plants to obtain the highest economy and fluctuations on reservoir plants. While the water which will be available each year can be forecast pretty accurately, there is need of some means of measuring precipitation in the mountains. At present the rate of inflow to the reservoirs, with observations of precipitation at gaging stations in the lowlands, is the basis of estimates.

S. J. Lisberger, Pacific Gas & Electric Company, San Francisco, said the method of operating plants followed by his company is similar to that outlined by Mr. Barre. Considerable difficulty has been experienced, however, in keeping vertical waterwheels on the bus after a short circuit opens a switch, owing to overspeeding of the unit. To avoid this trouble the governors have been adjusted to permit 12 per cent overspeeding. Eliminating any lag in the flow of the governor oil was suggested as another means of remedying the trouble.

Because of the extreme length of the hydro-electric transmission lines feeding Denver, the base load, made up of the most important loads, is carried on the local steam plant, said T. O. Kennedy, Denver Gas & Electric Company, and the loads of lesser importance on the water-power system. The buses are normally tied together by an oil switch which can be opened if transmission service is interrupted and the steam plant cannot carry the entire load.

The greatest problem of operating hydro-electric and steam systems owned by different companies in parallel is the assessing of charges for interchange of power, according to the views expressed by both Mr. Kennedy and L. L. Elden, Boston Edison Company. Maintenance of a constant frequency is very important in the East, owing to the effect on industrial production.

J. P. Jollyman, Pacific Gas & Electric Company, referred to a hydro-electric plant which his company operates at variable heads—70 ft. to 200 ft. (21 m. to 60 m.)—as a sort of blow-off for a reservoir to reduce waste of water and wear on gates.

The discussion on condensers was light, Mr. Barre suggesting that condensers be sectionalized so that one compartment might be flooded to allow cleaning of tubes without shutting down the entire unit.

Three excellent discussions on burning oil were contributed by A. H. Babcock of the Southern Pacific Company, Dr. E. S. Jacobus of the B. & W. Boiler Company, and C. R. Weymouth of C. C. Moore & Company, one discussing particularly the relative merits of mechanical and steam atomizers, another construction of boilers, the third important factors which should receive consideration in equipping an oil-burning plant.

In the paper by Mr. Babcock it was brought out that mechanical atomizers handle fluctuating loads better than steam atomizers and utilize the furnace space to better advantage, because the oil spray is discharged with a helical motion that permits better mixture of air and oil. Furthermore, because of their capacity for overloads, fewer mechanical atomizers are required per boiler; the efficiency of combustion is also higher.

Two hundred per cent has been the maximum boiler rating obtained with steam atomizers, whereas mechanical atomizers have produced as high as 400 per cent with good feed water and forced draft. For the reason mentioned steam atomizers can burn about 2½ lb. of oil per cubic foot of furnace volume, whereas mechanical nozzles can burn 10 lb. At normal boiler ratings the efficiencies obtained with the two types of burners are about equal, but at 240 per cent rating the efficiency is six points in favor of mechanical atomization.

Mr. Weymouth recommended not heating oil in storage tanks above 80 deg. to 90 deg. The temperature should be raised to about 180 deg. (depending on viscosity) between the pumps and burners, and self-cleaning strainers should be provided for Mexican oils. Economizers do not show so much advantage with oil as with coal, but steel casings for boiler settings do, particularly at low loads. Mr. Weymouth expressed the belief that the National Fire Protection Association rulings on oil burning are too drastic and suggested that a committee be appointed to obtain this modification according to past good practice. He also said many consumers of native oil cannot have their contracts renewed after the present ones expire, though the East is in a position to obtain foreign oil from Mexico.

Dr. Jacobus announced in his discussion that boilers can now be provided that will develop 150,000 lb. of steam per hour and that they can be built for 450 lb. pressure with slight modifiication. Wrought-iron economizers are available, internal corrosion being prevented by previously extracting oxygen from the water and external pitting being eliminated by preheating water to 140 deg. to 150 deg. by exhaust steam. Boilers fired with blast-furnace gas have had their efficiencies raised from 50 to 78 per cent. It was recommended that economizers should not have more than 70 per cent of boiler surface for safety. Boilers can now be provided twenty-six tubes high, a construction which affords longer travel of gases.

The discussion on burning pulverized coal was contributed by H. D. Savage of the Pulverized Fuel Company and F. A. Scheffler of the Fuller Engineering Company. The first speaker considered the combustion of pulverized coal as distinguished from the method of handling it and presented numerous sets of test data and heat balances for various plants burning different kinds of coal from lignite to anthracite silt and culm. Mr. Scheffler referred to the success which has been obtained with disposal of ashes of air conveyor systems.

Developments in Apparatus

On page 1261 an abstract is given of the report of the electrical apparatus committee. The following points were brought out in the discussions on it:

N. A. CARLE
Chief Engineer
Public Service Electric Co.

A. E. SILVER
Electrical Engineer
Electric Bond & Share Co.

R. F. SCHUCHARDT
Electrical Engineer
Commonwealth Edison Co.

W. K. VANDERPOEL
Superintendent
Public Service Electric Co.

F. V. MAGALHAES
Superintendent
Meter and Test Departments, New York Edison Company

F. E. RICKETTS
Superintendent Electric Stations, Consolidated Gas, Electric Light & Power Co.

R. S. HALE
Superintendent Research Department, Edison Electric Illuminating Co. of Boston

JOHN W. MEYERS
Assistant Sales Manager
Philadelphia Electric Co.

Chairmen of technical committees who presented reports at Pasadena convention: Mr. Carle, committee on prime movers; Mr. Silver, committee on inductive interference; Mr. Schuchardt, committee on electrical apparatus; Mr. Vanderpoel, committee on overhead systems; Mr. Magalhaes, committee on meters; Mr. Ricketts, committee on underground systems; Mr. Hale, committee on wiring, and Mr. Meyers, division of Power Sales Bureau on Economics of Use of Central Station Power. Reports of the last two committees were presented at Commercial Section sessions.

To protect against generator fires, the Redondo and Long Beach stations of the Southern California Edison Company are equipped to shut off the ventilating air and admit steam to stifle combustion. The system at Redondo has operated twice and been effective both times. At station A of the Pacific Gas & Electric Company a generator fire was started by a defective clamp that allowed ignition of some dirt on the insulation, R. C. Powell declared. The field circuit was opened, but the armature and field were damaged enough to require rewinding. By keeping its machines well cleaned the Great Western Power Company has avoided generator fires so far, said J. A. Koontz.

G. H. Bragg, Pacific Gas & Electric Company, San Francisco, said that the company has many synchronous-motor drives in substations, but they hold on as well as induction motors in case of trouble. No trouble is experienced with rotaries, owing to long lines of high inductance. The speaker expressed the opinion that tubing supported by pin-type or post-type insulators is more desirable than flexible conductors in strain, since the former construction requires less steel. To permit taking an oil switch out of service without interrupting service, Mr. Bragg favors providing a by-pass air-break switch between the disconnecting switches on the side away from the oil switch.

H. A. Barre said that synchronous condensers at the Eagle Rock substation of the Southern California Edison Company, were the only means whereby Big Creek transmission was made possible. Without them the voltage variations would be 47 per cent. Under present conditions, however, the voltage can be maintained the same at both ends up to a load of 50,000 kw. To carry full load a lagging kva. is produced by the zero field on the condensers. To start, the shafts are floated by oil, greatly reducing the starting kva.

Trouble with rotary converters has been practically eliminated by increasing the speed, separating the poles more (hence increasing the neutral zone) and by the use of high-reluctance commutating poles. With the latter, which have non-magnetic material between them and the frame, barriers between brushes are almost unnecessary. High-speed breakers have also helped considerably. One remedy for the oil-switch situation is to simplify switch construction and make the switches large enough, H. A. Barre declared. In the new Kern River station of the Southern California Edison Company no low-voltage buses or switches are used, switching being done on the high side. The station service is provided very easily by having step-down transformers. At another station this company is using a single-pole switch between each generator and transformer for synchronizing and using high-tension switches for protection. The auxiliary power is supplied over transmission line with direct-connected exciters.

A. W. Copley, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., expressed the belief that putting protection on top of protection may constitute a hazard. A method of rating circuit breakers cannot be established without operators agreeing on what they require. At present oil switches cannot be applied properly without considering the methods of system switching as well as the kva. to be ruptured.

J. E. Kearns, General Electric Company, referred to a new arrangement of switches for a 180,000-kva. to a 200,000-kva. substation in Chicago, devised by Mr. Jamieson. All switches of the same phase are in a row, thus reducing the size of the building required. The disconnecting switches are opened automatically when the oil switches open. A method of operating oil switches without control circuits, one that involves circulating high-frequency current through the main circuits, is being investigated by the General Electric Company.

Although the electric apparatus committee advocated subtractive polarity for transformers under 200 kva. and 7,500 volts, W. K. Vanderpoel, Public Service Electric Company, Newark, N. J., expressed the belief that many companies would object to this recommendation because transformers are in a class by themselves.

While standardization of transformer oils was recommended by A. E. Silver, Electric Bond & Share Company, New York City, manufacturing representatives declared that it would be impracticable to do this because in most apparatus the kind of oil required depends upon the internal construction and materials used. Mr. Silver said that, on high-voltage systems particularly, standardization of such oils would mean immense economy to the operating companies. In reply to this, M. O. Troy, General Electric Company, said that standardization cannot be allowed to retard development. Besides, oil does not run uniformly. There is one form of standardization, however, that will be desirable from both operating and manufacturing viewpoints, he said, and that is the standardization of ratings. This can be carried out very effectively and will be the means of reducing the cost of equipment considerably as less stock will have to be carried by the manufacturing company. If the electric apparatus committee could investigate whether it is a recommendable practice to use Y-grounded systems or not, it would be a great help to operating companies because the use of the grounded system will reduce the cost of an entire installation more than one-third.

Meters

Necessity for standardization of disk constants of watt-hour meters of the same ampere rating and voltage range, increasing in direct proportion to the capacity of various makes of meters, and of standardization of terminal dimensions and provisions for mounting current transformers was pointed out by the report of the committee on meters, F. V. Magalhaes chairman. Standardization of the disk contents would greatly simplify the testing formulas and calculations used by testers, thus saving the cost of tests and eliminating much of the possibility of error. This is particularly necessary at present because of the difficulty of obtaining competent readers and testers. Considerable expense would be saved in making changes of transformers were the terminals to be standardized, it was pointed out, because frequently when necessity for changes arise transformers of the same type and rating are not to be had and new mountings have to be installed to hold whatever type of transformer may be available.

The committee reports the completion of Section 10 of the meter code, on demand meters, thus completing the entire code, which has been in the course of preparation for thirteen years. The entire section is printed in the report. Under the subject of new development considerably more activity was reported than last year, following the period of the war. Experimental or completed developments were mentioned along the line of devices for kva. measurements reported by practically all of the manufacturers, as well as a number of improved demand meters.

In the discussion of the report interest was manifested in the characteristics of current transformers, the education of metermen, standardization of disk constants, definition of polyphase power factor and use of meter protective equipment. O. A. Knopp of the Pacific Gas & Electric Company, San Francisco, pointed out that it is wrong to compare current transformers by their phase angles unless the secondary power factors are taken into consideration. The volt-ampere capacity of current transformers must also be given serious consideration, said R. C. Lanphier, Sangamo Electric Company, otherwise accuracy may be sacrificed, particularly in polyphase units. Twenty-five volt-amperes to 35 volt-amperes was recommended as a desirable rating. This factor is not so important in the voltage transformers, but instrument manufacturers would like to have operating companies as a body specify the characteristics desired in all instrument transformers under various conditions. Instruction courses for metermen have been conducted with great satisfaction at the University of Iowa and will be started at the University of Illinois this summer.

The discussion indicated a need of information on the extent to which meter protective devices are employed, the purpose for which they are used (prevention of theft, or to facilitate test) and whether the customer, the utility or both shall shoulder the expense.

The revision of Bureau of Standards Bulletin No. 56, which refers to meters and measurements, will be conducted in co-operation with a sub-committee of the N. E. L. A. meter committee, F. V. Magalhaes, New York Edison Company, announced.

Overhead Systems

The principal activities of the committee of overhead systems, as reported by W. K. Vanderpoel, chairman, have been in the direction of improving the maintenance of suspension-type insulators, pointing out the advantages of preservative treatment for poles and cross-arms, and undertaking a study of overhead-line construction in co-operation with the Bureau of Standards for the purpose of bringing the National Electrical Safety Code to a satisfactory state of completion.

In connection with the work on insulator and maintenance, the committee sent out questionnaires which brought forth valuable information regarding suspension insulator practice. The approximate number of suspension units used per string for various voltages was found to be as follows:

Kv.	Companies Reporting	Wood Poles Suspension	Wood Poles Tension	Steel Suspension	Steel Tension
13	1	..		2 to 3	4
33	2	2 to 3	3 to 4	2 to 3	2 to 5
44	1	3	4	3	4
66	17	3 to 6	4 to 7	3 to 8	4 to 9
88	1			4 to 5	5 to 7
110	11	8	10	5 to 9	5 to 9
130	1	9 to 10	11 to 12	9 to 10	11 to 12
140	1	.	.	10	12
150	1		..	9	11

Of the methods of testing, the questionnaire developed thirty-three answers, of which seventeen indicated the use of the megger, seven the "buzz stick," one the oscillator, six no method at all, one visual inspection only, and one a special device of its own. It appeared that operating engineers ascribed the following reasons, in the order of their importance, for insulator deterioration: (1) Porosity; (2) minute cracks, permitting absorption of moisture; (3) troubles from expansion resulting from dissimilarity in coefficients of temperature expansion of porcelain, cement and hardware. It is the consensus of opinion, however, that difficulties due to porosity have been greatly diminished in the case of those insulators manufactured within the last five years. There have been many schemes proposed for the determination of porosity of insulators, but only one method seems to be effective, and that is the Fuchsine dye test.

Opinions regarding the protection afforded by ground wires are conflicting. Few operators believe that the ground wire protects lines from severe direct strokes of lightning, but there is a considerable difference of opinion regarding the protection obtained from induced lightning charges.

The practice of banking transformers is not so general as might be expected in view of the many advantages attendant upon such operation. This attitude is ascribed to the trouble experienced in restoring service after a local interruption, and some suggestions are given for overcoming such difficulties.

It is recommended that operating companies consider carefully the feasibility of treating poles. Whether the open-tank methods of brush treatments should be used will, of course, depend upon the extent and distribution of the work. The practice of one large operating company and the Bell telephone companies in pole treatment are given in the report.

Very interesting photographs of automotive equipment for line maintenance and construction work is given in the report of the committee, and some practical tools and devices are shown for line construction work.

Insulator testing and maintenance, pole reinforcement and treatment and joint usage of poles were the principal subjects touched upon in the discussion on the report of the committee on overhead systems. Some rather unusual temperature-cycle tests of insulators are being conducted by J. A. Koontz, Great Western Power Company, San Francisco, in which various types of insulators are subjected to cyclic temperature changes ranging from 32 deg. to 140 deg., under various conditions of strain and operating conditions. Thermocouples are inserted in some insulators to determine distribution of temperatures. The effect of continued testing on aging is also being investigated. Since each unit of a string of insulators is not always in perfect condition, H. A. Barre, Southern California Edison Company, Los Angeles, recommended that distribution of voltage over strings containing faulty disks be studied and compared with distribution over perfect strings.

J. P. Jollyman, Pacific Gas & Electric Company, San Francisco, pointed out that insulators give less trouble when dry or drenched with water than when dirty or subjected to ocean spray, fog, drizzling rain, etc.; therefore tests should be conducted under the more severe conditions.

Curves showing the rate of depreciation of insulators in service over an extended period were presented by C. F. Benham, Great Western Power Company, San Francisco. The results were segregated according to the climatic conditions to which they were subjected. Those in coast hill districts depreciated the most rapidly, those in mountain districts next, and those in the dry upper valleys least.

DETERIORATION OF SUSPENSION INSULATORS UNDER DIFFERENT CLIMATIC CONDITIONS

R. J. C. Wood, Southern California Edison Company, Los Angeles, reported more trouble with insulators supporting the central conductors on a steel-tower line than with outside conductors. Owing to the fact that these insulators were surrounded by a steel structure, whereas the others were not, Mr. Wood suggested that this condition might have caused the exaggerated trouble observed.

L. M. Klauber, San Diego (Cal.) Consolidated Gas & Electric Company, urged using as many insulator disks per string as possible, especially where daily cyclic temperature changes are extreme and where insulators are subjected to salt spray or other deposits.

Because of the importance of reliable service on large systems and the magnitude of the total capital charges compared with the cost of transmission equipment, R. M. Boykin, North Coast Power Company, Portland, Ore., contended that it is economically feasible to spend more money on insulation and maintenance.

J. B. Fisken, Washington Power Company, Spokane, Wash., referred to the increased life obtained from poles which had been purposely charred and then treated with hot creosote at 150 deg. Fahr. Since reinforcing of poles with steel bars driven into the wood weakens the fiber, Mr. Fisken recommended casting concrete around the butts, a method that had given great satisfaction. The cost is very reasonable. To inspect the condition of poles it was suggested that small holes be bored radially into them. This operation does not weaken the poles appreciably. By boring holes axially in the butts of poles and connecting the inner end with the atmosphere by small drill holes the interior of the poles might be impregnated by the open-tank method very effectively.

Results of tests conducted by the Forest Service at Madison, Wis. (Project 214), were outlined by R. E. Cunningham of the Southern California Edison Company, Los Angeles. The tests included investigations of the effectiveness of open-tank creosote, zinc chloride and creosote brush treatments, the first method being the most effective.

GROWING SERIOUSNESS OF INDUCTIVE INTERFERENCE WITH TELEPHONE LINES

Among the many points brought out by the report of the committee on inductive interference, A. E. Silver chairman, is the danger that lies in overemphasizing the benefit of keeping power and communication lines on separate routes or highways. While it is very desirable to encourage this policy within reason, particularly in planning for future growth, yet with the higher distribution and lower transmission voltages this is becoming increasingly difficult and expensive. With the multiplying demands for central-station power, it is essential that methods of co-ordinating the communication and power facilities be developed and applied with foresight.

Among the requirements to improve the situation, in the judgment of the committee, is general recognition of the principle that adequate power and communication service economically supplied are both essential to the public interest and that the companies supplying these services have a mutual responsibility to the public. This responsibility to the public does not lessen the responsibility of the power industry to itself in maintaining an equitable division of the liability arising from the inductive interference situation. It is the purpose of the committee therefore to establish definite procedure among the power companies for community of effort to avoid the inconsistencies and inequality of individual dealings with the trained staff of the telephone company with its fully prepared and nationwide policy.

In discussing this report the serious situation facing the power companies in meeting the demands of the telephone companies was emphasized by J. E. Woodbridge, of Ford, Bacon & Davis, and by G. E. Quinan, Seattle. Both John A. Britton and D. L. Huntington, Washington Water Power Company, spoke from an executive standpoint. They were followed by M. R. Bump of New York, who urged prompt action of the companies on a co-operative basis.

H. S. Warren, American Telephone & Telegraph Company, expressed the desire of the telephone interests to carry on a joint investigation of the subject on its merits with the intention of carrying out the conclusions irrespective of individual interests, a suggestion which was welcomed by the electric light and power companies.

W. G. Taylor, General Electric Company, urged the recognition of both sides of the problem—the susceptibility of telephone lines to inductive interference as well as the problem of the transmission company—suggesting the maintenance of a permanent co-operative body to handle this problem.

Underground Systems

After a careful study of the single conductor versus the three-conductor cable for high voltages, the committee on underground systems, F. E. Ricketts chairman, has come to the conclusion that for tensions up to 25,000 volts and loads up to 10,000 kva. the three-conductor cable is more economical than single-conductor cable, but it points out the possibilities and the advantages of the single-conductor design for higher voltages and greater loads.

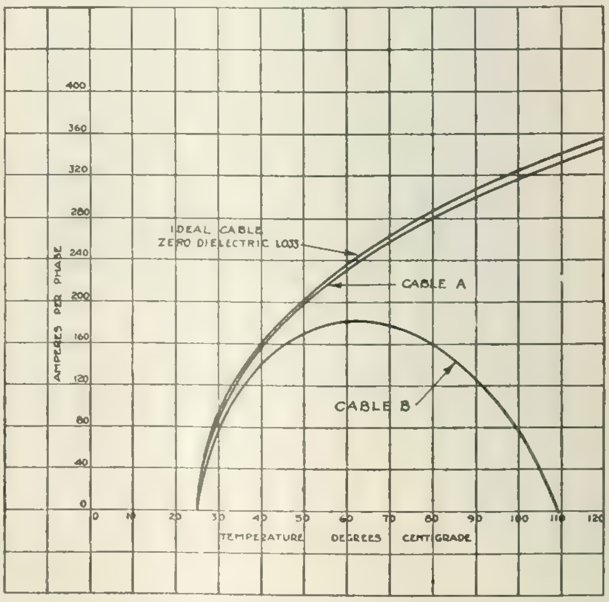
The subject of current-carrying capacity of underground cables as affected by dielectric and copper losses and temperature of duct lines is discussed, and the variation of the characteristics of the different tables are brought out.

Among the most important recommendations made by the committee is that covering specifications, developed in conjunction with the transmission and distribution committee of the A. I. E. E., for paper-insulated, lead-covered underground cable.

REDUCING DISASTROUS EFFECTS OF CABLE FAILURES ON DIRECT-CURRENT NETWORKS OF LARGE CAPACITY

It is the recommendation of the committee that companies give careful consideration to the prevention of extended troubles on direct-current networks, as considerable damage from this cause has occurred in the past. If, for instance, low-tension distribution cables are not bonded in each manhole, then in the case of a cable burning in two, the arc assisted by the molten metal will practically put positive or negative potential on the lead sheath and cause the burning of holes in lead sheath and arcing between the lead sheath and points of support. If other cables are in metallic contact with racks or supports, this positive or negative potential of the lead will be communicated to such other cables and may cause a rapid spread of the trouble which otherwise might be localized.

As in the report for 1918, the committee has included



CURRENT-CARRYING CAPACITY OF CABLES FOR VARIOUS DEGREES OF TEMPERATURE RISE statistics of high-tension cable failures, and it has also presented them for the year 1919. Operating results in 1919 appear to have been considerably better than in preceding years, showing only 8.2 failures per 100 miles of cable as compared with 13.1 during 1918. It is impossible to draw any general conclusions with only two years' data at hand, but the improvement is due in part to the replacing of old-type joints by some companies, to more favorable weather conditions in certain localities for the dissipation of heat, and in some cases to the reinforcing of feeders to clear up overload conditions.

R. T. Lozier, National Conduit & Cable Company, New York City, urged more exchange of experience on underground cable operation since it will help manufacturers meet requirements better.

Steam Railroad Electrification

The report of the committee on electrification of steam railroads, F. M. Kerr, vice-president Montana Power Company, chairman, consisted of separate reports by the following members: A. H. Armstrong, chairman electrification committee of the General Electric Company; R. Beeuwkes, electrical engineer Chicago, Milwaukee & St. Paul Railway; H. H. Cochrane, chief engineer Montana Power Company; Peter Junkersfeld, engineering manager Stone & Webster; F. H. Shepard, director of heavy traction for Westinghouse Electric & Manufacturing Company, and J. E. Woodbridge, resident engineer with Ford, Bacon & Davis, San Francisco.

Mr. Kerr explained that the committee found it advisable to discuss electrification from the viewpoint of the purchaser and the seller of electrical energy for railway purposes. He said that the Chicago, Milwaukee & St. Paul Railway and the Montana Power Company have demonstrated in Montana the entire practicability and the great superiority of electric power for the operation of a heavy trunk-line railway by more than four years of 100 per cent operation. The total yearly cost of operation averages about $11,000 per mile for the entire system of 10,000 miles. The cost of electrical energy purchased for the Rocky Mountain division is $1,600 per mile, or less than 15 per cent of the average total cost for the system.

ELECTRIFIED RAILROAD AS A POWER CONSUMER

Mr. Cochrane discussed power supply for electrification on the basis of experience obtained in supplying power to the Butte, Anaconda & Pacific and the Chicago, Milwaukee & St. Paul Railways.

He suggested that in future electrification projects the power company own all high-voltage lines, switches and transformers and deliver power to the railway at a suitable voltage for its motor-generator sets or whatever converting apparatus is used. With this arrangement the power company would own all the equipment necessary to supply consumers other than the railroad along electrified sections.

Mr. Cochrane pointed out that the ideal rate for a railroad is a straight kilowatt-hour rate. Peak loads do not come at the same time as a general thing, and the fact that they exist is ascertained by referring to the records rather than by any physical effect which they have on the power system. The power factor is about unity, and the load is so scattered that fluctuations in railroad loads have practically no effect on voltage regulation. The load factor on the entire division was about 50 per cent. Combining the total railway load with that of the rest of the Montana Power Company's system makes a total load with a daily load factor frequently in excess of 90 per cent, typical figures at present being 144,000 kw. average and 160,000 kw. maximum.

ENERGY SUPPLY TO RAILROADS

Mr. Junkersfeld discussed the requisites of an equitable power contract for railways. He said that the contract for power should provide automatically for wide fluctuations in cost of labor, fuel and other principal elements. This may take the form of a simple rate, perhaps a "block" rate, based upon both demand and consumption, with a provision for revision at suitable intervals at the option of either party to correct it for unforeseen conditions—changes in the art, in the purchasing power of money, in interest rates, in taxes and in other factors which may affect the cost of electric service.

ELECTRIFICATION ECONOMICAL FOR RAILROADS

F. W. Bellinger outlined the electric operation of the Butte, Anaconda & Pacific Railway since 1912 and gave data on the cost of locomotive maintenance, which varied from 5.3 cents per locomotive-mile in 1914 to 6.8 cents in 1919. He compared this with 16.1 cents per locomotive-mile for steam operation in 1909.

For the Chicago, Milwaukee & St. Paul electrification Mr. Beeuwkes gave details of first cost and comparative operating data for electrified and steam operated divisions which showed that the repairs were much less than for the steam locomotives replaced. He pointed out that electrification had in most respects far exceeded the expectations of the railway organization from an operating standpoint.

Mr. Shepard, in reviewing the service and needs of railroads, pointed out that the traffic of the country doubles about each twelve years, so that facilities must be provided in advance of needs without regard to the necessity for immediate financial return. The physical means by which the most can be obtained from the railroad plant is electrification.

Mr. Armstrong stated that a total consumption of about 53,500,000 tons is a rough approximation of the coal required to produce the electric power to haul the tonnage of 1918 by electric locomotives. This indicates the possible saving of 122,500,000 tons of coal as the annual return on universal electrification of the country's railways. Electrification, he said, involves no experiment with novel and untried apparatus. On the contrary, universal electrification could well follow closely along the lines of installations now in successful operation.

In discussing this report, the success of actual electrifications was confirmed by various companies. W. C. L. Eglin testified to the success of the electrified divisions in the Philadelphia district, as did also F. W. Smith of New York. The viewpoint of railroad men was presented by A. H. Babcock of the Southern Pacific Railroad, who pointed out the importance of disillusioning company officials who believe that money can be better spent in double-tracking systems or along other lines with which they are familiar.

Commercial Sessions

Meetings of the Commercial Section, presided over by John G. Learned, chairman, were held on the afternoons of Wednesday, Thursday and Friday. The following committee reports and papers were presented:

Wiring, R. S. Hale chairman.

Merchandise Sales, E. A. Edkins chairman.

Electrical Merchandise, F. D. Pembleton chairman.

Electrical Shop Management, C. E. Greenwood chairman.

Standardization and Testing, O. R. Hogue chairman.

Electric Range, J. Paul Clayton chairman.

"Electrical Salesman's Handbook," I. Lundgaard chairman.

Economics of the Use of Central-Station Electric Power, John W. Meyer chairman.

Electrochemical Processes, C. H. McClure chairman.

Industrial Electric Heating, N. T. Wilcox chairman.

Lighting Sales, Clarence L. Law chairman.

Street and Highway Lighting, W. T. Dempsey chairman.

Residence Lighting, M. Luckiesh chairman.

Commercial Aspects of Lamp Equipment, George H. Stickney chairman.

Industrial Lighting, H. H. Magdsick chairman.

Compensation of Salesmen, Adolph Hertz chairman.

Electric Steel Furnaces, Joseph McKinley chairman.

General Power, W. E. Murphy chairman. and "Electric Power in the Oil Fields," by W. G. Taylor.

Power Contract, R. H. Ashworth chairman.

Electric Development, Morse Dell Plain chairman.

Commercial Service and Relations with Customers, R. F. Bonsall chairman.

"Use of Central-Station Power in Electric Furnaces," Robert M. Keeney.

THE work of the Commercial Section this year, as outlined by the chairman, John G. Learned, has been to establish the Advertising and Publicity Bureau and the Merchandise Sales Bureau, to compile new booklets, issue circulars, etc., to hold frequent conferences, and in general to maintain an organization for developing the commercial phases of the industry and for disseminating knowledge pertaining thereto. The growing need by central stations of just such knowledge was pointed out by the chairman.

Merchandising

Four divisions compose the report of the Merchandise Sales Bureau, E. A. Edkins chairman—electrical merchandise, electric ranges, store management, and standardization and testing.

With regard to general commercial conditions the committee stated that it seemed doubtful that any decided drop in prices or curtailment of demand on the part of the buying public would come so suddenly as to have a serious effect within the present calendar year. The inevitable decline, however, cannot be far distant, and future delivery orders for 1921 should therefore be placed with considerable conservatism and on a shorter time basis.

Development of a merchandising cost system which will include all of the expense properly chargeable to this department is essential if the sale of electrical merchandise is to be successful, according to the report of the Electrical Merchandise Division, F. D. Pembleton chairman. From figures compiled to show the cost of doing business it was found that there was a wide difference among the companies, varying from as low as 10 per cent to 32.4 per cent, based on the selling price of the goods sold.

AVERAGE ELECTRIC RANGE'S REVENUE $47.47 PER YEAR

In the past two years a very large number of electric ranges have been sold, so that there are now about 75,000 ranges in use in the United States as compared with only about 10,000 in 1915, it was stated by the electric range division, J. Paul Clayton chairman. A conservative estimate shows a market for the year 1920 of approximately 75,000 ranges, and the number to be sold this year will be limited by the producing capacities of the manufacturers.

The diversity factor of the electric range load is greater than that of any other large class of electric load and aids materially in building up a load on the residence distribution system, now the most lightly loaded of all central-station lines. The average annual income from electric ranges throughout the country for 1919 was $47.47 per range, and the average additional capital investment to serve a cooking customer is from $45 to $150.

Electric water heating has been developed successfully, especially in localities served by water power and where a low rate can be offered for this class of service. The average income from electric water heaters now in use is $40 per year.

Operations of the electric shop by the central station must be conducted on a business basis if it is to meet successfully the competition of independent dealers and jobbers, it was stated by the electric shop management division, C. E. Greenwood chairman. Price cutting as a principle is harmful to the best interests of the industry, and no inducements of credit or deferred payments should be made which the independent retail establishment could not profitably offer.

A definite policy for the conduct of the business regarding charges, credits, exchanges, approvals and deliveries should be established, and all employees should be made thoroughly familiar with this policy. Periodic inventories should be taken indicating which are the slow movers in the stock. Unprofitable lines should be moved at a sacrifice if necessary to provide capital to be invested in new lines. The manager must know what his turnover is, which means a card system for perpetual inventory. There should be a definite plan and schedule for advertising which should tie in with the national advertising and other advertising of the distributer in the district.

Testing Bureau Recommended

The standardization and testing division, O. R. Hogue chairman, recommended that a national testing bureau be established for the purpose of testing all classes of electrical heating and motor-driven appliances. Such a testing bureau to be operated along lines that would furnish to its clients a thorough testing service, conducted along standardized lines and employing standard specifications to be approved by a committee consisting of representatives of central stations, jobbers, dealers, contractors, manufacturers and the N. E. L. A.

Considerable discussion followed the reading of the reports of the various divisions of the committee. Manufacturers suffered from a very bad slump between the armistice and June of last year, but at that time an avalanche of orders began to come in which completely swamped the plants, George A. Hughes, of the Edison Appliance Company of Chicago, asserted. All of the manufacturers, he continued, are trying to speed up production. As an example, next year the Electric Appliance Company will turn out 60,000 ranges that will have an average rating of 5 kw. each. Mr. Hughes explained that the present system of charging for the goods at their cost on date of shipment was due to the fact that the fluctuating prices of labor and material made it impossible to estimate with accuracy what the cost would be from day to day.

An interesting note was made by Lewis A. Lewis of the Washington Water Power Company to the effect that in his territory range installations earned 100 per cent per annum on the investment when used in connection with water heaters, collections of $80 per year being the average.

The idea of a central station trying to cut prices and so rule supreme in the merchandising field was ridiculed by A. C. McMicken of the Portland (Ore.) Railway, Light & Power Company, who said that merchandising at less than a profit is not a business builder. By working at a reasonable profit, he said, you invite electrical dealers into the field, which makes it easier for the consumer to purchase appliances. This, of course, results in greater consumption of energy, which is the point that the central station is seeking.

Anticipate enormous demands and slack periods was the message of R. W. Clark of the Puget Sound Traction, Light & Power Company, Seattle, Wash., who suggested that some work could be done along these lines so that a steady demand for appliances would be created.

Commercial Management

Consideration of the compensation of salesmen by the committee on this subject, A. Hertz chairman, has been restricted to the central-station field. The committee prepared a skeleton outline covering all the fields of a sales force in a highly specialized company. The small company may not have an individual for each phase of the work; still all the work of the smaller company is covered by the outline, which has six general branches as follows: (1)Lighting; (2) power; (3) heating; (4) light and power combined; (5) appliances; (6 technical men. Under these main branches are classifications for specialized work in each department. Having established this outline, it was necessary to determine a set of basic ratings figured on the minimum compensation paid to the men in each class.

In the discussion the sales manager's viewpoint was given by M. S. Seelman, Brooklyn, N. Y., who said that lighting salesmen have not been paid on a scale commensurate with the work done. Men should be paid enough so that they will not be attracted elsewhere, because the intimate knowledge of the business which they have learned at the company's expense should be utilized.

R. S. Hale, Boston, said that while merchandise salesmen could properly be paid on a salary and commission basis, it is only fair to the power salesmen that they be paid a straight salary as they are in no way responsible for the amount of energy used.

Power-Factor Clause in Power Contracts

The importance of improving power-factor conditions from the consumers' and companies' viewpoint was considered by R. H. Ashworth, chairman of the power contract committee, in his report. He urged studying how the problem can be solved and educating the consumer regarding the importance of improving his own installation.

The results of a questionnaire indicate that there is no standard of practice on the part of the power companies, either in determining power factor or in correcting it. Rates vary from the complete omission of the power-factor clauses to the inclusion of a flat penalty for poor power factor. A method which improves conditions is the use of the kilowatt-ampere rather than the kilowatt as a basis for rates. Some companies base penalties on the demand charge only, others on the kilowatt-hours used, the latter being preferable in Mr. Ashworth's opinion.

Standardizations of methods was urged particularly to facilitate dealing with commissions and developing of instruments. Penalizing for poor power factor was urged as the best remedy and should apply below 85 per cent in proportion to power factor. The bonus plan was not so highly regarded.

The desirability of basing penalties upon demand received considerable attention in the discussion of this report, H. L. Cook, Boise, Idaho, maintaining that meter complications resulting from other methods offset the greater accuracy. The encouragement of improvement on the part of the customer being the major end in view, any method which results in a proportional penalty should improve conditions. In many respects rates based upon kilowatt-amperes offer the best solution.

L. E. Smith, General Electric Company, felt that imposing penalties offered a better solution in that it permits the customer to make his choice of improving the power factor or shouldering the expense which his poor power factor involves.

The question is one which involves the large consumer principally, contended R. S. Hale, Boston, who indorsed the two-meter method and further agreed on the desirability of including penalties based on kilowatt-hour consumption. W. G. Vincent, Pacific Gas & Electric Company, suggested that a provisional reservation be filed with public service commissions releasing power companies from the necessity of serving customers with abnormally poor power factors.

Electric Furnaces

The high cost of metallurgical products of electrical furnaces and the growing cost of fuel assure central stations of large electric furnace loads, said Robert M. Keeney, director of department of metallurgical research, Colorado School of Mines, in his paper on the "Use of Central Station Power in Electric Furnaces." In the United States the majority of electric furnaces are operated by central-station power, which is not the case in Europe, where all plants having electric furnaces either have their own power plants or the central station has a plant set aside for this special load. The main point the electrical industry should watch in the upbuilding of this branch of the industry is the use of three-phase furnaces.

ELECTRIC STEEL FURNACE DEVELOPMENT FROM SEVERAL VIEWPOINTS

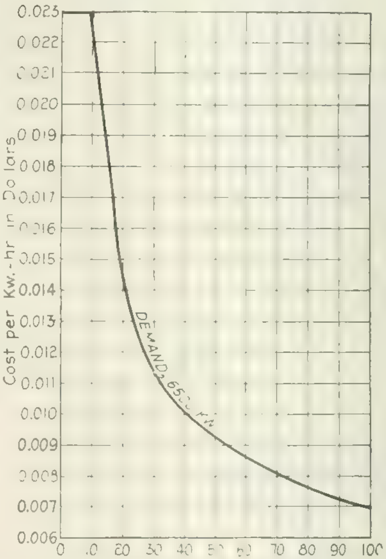
Development in electric furnace design has been toward making the furnace load more desirable to the central station, in the opinion of the electric steel furnace division, of which Joseph McKinley is chairman. Automatic charging, automatic regulation of the electrodes and increase of power capacity per ton rating of furnaces have helped in this development. The electric steel production in the United States represented 300,000,000 kw.-hr. power consumption in 1918. Figures for ten years are:

Year	Gross Tons	Year	Gross Tons
1909	13,762	1914	24,009
1910	52,141	1915	69,412
1911	29,105	1916	168,918
1912	18,309	1917	304,543
1913	30,180	1918	511,364

Considering the furnace from the user's standpoint, Edward T. Moore, in one of the papers supplementing this report, made some interesting statements regarding the cost of production of steel by this method. As shown in the curve, the power cost is a function of the load factor to a very marked degree. As a high monthly kilowatt consumption and a low peak demand produce a high load factor, it is the endeavor to keep the peak demand as low as possible. In this connection, one company has constructed a peak regulator to control the demand for power. By this means the load factor was increased from 45 per cent to nearly 60 per cent and the energy cost decreased, as shown in the curve, from 1 cent per kilowatt-hour to 0.89 cent per kilowatt-hour, which alone reduced the power cost of steel ingots approximately $1 per ton. A drop of load factor from 50 per cent to 40 per cent would mean in this case an increase in power cost of $1,800 a month with a consumption of 2,500,000 kw.-hr.

From the central-station viewpoint, as pointed out in the paper by E. C. Stone, the importance of load factor, furnace disturbances and off-peak power are fully recognized. On account of the rapid and wide fluctuations in load, electric furnaces have in some cases caused considerable disturbances in systems to which they have been connected. It is thought that "disturbance-limiting" standards may be established.

In giving the manufacturer's viewpoint W. E. Moore has shown that the manufacturer is also interested in the design of regulators to eliminate the instantaneous peaks. The factors limiting the growth of electric furnace business are the lack of power and also the lack of supplies such as electrodes and shortage of trained men for the work.



A HIGH-LOAD FACTOR IS IMPORTANT IN FURNACE WORK IN KEEPING POWER COSTS DOWN

Discussing the report, Frank D. Burr of Denver said that information regarding the results obtained by the electric furnace users should be carefully compared with results promised by the manufacturers. One advantage of electric furnaces that has been particularly observed is that they have turned out 43 per cent to 51 per cent good castings, whereas with other furnaces it is not unusual for only one-sixth to be perfect. The lack of service men and the distance of the furnace installation from the factory are great disadvantages in the West. Cost of power is comparatively unimportant, but it is significant that while castings can be turned out at $38 per ton with energy at 1 cent per kilowatt-hour, compared with $57 per ton by the converter method, they would cost only $44 per ton if the rate for electric service were increased 100 per cent.

W. L. Merrill, Schenectady, predicted that within ten years the furnace load would be greater than the entire motor load. He referred to casting anchor chain from electric steel, saying that the cost is approximately the same as that of forging, but the chain is 40 per cent stronger. Another advantage is that one man can produce sixty times as much steel chain as under the old system.

J. G. Learned pointed out that electric furnace users are now seeking power and are not only willing to pay a good rate for it, but in some cases are willing to finance the extensions and provide sufficient capital to pay for the necessary increase in the station generator capacity.

Industrial Heating

Activities of the industrial electric heating division, M. T. Wilcox chairman, were covered by three papers as follows: "The Electric Furnace for Melting Brass," by A. V. S. Lindsley; "Low-Temperature Industrial Heating," by R. T. Kaighin, and "Industrial Heating Applied to Medium and Low-Temperature Processes," by W. S. Scott.

An annual saving of $36,000,000 could be realized in the melting of brass and non-ferrous alloys by the use of electric furnaces, it was maintained by A. V. S. Lindsley in his discussion of the electric furnace for melting brass. Data on types and sizes of furnaces were given, showing an energy consumption per ton of metal melted of from 175 kw.-hr. to 300 kw.-hr., depending on the size of furnace and the nature of metal treated.

Manufacturers who formerly allowed from five to nine hours for japanning operations are now doing the same work much better with electric ovens in from thirty to sixty minutes, R. T. Kaighin stated in his paper, "Low-Temperature Industrial Heating," which covered electric heating as applied to japanning, paint drying and core baking. For japanning in Detroit there is a connected load in excess of 20,000 kw., in Toledo the electric japanning load is over 6,000 kw. and in Cleveland this load exceeds 5,000 kw.

A very complete description of the practical application and apparatus used in electric ovens was given by W. S. Scott in his paper on "Industrial Heating Applied to Medium and Low-Temperature Processes."

INDUSTRIAL HEATING AND ADVANTAGES OF ELECTRIC FURNACES

The additional advantages of electric furnaces besides the saving in heat cost were brought out in the discussion by Harold Fulwider of the General Electric Company. To show the progress that is being made in the electric furnaces, he spoke of an electric furnace to be used in the heat treating of gun forgings now being constructed. This furnace, which is 10½ ft. in diameter and 105 ft. high, will handle castings weighing 320,000 lb. and will represent a load of 2,850 kw. Central-station men should take over some of the work that had been done by the manufacturers in finding new uses for electric furnaces and ovens, he concluded.

A. C. McMicken, Portland (Ore.) Railway, Light & Power Company, said that the only two brass furnaces on the Pacific Coast, in his knowledge, are in Portland, and that the furnaces are giving excellent results. Running with an average heating cost of 1.4 cents per kilowatt-hour, they are able to compete with oil furnaces, despite the increased fuel cost, and at the same time are turning out a superior product. Besides, considerable loss in metal is being avoided. This particular load, Mr. McMicken pointed out, is not particularly attractive to the central station for two reasons —first, because the furnaces are of the single-phase type, and, second, because the power factor, even with special transformers and special reactances in them, averages only 72 per cent. Three-phase furnaces have better performance than this, the power factor in their case running around 90 per cent.

A home-made electric furnace which is being served by his company is making pig iron out of scrap metal. This furnace is of the three-phase type, turns out two tons of metal every hour and a half and has a load factor that is better than any other electric furnace served.

F. X. Mettenenet of Chicago then stated that his company has found that electric furnaces on a rate of 3 cents per kilowatt-hour are able to compete with gas furnaces, with gas selling at 65 cents per 1,000 cu.ft.

Wiring

Considerable space is devoted to the standardization of appliance plugs and housings in the report of the wiring committee, R. S. Hale chairman. The importance of this measure is being increasingly recognized, but there are two reasons why comparatively little progress has been made. The first is the genuine doubt as to the best standard, since both flat prongs and round prongs have distinct advantages and disadvantages, and further there is still a question as to whether there should be different types, one heavy and rugged for such articles as flatirons, and another type non-interchangeable with the first for light articles like heating pads, percolators, etc. The second reason is the disinclination of each manufacturer to adopt a standard other than his own.

From a letter from F. D. Goode, chairman Heating Appliance Section, A. M. E. S., it appears that of the two types of terminal structures used with flatirons at the present time—the flat type and the round—four manufacturers use the flat type. Standard attachment plugs virtually are interchangeable on these flat prongs now. At the same time six manufacturers make flatirons with round prongs. Arrangements have now been made for detail changes by some of the manufacturers which will permit the interchangeable use of a standard plug on all six of these irons in the very near future. This standardization does not yet affect all manufacturers of flat-prong or round-prong flatirons and as yet does not include appliances other than flatirons.

The committee feels that serious attention to the menace of fires from flatirons is merited, and that continued education of the public is the best way to combat this danger.

Tests on wiring at different ages are being continued, and in addition the committee is having prepared some sample boards showing different types of wiring, embracing also foreign practice. Furthermore, it is branching out into tests on portable cords, with a view toward standardization on minimum requirements based on experience. These tests are to be started this year and manufacturers have been asked to submit sample cards, confining themselves first to cords suitable for domestic iron use, No. 16, B. & S. stranded. It is hoped that through returns from appliance managers of central stations and from wiring contractors, and through laboratory tests, some rating can be given the various cords.

A description of heater cords to be tested by the Electrical Testing Laboratories under the auspices of the wiring committee and to be rated by commercial men and wiring contractors was presented under separate cover. Ratings are asked on twenty cords from nine manufacturers.

Power Service

During the past four years industry has encountered economic problems which, no doubt, existed heretofore but were not recognized because problems of seemingly greater importance demanded attention. The report of the division of the Power Sales Bureau on economics of the use of central-station power, John W. Meyer chairman, stated that probably the greatest problems to be met have been the rapidly advancing cost of labor, money and materials essential in the production of energy. These tendencies in commercial development are of interest to engineers, but a thorough understanding of them can be attained only by a detailed study of capital, gross earnings, cost of materials and replacement of capital destroyed.

The rapid growth in the use of electric drive in the textile industry was also taken up in detail by the committee.

Under "Public Utility Barometers" the committee discussed the central-station operation data being collected and published monthly by the ELECTRICAL WORLD and strongly recommended that the central-station industry lend all assistance to the ELECTRICAL WORLD in this compilation. In an excellent paper which formed a part of the committee's report H. H. Holding suggested the use of graphic records of sales to a group of representative industrial power customers as an index to industrial trade conditions.

The division on electrochemical processes, C. H. McClure chairman, allotted certain phases of its work to several members for investigation and report. The subjects treated include "Nitrogen Fixation" by C. B. Gibson of the Westinghouse Electric & Manufacturing Company. Mr. Gibson described the five processes, listing the advantages and disadvantages of each. These processes are : (1) the arc; (2) the cyanamid; (3) the nitride; (4) the direct synthetic ammonia; (5) the cyanide. The last two do not require electric energy.

A paper by J. A. Johnson of the Niagara Falls Power Company dealt with artificial abrasives.

Karl Horine of the Commonwealth Edison Company dealt with the subject of electrolytic chlorine, the importance of this industry being indicated by the capacity of plants in the United States and Canada, which in 1919 amounted to 170,000 tons per year. The electrical load is desirable to central stations both in its characteristics and its amount. It takes 2,600 kw.-hr. to produce one ton of chlorine.

A paper by C. A. Winder of the General Electric Company on the subject of phosphorus outlined the process of smelting rock phosphates with silica and carbon and showed the difficulties due to the penetrating qualities of phosphorus.

A paper on magnesium, also by Mr. Winder, described the apparatus used in the production of magnesium. The energy requirement is 25 kw.-hr. per pound.

A. F. Hibbeler of the Commonwealth Edison Company wrote on electrolytic refinement of zinc. While the electrolytic methods are scarcely past the experimental stage, their future seems assured on account of their higher efficiency.

James Brakes, Jr., of the Commonwealth Edison Company, treated the subject of electro-galvanizing, giving the various steps in the process, and described the method of cleaning the iron, which also is an electrical process. The costs of electro-galvanizing and coke and gas hot-galvanizing were compared, and the electric process was shown to be cheapest.

Another paper by C. B. Gibson was devoted to the manufacture of graphite.

The work of the division of electrical development, as outlined by the chairman, Morse DellPlain, has been along three lines: (1) new industrial electric processes; (2) special convention addressses; (3) papers for presentation before conventions of manufacturers.

There are several new wholesale uses for electric energy which should be mentioned, chief among which are purification of municipal water supply, sterilization of sewage, and dehydration of food products. In addition, the increased use of the electric furnace in the metallurgical industries has resulted in many new specific processes in that field.

Lighting Service

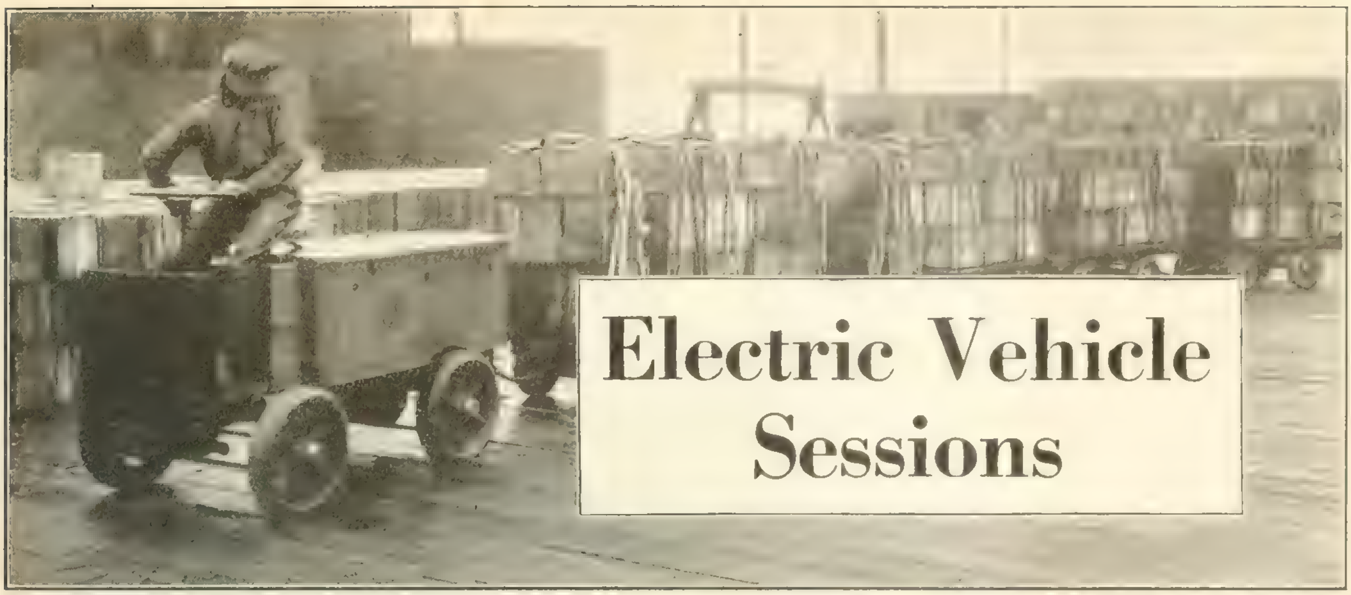
The activities of the Lighting Sales Bureau for the past year have been along lines similar to those of other years, though somewhat experimental, it is stated in the report of the bureau, Clarence L. Law chairman, as they were based upon a suggested organization made at the beginning of the year to determine upon a definite plan of future procedure. The bureau has operated during the year in six divisions as follows: (1) Commercial aspects of lamp equipment; (2) street and highway lighting; (3) store lighting; (4) lighting of large buildings; (5) residence lighting, and (6) industrial lighting. The chairman recommended that for the next year's work the bureau be divided into three divisions as follows: (1) Lighting practice; (2) lighting campaign; (3) lighting equipment.

It was thought that the most needed service in the field of the division on the commercial aspect of lamp equipment, G. H. Stickney chairman, would be to produce a reference book on lighting equipment, covering standard types, and to point out their merits and applications. The division has, therefore, prepared a classification of such equipments and has undertaken the collation of information which it proposes to present in a systematic form for ready reference.

The street and highway lighting division, under W. T. Dempsey, dwelt on the progress that is being made in highway lighting, park lighting, lighting fire department and police signal posts and lighting for traffic regulation.

A paper on "Lighting and the Householder," by M. Luckiesh, chairman of the residence lighting division, presented a résumé of conclusions reached by analyses of residence lighting. The keynote of the paper was that in general the householder is indifferent toward lighting.

While the central station is the only factor in the electrical industry constantly in contact with the customer, it has in the usual case failed to take the leadership in the problem of industrial lighting and, in the opinion of the industrial lighting division, of which H. H. Magdsick is chairman, the one way to correct this situation is to have men of ability who are thoroughly informed on the subject of illumination and capable of commanding respect as experts conduct the sales effort.



Electric Vehicle Sessions

The Electric Vehicle Section met on Friday afternoon, when, after the address of Chairman George B. Foster, committee reports and papers were presented to the section as follows:

Garage and Rates, Willis M. Thayer chairman.

Legislation, G. A. Freeman chairman.

"The Uses and Abuses of Electric Vehicles," by H. J. Butler and W. J. Burns.

Electric Vehicle and Power Sales Bureau Co-operation, E. S. Mansfield chairman.

Transportation Engineering, F. M. Feiker chairman.

"The Electric Truck Industry," by C. A. Street.

RAPID development of the electric vehicle business depends on adequate garage facilities. This was the point most emphasized by George B. Foster in his address before the Electric Vehicle Section. While the central stations have taken some interest in the promotion of vehicle business, as a whole the activity in this field has not been commensurate with the possibilities.

By keeping accurate cost records, promoting the establishment of suitable garages and meeting the competitor on his own ground the entire industry will be stimulated. The future of the business is very encouraging, concluded the chairman, and no central station should neglect this important field.

The discussion on the papers presented before the Electric Vehicle Section centered around the uses and abuses of electric cars. W. E. Clement of New Orleans emphasized the need of proper garages and supervision. That the present is the ideal time to sell vehicles, since they can be served without investing in line extensions, and that salesmen who have been taken off other work can well be used in this field were opinions expressed by those taking part in the discussion, among whom were G. B. Foster and E. W. Lloyd.

Making the Garage a Profitable Business

Off-peak vehicle load is profitable to the central station, but the garage, which seems to be the necessary medium through which such load is obtained, is not always profitable. For that reason the committee on garages and rates, Willis M. Thayer chairman, gave its attention to the conditions necessary to make a garage profitable.

After a careful investigation of various commercial ventures the committee has decided that a sixty-car garage is the minimum on which to establish a profitable business. The floor should be of ample size with a width of at least 60 ft. (18 m.) and length of from 150 ft. (46 m.) to 200 ft. (61 m.).

The handling of properly selected side lines is emphasized. In fact, in the opinion of the committee, a customer who does not buy his supplies through the garage should be looked on with disfavor.

While the central station has provided accommodation for electric vehicle users, better results can be obtained by operating a garage as an independent business, particularly in large cities where the business has been developed. Handling batteries for gas cars is also suggested as the volume is large and the profit good.

No Unfavorable Electric Vehicle Legislation During the Year

During the past year no legislation which discriminates against the electric vehicles has come to the attention of the committee on legislation, Chairman G. A. Freeman reported. The proposed uniform motor vehicle law, prepared by a joint committee representing the American Association of Highway Officials, the National Automobile Chamber of Commerce, the American Automobile Association and the Highway Industries Association, was briefly touched upon. In the opinion of the committee the proposed law favors the electric vehicle.

Uses and Abuses of Electric Vehicles

A paper by H. J. Butler and W. J. Burns enumerating the advantages of electric vehicles pointed out that it is easy to train help used to other lines of work to become safe operators. Another big advantage in the use of the electric truck is found in the fact that when the electric truck stops all movement of the mechanism stops. Moreover, the amount of power required can be measured in advance of purchase with instruments of precision.

A number of investigations have shown that from 15 miles to 18 miles a day is the average delivery mileage when horses are the medium. The average speed of a 2-ton electric truck is 14 miles to 15 miles per hour. This is from two to three times the speed of the horse-drawn vehicle. Of course, the field of operation of the electric truck is quite clearly defined, and rural or interurban deliveries of long mileage are purely within the radius of the gasoline truck.

Electric installation can be abused in two ways. The first way is by an attempt to have the electric truck perform long mileage at high speed, and the second is because of constant neglect of the battery.

From the accompanying chart, prepared and furnished by one of the largest operators of both gasoline and electric trucks in the United States, it can be seen that the cost per ton-mile for the gasoline truck has increased from 5.3 cents in 1915 to 6.75 cents in 1919, while the cost per ton-mile for the electric truck has decreased consistently from 4.74 cents in 1915 to 4.17 cents in 1919. Another interesting point which will be observed from reading this chart is that the average ton capacity per gas truck only increased from 3 to 3.27, while that of the electric truck in the same period increased from 1.6 to 2.7. The trucks from which these figures were compiled were all operating under equal conditions in city deliveries. The figures include all expenses except interest, depreciation, insurance and drivers' wages.

Co-operation of Electric Vehicle and Power Salesmen Recommended

The power salesman and the electric vehicle representative are in the same field, dealing with the same customers and, although the fact is not fully appreciated by either of them, have an interest in common. In the report of the electric vehicle and power sales bureau co-operation committee, E. S. Mansfield chairman, a study and suggestions have been made of ways and means by which each interest may benefit itself by working in sympathy and co-operation with the other. It is not to be expected that the power salesman will devote all of his time to the introduction of electric vehicles, but he should know something about electric transportation, the range of its efficiency and its relative economy.

Managers of some companies believe that the conditions in their localities are such that electric vehicles cannot be operated successfully, or that the amount of transportation is so small that it would not pay to appoint an electric vehicle power salesman. Even so, it would be better to have some one knowing the facts and conditions to notify prospective customers of them.

The electric vehicle representative cannot expect the fullest amount of co-operation from the central station unless he in turn shows the same spirit. A little study on his part, together with a conference with the central station, will put him in a position where he can tell the "prospect" a simple story which can afterward be confirmed by the power salesman. A little knowledge may enable the electric vehicle man to point out how by combining his charging load with other power he can obtain a better rate.

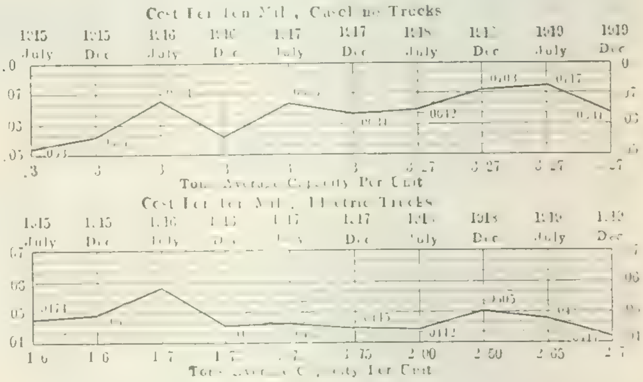
Lack of Transportation Engineering Education

While the large quantity of operating-cost figures collected by the transportation engineering committee, of which F. M. Feiker is chairman, are not comparative to the extent that accurate cost facts could be deduced from them, still they indicate that the cost of operating the electric vehicle, taking all factors into consideration, is about one-half the cost of gasoline transportation for similar operating conditions.

The committee was of the opinion that the way to present the growing importance of both the commercial and the industrial electric vehicle in the transportation industry is to associate them in the first place with the larger problem of transportation and in the second place with the problem of electricity in transportation, with all of which the central station has an increasingly important relation.

In this connection the committee made a study of transportation education. A questionnaire was sent to most of the educational institutions of the country, the results of which showed a lack of any definite conception of transportation engineering as such, although in places there is elementary knowledge of the general subject.

While transportation engineering is the big thing, there is no crystallized definition of a transportation engineer and there is far from any crystallized sentiment as to how the prospective transportation engineer is to be trained. Although not laying down a course in transportation, the committee felt that the subject could not be covered properly by the separate departments of a university taking it up from their own particular viewpoints. Rather should such a course be built up with the general subject in view, guided by an individual not tied by experience or sympathy to any one particular phase of transportation.



COMPARATIVE COSTS PER TON-MILE OF GASOLINE AND ELECTRIC TRUCKS

The report contains suggestions on transportation engineering from a number of universities together with requests for assistance regarding transportation engineering courses.

There are appended to the report the complete data received from the colleges in reply to the committee's questionnaire relative to instruction in transportation engineering.

The Electric Truck an Economic Necessity

In spite of several years of extremely keen competition with gasoline trucks, the electric truck remains an economic necessity in the transportation field, said C. A. Street, in a short paper on the subject of the electric truck industry. The proper application of the most economical machine is to use electric trucks for work within their capacity and gasoline trucks only for work beyond the capacity of electric trucks. Complete accurate operating cost records of large users of both gasoline and electric trucks prove that a 5-ton gasoline truck, operating an average of 40 miles per day, costs approximately $5 to $10 a day more than a 5-ton electric truck doing the same work.

The electric truck industry has not grown at the same rate as the gasoline truck industry, owing, possibly, to the enormous advertising and sales campaign carried on for years by the gasoline passenger car and truck interests.

Accounting Sessions

Chairman R. W. Symes opened the first accounting section on Thursday afternoon, the second session being held the following afternoon. At these times chairmen of the following committees presented their reports:

Credits and Collections, David Darlington chairman.

Classification of Accounts and Accounting Relations with Other Associations, William Schmidt, Jr., chairman.

Bonus Systems, H. A. Snow chairman.

Merchandising Accounting, C. W. Johnson chairman.

Accounting Service to Member Companies and the Monthly Bulletin, Frederick Smith chairman.

Motor Vehicle Records, G. P. Landwehr chairman.

Purchasing and Storeroom Accounting, W. F. Stevens chairman.

Federal Income Tax Procedure, H. E. Addenbrooke chairman.

Customers' Records and Billing Methods, J. D. Jacobus chairman.

Accounting Education, Douglass Burnett chairman.

WHILE the proposed Accounting Section of the National Electric Light Association is substantially the same in character as the existing Accounting Section, it is not possible to suggest a program for future work until the reorganization is carefully studied, Chairman R. W. Symes said in his address before the section. The work of the section will be considerably enlarged and its sphere of usefulness broadened by the new plan. Several of the accounting committees have been tentatively placed in the category of national or standing committees, and the work of such committees has been co-ordinated with that of like committees of other sections. With the proposed plans adopted another step in advance will be recorded and the work of the section should take an even more important place in the affairs of the industry.

328 Replies to Credit Questionnaires

Questionnaires sent out by the committee on credits and collections, David Darlington chairman, covering the methods employed in the credit and collection departments resulted in 328 replies from member companies. These replies showed that usually credits and collections are handled by a single department and credit requirements must be met before service is given; unpaid accounts must be settled up before customers can open new ones after service has been discontinued; exchange of credit information with other commercial houses is practiced by about 50 per cent of the companies; guarantees or deposits are required quite generally; discounts varying from 3 per cent to 20 per cent are given for prompt payment, and appliances are sold on the installment basis by most of the companies dealing in them.

Tabulated data from companies having fewer than 1,000 customers and companies serving more than 50,000 customers are given in the report, showing nature of billing, whether net or subject to discount, the percentage of collections received through mail, collectors, main and branch offices, percentage of deposits held based on monthly sales, number of collectors, percentage collected in calendar month in which billed and percentage of bad debts.

Standard Classification Soon to Be Completed

No stated meetings of the committee on classification of accounts and accounting relations with other associations, William Schmidt, Jr., chairman, were called or held during the year, but a large amount of correspondence has been conducted with the National Association of Utilities Commissioners, with the various state regulatory bodies and with the association heads of the Accounting Section. At a later date a conference will be held, and probably the matter of a national standard classification can be successfully adjusted at one sitting.

Opinion Divided on Efficacy of Bonus Systems

Bonus systems of increasing employees' remuneration are neither indorsed nor condemned in the report of the Accounting Section's committee on bonus systems, Harry A. Snow chairman. Of 133 large central stations surveyed, only twenty-four have bonus systems in use, although reports of nine bonus systems having been tried and discarded also were received. Wage plans of twenty concerns outside the electrical industry also were studied for additional data. Co-operation of employer and employee is essential to the success of any such plan, the report states, the primary object being to increase the efficiency and interest of the employee to the mutual benefit of himself and the company. Unfair advantage taken by either side must militate against the success of any such plan. In the appendix of this report actual details of bonus plans successfully in use in central stations are given.

Classification of Merchandising Accounting

The same classification of merchandising accounting has been retained by the merchandising accounting committee, C. W. Johnson chairman, that was submitted in 1917. A canvass of member companies as to their attitude in regard to the classification submitted, also a request for suggestions from them as to changes or additions that should be made in the accounts, brought out the fact that owing to the war and the general labor conditions of 1917 and 1918 member companies had not made use of the classification.

An index to merchandise accounting is proposed which consists of six main divisions, with subdivisions: (1) Revenue from merchandise sales; (2) cost of goods sold; (3) cost of installation; (4) selling expenses; (5) general expenses; (6) fixed charges. The smaller companies may desire to use only the main classification consisting of the six accounts. Those desiring more than the six accounts may use the first subdivision, of which there are twenty accounts, while the larger companies may avail themselves of all subdivisions. This extends the classification to a total of thirty-nine accounts.

Accounting Service to Member Companies

Since the previous report of the committee on accounting service to member companies, there has been a service department organized at the association headquarters in charge of F. W. Herbert, formerly a member of the Public Utility Commission of the State of Colorado, who is to assist in the accounting service work. The work of the accounting service has been very extensive during the past year, and numerous inquiries have been received by the state representatives.

In connection with the work the committee sent out letters to the various state representatives calling for suggestions. One of the problems which came to light was in respect to the handling of accounts where the consumer put up the money for an extension with an agreement for a refund on a certain basis over a period of years. In a number of cases the utilities commissions have felt that since this property had been paid for by the consumer it should not have been carried on the property or construction account of the utilities until such time as the actual refund to the consumer had taken place. It is the opinion of the state representative who brought up this point that such an agreement was working a hardship on the utilities, for the utilities would not be able to earn a rate of return or a percentage for renewals and contingencies on such property.

It is the intention of the committee, of which Frederick Smith is chairman, to continue the effort to extend the scope of this work and to cover the states which at the present time have no representative.

MOTOR VEHICLE RECORDS EMPHASIZE NEED OF BETTER ACCOUNTING

The efforts of the motor vehicle records committee, G. P. Landwehr chairman, have been concentrated on obtaining cost data on the interchangeable report which was recommended by the former committees. The results obtained by securing these figures, while of great value, proved conclusively that a new campaign must be started to have all companies consider their transportation department as a separate unit of the electric system. The committee is to continue the collection of data during the coming year.

SYSTEMATIC KEEPING OF PURCHASE-PRICE RECORDS

In the development of a system for keeping purchase-price records the committee on purchasing and storeroom accounting, W. F. Stevens chairman, holds that only those prices which have some potential value should be recorded. Instead of recording all prices a division should be made taking out all of those that are special or where there is a lack of description. The responsibility of maintaining the established standards of completeness should be delegated to one person. Data recorded should be as follows: Date of purchase order; number of purchase order; name of vendor; gross discount—net price; quantity.

Purchases of supplies may be grouped under the following heads: (1) Contracts; (2) formal orders; (3) emergency orders; (4) petty-cash transactions. The subject of emergency orders is one which the committee has taken up in considerable detail. With few exceptions the emergency order has found a useful place only where the purchasing organization is centralized at a distance from the stock centers. Its legitimate field is where a company has taken over smaller ones in surrounding towns. It is often necessary in this case to develop some form of local purchasing. The committee has gone into a detailed system of handling orders of this kind.

Inventory procedure is another subject which has been investigated with regard to its purpose, routine, operations, time of taking, responsibility for results, final report, study of errors of storehouse operation, precision of results and standard methods of comparison.

INFORMATION ON MAKING TAX RETURNS

In carrying out its work in giving member companies suggestions as to pitfalls in the federal income tax requirements, the committee on tax procedure, H. E. Addenbrooke chairman, prepared and sent out three papers. The subjects covered were "Accounting as Affected by the Federal Income and Excess Profits Tax Laws," "Questions Affecting Invested Capital and Net Income" and "Suggestions Affecting Consolidated Returns." A lesson was also prepared for the advanced accounting course on the general subject of tax laws and regulations.

CUSTOMERS' RECORDS AND BILLING METHODS

Depositing cash in bank with the least delay and causing the customer's account to reflect accurately as soon as possible the fact of his payment are essential to a good system of handling cash receipts, it was stated in the report of the committee on customers' records and billing methods, J. D. Jacobus chairman. Elimination of the peak in balancing of consumers' ledgers has been solved by sectionalizing the ledgers either by the routes by which they are read or by some other convenient method and balancing them as units at different times during the month, unit balances being taken when the unpaid bills are at a minimum, usually just prior to the billing period.

Rendering bills to residential and apartment-house customers at bimonthly or quarterly periods has been tried out in two instances, and the plan adopted has been in operation more than a year, with results so satisfactory that it is improbable that either company will revert to monthly billing. The saving in bimonthly billing has been approximately 50 cents per customer and under quarterly billing 60 cents per customer.

A system of combined billing and ledger posting by machine for customers' account has been adopted by a number of companies and has proved to be a great saver of time and labor.

In the discussion on the report E. J. Fowles of the Commonwealth Edison Company said that machine billing, if properly applied, would effect great simplification of customers' account, but that continuous meter reading and monthly and quarterly billing have not given universal satisfaction in the territory of the Commonwealth Edison Company. Mr. Schmidt, Jr., said that bimonthly and quarterly billing had greatly reduced the number of complaints, but that the expense is not justifiable. He estimated that from $350,000 to $400,000 additional working capital is required for bimonthly billing.

RESTRICTIONS ON SUBSCRIPTIONS TO ACCOUNTING COURSES REMOVED

The committee on accounting education, Douglass Burnett chairman, states that prior to Oct. 1, 1919, restrictions to the elemental and advanced accounting courses were limited to member companies, but owing to the request for the use of these courses by allied industries and educational institutions these restrictions have been removed. The advanced course is now at a stage where twenty-five lessons are available.

Raising Economy in Prime Mover Practice

Increased Attention Is Directed Toward Economy in Power-Plant Practice as Shown by Prime-Mover Report at N. E. L. A. Convention—Problems of Burning Low-Grade Fuels, Oil Engine and Hydraulic Practice Are Studied

RISING costs of fuel and labor have caused central-station engineers to attack, with new energy, the problem of increasing over-all plant economy. Progress in burning low-grade fuel is reported by N. A. Carle, chairman of the National Electric Light Association committee on prime movers, and it is stated that Diesel oil engines have been perfected to such a degree that they may be profitably considered for installation in central stations. Manufacturing companies are said to be correcting difficulties in steam turbines and boilers which were constructed during the war period. Problems arising out of the interconnection of steam and hydraulic stations are being scrutinized for the purpose of obtaining maximum economy in the whole system.

Operating records of single-shaft turbines, according to the report, have not been entirely satisfactory, and several additional turbine failures have occurred during the year. An analysis of the data indicates trouble due to vibration of the wheel structure causing fatigue cracks. Trouble has been accentuated in the disk where sharp tool marks or rough surfaces are present or holes in the wheel are drilled for balancing purposes. Considerable investigation is still necessary on the subject of vibration of wheels before all the facts can be known and the designs can be completely guarded against this trouble. Records of units manufactured since the last report indicate that 30,000-kw., 1,800-r.p.m., 60-cycle, and 35,000-kw., 1,500-r.p.m., 25-cycle, are the present maximum standard sizes of single-shaft, single-barrel units for large installations.

Starting Large Steam-Turbine Units

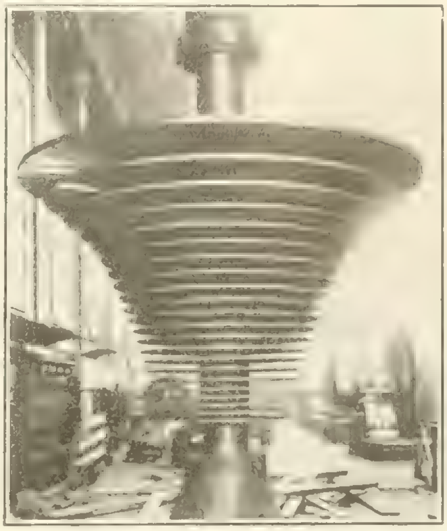
Elimination of danger from temperature changes in starting large turbines from the cold state cannot be accomplished by hard and fast rules. Generally, a partial vacuum of 15 in. to 20 in. (380 mm. to 500 mm.) is maintained during the warming up of sufficient steam to turn the unit at not more than 10 per cent of its speed, the safe minimum line being given as twenty minutes for units of 20,000 kw. capacity and thirty minutes for units of 30,000 kw. Application of load at a rate for these sizes not exceeding 1,000 kw. per minute seems to be the general rule.

Serious damage in some instances to the casings of large turbine units has resulted from contraction and expansion of steam lines. Emphasis is laid on the necessity of making the steam lines sufficiently flexible and providing anchorages in such positions as to prevent transmission of strains to the turbine casing.

Careful selection of oil for turbine use is pointed out as a necessity to eliminate troubles due to the tendency of manufacturers toward operation of lubricating oils at higher temperatures and the deterioration caused by contact with air and water occurring under working conditions. Current practice calls for frequent treatment by means of purifying and filtering devices. Two methods of treatment are generally used—the continuous system and the batch system, the first consisting of continuous circulation of the oil through the treating apparatus, while under the second the oil system is drained at regular intervals for treatment and replaced with a fresh supply.

Limitations in the Use of High Vacua

In connection with condensers and auxiliary air-removal devices it is reported that there has been no radical change in apparatus of this type. Operating engineers are, however, realizing more and more the possibility and advantages of high vacuum and are more systematically correcting faults of both the prime mover and condenser equipment to obtain this end.


ROTOR OF A 35,000-KW. TURBINE

The tendency toward large sizes of boiler units has continued during the past year. Units of 1,000 hp. to 1,500 hp. and over are quite common in central - station practice. The committee calls attention to the fact that with boilers made under war and post-war conditions troubles have developed due to faulty shop work. The Uniform Boiler Law Society reports that nineteen states and a large number of country and municipal bodies have adopted the code to date. Manufacturers report no radical changes in design features, but their statements do indicate a general tendency to turn out boilers of higher rated capacity, without increasing materially the maximum pressures now in general use.

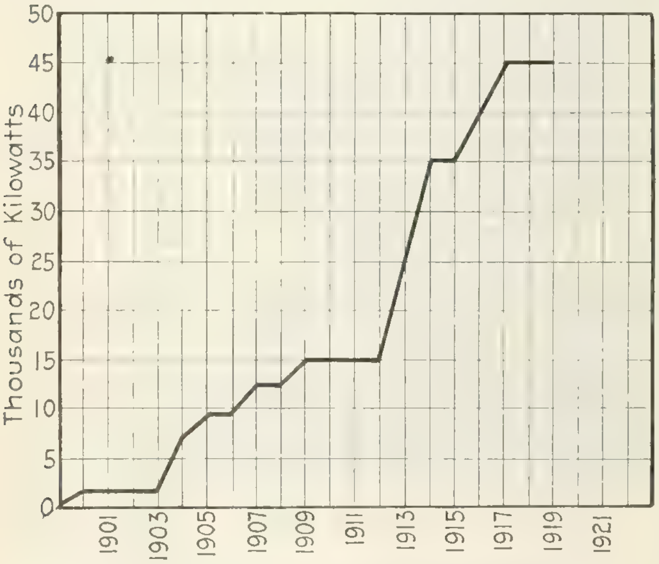
Little Trouble Has Developed with Superheaters

Perhaps the most important fact brought out by a questionnaire on superheaters was that, considering their difficult location and the delicate nature of their work, superheaters are causing a surprisingly small amount of annoyance and concern to the operators.

The tendency toward larger boiler units and high boiler ratings has emphasized the need for providing boiler-feed water which is free from incrusting solids and other troublesome ingredients. Although water treating plants are occasionally an absolute necessity on account of unfavorable feed-water conditions, they are more often merely a means whereby better over-all results are obtained. The use of evaporators for supplying make-up water for generating stations has come into use only during the last four or five years. Undoubtedly, high boiler ratings and large-sized boiler units have been largely instrumental in bringing about this development.

Because of the increasing adoption of higher steam pressures and the feasibility of constructing steel economizers to meet this condition, special interest attaches to this type and to the efforts being made by the manufacturers to eliminate troubles from internal corrosion that have been experienced both in this country and abroad. It is the committee's understanding that if the temperature of the water entering the steel economizer is kept up to 200 deg. F. (90 deg. C.) serious corrosion troubles are not likely to occur, as the heating to this temperature effects the release of most of the entrained air, to which the corrosive action appears to be largely due.

Lignite and sub-bituminous coals such as occur in Washington, Montana, Wyoming, Colorado, Dakota and Texas are commonly burned on hand-fired grates; less often on stokers. Using hand-fired grates with a surface considerably more generous than is the practice with bituminous coals, boiler ratings of 100 per cent and sometimes higher are obtained. The combined efficiency is ordinarily below 60 per cent except with the very best operation.



GROWTH IN SINGLE-SHAFT TURBINE RATINGS

In mechanically stokered plants, and especially with forced-draft stokers, much higher boiler ratings are obtainable than with hand firing. With coals of the sub-bituminous character boiler outputs up to 300 per cent of normal ratings may be realized, and with lignites as much as 250 per cent is possible. Results reported with various types of equipment are given in the table. These results are not necessarily the best obtainable. As far as regards boiler capacities developed the figures probably give fairly accurate ideas of what may be expected at present.

Interest Is Shown in Powdered Fuel

The past year has witnessed an increased number of plants installed to burn powdered coal and a quite rapidly growing interest on the part of engineers in this development. The handling of powdered coal in large quantities has been successfully carried on in steel plants and cement mills, the coal being transmitted for a distance as great as 2,000 ft. (600 m.) from the powdering plant. On the other hand, several companies are now placing on the market unit pulverizing equipments, one or two units being installed for each boiler. So far as the mechanical details are concerned, either the centralized powdering plant or the unit system seems to be highly satisfactory.

It should be noted in general that the overload capacity of boilers equipped with powdered-coal burning devices is not as a rule so high at present as the figures that can be obtained when using underfeed stokers. This question of overloads will undoubtedly be worked out, however, as it is simply a matter of proportioning furnace volume to boiler heating surface. In old installations the space available in changing over from stoker equipment to powdered-fuel equipment is not sufficient to give the necessary furnace volume. This is a limitation which is inherent in the old apparatus, however, and not in the system.

In connection with the increasing use of oil it might be pointed out that properly designed furnaces for burning powdered coal are also very well adapted for burning oil, thus giving a flexibility of fuel supply not easily attained when using stokers. The powdered-fuel equipment also makes available certain low-grade fuels that cannot as a rule be burned economically on stokers.

One of the questions which has been passed over too lightly by both manufacturers and users of this equipment is that of the ultimate disposal of the fine ashes which now pass out of the stack. If the use of pulverized fuel is extended, municipalities will undoubtedly pass ordinances to eliminate the ash nuisance.

TESTS ON BOILERS BURNING LIGNITE

Test No.	1	2*	3	4	5	6	7	8	9
Source and kind of fuel	North Dakota (Wilton 6-in. lump) lignite	Bear Creek Wyoming sub-bituminous	Bear Creek Wyoming sub-bituminous	Texas lignite	North Dakota lignite	Colorado sub-bituminous	Monarch Wyoming screenings lignite	Texas lignite	Texas lignite
Heat value per pound as fired, bituminous	6,700	9,400	9,400	7,100	7,100	9,200	7,000	7,100	7,200
Moisture, per cent as fired	37	15	15	33	34	23	33	34	34
Make of boiler	Stirling	.....	.....	Edge Moor	B.&W.	Connelly	Stirling	Edge Moor	Edge Moor
Boiler heating surface, sq.ft	2,500	...	.....	5,900	6,000	7,500	2,000	5,200	5,200
Make of stoker	McClave grate hand-fired	Chain grate	Chain grate	Coxe	Westinghouse	Westinghouse	Jones	Taylor	Taylor
Stoker size	68 sq.ft.	...	.....	10 ft. 9 in. x 17 ft.	Seven-retort		Two-retort	Seven-retort	Seven-retort
Duration of test, hours	7	8	8	4	7	†500	8	7	8
Per cent of boiler rating	150	210	160	135	140		75	155	195
Coal per square foot of active grate surface, lb. per hour	45	38	28	34	47		.	.....	.....
Coal per retort, lb. per hour	...	.	...	..	860		530	770	1,060
CO_2, per cent	.	13.0	12.5	8.5	13.5		.....	12.0	14.0
Flue gas temperature, deg. Fahr.	460	610	510	520	470		460	550	600
Equivalent evaporation from and at 212 deg. per pound coal as fired, lb	4.0	..	..	4.4	4.7		4.9	5.1	4.7
Combined efficiency, per cent	60	75	75	60	64	65	69	70	64

*Electrical World, Jan. 10, 1920.

† Service test on four boilers. During same period there were 340 banked boiler-hours.

Figures of oil production and consumption for the past year indicate that the United States is becoming more and more dependent on imports of oil to meet the rapidly increasing demand. The requirements of oil-burning ships and the improvements in the processes for converting heavy oils into gasoline are responsible for the diminished supply and poor quality of the oil available for general use as fuel. The tendency of oil-supply companies is to fix the price of oil at what the traffic will bear without any particular reference to the cost of production. For this reason it is difficult to see how an adequate supply of fuel oil at reasonable prices can become available for central stations until imports of oil from Mexico reach such proportions as to occasion a sharp decline in the market price.

On account of the recent difficulties in obtaining coal it has been urged that a more careful study of the shape of the storage piles of coal be made, not so much of the height as of the projected area, with a view to increasing the amount which can be crowded into a given space. Thus, circular piles in a row would contain less coal than one rectangular pile of the same length. The plea that small piles reduce the probable fire losses should not be taken seriously. At the first sign of heating in the rectangular pile the hot spot can at once be removed by cutting the pile at right angles.

The uniformly frozen state of coal in cars received by plants during the strike period and for a considerable time afterward demonstrated the very great need for comparatively cheap apparatus for breaking up such fuel. All the old-time expedients of pick and shovel and steam were brought into play, and while plants as a whole were able to survive, it was only at the expense of considerable labor and worry. One piece of machinery for unloading purposes which is comparatively new is manufactured by the Robbins Conveying Belt Company and is shown in the accompanying halftone illustration. It consists essentially of a cylinder into which the car to be unloaded is run. Suitable clamping devices are provided to hold the car in place. The cylinder is then revolved and the coal allowed to run out.

The past year showed increasing use of indicating and recording instruments for turbine and boiler rooms. The wider use of these devices has been justified by the savings realized since their introduction. Among the more important points brought out by the committee's investigation are the need of a reliable and reasonably cheap pyrometer, the adoption by some companies of meters on boiler blow-down lines, and the substitution of self-starting synchronous motors in place of clock mechanisms for instrument drive.

MOISTURE CONDENSATION IN TURBINE ROOM

Suitable ventilation of the turbine room today requires ample ingress of fresh air to the generators and liberal facilities to conduct outside the turbine room in summer the heated air leaving the generators. In winter the under side of the turbine-room roof must be kept reasonably warm; at the same time care must be taken that the heated air coming in contact with roof iron work has a low moisture content. Roofs built of hollow tile or with some other kind of air space are freer from condensation than those composed of a solid concrete slab.

It appears to the committee that the stationary Diesel engine has now reached a point of development where no radical changes in design may be expected in the near future. The engine as now constructed embodies many improvements and perfections in design, so that in point of reliability, accessibility of parts for inspection, cleaning and repair it is far in advance of the early Diesel engine. Its regulation, either when operating alone or in parallel with other units—steam or Diesel—is perfectly satisfactory.

Experience has shown that it is preferable to build a high-speed engine having several cylinders of small size rather than to increase the cylinder size. In large sizes (over 1,500 kw.), however, the two-cycle type has proved successful, and it is the type adopted by two of the larger manufacturers.

It should be borne in mind, however, that the fuel consumption of a Diesel engine is practically uniform, regardless of size, in contrast with steam plants. Its advantage in fuel cost is therefore greatest in small sizes. On this account and because of the inherent advantages of the large steam turbines (small floor space, low attendance and repairs) no rapid increase in the maximum size of the Diesel engines installed in central stations is looked for.

MACHINE FOR UNLOADING FROZEN COAL FROM CARS

The fuel consumption of the Diesel engine is now guaranteed at 0.4 lb. to 0.5 lb. (0.18 kg. to 0.22 kg.) per horsepower-hour at full load and 0.5 lb. to 0.6 lb. (0.22 kg. to 0.27 kg.) per horsepower-hour at half-load. This represents a thermal efficiency of 34 per cent and is about one-third the fuel consumption of an oil-fired steam plant of equal size. It is a performance which does not leave much room for improvement. Any reduction in fuel cost will be accomplished by adapting the engine to use cheaper fuels. This point has received considerable attention recently, and fuel atomizers have been perfected to use the heavy asphalt-base oils of Texas, California and Mexico. However, the committee still recommends the use of better grades of oil even at a slightly higher cost.

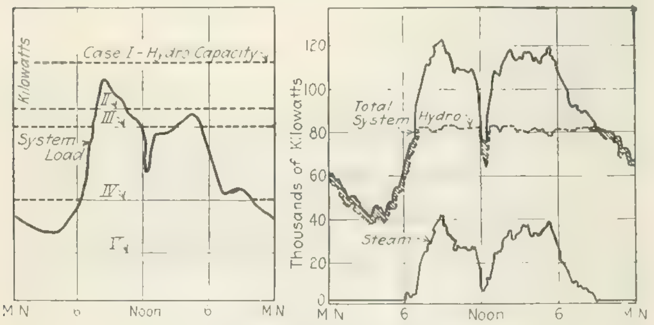
Operators of Diesel-engine plants have come to realize that the qualifications of those in attendance on the plants should be considerably above those which have been required in the past.

SINGLE WATERWHEELS OF 40,000 HP.

The increased size of waterwheels, together with the larger number installed, seems to be the most important feature of the past year's development. Single wheels of approximately 40,000 hp. capacity have been installed and much larger ones are contemplated. The growth of operating systems makes feasible this increased size of individual units. One large manufacturing company reports that it has totaled nearly 250,000 kw. in large hydro-electric generators (in units of more than 12,000 kw. each) started in the past year. While all of the large waterwheel manufacturers report this tendency toward larger units, yet there are a large number of smaller vertical direct-connected wheels being installed as additional or replacement units.

During the past year a new type of waterwheel has been developed by Forrest Nagler of the Allis-Chalmers Company. This is an exceptionally high-speed runner and was designed for low-head plants.

The Great Western Power Company of California has ordered, from the Allis-Chalmers Company, four 15,000-hp. tangential wheels built for operating under an effective head of 1,008 ft. (330 m.). These wheels contain twenty-one buckets, each 36 in. (90 cm.) wide and 24 in. (60 cm.) deep, and water is supplied from thirteen nozzles. They are to operate at a speed of 171.4 r.p.m. It may be of interest to state that several waterwheel manufacturers designed and recommended Francis-type wheels for this head at a speed of either 600 r.p.m. or 750 r.p.m. The operating engineers, however, considered that the erosion on the clearance passages and gate mechanism might be rather severe when operating under a pressure of over 430 lb. per square inch (30 kg. per sq.cm.). This, coupled with the fact that such a wheel would require a turbine-type generator with smooth core field, which was not suited for charging conditions on their long transmission line, led them to choose the impulse wheel.



TYPICAL HIGH-FLOW LOAD CURVES

At the right are actual curves from the Baltimore system for Dec. 11, 1919. The steam plants furnished 386,600 kw.-hr. at 38 per cent load factor, while the hydro plants supplied 1,636,500 kw.-hr. at 83 per cent load factor.

Automatic hydro-electric plants are receiving considerable attention. Several plants of this type have been built or rebuilt and are working very satisfactorily. These plants operate without attendants, and the gate openings and output are regulated, according to the water supply available, by means of a float control from pond level. These plants may be tied into a local power system or be run in connection with a steam station which takes care of the fluctuation of load and varying flow of stream.

The combined operation of hydro-electric and steam-electric generating stations has become a subject of vital interest to the central-station industry. It will be increasingly important in the future, since the marked trend toward interconnection will bring more and more steam plants into parallel operation with hydraulic plants and will make possible the development of water powers which cannot now be utilized economically. Yet intensive study of the subject is comparatively new. Individual companies and systems have made more or less careful analyses of their own conditions and problems, but there has been little information exchanged or published. These problems are outlined in considerable detail in the report.

Typical of the problem of combined operation of steam and hydraulic plants is that of load division. The problem is considered first from the point of view of a system operated for a minimum over-all cost. It divides itself naturally into two parts—high- or excess-flow operation and low- or deficient-flow operation.

By "high flow" is meant a flow which is more than sufficient to generate the system load up to the hydraulic capacity at a time when the excess flow cannot economically be impounded. There are five typical conditions of steam generation as illustrated by the load diagram as shown: (1) no peak steam generation, (2) single peak steam, (3) double peak steam, (4) all day steam and (5) twenty-four-hour steam.

Maximum hydraulic output will be obtained if the hydro plant generates the entire load during the off-peak hours and operates at maximum capacity during the peak hours. Theoretically, the hydro capacity lines in the figure would then also be the hydro load lines when they are below the system curve. This operation would give a minimum over-all operating cost. Actually it can never be entirely attained, unless there are no peak hours. It might be that such operation would increase maintenance cost at the steam plant more than it would decrease the operating cost.

Specific example is shown in the right-hand figure which gives typical high-flow load curves of the Baltimore systems. Energy generated by steam which might have been furnished by water power may, from the purely hydraulic point of view, be called "hydro losses" or "unnecessary steam generation" and is shown by the shaded area. Such steam generation may be divided into two classes:

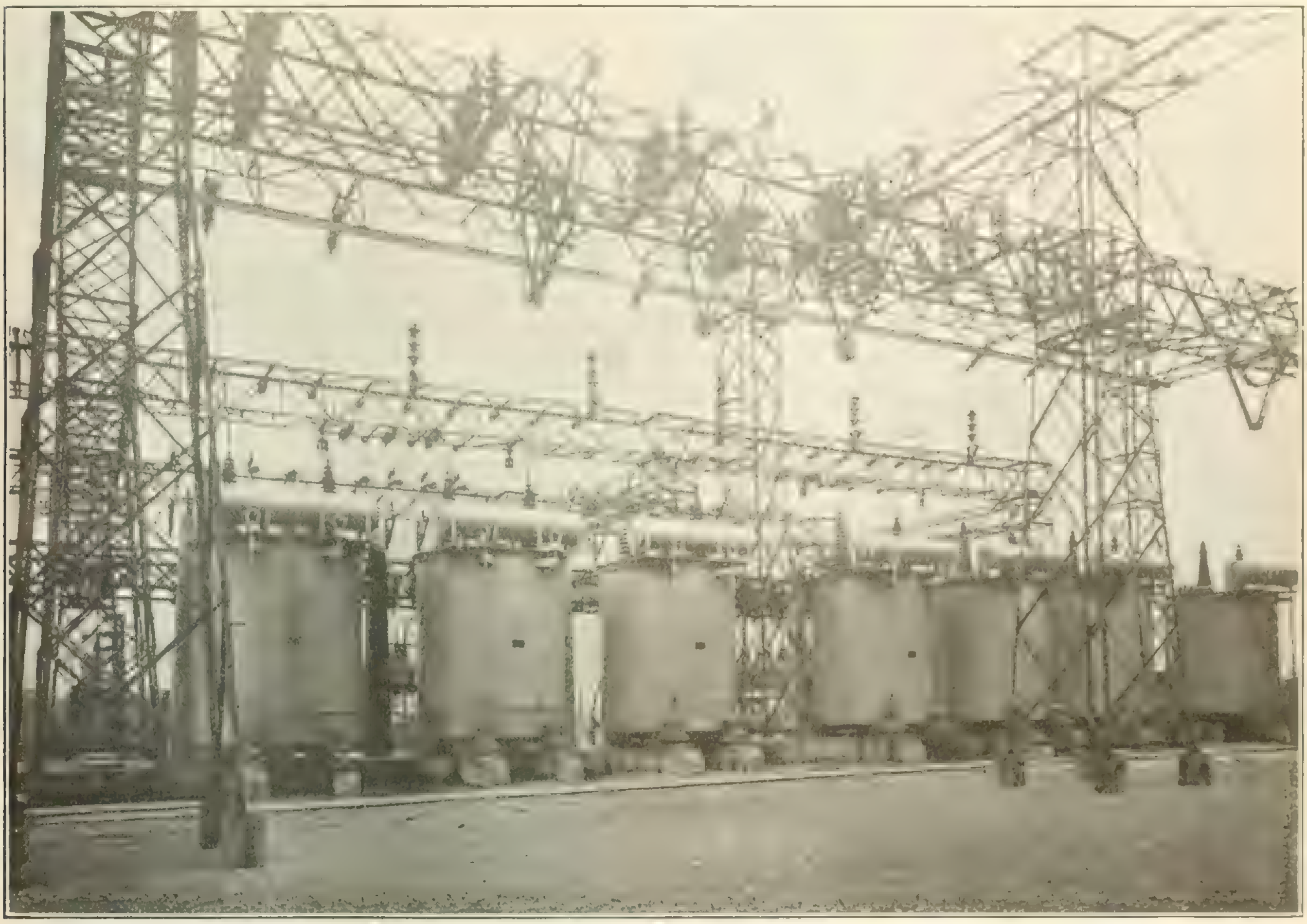
First—Steam generation for maintenance economy or safety of steam plant equipment, or for reliability of service. For example, in this case the "unnecessary" steam generation is due to the operation of a 2,000-kw. reciprocating engine unit in the early morning and late evening off-peak hours for purely steam reasons, or to carry minimum load on 20,000-kw. steam units.

Second—Unnecessary steam generation caused by faulty governing or load dispatching.

When a steam central-station company first takes energy from a hydro-electric plant there is usually a certain distrust of the reliability of the hydro service, and various measures have been adopted to enable the steam plants, acting as standby plants, to pick up a large portion of the load in the shortest possible time. This safeguarding of the reliability of service is both natural and justifiable until the hydro service has proved its reliability. It has been proved, in recent years particularly, that the individual hydraulic prime mover is more reliable than the individual steam turbine. Hydraulic prime-mover troubles have been rare as compared with those of steam turbines. The present-day single-runner vertical-type waterwheel-driven generator equipped with a Kingsbury bearing seems to give almost perfect continuity of service. It has nearly always been found that the hydro service can be restored before the steam plant can pick up a large proportion of the load even with a number of boilers held ready under "hot bank."

Present Status of Electrical Apparatus

Many Systems Are in Need of General Replacement and Maintenance Work, and N. E. L. A. Committee Points Out Dangers in Its Postponement—Standardization Appears to Offer Best Opportunity of Bringing Down High Cost of Equipment



LARGE OUTDOOR SUBSTATION WITH CONSERVATOR-TYPE, 10,000 KVA., 66,000/120,000-24,000/6.600 VOLT TRANSFORMERS

ONE of the very important points brought out in the report of the electrical apparatus committee of the National Electric Light Association at the Pasadena convention was that practically all utilities are suffering to some extent as a result of war-time curtailment of their construction programs and that nearly all companies find themselves now, at a time of very high prices, in a position where a gread deal of renewal and reconstruction work is absolutely necessary in order to restore the pre-war reliability of service. The committee further points out the great value of standardization which has already been accomplished, largely through the instrumentality of the N. E. L. A., and it is estimated that already a saving of several million dollars has been effected by the industry as a direct result. Further practical standardization of a nature not to impede development should be constantly aimed at.

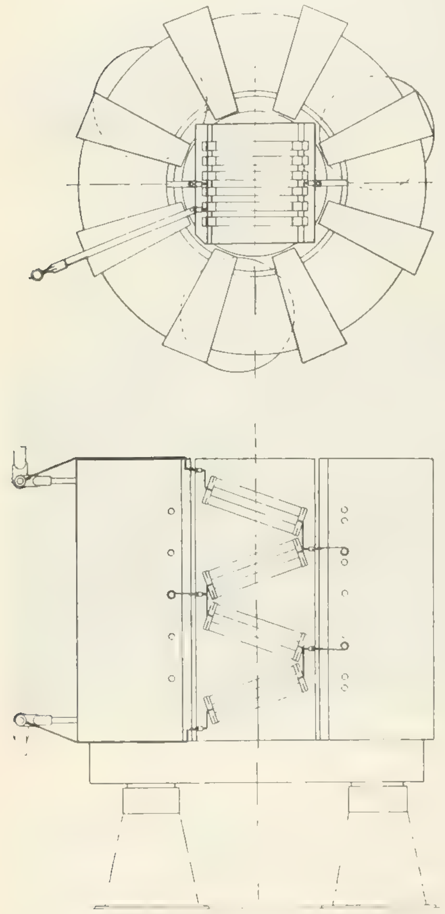
The work of the committee during the last year, under the leadership of R. F. Schuchardt, chairman, was so organized as to encourage activity in all parts of the country by means of a district plan of organization. The country was divided into six districts, the members in each forming the district sub-committee with its own chairman. The greatly shortened travel distance required of members and the attention which could be given to local problems by this plan of organization were the two main advantages sought.

A feature of the report is that the use of automatic substations for light and power as well as for railway service is rapidly increasing. Outdoor substations are also said to be growing in favor. Considerable progress is reported in the matter of the proposed rules of the National Electrical Safety Code through co-operation between the Bureau of Standards and the electrical apparatus committee.

In dealing with generating stations it was pointed out that the condition of heavily loaded systems and the consequent inability to disconnect units from the system in many instances for proper cleaning and inspection still exists to a large extent, but a much smaller number of generator failures and fires have been reported during this year. Additional evidence of the value of balanced-relay protection has been obtained in the case of a 12,000-kw. unit which failed owing to a field breakdown, causing a short circuit in the armature winding. The balanced relay promptly operated and the damage was limited to slight burning of the armature and field windings, which were easily and quickly repaired. Installations of fire-extinguishing equipment are divided in a fairly even way between those providing for use of water and those providing for use of steam.

CONTROL AND EXCITATION SYSTEMS SHOULD BE SEPARATE

The general subject of excitation is receiving considerable attention at the present time. The trend in large and medium-sized generating stations is unmistakably toward a practice in which each generator is provided with an individual source of excitation. The arrangement of excitation supply from a common bus is open to the objection that trouble at any point may seriously disturb the entire excitation system. It has become standard practice in many large steam stations to install generators equipped with an exciter on the end of the shaft. On several large systems employing individual excitation, particularly in metropolitan districts, storage batteries have been provided for emergency excitation in addition to spare exciter capacity. Until recently it has been common practice to operate control systems from the excitation busbars. Many large companies have now entirely separated these systems because of the effect of disturbances produced in the control system by trouble in the excitation system. Among the advantages of separating these systems are these: The control system is not rendered inoperative by trouble on the excitation system, grounds on either the excitation or control system do not affect the other, and burn-out of control lamps by high voltage momentarily impressed by disturbances on the excitation system and consequent serious confusion in operation in time of trouble are prevented.



RESISTOR IS MOUNTED WITHIN REACTOR

Regarding current-limiting reactors, the committee states that too much stress cannot be placed upon the importance of careful design and construction which will give the utmost reliability. There have been instances of reactor failures at times when their protection was most needed, but these have resulted in improvement of design. The General Electric Company has during the past year developed a resistor arranged for mounting inside of the reactor and for connection across its terminals. The reactor is of the cast-in-concrete type with a separate resistor unit. The function of the resistor is to absorb the energy of high frequency oscillations which may be set up, thus preventing the high resonant voltages from being built up across the reactor and other inductive apparatus on the system.

It is reported that grounding of the neutral of three-phase systems solidly or through resistance has rapidly become standard practice throughout the country for both 25 cycles and 60 cycles. It is usual practice not to ground the neutral of more than one generator at the same time in order to prevent possible cross-currents between generators.

Recently a number of companies have installed a system to aid in maintaining a constant average frequency. The instrument employed contains two separate movements and is known as the Warren Clock. Several companies have advised that the paralleling of two or more systems is facilitated because of the lesser time required for synchronizing where frequency is maintained to the degree of uniformity which is possible with this clock.

CIRCUIT-BREAKER RATINGS NOT YET SATISFACTORY

The work of the sub-committee on oil circuit breakers related to the methods of rating and the factors influencing interrupting capacity and to the general practice with regard to operating all circuit breakers under abnormal conditions and with regard to periodic inspections. The present method of rating the interrupting capacity of oil circuit breakers, as agreed upon and used by the several manufacturing companies, is to give the root-mean-square amperes which the breakers will interrupt twice, with an interval of two minutes between operations, and then be in condition to be closed and carry the rated current until it is practicable to inspect the breaker and make adjustments which may be necessary. The committee holds that the duty cycle adopted by the manufacturers is not representative of operating practice and recommends that manufacturers work toward establishing curves of ratings for each oil circuit breaker for any ordinary duty required.

Attention is drawn to the importance of educating primary or industrial customers, where it is the practice to have such customer provide the switching equipment, to appreciate the necessity of installing oil circuit breakers of adequate interrupting capacity when tied to the system of a large central-station company. It has been suggested that great advantages would accrue to the operating companies if the manufacturers could standardize the oil to be used in oil circuit breakers, and also in transformers. The time does not seem to be ripe, however, for such action on account of the experimentation which is being made to improve the quality of such oils. A noteworthy improvement has been made during the past year in the design of oil-circuit-breaker contacts. Some contacts in the past have been so designed that the mechanical stresses of heavy currents tended to force the contacts apart, whereas some present designs utilize the mechanical stresses to force the contacts more firmly together.

The transformer standards prepared by the committee last year have been reviewed after a year of use, with the result that only one change is recommended;

that is, that the minimum standard size be changed from 25 kva. to 37½ kva. for the 33,000-volt class. It is said that these standards have resulted in holding down the price increase of transformers, which would have otherwise been 30 to 40 per cent higher.

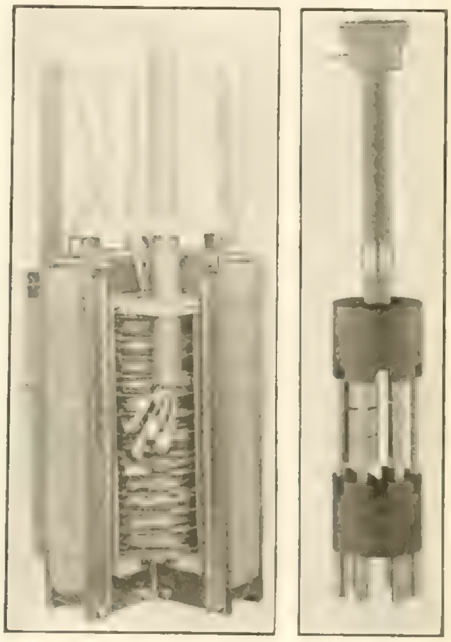
The principal improvements to eliminate the possibility of explosions and fires in transformers have been the removal from above the oil surface of unshielded conductors with their corona hazard and the discontinued use below the oil level in tank construction of solder or other materials of low melting point. Further precautionary steps have been taken recently by at least one large manufacturer in the development of tank construction in which the tank is completely filled with oil. A small auxiliary tank is provided above the main tank to which it is connected. The oil extends up into this smaller tank and thereby prevents the effect of varying level due to temperature changes from reaching the transformer.

The largest single-phase power transformers developed so far consist of a 70,800-kva. bank of transformers made up of three 23,600-kva. single-phase units, to step up from a delta generating voltage of 11,500 volts, 60 cycles, to a star line voltage of 66,000 volts or 132,000 volts. These units are of the shell type, having a temperature rise of 55 deg. C. at full load, and the guaranteed efficiency at full load is 99 per cent. The height of the tips of high voltage bushings is 22 ft. (6.7 m.) and the largest floor space dimensions of each unit lie within a circle whose diameter is 10 ft. 3 in. (3.1 m.).

A ratio adjuster has been devised to facilitate the changing of taps on transformers. Its use eliminates the necessity of links or connectors on the connecting boards for making tap changes and also of bringing the tap leads an appreciable distance from the coils. Another new development is the alternating-current network protector, which has been improved in construction as compared with earlier devices. The function of this protector is to disconnect automatically on both primary and secondary sides a defective transformer feeding an alternating-current network, so that the current which otherwise would be supplied by the network to the internal short circuit in the defective unit will not blow the fuses of adjacent transformers.

Both the large manufacturing companies have recently developed apparatus for indicating the hot-spot temperature of the transformer windings. The Westinghouse company has developed an indicating thermometer of the dial type which will indicate directly the approximate hot-spot temperature of the windings in a transformer under any conditions of load. The essential parts of the device are shown in the illustration. The actuating element of the outfit is a metal bulb placed in the hot oil of the transformer. Connecting the bulb to the instrument is a small copper tubing inclosed in a flexible armored tube for protection. The bulb is filled with a fluid whose expansion and contraction with changes of temperature cause the needle of the instrument to indicate the temperature. Surrounding the bulb is a heating coil which is connected through a current transformer to one of the windings of the transformer whose temperature is to be measured. This heating coil therefore carries at all times a current which is proportional to the load current of the transformer. The General Electric Company has developed a temperature indicator consisting of a temperature coil or resistance element inserted in the transformer winding and electrically connected to an indicating instrument external to the transformer.

Reports from various districts this year indicate a very noticeable activity not only in the amount of consideration given to the subject of automatic substations at the present time, but also in the purchase of equipment for actual installations. It is unlikely that the automatic substation will entirely supplant the substation with attendants. It is suggested, however, that careful thought be given to making all additional substations of the automatic type and to installing automatic and semi-automatic control features on equipment in existing stations where attendants are employed. There are several contributing factors making this desirable, among which may be mentioned (1) increasing cost of operating attendants, due (a) to increases in operators' wage scales, (b) to shortening of the hours of work; (2) increasing value of real estate in densely populated area; (3) greater rapidity in the restoration of service following a system interruption where automatic equipment is used. By the employment of automatic equipment it becomes possible to install relatively small units in centers of load areas, with relatively small investment in the high-tension feeder supplying the equipment and with comparatively small investment in feeder copper for


TRANSFORMER AND RATIO ADJUSTER FOR 33 KV.

COST OF AUTOMATIC SUBSTATION EQUIPMENTS

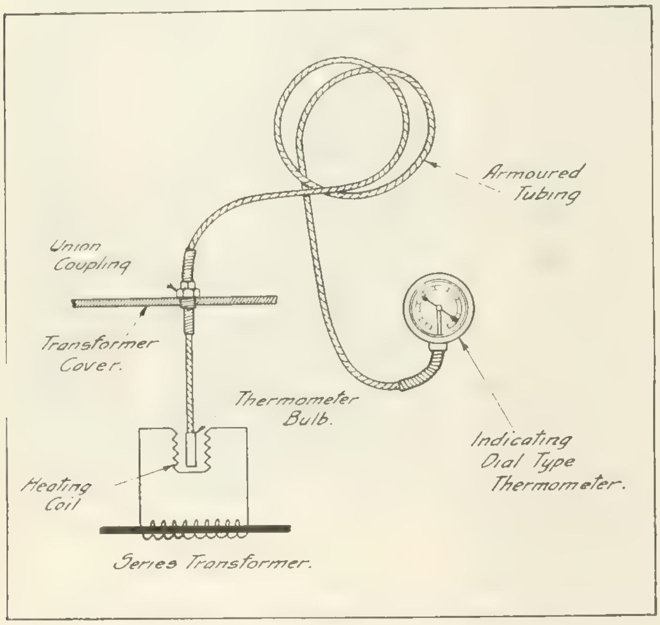
Approximate price per kilowatt (f.o.b. cars manufacturing plant), including converting equipment and control

Type	Capacity	Price
25-Cycle equipments:		
Booster converter, 240/300 volt, d.c., oil-cooled, three phase transformers, 13,200 volts..................	At 250 volts 550 kw. 750 r.p.m.	$27
Booster converter, 240/300 volt, d.c., oil-cooled three phase transformers, 13,200 volts..................	1000 kw. 500 r.p.m.	40
Booster converter, 240/300 volt, d.c., oil-cooled, three phase transformers, 13,200 volts..................	2000 kw 500 r.p.m.	31
Shunt converters	500 kw 750 r.p.m.	24
	1000 kw. 500 r.p.m.	37
60-Cycle equipments:		
Booster converters, 240/300 volt, d.c., three-phase, oil cooled transformer, 13,200 volts	500 kw 1200 r.p.m.	$23.50
	1000 kw. 900 r.p.m.	35 to 37
	1000 kw. 720 r.p.m.	35 to 37
	2000 kw. 400 r.p.m.	27
Motor generator set, shunt wound, 275-volt generator, 13,200-volt motor..............................	1000 kw 720 r.p.m.	31
	1800 kw. 514 r.p.m.	29

carrying the output from the machines to the load. Herewith is a tabulation of price per kilowatt of converting equipment of various characters for 25 cycles and 60 cycles, which is generally representative of the cost in November, 1918, including the converting equipment, the transformer where required and all necessary alternating-current and direct-current control and switching equipment for full automatic operation of the unit.

While the foregoing relates specifically to direct-current substations, it applies also to alternating-current distributing substations, particularly those of the transformer type where power is reduced from the transmission voltage through suitable transformers and distributed at 2,300 or 4,000 volts. It may be said that the successful application of automatic features of operation to the substation is in a large measure attributable to the development and improvement in relays which has taken place in the last few years.

The first full automatic control for industrial service is being manufactured for a large company in Detroit. This control is to operate a 500-kw. synchronous motor-generator set in an outlying portion of the plant. The load during the period of small demand is carried by the central power plant. The automatic control operates when the local bus voltage drops below a certain point. The control is designed to start the motor from auto transformers in the usual manner, throwing on full voltage when the motor is in step.



TRANSFORMER HOT-SPOT TEMPERATURE INDICATOR

The first full automatic substation for supplying current to a three-wire network is being manufactured for a large central-station company in Minnesota. This equipment consists of a 500-kw. synchronous motor-generator set. The generator is flat-compound for 250-volt operation and is equipped with balance coils for three-wire operation. In this equipment no effort is made to parallel voltages before connecting the direct-current end to the line. The field rheostat is set for the proper running voltage and left at that point, the compound winding taking care of regulation under changing load conditions. This equipment will be started by an indication of low voltage and shut down on low current. This machine will help out the network immediately surrounding its location up to half its capacity, at which point the feeder resistors will operate to shift the load onto the large substation some 2,000 ft. or 3,000 ft. (600 or 900 m.) away. Copper feeders of sufficient size to give 5 per cent regulation if supplied from the nearest existing substation would cost approximately $45,000 installed. The automatic substation complete, including the 4,000-volt supply cable, will cost approximately $32,000 installed.

In the report of the committee it is pointed out that many automatic substations are now being planned for various parts of the country.

The committee is of the opinion that generally greater consideration should be given to the use of outdoor substations. The operating engineers of several large systems now employing indoor-type high-voltage substations have expressed the opinion that they would now unquestionably favor the use of outdoor-type substations. Those companies which already have outdoor high-voltage substations seem to be thoroughly satisfied with their operation. Report has been made of an order recently placed calling for two 12,000-kva., three-phase, core-type, 60-cycle, self-cooled outdoor transformers mounted on trucks for location near a generating station to step up from a generated voltage of 4,500 to a transmission voltage of 27,000. The transformers will be designed to withstand without injury a short circuit for five seconds on the secondary windings with full voltage applied at the primary wide. There will also be provided a capillary-tube thermometer mounted on the transformer case and a thermostat the closing of whose contacts, at dangerous temperature, will ring an alarm in the switchboard attendant's room in the generating station. The transformers are reported to be the largest self-cooled units in the world.

STARTING LARGE SYNCHRONOUS CONVERTERS

In units of 1,500 kw. to 2,000 kw. and above the high-tension starting equipment is probably less expensive to install in the case of manually operated switches and much less expensive if electrically operated switches are employed in the high-tension connection, as compared with electrically operated switches in the low-tension connections. The elimination of the low-tension switches will materially simplify the arrangement of these connections and permit of considerable shortening of the leads. This alone may eliminate all difficulties from the reactance of the leads of high current capacity. Some experience data will be required before general recommendations can be made.

Regarding the development of iron-tube rectifiers for heavy service, two manufacturing companies gave reasons for the abandonment of development work on such units, which have not come up to early expectations.

The wireless telephone appears to offer considerable promise as a means of communication between important substations and generating stations of transmission systems covering large areas. It is said that experiments are being made with it in Montana.

Member companies are urged by the committee to incorporate the N.E.L.A. motor rules in their own book of rules and to send to the apparatus committee any comments or criticism they may have to make, especially regarding their experience with them in practice.

Developing the Electrical Possibilities in Arkansas

Sound Engineering Practice and Practical Ingenuity Combine to Reach Seasonal Loads That Give High Annual Load Factor

THE Arkansas Light & Power Company of Pine Bluff, Ark., is developing a territory that is particularly interesting from a central-station standpoint. On account of the unusual character of the loads available and the ingenious methods employed in making the construction economical and reliable, the problems encountered are different from those of most transmission systems. In the first place, the loads—that is, the important power loads—are seasonal; but at the same time the most important seasonal classes of power business come at different seasons of the year and are so spread out through the twelve months that one begins as the other leaves off, thus producing when taken together a satisfactory annual load factor. These loads are (1) the irrigation pumping load for the rice fields, which begins approximately the first of May and ends about the first of September; (2) the cotton-gin load, which begins about the first of September and ends about the first of January; (3) the cotton-seed-oil mill load, which begins about the first of September and ends about the first of May. The combination of these three loads, together with the ordinary commercial lighting and power loads, gives a fairly uniform load curve, with the exception of a small sag from the first of January to the first of May.

How Seasonal Loads Give Good Load Factor

Within the territory which the company can serve from its Pine Bluff central power station and transmission lines there are a considerable number of rice-farming installations that might be electrified. Fifty-one irrigation wells are now motor-driven, and these afford a connected load of 3,900 hp. The average area irrigated per well is 130 acres (5c. hectares). This requires an average discharge from these wells of 1,250 gal. (4,730 l.) per minute. The wells producing this volume of water generally operate against an average head of 90 ft. (27 m.). A few of these wells are of the open-pit type, but the larger percentage are bored wells with usually a 10-in. (25-cm.) casing. In all cases the wells are equipped with two-stage or three-stage vertical centrifugal pumps with efficiencies that range from 30 per cent to 70 per cent. These installations give an average demand of 45 kw. and consume an average of 47,500 kw.-hr. per well per season.

Within the territory which is served by the transmission lines out of the Pine Bluff central power station, as well as many of the towns controlled and operated by the company, there are numerous cotton gins. When these cotton gins are motor-driven the average installation is 60 kw. and consumes an average of 12,000 kw.-hr. in the ginning season. Sixteen cotton gins are now connected to the transmission line of the Pine Bluff central power station, making a total connected load of approximately 1,000 kw.

The mechanical equipment of cottonseed-oil mills is easily and satisfactorily arranged for electric motor drive, and these mills operate continuously from 12 o'clock Sunday night to 12 o'clock Saturday night, there being a very small difference between the night demand and the daylight demand. The average cottonseed-oil mill requires approximately 500 hp. to operate all of the machinery. Some of the mills are large, requiring up to 2,500 hp. The Pine Bluff central power station and transmission-line system have at present a connected load of approximately 2,000 hp., which with the cotton-gin load nearly balances the seasonal load furnished by irrigation pumping.

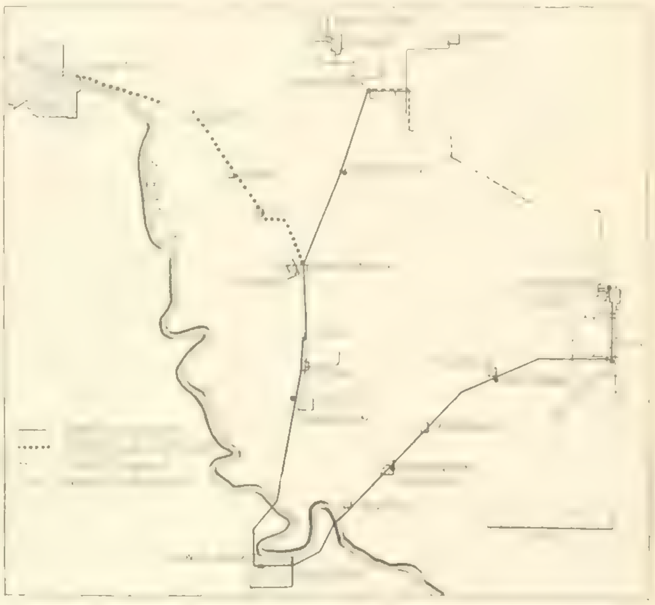


FIG. 1—MAP OF ARKANSAS COMPANY'S PROPERTY

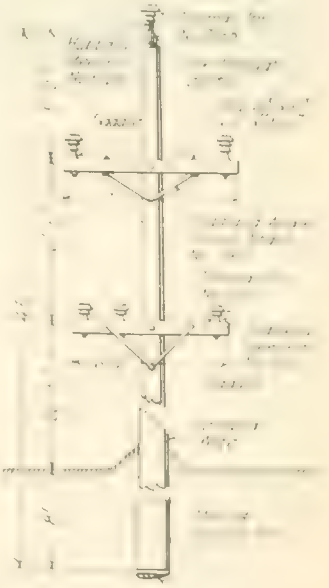


FIG. 2—STANDARD STRAIGHT-LINE CONSTRUCTION

The spacing on the 33,000-volt lines is adequate for 66,000-volt operation. The distance between wires on the two-wire side of the 22,000-volt arm is 18 in. The pole-top bracket is a success.

The combination of these enterprises with the usual town and city loads available produces a high annual load factor. This condition, however, does not change the fact that many of the individual transmission and distribution lines that are built cannot serve all three classes of load. The company calls 22,000-volt, 33,000-volt and 66,000-volt lines transmission lines and designates as distribution circuits lines operating at 13,200 volts, 6,600 volts and 2,300 volts. In regard to the engineering of these lines, William Crooks, chief engineer for the Arkansas Light & Power Company, said:

"There is similarity between transmission-line systems and railroad systems, since the 66,000-volt and 110,000-volt lines correspond to the main-trunk railroads and the 33,000-volt lines to branch-line railroads, with the 6,600-volt and 13,200-volt distribution lines as feeders. There is also quite an analogy between the philosophy of location of railroads and of transmission lines. The same general laws apply to both. The successfully located railroad is the one for which the location and type of construction were so selected that its earning capacity is at a maximum, or, in other words, the location and type of construction should be selected so that the annual traffic per mile divided by the cost per mile is a maximum. This rule applies as well to the location and selection of the type of construction for a transmission line, except that it must be borne in mind that in selecting the type of construction there are no periods of interruption in which no traffic comes over the transmission line, as in the case of railroads, and ample provision should be made to take care of any possible future growth in the loads that the transmission line will carry. The term location in this sense is the general term, which includes a consideration of both the financial and engineering features and takes into account the feasibility of serving or not serving certain load centers in the general territory under consideration.

"In actually locating a transmission line upon the ground the most direct line between two determining load centers is the most desirable. However, consideration given to ease of transportation during construction, policing, maintenance and repair may vary this procedure. It has been found just as advantageous to locate transmission lines with the aid of survey parties as it is to locate railroads in that way. To actually stake out the poles with a transit is the only way to secure perfect alignment in the pole line."

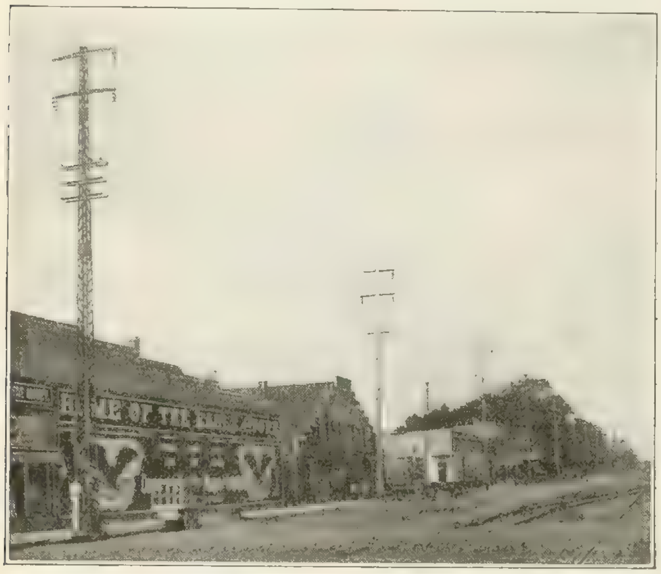


FIG. 3—TRANSMISSION LINE IN STREETS OF PINE BLUFF

Use is made of suspension insulators, while out in the country pin-type insulators are employed on the same line. This gives a high factor of safety in the city. This steel tower and another just like it were made from the latticework taken out of an old gas holder. The 205-ft. power-house stack is in the distance.

The application of these principles of line location are shown on the accompanying map (Fig. 1), which gives in detail the principal transmission system and shows the relation of the 6,600-volt lines which serve the pumping load to the system in general.

Of completed transmission and distribution line the company now has 102 miles (164 km.) of 33,000-volt line, 45 miles (69 km.) of 22,000-volt line, 38 miles (61 km.) of 13,200-volt line and 70 miles (112 km.) of 6,600-volt line. About 22 miles (35 km.) of 33,000-volt line is now under construction, and material for 42 miles (67 km.) in addition to this is on order. Other lines are contemplated. All 33,000-volt lines are built with spacings sufficient for 66,000-volt operation, as is shown in the drawings. The poles are spaced on 265-ft. (80-m.) centers, or twenty to the mile, for No. 4 copper or larger and 310 ft. (94 m.), or seventeen poles per mile, when No. 0 or larger steel-covered aluminum cable is used for conductors. The lines are sectionalized at intervals of from 5 miles to 10 miles (8 to 16 km.) by means of disconnecting switches designed to be opened only under no-load conditions. Some of the lines contain interesting special features which will be described in other articles. These include a long iron span or home-made towers, grounding precaution, special pole-top brackets and sturdy railroad crossings.

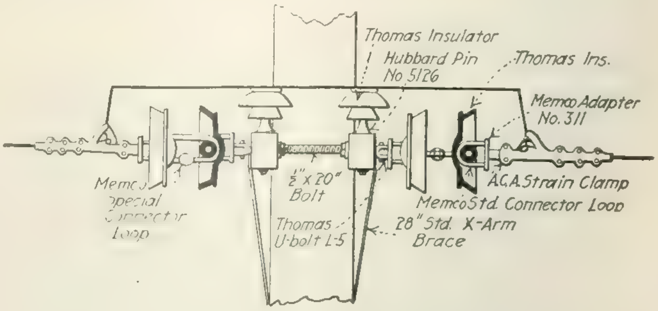


FIG. 4—DOUBLE-ARM DEAD-END PRACTICE

On 13,200-volt and 33,000-volt line one dead-end per mile is installed and the pole is guyed four ways with $\frac{3}{8}$-in. guy wire.

Clearing a Wooded Right-of-Way

It is the practice to be liberal in spending money for cleared rights-of-way. When lines traverse wooded country the terrain is cleared of all trees and underbrush for 25 ft. (8 m.) on each side of the pole and in addition all trees that would come within 10 ft. (3 m.) of the line in falling are cut. Such lines cost about $28,000 a mile to construct in Arkansas without substations. Negro labor is usually employed in all construction.

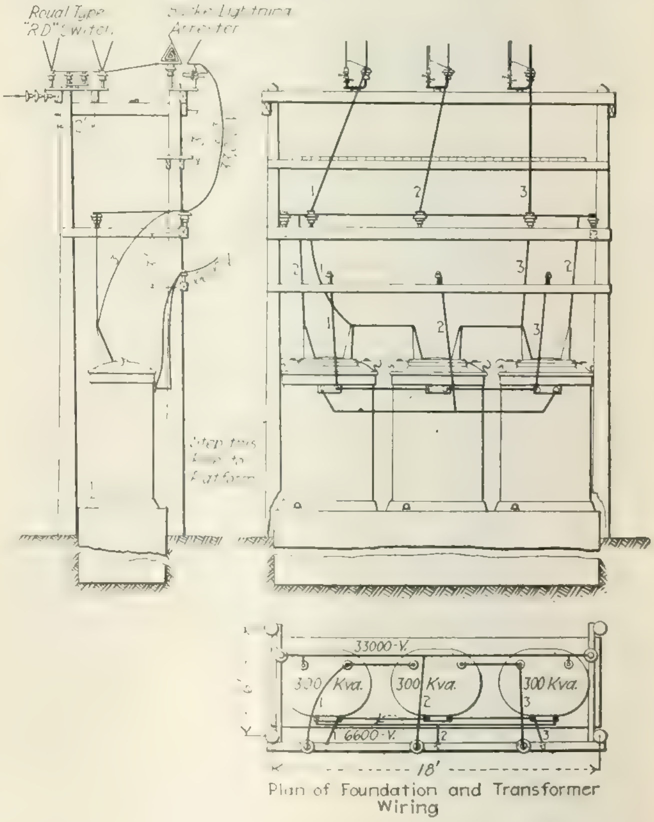


FIG. 5—33,000/6,600-VOLT STANDARD SUBSTATION

These lines partly interconnect the company's fifteen plants and the thirty-six towns in which it operates.

The 6,600-volt lines are carried on 30-ft. (9 m.) poles spaced thirty to the mile. Flat-top construction and flat iron arm braces with 6-ft. (1.8-m.) arms and with No. 2, No. 4 and No. 6 conductor are used. These lines are sectionalized with cut-out boxes carrying removable fuses and Burke horn gaps. Standard substations have been designed for 33,000/6,600-volt transformation and for 6,600/220-volt installation. Both of these types are illustrated, the latter being the one commonly found on rice farms when pumping motors are served. In this case particular attention was given to designing the 6,600-volt side so that a man on the platform would be in very little danger of coming in contact with the 6,600-volt circuits.

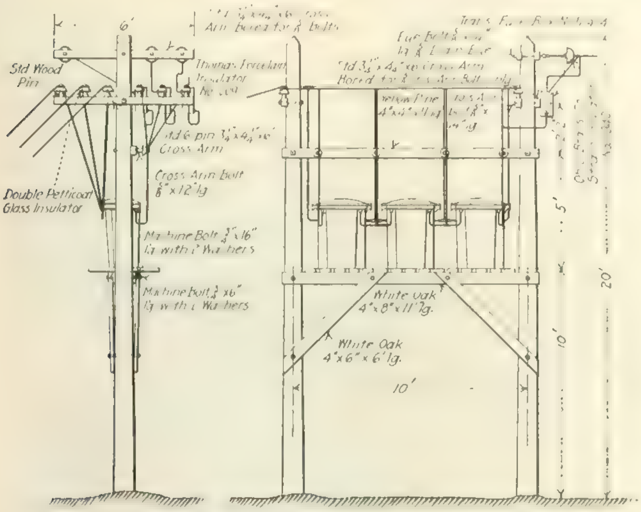

6'
Std Wood Pin
Double Petticoat Glass Insulator
Cross Arm
Cross Arm Bolt ⅝" x 12" lg
White Oak 4" x 8" x 11' lg.
White Oak 4" x 6" x 6' lg.
10'
5'
10'
20'

FIG. 6—6,600/220-VOLT STANDARD SUBSTATION

This is the type of substation which is used on the premises of rice farmers. It is designed as a safety-first installation.

Electric Power for Ferro-Alloy Plants

THE cost and availability of electric power for electrometallurgical work is a determining factor in the location of ferro-alloy plants as well as in the choice of process employed for some alloys, according to a recent report made by Robert J. Anderson before the American Electrochemical Society in Boston. The domestic ferro-alloy industry has been centered for years near sources of relatively cheap power—Niagara Falls, chiefly, and the Pacific Coast—but with the advent of high prices during the war it was profitable to operate plants at points where power was relatively costly and far removed from the steel-making centers.

Foreign ferro-alloy progress has in the main followed the hydro-electric developments in France, Switzerland, Italy, Norway and Sweden, and the domestic ferro-alloy industry did not expand at the same rate as the foreign industry prior to the war because of the lack or remoteness of cheap power. This is a condition which will not be soon overcome in the United States, and ferro-alloy plants will continue to be located chiefly according to the relative weight of the following factors: (1) Cost and availability of power; (2) location of hydro-electric plant; (3) distance to steel-making centers; (4) location of high-grade ore supplies. The first three factors are the predominating ones under normal conditions, but emergencies such as a war can radically upset accepted practice.

Readers' Views and Comments

The Double-Base Lamp

To the Editor of the ELECTRICAL WORLD:

SIR: The double-base lamp described on page 1107 of your May 8 issue appears to have several inherent disadvantages which should be taken into account before it is too widely distributed. These disadvantages may be enumerated as follows:

First, the fact that one of the bases is "live" when the other is screwed into a live socket makes its use in the ordinary household dangerous. Receiving a shock from either carelessly or ignorantly touching the two contact points might prove fatal. Second, it appears from the illustrations that a much more complicated arrangement is necessary than with any of the double plugs or current taps on the market, involving the use of an extra socket and attachment plug. Third, it is necessary to have the light burning at all times that the lower end is in use, a condition which is neither desirable nor economical.

Bridgeport, Conn. JOHN W. SHALLENBERGER.

High-Voltage Transmission Systems

To the Editor of the ELECTRICAL WORLD:

SIR: I am greatly interested to note in your convention issue of May 8 the remarkable table, replete with valuable data, of the transmission systems in the United States, Canada and Mexico operating at 44,000 volts and over. In commenting on the splendid development that is thus evidenced, the remark may be made that it probably cannot be fully appreciated until one compares such conditions with those of little more than fifteen years ago. I have lying before me a list, now quite scarce, of polyphase plants, issued by the General Electric Company, under date of September 1903, enumerating plants that had been contracted for or installed up to that time where the total capacity was not less than 500 hp.

Of such plants there was the very respectable number of 332, on the North American Continent, in Japan, India, Africa, etc., but of all these only twelve were enrolled as operating at 40,000 volts or more. I cannot place my hand on any Westinghouse data of the same period, but perhaps we may assume about the same figure, or, say, a total of twenty-five plants at 40,000 volts and upward.

The new table in the ELECTRICAL WORLD brings to account no fewer than seventy-three plants of 44,000 volts or above, and in this compilation there is included no plant situated beyond the shores of the Atlantic or the Pacific.

Moreover, the General Electric table of 1903 gave only five systems with 60,000 volts line transmission. In the present table of seventy-three plants only ten are below 66,000 volts, but between 150,000 volts and 44,000 volts there is a literal riot of potentials, which becomes bolshevistic when you get to the transformers and substations. THOMAS COMMERFORD MARTIN.

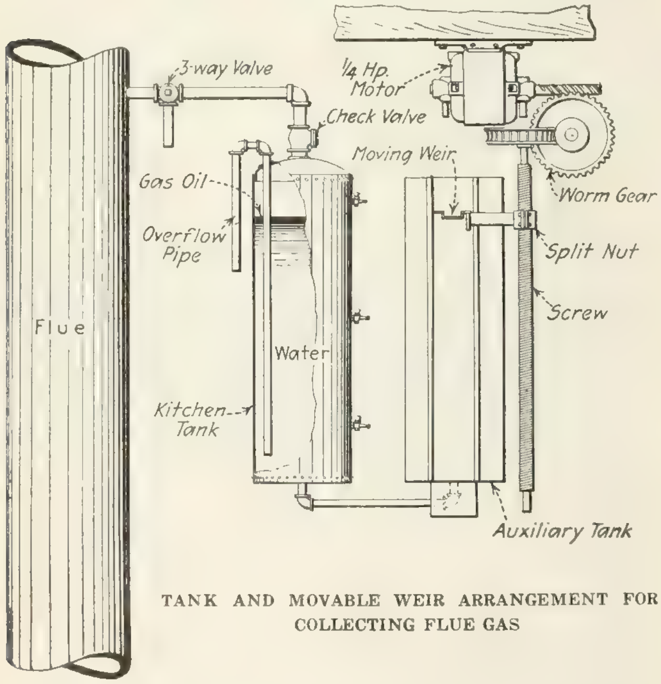
New York City.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

One Flue-Gas Test Tank Used for Three Shifts

BY THE aid of a traveling weir and suitable pipe connections analyses of average flue-gas conditions during each of three shifts are obtained from one 20-gal. (75.7-l.) kitchen boiler tank in an installation of thirty-two 500-hp. boilers at Joplin, Mo. The gas tank is connected to an auxiliary tank in which is a weir which travels from the level of the top of the tank to the bottom in twenty-four hours. The weir is moved by a vertical screw driven by a ¼-hp., 1,500-r.p.m. motor through two 50-to-1 worm gears which give a 2,500-to-1 speed reduction. After both tanks are filled with water the weir is made gradually to fall, reducing the water level in the tank 2.4 in. (60 mm.) per hour. This draws gas from the flue into the upper part of the tank. A split nut is provided for raising the weir after every day's operation. On the surface of the water in the tank is about 1 in. (25 mm.) of oil, and a check valve is provided to keep this from entering the gas inlet pipe. A water overflow pipe extends almost to the bottom of the tank and bends over at the top where a vertical pipe is tapped into the bend to act as a siphon breaker.



TANK AND MOVABLE WEIR ARRANGEMENT FOR COLLECTING FLUE GAS

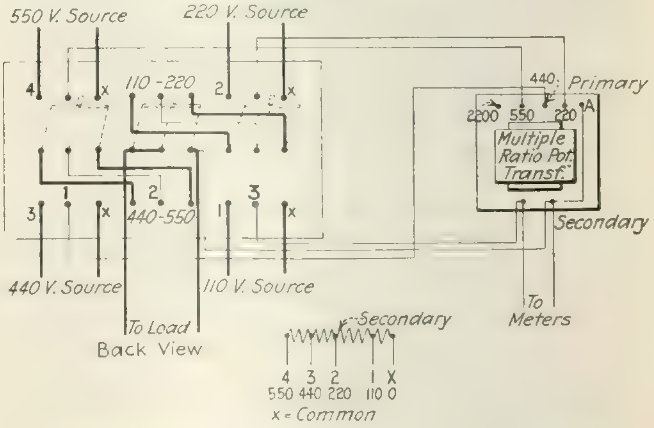
A three-way valve in the gas inlet pipe permits gas samples to be taken directly from the flues when desired. Cocks are inserted in the tank every third of the way from the top for taking flue-gas samples at the end of each shift. The second sample is the average of the first two shifts, and the third sample is the average for the day's run. The samples for the second and third shift are therefore corrected accordingly. Before taking any sample the top and side of the gas section of the tank are connected by a rubber hose and the gases are thoroughly mixed.

FRED M. RICHARDS,
Chief Engineer of Power Plants.
Empire District Electric Company,
Joplin, Mo.

Instrument Transformer Ratio Changed Automatically with Test Voltage

BY CHANGING the potential transformer connections automatically when the terminal voltage on the board is changed the switch arrangement here described prevents incorrect voltage from being impressed on the meters used. Four voltages, 110, 220, 440 and 550, may be obtained at the load terminals of this board by varying switches Nos. 1, 2 and 3 as shown in the table. When a certain voltage is impressed on the load terminals the same voltage is impressed on the multiple-ratio potential transformer and to protect the meters it is impressed on the primary terminals of this transformer corresponding to the voltage, so that about 110 volts is always impressed on the meters. In the diagram the meter connections are in light lines while the load conductors are shown heavy.

If the different sources are taken from taps on the secondary of the same transformer, so that one side, *X* (below), is common, the arrangement may be greatly simplified by eliminating one blade on each of the switches, using two-pole switches instead of three-pole. This arrangement may also be used for direct-current work, the main lines being connected to the various voltage sources as with alternating current, but the instrument leads being connected to the respective taps on a multiplier instead of an instrument transformer.



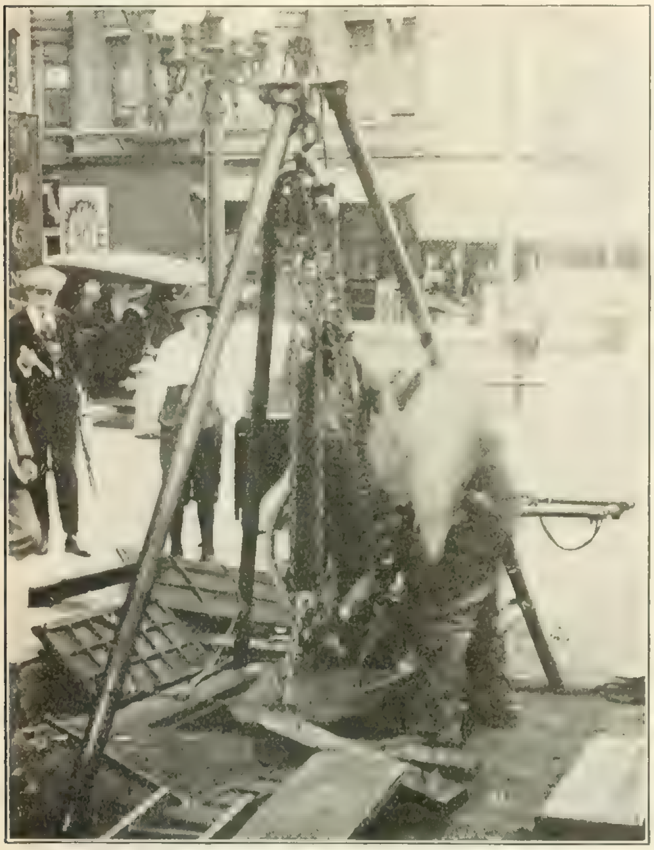
METER CANNOT BE SUBJECTED TO TOO HIGH VOLTAGE

For 110 volts, No. 2 up, No. 3 down, No. 1 out; for 220 volts, No. 2 up, No. 3 up, No. 1 out; for 440 volts, No. 2 down, No. 1 down, No. 3 out; for 550 volts, No. 2 down, No. 1 up, No. 3 out.

Schenectady, N. Y. L. B. JOHNSON.

Tripod for Lowering Equipment Into Manhole

FOR lowering transformers and other heavy equipment into manholes the tripod shown here is employed by the Southern California Edison Company, Los Angeles. The tripod has three legs formed of pipe and fitted at the top with a cap holding an axle which pivots in the iron tripod head. By means of small chains fastened from each leg to the next the legs are prevented from spreading. For lowering very heavy equipment a chain hoist is hung to an eye in the head of the tripod. Lighter equipment is handled by means of a cable passing over a pulley fastened on the top of the head.



CHAINS PREVENT SPREADING OF TRIPOD LEGS

C. W. GEIGER.

San Francisco, Cal.

How to Start Boiler Without Flooding Superheater

ALTHOUGH it formerly was the general opinion that superheater tubes should be filled with water while the boiler was being started up to prevent burning of the tubes, many superheaters are now operated without flooding. The old theory would probably still hold good if it were customary to put an extremely hot fire under a full boiler and force it to a point where it could be cut into line in a short space of time. The general practice today, however, of draining the tubes before starting a fire does not require flooding equipment, and this meets with the approval of the manufacturers. Before starting a fire in the Texas Power & Light Company under a boiler that has been idle or banked all superheater drainage valves are opened wide until the condensation has been completely drained. The drain valves are then turned to within one turn of the closed position and allowed to remain so until the boiler is actually in service. This will remove any accumulation of moisture due to condensation, will remove the air and vapor that is given off by the water in the boiler, and will create circulation in the superheater tubes and thus prevent overheating. If this procedure is followed, practically all danger of burning tubes is avoided.

Another most important factor in the operation of superheaters is the setting of the valves. These valves should be set to open before the safety valves of the boiler. This will insure circulation of steam through the tubes even though the station suddenly loses its load.

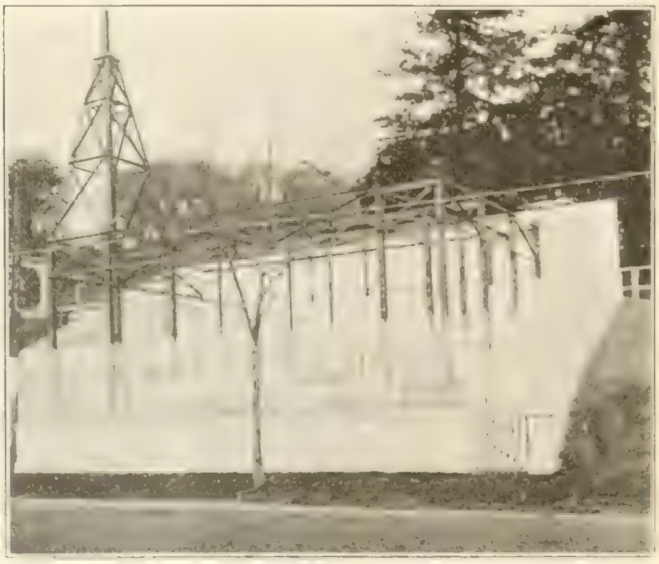
DANIEL G. FISHER.

Texas Power & Light Company,
Dallas, Tex.

Terraced Substation Built in Difficult Location

BECAUSE it was impossible to grade a strip of ground between two highways, the outdoor substation shown here was constructed with a terraced base on a side hill inclined about 40 deg. to the horizontal. Three air-cooled Pittsburgh transformers aggregating 2,000 kva. in rating, switches, meters and regulators were mounted on reinforced-concrete platforms located step-fashion on piers set into the bank. Uprights of 6-in. (15-cm.) H-section and 6-in. channels are used for the steel structure. The area occupied is 45 ft. x 26 ft. (14 m. x 8 m.), and a tower 42 ft. (13 m.) high is provided for the outgoing 2,300-volt lines. The overhead work, including two 2,300-volt buses and one 13,200-volt bus, is mounted on the steel structure. The structural cost of the installation exclusive of electrical equipment was $5,088.

This station, which is in Leicester, Mass., will be supplied from the Webster Street station of the Worcester Electric Light Company by a 13,200-volt, three-phase, lead-covered underground cable, and provision is being made for four outgoing 2,300-volt overhead circuits for local distribution, with an additional street-lighting circuit.



CONCRETE FOUNDATIONS ARE CONSTRUCTED IN FOUR TERRACES

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

Commutator Slotting and Maintenance

COMMUTATOR slotting has been gaining favor in the industrial field, and today the majority of industrial and railway motor commutators are of the undercut type. Undercutting increases the life of both commutator and brushes and to a large extent eliminates flat spots, sparking, glowing of brushes and burning of the commutator. It also reduces the heating and in this way permits an increased load to be carried on the machines. Where undercutting has been found unsatisfactory it has nearly always been due to particles of mica being left flush with the commutator surface or to the use of improper brushes.

Commutator slotting, or, as it is often called, grooving, consists in removing the mica from between the commutator segments to a depth of about 1/32 in. to 3/64 in. (0.8 mm. to 1.2 mm.) below the surface of the commutator. The usual tendency is to undercut too deeply, and the rule should be to undercut little and often. The usual undercutting equipment consists of a circular-milling saw driven by some convenient means, although there are two or three hand tools on the market. These hand tools will ordinarily answer the purpose and in many cases give as satisfactory service as the automatic type of saw. Broken hack-saw blades are also frequently used for undercutting, but care must be exercised in the use of this tool.

The slots in the commutator should be cleaned out occasionally, especially when oil creeps onto the commutator from the bearings and when the machine operates in a dirty location. Under such conditions it is advisable to paint the slots, after slotting, with an air drying, insulating varnish and remove any surplus varnish from the surface of the commutator with sandpaper or a commutator stone.

After undercutting the mica each slot should be beveled with a V-shaped tool or commutator slotting file to make sure that the slots are free from mica and to remove burs of copper left by the slotting tool.

When a commutator has to be turned or ground this should be done before the mica is undercut. Before undertaking to grind or turn a commutator, however, it should be examined carefully to make sure that it is tight. The examination should be made just after the machine is stopped and before it has a chance to cool down, as the bars are most likely to be loose at that time. Most commutators need to be tightened after six to nine months' service and again after two years, owing to the seasoning of the insulation. However, they should remain tight indefinitely thereafter.

After the mica is undercut the commutator should be polished with a commutator stone or a very fine grade of sand paper attached to a block rounded to fit the commutator. Some engineers condemn the use of emery cloth for this purpose, but others find no difference between the effects of sandpaper and emery paper, provided that the emery paper is not too coarse. For all practical purposes, however, the commutator stone is safer to use as it leaves the commutator free from scratches. This is important as the brushes to be used on an undercut commutator have no abrasive action and therefore cannot polish out any scratches that are present.

DONALD S. MERTON.

Cleveland, Ohio.

Electrically Hardened Dies Have Longer Life Than Gas-Hardened Ones

COMPARISONS of taps hardened in an electric furnace and taps hardened in a gas furnace at the shops of the Frankford (Pa.) Arsenal indicate that superior physical qualities as shown by longer life are obtained with the electric treatment. The gas furnace was of the partial muffle type, burning illuminating gas. The electric furnace was, after brief instructions, operated by the same man who had been hardening taps in the gas furnace for several years.

The taps were 1.504 in. (38.2 mm.) in diameter, had twelve threads per inch (about 2.1 mm. thread), and were used in tapping fuse holes in 3-in. (75-mm.) steel projectiles. Tests were made on taps from four different brands of steel. The figures in the table represent the number of holes tapped after each grinding. With each brand of steel the taps hardened in the electric furnace showed a greatly increased life over those hardened in the gas furnace.

NUMBER OF HOLES TAPPED BY DIES AFTER HARDENING

	New	First Re-grind	Second Re-grind	Third Re-grind	Total	Increase in Life per Cent
BRAND A						
Average (7) gas-treated	29	204	86	65	384	
Average (2) electrically treated.	100	270	33	103	506	32
BRAND B						
Average (7) gas-treated	84	151	25	36	296	
Average (2) electrically treated.	7	384	26	20	437	48
BRAND C						
Average (9) gas-treated	94	210	207	9	520	
Average (8) electrically treated.	414	232	129	8	782	50
BRAND D						
Average (7) gas-treated........	131	243	340	71	792	
Average (2) electrically treated.	520	107	350	10	987	25

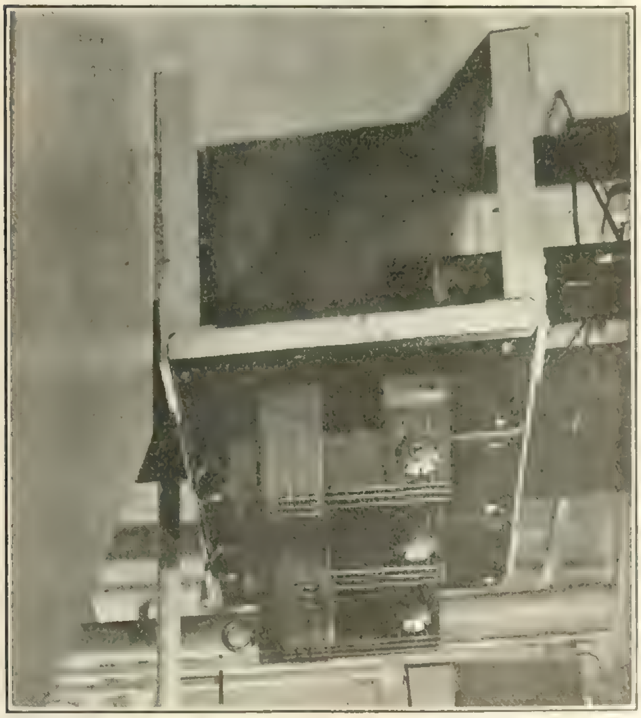
Except with brand B, the average is very marked before the first regrind. The fact that these taps averaged 384 holes after the first regrind indicates that the fault is not in the hardening but in some unavoidable feature in the grinding, or in the use of the taps. The outer case of the taps should be the hardest, and if the tap is held to shape in hardening, more of its hard surface remains for use. This would probably be the case in the electric furnace and might account for the greater life before the first regrind. Then, again, there is more decarbonization in the gas furnace, and this would cause the surface to be composed of low carbon steel, which would not be good for cutting purposes. In the electric furnace the work is, heated in a neutral atmosphere and emerges virtually as clean after hardening as before it was placed in the furnace, saving considerable time and money for finishing.

The electrical treatment given these dies, which is patented by the Leeds & Northrup Company, Philadelphia, makes use of a recording thermocouple which indicates by a "hump" in the temperature curve that the critical point in the heating of the metal has been reached. This hump corresponds to a pause in the temperature rise, in spite of the fact that heat is being steadily transferred to the work. It is said to be an accurate means for determining the exact amount of heating that should be applied to the material under treatment. G. H. GIBSON.

New York, N. Y.

Mounting a 3,500-Amp. Switch in a Limited Space

ON ACCOUNT of the limited space available, a set of 3,500-amp. disconnecting knife switches shown here were mounted on the under side of three 8½-in. x ¼-in. (3.8-cm. x 0.7-cm.) angles. This structure was placed between the fire wall separating two rooms and the front of the switch cells in the switchboard room, each of the disconnecting switches having three ¼-in. x 3-in. (0.6-cm. x 7.5-cm.) blades. These switches are employed to cut off the 440-volt busbars from the service mains in one of the distributing switchboard rooms of the Gillette Safety Razor Company's factory at Boston, Mass.

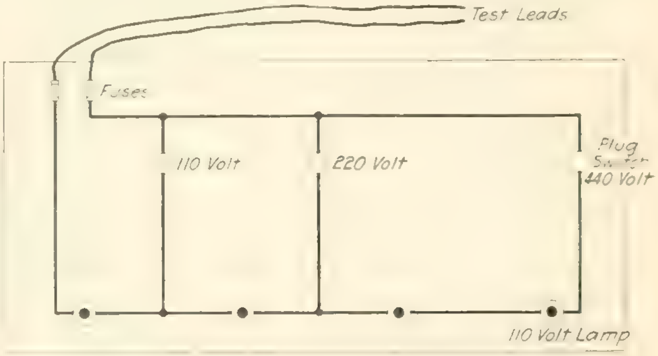


SWITCH MOUNTING SAVES ROOM AND REQUIRES LITTLE COPPER

In making repairs or other work necessitating the opening of a trunk line the switches, without load, can readily be opened from the floor level with the usual switch hook. When open they are high enough to be out of the way of any one passing beneath them.

Lamp Bank for Testing on Several Voltages

BY INSERTING the plug in the proper switch, the bank of test lamps shown in the accompanying illustration may be used on 110-volt, 220-volt or 440-volt circuits. To make this outfit, four sockets are mounted as shown and connected through two fuses to flexible test leads. Four 110-volt carbon incandescent lamps are used in the sockets. This outfit is mounted in a box measuring 6 in. x 8 in. x 10 in. (12 cm. x 25 cm. x 20 cm.) with a heavy glass on each side, one glass being removable. A handle for carrying is placed on the top. The plug switches are mounted either on the outside of the box or inside so that the plug may be inserted through holes in the box. The plug for each respective voltage should be plainly marked.



PLUG INSERTED FOR DIFFERENT TEST VOLTAGES

As there are three voltages in the plant where this device was made, it was formerly necessary for the men to carry three outfits or else three extra bulbs. By means of the bank described much time has therefore been saved. EUGENE TYLER,
Chief Electrician.

Massillon (Ohio) Bridge & Structural Company.

Reversed Series Field Caused Fan to Blow Fuses

EVEN though the series field on a compound-wound motor is reversed, if the motor is operating at a fairly light load it will perform its work without drawing an excessive current. When, however, the load is increased to full load, the series winding will greatly decrease the strength of the fields and thus the motor will draw a very heavy current. Such was the case in an Eastern macaroni-drying plant having a number of fans operated by compound-wound motors. These motors would run for days with perfect satisfaction, and then for an unexplained reason the fuses would begin blowing. An investigation finally showed that the motors generally operated about three-quarters load, but that when certain doors and windows were opened, allowing a draft to blow through the drying room in opposition to the direction of the fan draft, a heavier load was put on the motors. This heavier load by drawing more current through the series winding weakened the field, which in turn allowed still more current to flow. This resulted in blowing the fuses as has been described.

After the series field of these motors were reconnected correctly the motors operated satisfactorily under all conditions and have given no more trouble.

New York, N. Y. FRED SOLLER.

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

How a Farm Paper Is Fostering Public Utility Service to Farmers

"A RATHER sinister agitation for 'home rule' by municipalities over the public utilities has developed in the Middle West," says the *Rosenbaum Review*, a farmers' publication having wide circulation in Illinois and other Middle Western states. This paper goes on to say: "Farmers and bankers are the people who should be most concerned, but they do not appear to realize it. Future development and prosperity of farming communities depend largely upon the amount and character of public utility service they can secure, because farming efficiency depends upon electrical power and interurban cars."

This paper also tells its farmer readers that "public utilities cannot be attracted to projects of expansion and intensive development if they have to serve many masters, as home rule implies.

Comparative Cooking Values of Coal, Gas, Various Fluid Fuels and Electricity

PROF. B. L. STEELE of the physics department of the Washington State College has prepared tables, the result of extended investigation made with great care, on the comparative efficiency of coal, gas, kerosene, gasoline alcohol and electricity as applied to cooking. The value in calories of 5 cents' worth of each of these fuels, excepting gas, at the prices prevailing in December, 1916, was:

Coal (Rock Springs), at $10 per ton	32,250,000
Kerosene, at 20 cents per gallon	8,550,000
Gasoline, at 25 cents per gallon	6,130,000
Alcohol, at 75 cents per gallon	1,340,000
Electricity, at 3.85 cents per kw.hr	1,116,000

Professor Steele's second table gives the average efficiencies of the various kinds of cooking equipments. In determining the maximum efficiency of the coal range the entire top was covered with large vessels of water, the oven being similarly used. The fire was not lighted until the initial water temperature had been taken, and usually 2 lb. of kindling and 10 lb. of coal were completely burned before the record of the final maximum temperature was made. It was estimated that in the average home not more than one-fourth of the available coal-range space is utilized at any one time and that the cooking operations are carried on less than half of the time during which the coal is burning. The comparative figures in percentage of efficiency follow:

	Per Cent
Coal range (entire space utilized)	18
Coal range (estimated home cooking), about	2
Flame-contact burners (kerosene, etc.)	28
Electric heaters, surface	45 to 65
Electric heaters, inclosed	70
Electric heaters, immersion	90

Nearly every kind of electric heating appliance was used and under widely varying conditions. Room temperatures, existence of air currents from open windows, material and condition of surface of utensil used, wattage of heater, relative size of heater and utensil, and quantity of water heated, were all found to affect the efficiencies materially, particularly with heaters of the surface and immersion types.

Another table gives, in calories, the heat available for cooking in 5 cents' worth of each of the fuels, proper allowance having been made for the working efficiencies of the various cooking appliances:

	Calories
Coal (range at 2 per cent efficiency)	623,000
Kerosene (range at 28 per cent efficiency)	2,400,000
Gasoline (range at 28 per cent efficiency)	1,716,000
Electricity (range at 60 per cent efficiency)	669,600
Alcohol (at 28 per cent efficiency)	375,200

The average cost of cooking a meal with a coal range having the water front connected was found to be 5.70 cents, for a coal range with the water front disconnected 3.67 cents, and for an electric range 3.72 cents. These figures were quoted by M. C. Osborn of New Britain, Conn., in a paper presented under the auspices of the publicity committee of the New England Section, National Electric Light Association.

Revenue from Non-Ferrous Electric Furnaces More than from Induction Motors

SOME central-station men seem averse to supplying service to non-ferrous electric furnaces because they are usually single phase. However, R. F. Benzinger of the Electric Furnace Company, Alliance, Ohio, points out that two or three such furnaces can often be installed to balance the load, and even when that is not possible the single-phase resistance type of furnace will yield a greater income to the utility per kilowatt and per ampere of capacity provided than is obtained from the average three-phase induction-motor load.

The resistance furnace requires preheating for about three hours before the first charge, so that when working nine hours a day in a foundry the power consumption is uniform for about twelve hours. The load factor is then about 50 per cent, and as no inductance is required in the circuit the power factor is in the vicinity of 98 per cent. A single-phase, 100-kw. resistance furnace operated as above shows about 45 per cent more income per kilowatt of station and line capacity and about 25 per cent greater revenue per ampere capacity provided than a 100-kw. induction-motor load operating nine hours per day at an average of 60 per cent load factor and 80 per cent power factor. The increase in revenue will vary somewhat, depending upon the rates under which the service is supplied.

Promoting Acquaintance of Municipal and Utility Officials

TO ENABLE public utility men and representatives of city departments to get acquainted with one another, an organization known as the "Public Service Associates" was formed about six years ago at Springfield, Mass., upon the initiative of Walter L. Mulligan, general manager United Electric Light Company. At a recent meeting of the New England Section of the N. E. L. A. Mr. Mulligan, as chairman of the public policy committee, was asked to outline the work of this organization, which has been highly successful in maintaining a friendly co-operation among public service men.

"The idea," said Mr. Mulligan, "was to get the city and utility men to know each other, so that as matters came up regarding permits for underground work, poles, etc., time would be saved, and each side would know that the other was not quite so 'bad an actor' as might have been imagined beforehand. We meet once a month in Springfield around the luncheon table. The gas and electric companies are represented, the street railway, the telephone company, the three railroads entering Springfield, and head of the department of every subdivision of the city's activities, such as the sewer and street departments, engineering and public works, as well as the Mayor."

The speaker pointed out that all the individuals interested are present at a time when a given subject is under discussion. The press is allowed a representative. The plan has ironed out a great many troubles.

Electric Development of the West Compared with Other Sections

THE data in the report of the National Electric Light Association committee on water power which was presented at the Pasadena convention furnishes interesting comparisons of power production and consumption per capita. The Mountain and Pacific States of the Far West lead the nation in these respects—a fact of special interest in connection with the water-power legislation now pending in Congress, approximately 70 per cent of the undeveloped water power of the nation belonging to those states.

REVENUE, EXPENSES AND OUTPUT OF CALIFORNIA CENTRAL STATIONS *

	Total Gross Operating Revenue	Total Operating Expense
Standard Gas & Electric Company	$2,274,962 62	$1,638,046 33
San Joaquin Light & Power Company	3,211,570 44	2,215,982 47
Great Western Power Company	3,128,928.50	1,570,443.63
Pacific Gas & Electric Company	25,938,371 99	17,578,262 39
Coast Counties Gas & Electric Company	519,792.72	350,739.29
California Oregon Power Company	724,418 88	452,156 20
Southern California Edison Company	9,241,245.96	5,445,341.45
Mount Whitney Power & Electric Company	1,360,582 64	1,049,978.17
Southern Sierras Power Company	1,596,832 59	482,596 69
Western States Gas & Electric Company	1,901,330.61	1,105,292 74

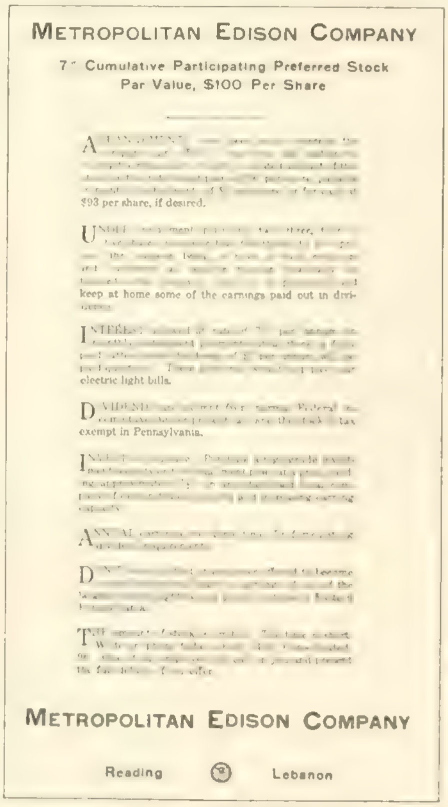
* Total output of all California companies, 3,334,430,841 kw.-hrs.

The data show that in the Western States the per capita consumption of power in 1919 was 673 kw.-hr., the Atlantic section coming next with a per capita consumption of 363 kw.-hr. The section having the smallest per capita consumption was New England, with 254 kw.-hr. The average of the whole country was 334 kw.-hr. The gross operating revenue for the California companies and their total operating expense are given in the accompanying table. On page 1099 of the ELECTRICAL WORLD for May 8, the output of all companies generating more than 100,000,000 kw.-hr. was given.

At the present time the Western load equals 1,289,000 kw., and careful estimates made by the individual companies indicate a peak in 1928 of 2,807,000 kw. The present load is being carried by an installed electrical capacity of 1,664,267 kw., which will have to be increased to 3,440,500 kw. in 1928. Of the former figure 1,241,312 kw. is now hydro-electric, and in 1928 2,753,000 kw. will be hydro-electric. This increase in plant will add $710,510,000 to the present investment of $665,706,800, making a total investment in 1928 of $1,376,216,800.

Pennsylvania Property Sells $558,600 Stock to Customers and Employees

DURING a four weeks' campaign which ended May 3 the Metropolitan Edison Company, Reading, Pa., through an organization composed exclusively of its employees, sold to employees and customers $558,600 of its 7 per cent cumulative participating preferred stock of a par value of $100 a share. Under a monthly saving investment plan the stock was offered in lots of one, two, three, four or five shares, not over five shares, at $95 per share, payable $5 a share at time of application and $5 a share each month thereafter until purchase price is paid. Those so desiring could buy the stock for cash at $93 per share and accrued dividend. Of the 5,586 shares sold, 2,764 were sold for cash and 2,822 were sold on the monthly saving investment plan.



METROPOLITAN EDISON COMPANY

7% Cumulative Participating Preferred Stock
Par Value, $100 Per Share

$93 per share, if desired.

keep at home some of the earnings paid out in dividends.

electric light bills.

exempt in Pennsylvania.

METROPOLITAN EDISON COMPANY

Reading Lebanon

NEWSPAPER ADVERTISEMENT USED BY METROPOLITAN EDISON COMPANY

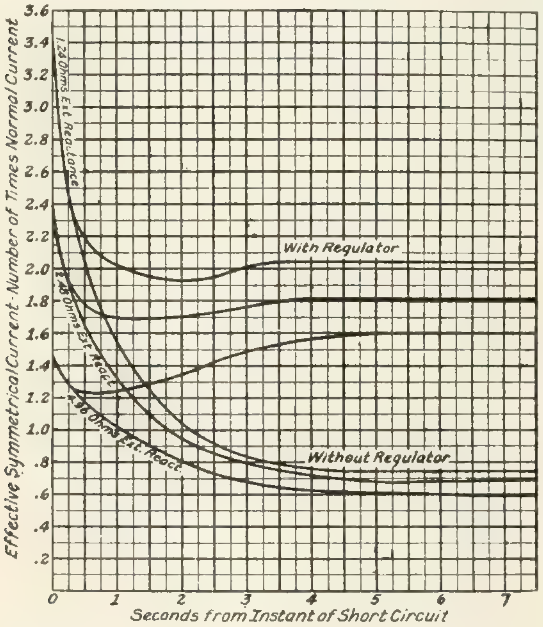
The above shares were sold to 2,353 purchasers, of whom 1,242 bought one share each, 523 bought two shares each and 308 bought five shares each. The balance comprises purchases of varying amounts. The purpose of this sale of stock was to provide capital for increasing the company's generating facilities and making other extensions to its property and at the same time give employees and customers an opportunity to participate in the prosperity of the company and become interested in its affairs.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Short-Circuit Tests on a 10,000-Kva. Turbine Alternator.—E. S. HENNINGSEN.—The series of tests described in this article were made for the purpose of amplifying data that had been compiled on the behavior of alternators under short circuit. The performance of definite-pole machines under short circuit had previously been analyzed, it is said, by means of extensive tests, but the characteristics of the alternator with smooth-core rotor were not so well known. The tests were conducted under numerous conditions of short circuit, with various arrangements of reactors in circuit and with no reactors in circuit. Special precaution was taken to eliminate errors, and meter readings were taken as a check on oscillograph records. The curves show the effect of automatic regulator action on the value of armature current from the instant of short circuit until sustained values are reached.—*General Electric Review,* March, 1920.



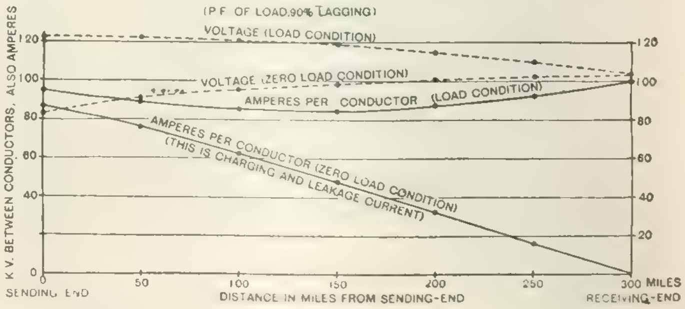
SHORT-CIRCUIT TEST OF A 10,000-VOLT, THREE-PHASE ALTERNATOR WITH EXTERNAL REACTANCE

Generation, Transmission and Distribution

Electric Drive in Paper Mills.—E. TANNER and C. F. PAPWORTH.—The writer gives a description of a large paper mill in the south of England having a capacity of 1,500 tons of paper per week. He deals particularly with the generating plants, lighting and heating, and the power installation. He states that approximately 250 motors are used, varying from 150 hp. to ½ hp., embodying all makes of drive, direct-coupled, belt-driven, chain-driven or geared, according to the purpose for which they may be required. It has been found desirable in cases where motors of 40 hp. and over are controlled by the ordinary starting panel, comprising double-pole switch and fuses, ammeter and starter (such motors being variable-speed type are subject to momentary overload), to fit either a single-pole or double-pole circuit breaker in place of the usual fuses. This saves the expense and inconvenience of replacing the ordinary porcelain bases and fuse carriers. He states that the bulk of the service of the motors is driving pumps, which is of great importance in the paper mills. He foresees an excellent future for electricity in the paper mills in England.—London *Electrician,* March 26, 1920.

A National Power Distribution Project for Spain.—F. CHAPELAIN.—A final report has recently been presented by a Spanish commission which has investigated the advisability of providing Spain with a nation-wide system of high-tension transmission lines for utilization and distribution of the greater part of the available water power. It is estimated that while only 300,000 kw. are now developed, another 2,000,000 kw. could easily be added by further development of the waterfalls. In the report a distribution system is sketched which consists of a closed bus encircling the entire country, with interconnecting lines radiating from Madrid to various points on the circumference. The cost is estimated at 130,000,000 pesetas for a total of about 4,800 km. (3,000 miles) high-tension lines. The system is planned for three-phase transmission at 50 cycles and 120,000 volts. —*Revue Générale d'Electricité,* Feb. 21, 1920.

Electrical Characteristics of Transmission Circuits—VIII.—WILLIAM NESBIT.—One of a series of articles in which the performance of long transmission lines are considered. On account of the unusual distribution of current and voltage along the lines, a more rigorous solution is required in the particular case here considered than in those given in previous numbers of the series. The curves shown in the figure are for a 300-mile (480-km.) line operating at a nominal voltage of 100,000 and at 60 cycles, and the curves show the variation current and voltage along the line. The electrical constants for such a line may be determined mathematically by the use of hyperbolic functions or by their equivalent convergent series. Graphically they may be



CURRENT AND VOLTAGE DISTRIBUTION ON A LONG LINE obtained to a high degree of accuracy from such diagrams as the Wilkinson charts, which are included in the article. The writer then shows the application of the Wilkinson chart to a typical long-line problem.—*Electric Journal,* March, 1920.

Over-Pressures in Hydraulic Conduits.—In some fundamental papers regarding the theory of hydraulic surges in closed conduits, such as result from manipulation of the outlet valve, Alliévi demonstrated a graphical method of finding the maximum pressure to be expected in practical cases. The present paper applies this method and shows in detail how to adapt it for the solution of various problems of this kind. A great number of graphical charts are presented, which materially simplify the discussion, and the method is said to have the advantage of not necessitating any thorough knowledge of the rather complicated mathematical theory of hydraulic surges.—*Revue Générale d'Electricité,* Jan. 17 and 24, 1920.

Possible Development of Hydro-Electric Power in British Guiana.—STAFFORD X. COMBER.—This is a preliminary report of the information gathered during a brief study of the Cuyuni, Lower Essequebo and Demerara Rivers. The relative advantages of various possible sources of power are discussed and definite recommendations are made with regard to the steps which should be taken in their development. The author considers the needs of hydro-electric energy for fertilizer and power for the sugar industry of British Guiana and recommends the continued study of the streams for early hydro-electric development.—*Report to Governor of British Guiana,* 1919.

Systems, Installations and Appliances

Electric Plowing Machines.—ACH. DELAMARRE.—At a fair in Saint Germain the Compagnie Electro-Mécanique for the first time demonstrated in public its electric plowing machinery. The plow is pulled by steel cables, which bend around drums on special anchored drum cars and run in on two large drums on the main electric power car, the car standing still during the plowing. The cable drums on the power car are actuated by a 500-volt, three-phase induction motor of 40 hp. output. The drum capacity is 600 m. (1,970 ft.) of cable, so that for each position of the power car four squares, each 240 m. x 240 m. (787 ft. x 787 ft.) may be plowed. A total area of 23 hectares (57 acres) thus may be covered without moving the power car. The disadvantage of this system, called the "roundabout" and originally developed by Howard for steam plowing, is that very heavy losses, amounting to 81.5 per cent of the total losses, are caused by the great length of cable which is always sliding along the ground when the plow is moving. The total cost of electric plowing with this outfit is estimated at 93.75 francs per hectare ($5.78 per acre) as compared to 153.20 francs per hectare ($9.55 per acre) for plowing by horse. One outfit is capable of covering 2.5 hectares (6.2 acres) per day, and the electric power consumption is about 90 kw.-hr. per hectare (36.4 kw.-hr. per acre).—*Revue Générale d'Electricité,* Jan. 10, 1920.

Electrophysics and Magnetism

On the Theory of Electron Discharge.—PAUL EPSTEIN.—The ordinary theory of the internal phenomena in electron discharge tubes extends analytical treatment only to the two limiting cases of (1) very high voltage, electron saturation, and (2) very large emission, space charge saturation. In general there will be formed around the filament a cloud of electrons, representing a negative space charge. The potential will therefore first fall to negative values and then gradually increase to positive values close to the anode plate. Thus, if an electron is emitted with enough velocity to pass through the retarding effect of the initial potential drop, it will reach the plate, but if its velocity is less than a certain critical value it will be forced back to the filament. Taking all this into consideration, and assuming that the electrons are emitted from the filament with a velocity distribution according to the Maxwell formula and that no collisions occur, the author has worked out a general solution of the Poisson equation, which degenerates in particular cases into the Richardson emission formula and into the Langmuir-Child equation involving the power of 3/2 of the anode potential. The theory refers to the idealized case of a plane-infinite system.—*Berichte der Deutschen Physikalischen Gesellschaft,* March 30, 1919.

Telegraphy, Telephony and Signals

New Phenomena Discovered by Means of Vacuum-Tube Amplifiers.—The tremendous energy amplifications obtainable in modern triode amplifiers seem to open up new fields for research concerning the constitution of matter. Recently Schottky stated that by employing sufficiently powerful amplifiers it should be possible to hear in a telephone the sounds caused by the individual electrons colliding with the atoms in a conductor carrying electric current. Schottky indeed suggested that a limit was set to the possible amplification obtained with electron tubes by the noises or electric disturbances emitted when the electrons impinge upon the plate of the tube. Barkhausen now has actually observed similar phenomena in ferromagnetic substances. In listening with a multistage amplifier across a coil wound on one leg of an iron core, he heard a crashing sound when the magnetic induction in the core was continually varied by advancing and then pulling back a magnet. He explains this sound as resulting from the electromagnetic shocks given to the amplifier when the individual molecular magnets suddenly go over from one polarity to the opposite as the field strength changes. The best results were obtained with rather thin wires.—*Physikalische Zeitschrift,* Sept. 1, 1919.

The Poulsen System of Radio-Telegraphy.—G. PESSION.—The subject is discussed under the five headings: General theory, technical production of the arc, matters relating to the production of the poulsen arc, efficiency of the arc, and arc and spark.—London *Electrician,* April 9, 1920.

Miscellaneous

Molded Insulating Composition.—R. T. FLEMING.—In this part of the article a description is given of the various raw materials that enter into the manufacture of molded insulating compositions. Some of the characteristics of the various types of molded compositions are given in above table.—*Beama,* March, 1920.

Material	Resists Temperatures of	Dielectric Strength	Moisture Absorption
Bakelite	100 to 200° C.	Medium 200 mil.	Very good
Molded rubber	To 100° C	High 400 mil.	Good
Asbestos	Red heat	Low 100 mil	Bad, 7%
Shellac...............	To 70° C.	Medium 250, 300/ mil.	Medium between and (b)

News in Brief

Summary of Market Conditions and of Recent and Approaching Happenings of Importance to the Industry

SOMEWHAT better quantities of electrical supplies have reached jobbers this week. Special attention is being given to the clearing of sidings and yards, and a large number of freight cars have been unloaded and sent away. Manufacturers are able to lay hands on a few cars, and fresh shipments are beginning to come through.

IN THE non-electrical metal market price cutting has been assuming great proportions. Virtually no reductions are reported in the electrical markets except that certain large department stores are selling at low prices limited amounts of appliances bearing their own names as well as portable lamps.

JOBBERS in the vicinity of manufacturing plants have good stocks of materials from these factories. Those at a great distance are suffering from shortages. Regardless of other conditions, stocks are about dead on most steel materials used in the electrical trade.

BUYING of supplies is falling off because of inability to deliver. The demand, however, is as strong as ever and expected to increase.

OFFICERS of the National Electric Light Association for the coming year were elected at Pasadena as follows: President, Martin J. Insull, Chicago; first vice-president, M. R. Bump; second vice-president, F. W. Smith; third vice-president, Walter H. Johnson; fourth vice-president, F. T. Griffith; treasurer, H. C. Abell.

HOT SPRINGS, Ark., is likely to be the meeting place of the National Electric Light Association next year.

SECTION chairmen of the N. E. L. A. for the ensuing year are to be: Public Relations Section, J. E. Davidson; Technical Section, I. E. Moultrop; Commercial Section, M. S. Seelman; Accounting Section, J. C. Duyne.

FORTY-FOUR engineering organizations with an aggregate membership exceeding 100,000 have signified their intention to send delegates to the organizing conference of technical societies to be held in Washington on Thursday and Friday of next week. The American Association of Engineers will be represented.

FOR THE administrative year beginning August, 1920, A. W. Berresford of Milwaukee has been elected president of the American Institute of Electrical Engineers.

W. L. R. EMMET was made the tenth recipient of the Edison medal at the annual meeting of the A. I. E. E. last week.

GROSS earnings of the Westinghouse Electric & Manufacturing Company for the year ended March 31, 1920, were more than $136,000,000; net dividend available for income, $15,206,341.

MORE than $17,000,000 is to be spent this year on the projects of the Hydro-Electric Power Commission of the Province of Ontario.

PUBLIC utility delegates to the second annual convention of the Industrial Relations Association of America, held at Chicago last week, organized a public utility section of the association.

ACTIVE co-operation by the government with public utilities in the study of the engineering involved in their business was urged by Dr. E. B. Rosa of the Bureau of Standards before the Washington Academy of Sciences.

FAVORABLE action on the formation of a Southwestern Geographic Section of the N. E. L. A. was taken at the Galveston meeting of the Southwestern Electrical and Gas Association.

TO MEET the cost of building a new steam-turbine plant the Hartford (Conn.) Electric Light Company is planning an increase in capital stock from $8,250,000 to $10,000,000.

IMPORTANT principles are at stake in the case of the Webster & Southbridge Gas & Electric Company, before the Massachusetts commission, against the entrance of the New England Power Company as a competitor for power business in a field hitherto cultivated by the former central station.

REVISED figures for "overhead" cost accepted by Massachusetts electrical contractor-dealers at Boston range from 46 per cent on jobs costing $200 to $500 to 10 per cent on jobs costing $50,000 to $70,000. Labor cost averages 40 per cent in these figures.

GOVERNOR COOLIDGE of Massachusetts in a special message to the State Legislature urged increasing the legal rate of interest on gas and electric utility bonds and notes above 6 per cent to attract capital.

R. SANFORD RILEY was elected president of the Stoker Manufacturers' Association at its Lakewood (N. J.) meeting.

A PROPOSED new code of ethics which it is suggested could serve as a basis of a declaration of principles for all engineers was prepared by a committee of the American Society of Mechanical Engineers for discussion at its St. Louis convention.

VALUATION of public utility properties at present construction costs is favored by Sanford Robinson of New York, who recently testified before the Interstate Commerce Commission.

TEXAS may establish a public utilities commission at a special session of the Legislature now being held. Such a body, subordinate to the principle of municipal home rule, is favored by the League of Texas Municipalities.

PROPOSED changes in the National Electrical Safety Code affecting pole strength, joint poles, signal lines and other requirements have been issued by the Bureau of Standards.

IN THE majority report of the special war expenditures committee to Congress the government war loan to the Alabama Power Company is condemned as unjustifiable and unnecessary and the government's policy is held to have built up a monopoly of power in northwestern Alabama.

THE REPORT of the American representatives at the meeting of the technical committees of the International Electrotechnical Commission indicates progress toward adoption of international standards.

GOVERNOR SMITH of New York vetoed the daylight-saving repeal bill passed by the Legislature.

TO SAFEGUARD the Greater Wheeling (W. Va.) district in emergencies, the Wheeling Electric Company is to build a new power loop to Windsor.

SHORTAGE of coal caused by the freight blockade again threatens public utilities in the East and the Middle West.

TEMPORARY growth in the number of casualties in public utility operation is ascribed by the Utilities Mutual Insurance Company to "military scorn for personal danger" on the part of returned soldiers.

News of the Industry

Chronicle of Important Events and General Activities in the
Technical, Commercial and Manufacturing Fields With Announcements and
Reports of Association Meetings and Conventions

Utilities Again Feeling Pinch of Coal Shortage

DIMINISHING coal piles because of the transportation tie-up are becoming rather alarming in the electric light and power field. The most pessimistic reports come from the Middle West, although one of the large Eastern systems at one time was down to a single day's supply.

The Indiana Public Service Commission has recommended that the Interstate Commerce Commission establish priority shipments of coal for public utilities.

The Michigan Public Utilities Commission has made a similar request. An acute coal shortage exists in Michigan, where 125 electric light and power plants are said to be extremely short. In fact, plants in Kalamazoo, Saginaw, Pontiac and some others in smaller places, according to reports, have been obliged to shut down completely.

New York's coal supply seems to be in fair condition, but the same is not true of Chicago. The Commonwealth Edison Company, it is reported, has recovered only half of the 1,500 coal cars loaned to the government almost a year ago.

The situation, however, is expected to become easier as authority has been invested in the Interstate Commerce Commission to move coal by securing "empties" for the West.

New Power Loop to Protect Wheeling Against Storms, Strikes, Etc.

TO SAFEGUARD the Greater Wheeling (W. Va.) district in the event of emergencies, such as storms, strikes or other situations that cannot be controlled, the Wheeling Electric Company will establish a new power loop to Windsor on the West Virginia side. Work will be started in the course of the next three weeks.

Although it is not generally known, the city of Wheeling is at the present time being supplied with light, heat and power from Windsor by way of the two loops on the Ohio side. Since May 1 the electrical workers of the Wheeling company have been on strike and the Wheeling plant has been closed down.

The new loop will run through Fulton at Rudler's, where a substation will be erected, and continue on a straight line due north to Windsor. The work on the substation will start in three weeks' time, but on account of the difficulty in procuring steel, the loop will not be begun till Aug. 1. The new loop will increase the capacity of the plant, according to Superintendent J. B. Garden, and give three methods by which to get power down to Wheeling.

The frequent damage wrought by winter and summer storms, as well as other contingencies, has made the move imperative for the protection of patrons in this district. The substation at Rudler's will supply the suburban district with light and also be used to distribute light and power to the Mold & Foundry and Whitaker-Glessner plants.

W. L. Emmet Receives Edison Medal at Annual Meeting of A. I. E. E.

WILLIAM LEROY EMMET was formally presented with the Edison medal, for inventions and developments of electrical apparatus and prime movers, at the annual meeting of the American Institute of Electrical Engineers on Friday evening, May 21. The medal is awarded, it was explained by Dr. Carl Hering, by the Edison medal committee "for meritorious achievements in electrical science, electrical engineering or the electrical arts." Associates of Thomas A. Edison founded the medal in 1904 to commemorate the period in the rise of electrical engineering of which Edison is typical. Mr. Emmet is the tenth recipient of the Edison medal, which has been awarded yearly, with the exception of the year 1915, since 1909.

In discussing Mr. Emmet's achievements, H. W. Buck, past-president of the Institute, pointed out that by tradition and inheritance Mr. Emmet should have been an artist, but that the artist's vision to see great things and the power to bring them into reality were valuable attributes to his success as an engineer. In looking back over the work which Mr. Emmet has carried on for twenty-five or thirty years its originality is sometimes in danger of being overlooked. However, Mr. Buck reminded the meeting, much of the present-day construction and design of electrical apparatus which is now accepted as standard practice is the direct result of methods conceived and applied by Mr. Emmet in the early period of the industry when everything was on an experimental basis. He was chiefly responsible for present insulation methods when in 1887 he substituted oiled cambric for shellacked mica insulation. The oil-immersed switch was distinctly an idea of Mr. Emmet's and came at a time when the development of the central stations had come to a standstill because of their inability to control the circuits.

Mr. Emmet started his most important work, Mr. Buck stated, in 1900 in the development of the Curtis steam turbine. Here again his vision of the possibilities of the turbine enabled him to carry his operations through to success, and in 1902 the first 500-kw. machine was installed at Newport, R. I., and was very successful. This was followed about three months later by a four-stage 3,000-kw. machine which gave much better steam economy and really established the turbine on a firm basis. By the end of that year the first and famous 5,000-kw. machine was installed in Chicago, and its success soon became known all over the world.

In connection with Mr. Emmet's work on the turbine he was the first to point out to steam engineers the tremendous importance of high vacuum in the operation of the turbine. Development of the turbine for ship propulsion was started by Mr. Emmet in 1907 and was first introduced on two fire boats in Chicago. In 1909 the first proposition was made to the government for the operation of battleships in this manner.

In his response following the presentation of the medal Mr. Emmet told in an interesting and sometimes amusing manner about his early experiences with the first street railway motors, the obstacles overcome and the inadequacy of equipment with which he had to work. Of his work in the development of alternating-current generators he stated that one of the greatest difficulties that had to be surmounted was the hunting of alternators operated in parallel by reciprocating engines. This apparent defect of the electrical apparatus he traced to the engine governors, and with a few changes in design which he suggested the trouble was entirely eliminated. The first successful parallel operation of alternating-current generators was in Omaha, where forty-eight-pole, 300-kw. machines were installed. Speaking of his work on the turbine, he paid tribute to the support and assistance which Mr. Curtis gave in its development.

Comment on Mercury Turbine

At present Mr. Emmet is working on the perfection of a mercury turbine from which highly efficient results have been obtained. Preferring not to go into details on this subject, he said that the over-all thermal efficiency of the mercury turbine equaled that of the Diesel engine and were the firing conditions up to the standard of a large central-station boiler room energy could be generated on the basis of 11,300 B.t.u. of fuel consumed per kilowatt-hour.

To show the extent of Mr. Emmet's activity in the electrical art, it may be added that he has taken out 105 patents on electrical and kindred apparatus.

As this was the annual meeting of the Institute, the report of the board of directors was made and the result of the ballot on the amendment to the constitution and election of officers was announced. The vote on the amendment to the constitution showed 3,936 in favor of and 36 against the adoption of the amendment, which permits the creation of districts, each district to be presided over by a vice-president.

A. I. E. E. Officers

The following officers were declared elected for the administrative year beginning August, 1920: President, A. W. Berresford, Milwaukee; vice-presidents, E. H. Martindale of Cleveland, Charles Robbins of Pittsburgh, Charles S. Ruffner of New York, C. E. Magnusson of Seattle, C. S. McDowell, U. S. and L. T. Robinson of Schenectady; managers, E. B. Craft of New York, Harold B. Smith of Worcester and James F. Lincoln of Cleveland; treasurer, George A. Hamilton, Elizabeth, N. J. (re-elected).

The above, together with the following hold-over officers, will constitute the board of directors for the next administrative year: Calvert Townley, New York; Comfort A. Adams, New York; Walter A. Hall, Atlantic, Mass.; William A. Del Mar, New York; Wilfred Sykes, Pittsburgh; Walter I. Slichter, New York; G. Faccioli, Pittsburgh; Frank D. Newbury, Pittsburgh; L. E. Imlay, Niagara Falls; F. F. Fowle, Chicago; L. F. Morehouse, New York.

At the meeting of the board of directors held on the same date F. L. Hutchinson was re-elected secretary.

Electric Utility Securities Compare with Industrials in Permanence of Value

IN AN interim report to the Investment Bankers' Association of America by the committee on public service securities, of which O. B. Willcox of Bonbright & Company is chairman, the inevitable expansion of the electric power industry is predicted. A review is made of the effects of war-forced economy on the public utilities, the cost of generating energy, the increased use of electricity, electrification of the railroads, and the present financial status of electric central stations.

Recent reports of electric power companies, the report states, indicate that under commission regulation these companies have largely offset increased costs of operation by increase of rates for service, with resulting recovery in net earnings, and the rate of earnings of many of the power companies shows satisfactory surplus above charges. Their reports further indicate, it is pointed out, that power companies are again getting into position to justify the confidence of the investment banker in financing their maturities and their requirements for new capital for expansion and sustaining their contentions that electric power and light companies offer investment securities comparable with the best industrials in permanence of real value and certainty of return.

"As the pressure of the high costs of operation, with resulting decrease in earnings, disturbed confidence in public utility securities," the report concludes, "so the response made by regulating authorities in approving rate increases should tend to restore that confidence, strengthened by proof accumulated through the war period that the public and the regulating commissions recognize that the power and light companies are an essential part of our industrial fabric and are entitled to fair rates for their service and a fair return.

"With improving earnings and with full appreciation of the economic and financial history of these companies during and since the war period, their credit should steadily improve and their requirements for money with which to meet maturing obligations and to expand their facilities to take on business offered should again be satisfied through investment markets (subject, of course, to general financial conditions) at gradually decreasing costs for money; and it may also be expected that the general price level of the outstanding securities of companies which have creditably survived the disorders of the past few years will substantially improve."

Aylesworth to Address Canadian Electrical Association

JUNE 16, 17 and 18 have been selected as the dates for the annual convention of the Canadian Electrical Association, which will be held at the Ritz-Carlton Hotel, Montreal. The first day will be devoted to reports of committees and of representatives on the committees of the National Electric Light Association. On the second day M. H. Aylesworth, executive manager of the N. E. L. A., will speak on the enlarged activities of that body and the work accomplished at the Pasadena convention. There will also be a paper by Paul M. Lincoln on the maximum-demand meter and other papers not yet announced. An executive session will occupy the last day of the convention, and the revised constitution will be placed before the delegates for their approval.

More Than 100,000 Engineers to Be Represented at Conference

UP TO May 25 forty-four engineering organizations, with an aggregate membership exceeding 100,000, had signified their intention to send delegates to the organizing conference of technical societies in Washington, D. C., Thursday and Friday, next week. Details of the tentative program were announced in ELECTRICAL WORLD last week. There will, in all probability, be certain minor changes before the date of the meeting, but the sessions will follow the general plan previously outlined. Here follows the complete list of societies which will be represented at the conference:

American Association of Engineers, American Association of Petroleum Geologists, American Ceramic Society, American Electric Railway Engineering Association, American Electrochemical Society, American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Railway Engineering Association, American Society for Testing Materials, American Society of Civil Engineers, American Society of Mechanical Engineers, American Society of Refrigerating Engineers, American Society of Heating and Ventilating Engineers, American Society of Safety Engineers, American Water Works Association, Illuminating Engineering Society, Institute of Radio Engineers, Mining and Metallurgical Society of America, Society for the Promotion of Engineering Education, Society of Automotive Engineers, Society of Naval Architects and Marine Engineers, Society of Industrial Engineers, Colorado Society of Engineers, Portland Technical Council, Kansas Engineering Society, Engineers' Society of Western Pennsylvania, Mohawk Valley Engineers' Society, Florida Engineering Society, Illinois Society of Engineers, Indiana Engineering Society, Brooklyn Engineers' Club, Cleveland Engineering Society, Detroit Engineering Society, Vermont Society of Engineers, Society of Engineers of Eastern New York, Associated Engineering Societies of St. Louis, Atlanta Joint Technical Society, Engineers' Club of Trenton, Engineering Society of Buffalo, Engineers' Club of Columbus, Engineers' Club of Philadelphia, Washington Society of Engineers, Joint Council of Engineers, St. Louis; American Concrete Institute, New England Water-Works Association, Engineering Society of Akron and National Fire Protection Association.

Southwestern Association Holds Most Successful Convention

IN ATTENDANCE, interest manifested, work done and results accomplished the fifteenth annual convention of the Southwestern Electrical and Gas Association, held at Galveston, Tex., May 13, 14 and 15, stands out as the most successful in the history of the association.

The most important features of the convention sessions, in addition to the question box, were the address by G. L. Burr of the Guaranty Trust Company of New York on "The Successful Financing of Public Utility Needs" (reported in the ELECTRICAL WORLD for May 15, page 1154); an address by B. J. Mullaney of the Illinois Committee on Public Utility Information on the work of that committee and its results; an address by W. H. Blood, Jr., on "Insurance and Kindred Matters Affecting the Public Utility Industry"; an address by J. F. Owens of the Oklahoma Gas & Electric Company on "Public Utility Association Work"; an address by Dr. E. P. Schoch, head of the department of chemistry of the University of Texas, on "The Unlimited Possibilities of the Unlimited Supply of Texas Lignite," and an address by H. C. Abell, treasurer of the National Electric Light Association, explaining the work and possibilities of the national association as an aid and asset in state or sectional association work and urging the formation of a Southwestern Geographic Section of the N. E. L. A. by the associations of Texas-Louisiana, Oklahoma and Arkansas. Favorable action was taken. The convention was also addressed by representatives of the Mississippi Electrical Association relative to its admission into the Southwestern Geographic Section. Action will be taken on the matter at an early date by the Texas, Oklahoma and Arkansas Associations.

A committee of eleven operating and technical members was appointed to investigate the matter of Texas lignite and report to the executive committee.

Entertainment features included a ball at the Hotel Galvez given by the supply section, a banquet-"joviation" given by the association and other special entertainment for the visiting bodies.

A. Hardgrave of Dallas was elected president, C. E. Calder of Dallas first vice-president, Alba H. Warren of El Paso second vice-president, S. R. Bertron, Jr., of Houston third vice-president, H. S. Cooper of Dallas secretary, and J. B. Walker of Dallas treasurer.

A. A. E. States Position on Proposed National Federation

THE American Association of Engineers has accepted the invitation of the joint conference committee of the national technical societies to the conference to be held in Washington on June 3 and 4 for the purpose of forming a comprehensive organization. In its letter of acceptance the A. A. E. indorsed the provision for non-interference with interrelations with respect to technical matters and the maintenance of the autonomy, functions and operations of individual organizations. The idea of having local affiliation of existing groups of engineers in order to facilitate united action in local questions of public welfare and other matters of common interest was approved.

The proposition for a national association of engineering organizations by means of a national council composed of representatives widely chosen by local affiliations or organizations and by national organizations, meeting annually and acting through an executive board, did not meet with the favor of the A. A. E., which held that such a plan would duplicate effort and add useless machinery, tending to restrict progress along welfare and non-technical lines.

"Our association," the letter states, "is doing such work at the present time in an efficient manner, and our growth proves that results are being obtained. This viewpoint is based on the result of our experience, and consequently we do not believe that the organization proposed would be any inprovement over existing machinery." For this reason it was stated that little or no financial help could be expected from the A. A. E.

The A. A. E. also stated that in its opinion the simpler the machinery of organization the better will it be adapted to expansion.

The following delegates have been selected to represent the A. A. E. at the conference: George W. Fuller, consulting engineer, New York City; Isham Randolph, consulting engineer, Chicago; W. H. Finley, president, Chicago & Northwestern Railroad, Chicago; Dr. F. H. Newell, head of the department of civil engineering, University of Illinois; L. K. Sherman, president of the United States Housing Corporation, Washington, and president of the A. A. E.; Daniel L. Turner, chief engineer Transit Construction Commission, New York City; A. B. McDaniel, principal engineer construction division of the army, Washington; R. C. Bailey, district secretary of A. A. E., Washington; William J. H. Strong, president Chicago Chapter, A. A. E.; A. N. Johnson, consulting highway engineer, Chicago; Dean G. M. Butler, University of Arizona; H. O. Carman, chief engineer Public Service Commission of Indiana; I. W. McConnell, New York City; Morris Bien, assistant to the director United States Reclamation Service, Washington; W. A. E. Doying, inspecting engineer Panama Canal, Washington; J. K. Anderson, consulting engineer, Charleston, W. Va.

Proposed Code Changes on Signal Lines, Pole Strength and Joint Poles

PROPOSED changes in the rules on signal lines, on required pole strength, on joint poles and other subjects of Part 2 of the National Electrical Safety Code were issued May 15 by the Bureau of Standards. Signal lines are now subjected by these changes to most of the requirements imposed upon supply lines, although there are some differences which will be enumerated below; where a weak pole is supported by two adjacent poles the average strength of all three must meet the code requirements.

In the changes for signal lines the rules have been made the same as those for supply lines regarding location of poles, guys and anchors, regarding insulators or guards for guys and spans, and regarding strength of poles and cross-arms. Among the exceptions is the rule that signal conductors may be spaced 3 in. apart where this has been customary and may be strung on the same arm with 7,500-volt lines owned by the same utility. For spans up to 150 ft. signal conductors which would fall in class C may be graded D. The minimum allowable conductor sizes are also smaller than for supply lines as outlined in the November changes of the code, and further changes allow No. 10 steel to be used on spans of 125 ft. to 150 ft. at crossings in arid regions. The sizes for aluminum wire have been eliminated, but all conductors must have the strength of the minimum hard-drawn copper conductor. Clearance of signal wires over spaces accessible to pedestrians only shall be 12 ft. for circuits over 150 volts. The clear space at the crossing of the lowest signal wire, guy or messenger and the lowest wire of a similar nature paralleling a railway track shall be at least 2 ft. where the sum of the distances from the nearer support of each span is not more than 100 ft. The working tension of messenger cable is set at 3,500, 5,900 and 9,500 lb. for cable weighing respectively under 2.5 lb., from 2.5 lb. to 5 lb. and from 5 lb. to 8 lb. per foot.

The principal ruling regarding pole strength is that a pole not meeting the requirements will be permitted when it is the center pole of three, of which the average strength meets the requirements, provided that the weak pole is not less than 25 per cent of regulation strength. The specifications for strength apply to grade B construction. Grade A is one and a half times grade B, while grade C is two-thirds of grade B. Another revision is that for "special" poles (except at crossings over railroads or signal lines) two-thirds of the moment due to wind pressure shall be used in finding the stresses on the poles. These "special" poles must be especially selected clear wood, must correspond to poles usually classified as class A for grade A or B, and as class B for grade C, and they shall be systematically inspected and maintained.

Where at a crossing, or in cases of conflict or common use of poles, circuits of different grades are concerned the construction for the upper circuit must be at least as good as would be required for the lower circuit if it were above. For joint poles constant-current circuits of 10 amp. require class A and circuits of 7.5 amp to 10 amp. require class B construction. Span wires or brackets on lamp or trolley wires on joint poles must be at least 2 ft. from signal-line cross-arms, 1 ft. from signal-line messengers, and preferably 1 ft. from signal terminal boxes. Where a signal line is below the supply line and carries not over four wires, mainly for local service or subscribers' loops, or not over two local telegraph or fire-alarm wires, grade C may be used for the supply line. Clearance between conflicting lines shall be at least 4 ft. and not under the normal sag of the conductor with greater sag, plus 0.2 in. per kilovolt of the higher voltage.

The minimum allowable conductor for medium and light loading is now No. 6 medium or hard-drawn copper, and for steel No. 8 for less than 150 ft. and No. 6 for longer spans. Factory flash-over tests on pin-type insulators are now required to last only three minutes.

Westinghouse Company's Gross Earnings $136,052,092

ALTHOUGH the gross earnings of the Westinghouse Electric & Manufacturing Company, as shown by its annual report for the year ended March 31, 1920, were $24,327,851 less than the 1919 figures, the net manufacturing profit of $15,079,830 is only $632,711 below the 1919 level. The gross business of the year was $136,052,092, or the second largest ever reported by the company. In 1919 the company reported a gross of $160,379,943. Interest charges and taxes were substantially reduced during 1920, and the net income available for dividends in the year just closed was $15,206,341, as compared with $15,059,008 for 1919. The balance sheet shows current assets of $101,896,951 and current liabilities of $31,002,540. Working capital of $70,894,411 is shown, and the surplus at the end of March was $43,435,763. In 1919 the working capital of the company was $69,694,611. Inventories in the present report are placed at $63,018,123 as compared with $59,550,262 in the preceding year.

In his statement to stockholders Guy E. Tripp, chairman of the board, said in part:

> Throughout the year, but more particularly during the last six months, there was a gradually increasing demand for the products of your company. The value of unfilled orders on April 1, 1920, was $71,156,732. The property and plant account representing real estate, buildings, equipment, etc., shows a reduction as compared with the previous year, due in part to the sale of certain plants which were engaged mainly in the manufacture of munitions. During the year H. W. McCandless & Company was dissolved and its business taken over by the Westinghouse Lamp Company. The stock of the J. Stevens Arms Company has been sold; therefore its operations are not included in this report.
>
> The development and extension of the business of your company, together with the increased costs of operation due to higher wages and higher prices for raw materials, have required a large amount of additional capital.
> is in excess of its present plant capacity and a continuation of this demand will make necessary further additional facilities and still larger working capital.
>
> The current demand for the products of your company

More Than $17,000,000 to Be Spent on Ontario Hydro-Electric Schemes

ACCORDING to a published statement, more than $17,000,000 is to be spent on the Hydro-Electric schemes of the Province of Ontario this year. A great proportion of this, $10,500,000, is for the Queenston-Chippawa development. The next largest sum is for the Port Arthur and Thunder Bay development, $2,500,000. Following are the estimates of expenditure: Niagara system, $1,250,000; Severn system, $50,000; Eugenia and Saugeen systems, $475,000; Muskoka system, $40,000; Port Arthur and Thunder Bay or Superior system, $2,500,000; Wasdell system, $90,000; St. Lawrence system, $500,000; Rideau system, $250,000; miscellaneous, $500,000; Queenston-Chippawa development, $10,500,000; Central Ontario system, $750,000; Nipissing system, $175,000; expenditures on account of province, $177,000.

Public Utility Employment Managers Organize

WITH the object of developing the employment and personnel work in which they are most directly interested, the public utility delegates to the second annual convention of the Industrial Relations Association of America, held in Chicago, May 19-21, 1920, organized a public utility section. W. H. Vickers, employment manager of the Consolidated Gas, Electric Light & Power Company of Baltimore, was chosen chairman, and F. F. Hennaman, personnel supervisor of Day & Zimmerman, Inc., Philadelphia, secretary and treasurer. A meeting will be called at a time and place to be decided later at which definite plans for work will be formulated.

J. E. Shute, assistant to the general superintendent of the Penn Central Light & Power Company, Altoona, Pa., described a system of rating employees which has reduced their labor turnover from 122 per cent for the year prior to the operation of the system to 24.3 per cent for the first ten months of its operation.

Stoker Manufacturers to Continue Work Begun During War

ORGANIZED as an aid to fuel conservation during the war and to protect the interests of this important group of manufacturers, the Stoker Manufacturers' Association has just as great work to do in the future, declared President P. A. Poppenhusen in his opening address to the Association at Lakewood, N. J., on May 18, to promote a co-operative spirit, maintain high ethical standards of business dealing and make the customer realize that buying a stoker is more than buying so much cast iron, being rather the buying of engineering knowledge.

S. A. Armstrong, in a paper on the "Development of Stoker Organization from the Standpoint of Ideals and Ethics," emphasized the need for ethical dealings.

That, important as the relation of the cubic feet of combustion space to the square feet of grate surface is as regards the efficiency of combustion, this particular point has not been given the serious consideration that it deserves was the opinion voiced by Henry Kreisinger, Bureau of Mines, in his talk on the relation between the combustion space and the efficiency of combustion. He showed numerous tables and curves of actual tests made by the Bureau of Mines.

A. R. Maujer talked to the association on the possibilities of co-operative advertising.

Of the fifteen member companies of this association eleven had representatives at the meeting, with an attendance of about twenty-eight representatives. Officers elected for the ensuing year were as follows: President, R. Sanford Riley, Sanford Riley Stoker Company; vice-president, M. Alpern, American Engineering Company; treasurer, H. E. Pratt, Babcock & Wilcox Boiler Company; secretary, J. G. Worker. The two other members of the executive committee were H. A. Hatton, Laclede Christy Clay Products Company of St. Louis, Mo., and S. A. Armstrong, Underfeed Stoker Company of America, Detroit, Mich.

Utility Interest Should Exceed 6 Per Cent, Says Massachusetts Governor

IN A SPECIAL message to the Massachusetts Legislature on May 19 Governor Coolidge declared that the legal rate of interest on public utility securities should be increased above 6 per cent, in view of the present high cost of money and inability of such companies to issue securities at rates which will attract new capital. The ways and means committee will report a bill to this end. The message follows:

> Several of the gas and electric light companies of the commonwealth find it necessary to finance themselves to provide for meeting maturities on notes and bonds. They are unable to sell stock and are unable to sell bonds on this market without paying above the present legal rate of 6 per cent.
>
> There are two courses open—to increase the charge made to the public for gas and electric light service to such an extent as to insure returns considerably in excess of what has heretofore been the policy of this commonwealth, or to provide temporarily for financing at an interest charge in excess of 6 per cent. It seems perfectly apparent that the public welfare would best be served by the latter course. It is therefore recommended that the rate of interest at which such companies can issue bonds and notes which may be issued within a period not in excess of five years from the taking effect of this recommendation as law be such as is approved from time to time by the Department of Public Utilities. If this be done, it will no doubt result in a considerable saving to the public.

Entertainment Details of Contractors' Convention in October

ARRANGEMENTS have been partially completed for the coming convention of the National Association of Electrical Contractors and Dealers to be held in Baltimore during the week of Oct. 4. Headquarters will be at the Southern Hotel, where all meetings will be held. The executive committee meets Oct. 4 and 5. The convention proper opens the morning of Oct. 6, and in the evening there will be a reception and dance. The afternoon of Oct. 7 will be devoted to an outing to Annapolis, Md., where the delegates will be addressed at the State House by Governor Ricky, going afterward to the Naval Academy. The annual dinner of the association will be held Oct. 8.

Secretary W. H. Morton announces that the "Standard Cost Accounting System" put out by the association has been advanced in price in order to cover the greatly increased cost of paper, handling charges, etc. The association is still handling the system to members at cost. The new price of the complete system is $35 to members and $50 to non-members.

Texas Considers Placing Utilities Under State Regulation

WHETHER or not the Texas State Legislature at a special session now being held will be called upon to enact a law placing public utility plants under state control will, it is stated, depend upon the length of the session and the time that may be at the disposal of the lawmaking body to consider such legislation. At the recent annual convention of the League of Texas Municipalities a resolution was adopted placing that body on record as favoring the creating of a public utilities commission. The resolution, however, has a distinct flavor of home rule. It declares that "every municipality, whatever its size, should have the right to regulate the service rendered and the rates charged within its corporate limits by public utilities."

The resolution further asserts that utilities which serve municipalities or communities indirectly, by supplying any commodity or service to local utilities which in turn distribute it to the public, should be completely under the control and regulation of the Public Utilities Commission.

Co-operation Between Manufacturers and Jobbers Emphasized

CLOSER team play between manufacturers and jobbers was advocated at a recent meeting of the New England Electrical Supply Jobbers' Club, at which the principal addresses were made by E. W. Rockafellow, general sales manager, supply department, Western Electric Company, Inc.; F. A. Wilson-Lawrenson, general sales manager Union Carbide & Carbon Corporation, New York, and A. A. Gray, advertising counsel Electric Supply Jobbers' Association, Chicago. The functions of the supply jobber were discussed by Mr. Rockafellow at the beginning of the meeting, and Mr Wilson-Lawrenson set forth the advantages of direct selling.

Mr. Rockafellow pointed out that merchant pipe has been sold through jobbers since 1904 by the National Tube Company. Today iron conduit and dry cells are distinctive jobbers' lines. The manufacturer does well to avoid mixing the policies of production and of sales, relying upon the jobbers' organizations, which buy in large quantities, relieving the producer of the cost and direction of a large traveling sales force, extra accounting and collections. The economic status of the electrical supply jobber was sometimes misunderstood during the war. Many manufacturers gave the Government jobbers' prices, but the resulting difficulties of delivery were most trying. In one case the maker of a certain wiring fitting had his goods distributed in the stockrooms of 150 jobbers in different parts of the country, and yet it was necessary under the methods adopted to send long distances for material which might have been shipped from jobbers' stocks but a few miles away. In one instance the authorities sent 3,000 miles for a five-dollar fitting which a local jobber could have supplied within a few hours.

Where the jobber was called upon to serve the Government, the speaker said, his deliveries were most helpful, and in a celebrated case which has never before been made public an order for $998,000 worth of supplies for the American Expeditionary Force was handled in record time by the co-operation of fifteen jobbers and seven or eight manufacturers. The first shipment to France was made in seven days, and in fourteen days the entire order was filled and en route.

In conclusion, Mr. Rockafellow urged more frequent meetings of representatives of jobbers and manufacturers for the interchange of viewpoints.

F. S. Price, president Pettingell-Andrews Company, Boston, said that the electrical industry faces the greatest business opportunities in its history and that through co-operation great advances can be made. He stated that the central station can make good use of the stabilizing co-operation of the jobbers and their organizations in combating socialistic tendencies, and outlined recent efforts toward better relations in New England, expressed in the formation of contact committees in the organizations of the jobbers, central stations, contractor-dealers and manufacturers.

Report of Progress on International Standards

A PRELIMINARY report of the recent Brussels meeting of the advisory technical committees of the International Electrotechnical Commission was published in the ELECTRICAL WORLD for April 17. A more complete report by the American representatives indicates that very important work was done toward the adoption of international standards by the committees on rating, definition, graphical symbols and standard voltages.

As the meeting was not a plenary one, the actions of the advisory committees are not official decisions of the International Electrotechnical Commission. They are now before the national committees for study before official action is taken in a future plenary meeting.

Rating—The advisory committee on rating was presided over by Guido Semenza of Italy. The principal results of the meeting of this committee were the acceptance of:

1. The hot-spot principle as a basis of standardization. It was agreed, however, that the working rules should contain only values of limiting observable temperature and temperature rise, and not the actual hot-spot values.

2. The classification of insulating materials. This classification is the same as the present A. I. E. E. rules with the addition of a new class, to be known as class "O," of unimpregnated cotton and similar materials.

3. The classification of methods of measurement, which is the same as that of the A.I.E.E. rules.

At the request of the American delegates the question of the terminal marking for transformers was deferred, with the understanding that the American committee would submit a scheme sufficiently comprehensive to include all classes of apparatus and machinery.

Definitions.—This committee held joint sessions with the committee on symbols, under the presidency of Prof. Janet of France. Definitions of about sixty terms were approved. These are terms which have been before the national committees for several years.

Symbols.—The Italian graphical symbols, which had been formally submitted by the Italian national committee at a previous meeting, were taken as a basis for discussion. Agreement was reached upon a list of about 100 symbols.

Standard Voltages.—Owing to variety of circumstances, a great many voltages are now in use in Europe, and in the absence of standardization work other voltages are being added.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Electrical Growth of Salina, Kan.—From an output of 619,836 kw.-hr. in January, 1919, to 1,129,391 kw.-hr. in January, 1920, is the record of growth of the Light, Power & Gas Company of Salina, Kan., a city of 15,000 people which prides itself on its good illumination and electrical displays.

Summer Course in Industrial Management.—For the fifth consecutive year the Pennsylvania State College has organized a two weeks' summer course in industrial organization and management. The course will run from Aug. 6 to Aug. 21 and be under the supervision of Edward J. Kunze, head of the department of industrial engineering of the college.

Metric System in Great Britain.—A parliamentary commission in England is collecting information on the metric system of weights and measures and will recommend legislation on the subject. Large importing and exporting houses are reported to be generally in favor of adopting the system, and a conference between the United States, the British Isles and the British dominions is suggested.

Electrification of Swedish Railroads.—The Swedish government has received from official investigators a report favorable to the electrification of all the railroads of the country, a project rendered desirable by the almost prohibitive cost of coal. Owing to the great initial outlay, however, the work would have to proceed gradually, and it is recommended that eight water-power stations be successively built, each to serve a separate district. The state railroads, it is estimated, would require about 413,000,000 kw.-hr. a year, the privately owned railroads 295,000,000 kw.-hr. and the railway to the frontier a further 90,000,000 kw.-hr.

New Use for a Desk Fan.—A correspondent of *Power Plant Engineering* has discovered a novel use for a desk fan—that of demagnetizing a watch. This is how he restored an erratic timepiece to good behavior: "I removed the armature and laid the fan on the desk in a horizontal position. Next, taking the watch and tying a string about 2 ft. long to the ring, and spinning the watch quite fast, I lowered it into the armature of the fan after turning on the current, not allowing the watch to stop spinning while it was in the armature. This happened about three months ago, and my watch is keeping as good time now as it ever did. I used alternating current at 110 volts."

Lighting Up Nicaragua.—The total population of Nicaragua is only 700,000, but its claim to progressiveness has been recently vindicated by contracts for electric lighting plants made by the municipalities of Jinotega, Bluefields, Jinotepe, Diriamba and Granada. The capital, Managua, already has an electric lighting system.

Cheap Electricity from Lignite.—According to the American Chamber of Commerce in London, a copper refinery costing £10,000,000 is to be set up at Newton Abbott, in Devonshire, on a site where the requisite electrical energy can be generated from deposits of 800,000,000 tons of lignite. There is at present no electrolytic refinery in Great Britain, 90 per cent of the copper used in British industries being imported from America. It is anticipated that the commercial development of Devonshire's lignite deposits will enable electric power to be generated so cheaply as to make it possible to supply it in bulk to all the towns in south Devonshire as well as to industries in the neighborhood.

Electric Drive at Galveston Dry Dock.—At the new two-million-dollar floating dry dock at Galveston, Tex., now in full operation, the pumping is done by electric drive. The dock is divided into two parts of unequal size. In the larger section fourteen 12-in. horizontal centrifugal pumps are driven in groups of seven by two 200-hp. electric motors of slip-ring type, with armature resistance and having controllers so arranged as to operate the motors at five different speeds. In the smaller section of the dock two 125-hp. electric motors drive eight pumps. Two-phase, 60-cycle alternating current at 220 volts is furnished from the central power station in Galveston by submarine cable laid in the channel. The twenty-two pumps operated at one time can raise a 10,000-ton ship onto the dock in one hour and in doing so will handle approximately 17,000 tons of water.

Louisville Electrical Exposition Plans.—Those responsible for the bi-state electrical exposition to be held in Louisville, Ky., on Oct. 25 to 30, inclusive, are expecting an augmented support because of the abandonment of the Chicago Electric Show this year. The executive committee, which is under the chairmanship of R. Montgomery of the Louisville Gas & Electric Company, has published a twelve-page booklet for the guidance of the organization upon which the success of the undertaking depends. The names and addresses of the members of every committee are given and the duties of each committee are enumerated. In many cases this information is supplemented by suggestions from the executive committee as to how the work might be carried out and how one committee can help another. Every committee has been made definitely responsible for its part of the undertaking, so that there should be no duplication or omission of essential details.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Business Paper Editors.—The National Conference of Business Paper Editors will convene at the Congress Hotel, Chicago, on June 4.

A. I. and S. E. E., Philadelphia Section.—The annual outing of this section will be held at Brown's Mills in the Pines, N. J., on Saturday, June 5.

Association of Municipal Electrical Utilities of Ontario.—The semi-annual convention of this association is to be held at Niagara Falls on June 10 and 11, instead of June 17 and 18, as formerly announced.

Florida State Association of Electrical Contractors and Dealers.—W. H. Satchwell of Jacksonville was elected president and J. G. Spencer, Jr., secretary of this association at its first meeting, held for organizing purposes on May 7.

Electrical Co-operative Convention.—Electrical manufacturers, dealers, contractors, jobbers and central-station operators are to meet in a "co-operation convention" at the Hotel Vancouver, Vancouver, British Columbia, on May 31 and June 1.

New York Electrical Society.—This society held a meeting in the Engineering Societies Building on Wednesday last, May 26, at which Kenneth S. Johnson, engineering department of the Western Electric Company, made an address on "Elementary Phases of Telephone Transmission Engineering," illustrated with lantern slides.

Chicago Section, I. E. S.—At the last meeting of this section of the Illuminating Engineering Society for the 1919-1920 season, held at Lewis Institute on May 13, Prof. F. C. Caldwell of Ohio State University spoke on "Good Lighting in the Schools." The following officers were elected: Chairman, J. L. Stair; vice-president and secretary, J. J. Kirk; managers, Frank F. Fowle, Edwin D. Tillson, F. D. Benson, John M. Foster and A. F. Hunt.

Chicago Section, A. I. E. E.—J. R. Bibbins, chairman-elect of the section and supervising engineer of the Arnold Company, read a paper on city transportation problems before a largely attended joint meeting of this section of the Institute and the Western Society of Engineers on the evening of May 12. As chairman of the section next year Mr. Bibbins will have associated with him M. M. Fowler as secretary and an executive committee consisting of A. F. Riggs, C. A. Keller, F. F. Fowle, S. A. Rhodes and E. J. Blair.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Employer Responsible for Flywheel Accident.—Injury to an employee through his clothing catching on the key which fastened a flywheel to its shaft near a pulley that he was adjusting constitutes, in the judgment of the Supreme Court of Oregon, a liability for the employer, who, under the employers' liability act, is required to use every precaution not in impairment of the efficiency of the machinery to protect employees. (188 P. 700.)

Powers of Florida Railroad Commissions.—The Supreme Court of Florida in giving judgment in a railroad rate case declared that where it is doubtful whether a statute authorizes a municipality to fix rates for a public utility company the doubt must be resolved against the city, but that this rule has no application to the Railroad Commissioners of the state, an act of 1913 providing that "all doubts as to their jurisdiction and powers shall be resolved in their favor." (84 So. 61.)

Unconstitutional Provision of Oklahoma Corporation Commission Law.—In two cases carried from Oklahoma to the United States Supreme Court that court found that a provision of the law establishing the Corporation Commission of Oklahoma which was construed by the Oklahoma Supreme Court as authorizing no review of the orders of the commission fixing rates except by an appeal in contempt proceedings for violation of the order, which violation might be punished by a penalty of $500 a day, contravened the Fourteenth Amendment of the United States Constitution because of this absence of an opportunity for a judicial review. [Since the case arose the Legislature of Oklahoma has amended the law to permit appeals to the State Supreme Court.] (40 S.C.R. 338.)

Definitions Affecting Watercourse Development.—A channel formed by water which previously spread over the land and disappeared into the ground but which was artificially concentrated and has continued to exist for more than thirty years may, the Supreme Sourt of California holds, be considered as a watercourse wholly natural in origin. A channel with defined bed and banks and habitually used by water passing down as a collected body or stream in seasons during which streams in the region are accustomed to flow is a watercourse in the legal sense, although it may be dry except in the winter and spring and may be dry at intervals during those seasons. Surface waters are those which fall on the land from the skies or arise in springs and spread over the surface of the ground without being collected into a definite body and do not include waters already gathered into a definite body flowing as a stream in a watercourse. (188 P. 554.)

Missouri Law of Contributory Negligence.—In finding for the plaintiff in a suit against the Union Electric Light & Power Company of St. Louis for damages because of the death of a fireman who fell from a platform 12 in. wide and 12 ft. above the floor, from which he was required to reach dampers 6 ft. above the platform, the platform having no railing and being badly lighted, the Supreme Court of Missouri observed: "That the deceased assumed the risk probably is the law in most jurisdictions. It is not in this one. The doctrine of this court is that an employee only assumes such risks in respect to the place where he is put to work as are incident to the service after the employer has performed his duty by using care to provide a place of reasonable safety; and although the danger of the place may be obvious, if this is due to lack of care on the part of the master to furnish a safe place, the servant does not assume the risk." (219 S. W. 902.)

What Constitutes a Competing Company—Compulsory Service.—An important decision has been handed down by the Supreme Court of North Carolina in the suit of the Salisbury & Spencer Railway Company against the Southern Power Company to enforce service. The main points in the decision are: (1) A hydro-electric company cannot, as a public service corporation, be compelled in ordinary circumstances to supply a competitor of like character with the material necessary to enable the latter to discharge its duty to the public; (2) an electric street railway and a retailer of electricity engaged in supplying the citizens of municipalities with energy to light their residences and for other private purposes are not competitors of a hydro-electric power company engaged in wholesaling electricity and so can compel the power company to supply them; (3) when a hydro-electric company began to sell its energy to smaller corporations for purposes of resale and distribution among the public, every such retailing corporation obtained equal right to be served and the hydro-electric company must not discriminate, though it need not necessarily sell to all at the same price; (4) if, in mandamus proceedings, it shall be decided that corporations engaged in retailing electricity are entitled to a decree compelling a hydro-electric power company to furnish energy required by them, then, in case the parties to the action cannot agree on a price, the matter can be taken before the Corporation Commission and the defendant power company can be required by the court to furnish electricity at the rate fixed by the commission. (102 S. E. 625.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Failure to Set Up Depreciation Reserve Condemned.—In passing upon a recent telephone case the Wisconsin Railroad Commission took occasion to emphasize the point that a public utility is not justified in placing the cost of past depreciation on its future subscribers where the amount which should have been reserved for depreciation has been expended on dividends.

Rates Less Than Cost and Free Service Are Discriminatory.—In granting an increase of rates to the Mission Range Power Company, the Montana Public Service Commission has asserted that a wholesale rate less than cost is discriminatory, as is also free service to stockholders and employees. Consumers, the commission says, are not entitled to rates lower than necessary to produce a fair return on a utility company's investment.

Capitalizing Cost of Developing Business.—The cost of developing a utility business measured by early losses is to be capitalized only in a case in which the company has established its business and is earning a fair return, according to a recent finding of the Public Service Commission of New York, Second District, for otherwise the less the success of the company the greater would become its estimated value for rate-making purposes.

A Company Without a Franchise Is Not in the Field.—A public service company not having a franchise to operate in a particular town cannot, according to a decision of the New York State Public Service Commission, Second District, invoke, as against a company desiring to serve such town, the rule that it is against public policy to permit a competing company to enter a field already occupied by an existing corporation able and willing to provide adequate service, since it cannot be said to be already in the field.

Electric Customers Must Not Be Required to Make Up Gas Deficiency.—In dismissing without prejudice the application of the Public Service Company of Northern Illinois for increased gas rates in forty-eight communities, the Illinois Public Utilities Commission reiterated the opinion previously expressed by it that to permit gas consumers to receive their service at less than cost while consumers of electricity are required to make up the deficiency would be contrary to the spirit of the public utilities commission law and to decisions of the United States Supreme Court.

W. S. Finlay, Jr., who in 1917 was made superintendent of motive power of the Interborough Rapid Transit Company, New York, has resigned to become vice-president of the American Water Works & Electric Company. Mr. Finlay was born in Hoboken, N. J., in 1882, and began his education in the public schools of Brooklyn. He was graduated in mechanical engineering at Cornell University in 1904. Soon after graduation he entered the employ of the Interborough Rapid Transit Company as an assistant on the staff of H. G. Stott. His early work in the company was identified with the construction of the Fifty-ninth Street power station. Later he was utilized by Mr. Stott in doing experimental and research work in connection with schemes for the development of that station and the promotion of its efficiency. In 1907 he was placed in charge of construction work arising from the requirements of increasing plant load. In 1909 Mr. Finlay left the Interborough, continuing in engineering work for a brief period with the New England Engineering Company. Subsequently he became associated with his father, W. S. Finlay, in commercial work, returning to the Interborough in 1915 to take charge of the installation of turbines and auxiliary mechanical equipment necessitated by the extensions to the subway and elevated systems. Upon the death of Mr. Stott, Mr. Finlay was appointed as his successor as superintendent of motive power. In that capacity he, in addition to supervising operation of the power-generating system of the company, had charge of the engineering and construction work coming within the scope and control of the department, this recently involving additions of power output capacity amounting to 165,000 kw.

W. S. FINLAY, JR.

Frederick G. Cottrell, chief metallurgist, Bureau of Mines, Department of the Interior, on May 5 was appointed by President Wilson to be director of the Bureau. He will succeed Dr. Van H. Manning, whose resignation will take effect June 1.

Men of the Industry

Changes in Personnel
and Position
Biographical Notes

R. G. Justus of the Sapulpa (Okla.) Electric Company has been appointed local manager at Bristow, Okla.

A. L. Burbank, of Pueblo, Col., has been made auditor of the Northern States Power Company at Sioux Falls, S. D.

R. W. Davenport of the United States Geological Survey is making a trip through Idaho, Utah, Washington, Oregon and California to study problems concerning the administration of water powers on public lands in those states.

R. F. Gooding, recently with the Buffalo office of the Westinghouse Electric & Manufacturing Company as sales engineer, has become associated with Mees & Mees, consulting engineers and industrial architects, at Charlotte, N. C., as electrical engineer for the firm. Mr. Gooding was graduated in the course in electrical and mechanical engineering at Clemson College, South Carolina, in 1905, after which he spent four years with the Westinghouse Electric & Manufacturing Company as an engineering apprentice and draftsman. He then became assistant electrical engineer of the Duquesne Light Company at Pittsburgh, after which he returned to the Westinghouse company as designing engineer on power stations, substations and switchboards. In 1915 he represented the company in England as commercial engineer on switchboards and protection apparatus. Later he became assistant engineer in the station construction department of the Philadelphia Electric Company, returning to the Westinghouse Electric & Manufacturing Company as salesman and engineer in 1918. As electrical engineer for Mees & Mees, Mr. Gooding will be responsible for the electrical part of all the new developments of this firm. Mr. Gooding has contributed several articles on the calculation of short-circuit currents in large networks to recent issues of the ELECTRICAL WORLD.

Walter L. Mulligan, for the past eighteen years manager of the United Electric Light Company, Springfield, Mass., has been elected treasurer of that company, to fill the vacancy caused by the recent death of W. A. Lincoln, who had served as treasurer for more than thirty years. Lorenzo J. Scott, who has been assistant manager for several years, has been appointed manager to fill the vacancy caused by Mr. Mulligan's promotion.

Alfred C. Jordan, heretofore superintendent of equipment for the Cumberland County Power & Light Company, Portland, Me., has resigned to accept a similar position with the Elmira (N. Y.) Water, Light & Railroad Company. Mr. Jordan's new duties will include the superintendency of the railroad shop and overhead lines of the light and railroad departments of the company. Before joining the engineering staff of the Cumberland County Power & Light Company in 1916 Mr. Jordan was for some years associated with the Elmira company.

L. H. Newbert, who was elected president of the Pacific Coast Section of the N. E. L. A. on May 17, is manager of the commercial department of the Pacific Gas & Electric Company. Mr. Newbert joined that company in 1900 and was in charge of power and lighting sales in the district around Marysville. Later he was transferred to the San Francisco office as head of the sales department. When the commercial and sales departments were combined Mr. Newbert was appointed head of the new commercial department. During the past year he has been closely identified with the California Electrical Co-operative Campaign in the capacity of chairman of the advisory committee and at the recent N. E. L. A. convention he presented the report of the committee on co-operation in industry, of which he was chairman.

L. H. NEWBERT

Dr. T. S. Taylor, who during the last three years was research physicist in the research laboratory of the Westinghouse Electric & Manufacturing Company, has recently left this company to become industrial fellow, Magnesia Association, at the Mellon Institute of Industrial Research, Pittsburgh. Dr. Taylor took his undergraduate work and also his doctorate in physics at Yale University, receiving the degree of Ph.D. in 1909. His recent researches in connection with heat transmission as applicable to the disposition of heat from electrical machinery and also through insulation used in the conservation of heat have attracted wide attention among electrical engineers.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Washing-Machine Makers' Output Badly Curtailed

WASHING-MACHINE manufacturers were just beginning to get larger and more frequent supplies of wringers, motors, sheet steel and copper, and even crating, when the transportation tie-up made conditions worse than they were before. Lack of these materials is seriously curtailing output of washers and in some cases causing shutdowns. This condition would be very serious for manufacturer, jobber and dealer were it not that the available credit for the time-payment sales of washing machines is barely sufficient to finance the sale of the present output of machines, and credit may be curtailed still further.

It is true that the shortage of wringers alone is holding up a great many of these manufacturers today; furthermore, some of them have been obliged to shut down their plants because of this one lack, shipments on which have been reported seven months behind.

A number of the manufacturers are figuring on foreign business, but the present rate of exchanges and the subnormal factory production makes it practically impossible to enter the foreign field at the present time. It is understood that one manufacturer recently had to refuse an export order of 12,000 washing machines because of the conditions of factory output. This market, however, is expected to improve to a great extent as soon as these conditions have been overcome.

Credit Limits Electrical Production That Can Be Marketed

MANUFACTURERS of diversified electrical products have come to believe that the forced limitation of their output during the past year or more is a blessing which is in a large measure responsible for the strong position of the industry as a whole today. Larger production of electrical apparatus and merchandise at the prevailing high-production cost would undoubtedly have further expanded the credit structure at a time when efforts were being made to reduce the existing inflation. Up to a few months ago bankers would no doubt have financed electrical manufacturers, jobbers and dealers to permit them to handle an increased production, and it was generally considered to be very unfortunate that the industry was unable to buy or make all the goods that could be sold.

However, now that loans are being called in and credit is being curtailed, manufacturers are glad to have money in the banks instead of having it tied up in new construction. Electrical contractors and dealers consider themselves fortunate to be able to keep up their business and their prices at a time when in some other lines stocks have to be disposed of at a sacrifice.

Time payment terms, on which the higher-priced household devices are largely sold, have been shortened, and dealers are experiencing difficulty in financing the sale of these devices in the quantities now being furnished them. Some industrial customers could have bought more electrical equipment if it had been available, but the central stations as a class could not have financed the new power-plant and distribution equipment necessary to furnish the power for its operation.

It is not so much the number of units produced as it is the cost of production that is bothering thoughtful manufacturers. What the electrical and practically every other industry needs is a large production of goods at a cost which will permit them to be sold at a profit when the deflation of the credit structure has been completed. It is realized that credit may get tighter before it gets easier, and if that proves to be the case further decreases in the production of high-cost goods would help the general credit situation.

Stoker Makers Face Curtailment Unless Tie-Up Ends

DEMORALIZED freight conditions are particularly serious to manufacturers of stokers. In several cases the rapidly accumulating stock in warehouses is becoming so great that production will soon be reduced or cease altogether unless the product can be moved. While orders are plentiful and show no signs of let-up and while the raw-material situation is not quite so acute as with other industries, because most of this material is in the nature of bulk raw material such as iron ore, etc., there is little use in tying up money in equipment that cannot be placed in the customers' hands.

Stoker men are rather optimistic as regards the future of the business. While setting their houses in order to meet any possible contingency in regard to trade conditions, they do not anticipate that the effect of possible depression will be so serious in their industry as in others. As coal costs mount higher and higher and delivery conditions become worse, less argument is needed for the sale of mechanical firing devices. Appearances point to the fact that they are rapidly taking their place among those necessities which even in a time of commercial depression would be salable because of economic factors.

Slight Improvement Shown in Traffic Movement

MANUFACTURERS of electrical apparatus report slightly better movement of materials this past week. While freight yards and sidings are still badly congested and strings of cars may be seen stretched out for long distances along rights-of-way, there has been a gradual unloading of freight in the yards and a release of the cars to the road again. Although long trains of empties have been sent West for grain shipments, manufacturers are finding a few cars here and there wandering in to their sidings, and they are able to relieve some of the congestion of piled-up finished products in their warehouses. A great part of the material which jobbers are receiving, however, seems to be coming from gradually opening yards.

Economic Aspects of General Commodity Retail Price Slashing

IF, AS was stated at the Del Monte convention of the Electrical Supply Jobbers' Association, the downward trend of the market will take its cue first from food products and secondly from clothing and the other personal commodities, then it would not be amiss to look at the market conditions in fields other than the electrical. In the electrical market, it is true, prices are still advancing

Strange as it may seem, there is no tendency to cut retail food prices except in the fresh vegetable line. Canned and package goods show no drop nor do meat and meat products. Wholesale prices, however, on many of these lines, especially live meats, have been receding for some time. In virtually every line the farmer is receiving less for his produce.

In the clothing and house-furnishing lines retail prices have been subject all over the country to what seemed almost hysterical slashing, cuts of 20 to 33 per cent being commonly reported. The movement, which started in the East, spread like wildfire and quickly brought about another spending orgy.

After the novelty of the first week or ten days passed off the excitement began to subside, and retail buyers are now taking the drop for granted. It is doubtful, however, if the average retail buyer can again be lured by higher prices. There is a real demand for reductions which is quite contrary to the spirit of the people ten months ago.

The National Association of Manufacturers in recent convention urged its members to work to bring about a reduction in the prices of commodities. Others feel the same way, but there is still a strong feeling that falling prices are all right for the other fellow's products. This feeling, which it must be admitted has been evident in certain electrical lines, is having its retarding effect.

Retail prices of electrical goods, including portable lamps and shades and those socket devices bearing the retailers' nameplates and even some standard lines, have been cut. In one case vacuum cleaners made in a prominent Middle Western factory were disposed of at around $17.

To what extent this wave of retail buying stimulated by cuts in price will affect the market is not definitely known. It is certain that further slashes will be arrested for the time being. Also it seems to indicate that any orderly downward trend is not to be expected.

It would not be surprising, therefore, to see thhe market act something like a bouncing tennis ball—deep slashes, slight recovery, another slash and recovery, etc., the average all the while showing a definite downward tendency.

Metal Market Situation

A LIFELESS condition rules the metal markets. Transportation embargoes are still a serious consideration in the movement of raw materials, and refiners' supplies are at a low ebb. Consumers have no desire to buy under these conditions. Producers of copper are quoting on a merely nominal basis at 19 cents, while the outside market is weaker, with offerings to sell at 18.25 cents delivered for June. The copper and brass scraps are ¾ cent to 1 cent lower than they were two weeks ago, and buying is at a standstill. London copper prices are about £17 below the level of May 12.

Zinc has receded about twenty points since last week and producers are unwilling to meet this new level of 7.90 in New York.

Better supply of lead is expected in another month's time; meanwhile, the outside market is making light sales at a price about thirty points above the 8.50-cent level of the largest producers.

NEW YORK METAL MARKET PRICES

	May 19	May 25
Copper	£ s d	£ s d
London, standard spot	98 5 0	98 5 0
	Cents per Pound	Cents per Pound
Prime Lake	18.75	18.50 to 18.75
Electrolytic	19.00	19.00
Casting	18.25	17.75
Wire base	22.50–23.00	22.50–23.00
Lead, trust price	8.50	8.50
Antimony	9.37½	9.00
Nickel, ingot	42.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Zinc, spot	8.10	7.90
Tin	54.25	51.25
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.00 to 16.50	15.75 to 16.00
Brass, heavy	9.00 to 10.00	[illegible]
Brass, light	8.00 to 8.50	8.00 to 8.50
Lead, heavy	7.00 to 7.25	7.00 to 7.25
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

DEMAND for electrical goods is heavy, although a slight reaction on account of price cutting in other industries has slowed up orders during the past week. There has been no price cutting in the electrical field, according to reports received up to the time of going to press.

Jobbers find it more and more difficult to transact business, on account of badly depleted stocks, although shipments now en route will enable them to clear up a large majority of back orders. Poor crop conditions in the South have caused a slight falling off of sales in the country districts. Freight is being delivered in greater volume in New York, Chicago and Boston than heretofore, and, in addition, Pacific Coast points are commencing to receive stocks which have been en route for many weeks. With prospects of greatly improved shipping conditions in June as compared with May, jobbers are preparing to receive and bill out a heavier volume for June to make up for the slack periods during April and May when shipments were poor.

Price changes are noted this week on fuses and on small sizes of alternating-current motors.

NEW YORK

Jobbers, owing to a continued curtailment of freight shipments, have been forced to mark time during the past week. Demand has fallen off, influenced to some extent by the price cutting in retail shops on non-electrical goods. In a representative case one jobber's daily orders fell off from an average of fifty-five orders to thirty, covering a period of several days. There has been no indication of price cutting in electrical goods except in one or two instances in large department stores where the name of the store appears on the appliance sold.

Commercial associations and railway executives are cooperating to improve shipments and clear up the congestion of freight in the metropolitan district, and from reports at the time of writing conditions should be much better during the next few weeks. This will enable the filling of a large number of back orders still on hand and will bolster up sales for the latter part of May and for the month of June. Commercial building plans are going ahead in good shape from the reports of large new structures appearing daily.

Wire.—Many shipments of rubber-covered wire, especially No. 14, have brought jobbers' stocks back to normal or above. The larger sizes are in fair demand, although sales on the smaller sizes are much better. No. 14 is quoted at $11 to $12 per 1,000 ft. in lots of 5,000 ft. or more.

Lamps.—Jobbers' stocks are in fair shape, with shortages reported from certain sources in the 75, 100 and 200-watt sizes. Many shipments of smaller sizes were received during the week.

Conduit.—Conditions remain unimproved, the shortage being acute. The ¾-in. and 1-in. sizes are scarce, although small stocks of ½-in. and the larger sizes are known to exist.

Flexible Armored Conductor.—There is little or no stock to be had. Jobbers have trucked some from nearby points, but it has all been disposed of in short order. A considerable amount is en route, but no surplus can be expected for many months. Prices vary, but No. 14 double-strip is quoted at $120 per 1,000 ft. in coil lots.

Fuses.—Demand continues steady with stocks slightly below normal. An increase of 5 to 10 per cent on ordinary fuses has been made by several manufacturers.

Non-Metallic Flexible Conduit.—Stocks are low and few shipments are being received. Prices for the ¼-in. and 7/32-in. are $37.50 and $35 per 1,000 ft. in lots of 1,000 ft.

Porcelain.—Knobs, tubes and cleats are being received in quantities by truck. Stocks are low, generally, and prices fluctuate.

Outlet Boxes.—Stocks of the popular sizes are scarce. Manufacturers have been unable to get raw materials and deliveries have been held up accordingly.

CHICAGO

Trade comment this week is of little value, as the market is so circumscribed by outside controlling factors that its natural trend is difficult to determine. New business with both the jobber and the manufacturer has unquestionably fallen off considerably, but just how much of this is due to the general trend of business and how much to extraordinary circumstances is unknown. Every one is as busy as ever. Activity now is confined largely to attempts to obtain goods already on order rather than to the placing of new orders. Transport troubles have been mitigated to a slight degree only, if at all, and the maintenance of stocks is not possible.

Delays are by no means uniform. Some manufacturers, able to obtain all needed material except some one essential, are piling up constantly increasing volumes of partly finished goods, thus augmenting their already heavy inventories. The one relieving feature is that the railroads are generally accepting outbound consignments.

Reductions in operating force and in hours are being made by some manufacturers on account of material shortages, and if fuel conditions, now getting serious, are not soon relieved, extensive shutdowns may be anticipated. All companies having transmission lines, either power, telephone or telegraph, are having great difficulty in obtaining sufficient supplies for proper maintenance and for the completion of extensions under way. New construction work is out of the question.

Retail trade continues excellent. Great activity is being shown by the large department stores in the sale of washing machines and vacuum cleaners. Tight money is presenting a difficulty in the way of financing retail campaigns on the deferred-payment plan.

Motors.—Dealers' stocks are getting in worse shape every day because of the continued non-arrival of motor shipments. A 10 per cent advance is noted, effective May 15, on Century Electric Company's output of single and polyphase automatic starting motors, split-phase motors and fans.

Compensators.—Local supply of compensators is as scant as that of motors. Unfortunately, the compensators in stock frequently fail to match motors on hand, and in many cases the motors are being shipped with starters to follow. It is understood that sufficient units are in transit to supply these unfilled orders, but the arrival is uncertain. Stocks will undoubtedly be badly broken for some time.

Transformers.—Previously reported heavy demand has left only certain sizes of distribution transformers obtainable for immediate delivery. Some complaint is heard concerning excessive losses on station transformers of recent make, because steel used in construction did not conform to established standards.

Fuses.—New prices are anticipated on D & W fuses, both cartridge and refillable types, involving slight increases on most items of the line.

Friction Tape.—With demand less than has been anticipated, stocks in all grades are now well maintained. Current price on high grade is 90 cents per pound in 1-lb. to 5-lb. quantities, 78 cents from 6-lb. to 25-lb. and 75 cents in larger lots. Similar quantities on medium grade are quoted at 78, 70 and 60 cents per pound.

Northern Cedar Poles.—The strike in the producing fields of the North has ended in a satisfactory compromise. All yards are reported working or going to resume immediately. Some shipments are going forward and stocks are getting in good shape. Prices are steady.

Flatirons. — Western Electric 6½-lb. irons, previously priced at $7.50, have been advanced to $8. Those makers of irons who have not recently advanced lists are expected to do so in the near future. Under heavy demand stocks remain in good shape.

Ironing Machines.—Little sales effort is being expended on ironing machines because factories are able to supply them in limited quantities only. They are receiving ready favor wherever they are featured.

BOSTON

An enormous volume of orders continues to flow into the hands of the jobbers. One leading house reports gross sales in dollars 75 per cent ahead of last year to May 1, notwithstanding delivery difficulties. Stocks are very spotty, the supply of rigid conduit and small motors being extremely low. Collections are fair. Prices are stiffer on motors, N.E.C. approved fuses, meters and metallic flexible conduit. Deliveries are improving slightly as the railroads relax embargoes on material traveling outside New England. Small shipments are coming through better, and orders placed in the early winter are being received. Building construction continues active. Cool and rainy weather has retarded the retail sale of seasonal appliances somewhat but has greatly increased the supply of hydroelectric power in New England. Labor conditions in electrical manufacturing plants show improvement.

Motors.—Wagner single-phase motors have increased from 5 to 10 per cent in price through discount changes in sizes of 1 hp. to 7.5 hp. Century motors are up 10 per cent. The demand for small motors is tremendous. Deliveries are quoted from sixteen to twenty weeks. The Boston market is practically bare of single-phase motors.

Fuses.—Leading makes of approved fuses are up 10 per cent. Stocks are in good shape, but some sizes are low.

Meters.—Trade is brisk and much house wiring is under way. Prices are about 10 per cent. higher than last month. No one is bragging about his stock unless to selected customers. Raw material is flowing a bit more freely into the factories.

Lamps.—By careful handling trade requirements are being met reasonably well. One distributer has a stock of 500,000 lamps in Boston but is husbanding deliveries, keeping close to immediate needs. The outlook is for an extraordinary year's business.

Fans.—Stocks act as though "frozen in." Jobbers vary in their holdings, but immediate needs will be promptly met. Complaint was heard Monday as to failure to receive some shipments from Middle Western factories in time for early summer trade. A representative 12-in. straight fan lists at $29.60, with 25 per cent off in lots of twenty-four or less.

Wire.—Prices are steady and the supply good. Rubber-covered No. 14 brings $11.75 per 1,000 ft. in 5,000-ft. lots. Weatherproof wire No. 6 is quoted 34 cents per pound reel lots. Bare base, 24 cents.

Flexible Armored Conductor.—Several carloads have been received within a few days. No. 14 single-strip brings $110 per 1,000 ft. in 1,000-ft. lots. The worst appears over in this class of material.

Non-Metallic Flexible Conduit.—Prices are steady at $35 per 1,000 ft. for 7/32-in. and $38.50 for ¼-in., in 1,000-ft. lots. Stocks are better, though this material as a rule goes into service not long after it reaches the distributer.

"Nail-it" Knobs.—Sales are going through better, but rail deliveries are trying. One jobber has had 130 barrels en route from New York for the past six weeks. Motor-truck shipments at high cost resulted. In barrel lots the going price is $31.50 per 1,000. A shortage in tubes is noted in some quarters.

Flexible Metallic Conduit.—The discount has been cut five points off double list in coil lots.

ATLANTA

The latest report of the Commissioner of Agriculture for Georgia dealing with the crop outlook for the state is rather pessimistic. Only a small percentage of the cotton acreage has been planted, while such cotton as has come up has been severely damaged by the weather. Reports from the middle portion of the state are that heavy planting of food products will be substituted in a great number of instances for cotton. This condition has caused some slackening in purchases in the rural communities, and one jobber who deals directly with the agricultural and rural trade in the lines of farm-lighting outfits, small generator sets, etc., reports a noticeable slackening in sales and an unusual amount of cancellations. Other jobbers, however, report conditions as satisfactory, business for the month of May to date having exceeded that for a corresponding period in April.

Several of the larger firms are tightening up on the extension of credit and are refusing to ship incoming orders except on sight draft bill of lading attached, unless purchaser will liquidate outstanding accounts. Collections in general are reported good, with the exception, however, that the contractors in the small towns are slower than usual in the payment of their accounts. This is also true of the hardware dealers handling electrical specialties as a part of their business.

Meters.—Considerable difficulty is being experienced in obtaining meters in sufficient quantities to meet the demand. While the smaller meters are still available, shipments are lengthening, and in the case of the larger sizes, particularly the 2,300-volt type, they are quoted at three to four months.

Distributing Transformers.—The transformer shortage, especially in sizes of 15 kva. to 50 kva., has become quite severe, and no stocks of these sizes are in the territory to supply an insistent demand.

Motors.—The motor situation shows no improvement, in fact, shipments as at present quoted are considerably longer than was the case thirty days back. There are virtually no stocks of new motors in the territory and the supply of the second-hand variety has been exhausted by the insistent demand. Single-phase deliveries are thirty to forty weeks.

Sewing Machines.—The expected activity in this specialty has failed to materialize and jobbers report an unsatisfactory turnover of this article. Plentiful stocks are on hand and jobbers are hoping that the opening up of the real spring weather will stimulate movement.

Washing Machines.—The demand for washing machines continue to show an increase. Recent shipments have put stocks in materially better shape than they were thirty days ago.

Lamps.—Railroad embargoes are beginning to be felt in the lamp field. One of the largest jobbers is completely out of the 100-watt sizes, and the 75-watt size is becoming quite scarce. Shipments are coming through so slowly that the very brisk demand will badly deplete local holdings unless conditions improve immediately.

Wire.—An acute shortage in popular sizes of weatherproof is felt throughout the section. The large sizes of rubber-covered are on hand in fair quantities, but No. 12 is very hard to obtain. Prices, rubber-covered, 28 cents; weatherproof, 29 cents.

SEATTLE—PORTLAND

The past week has shown a gradual decrease in the volume of business transacted in Seattle by electrical jobbers. Retailers also report business slowing up, although the decrease is not nearly so noticeable as in the case of jobbers. This condition is attributed by most jobbers to high prices and the general feeling of uncertainty which is more or less prevalent in this section. The incoming freight situation shows no improvement, consequently stocks, generally speaking, are in a bad shape.

Building activities in Washington show a sharp increase in new construction either under way or ready to proceed. Business in all lines, from the manufacturer down to the retailer, reports a continuing tendency downward. No price changes have been noted during the past week. The collection and credit situation remains practically unchanged. There is considerable hesitation about starting much new work of any magnitude, and the inability to procure stock from the East seriously hampers business. There is a tendency among retailers and contractors to contract gradually rather than expand at the present time, materially reducing their overhead in an attempt to forestall the possible business depression.

Motors.—Stocks, generally speaking, are shot to pieces, in the face of a steady demand especially for the smaller sized motors. Fractional sizes are practically unobtainable, and no hope of immediate relief is entertained even by the optimistic jobbers.

Schedule Material.—In the face of active demand, which is showing a decrease, jobbers' stocks are nearing total depletion, with no immediate prospects of improvement. Shipments are slow, uncertain and exasperating.

Flashlights.—Demand is showing an increase, but stocks are spotty with shipments coming in slowly. Battery supply is running low. Prices show no change.

Friction Tape.—An insufficient quantity is on hand to supply the demand, which is brisk. Shipments are coming through slowly and irregularly. Prices are trending upward.

Lamps.—Local requirements are being well handled, but no excess stocks can be built up because of light shipments. In Puget Sound cities the demand for lamps for residences is heavy, but industrial sales are showing a continual dropping off.

Heating Devices.—Delivery dates are exceedingly uncertain and prices are trending upward. Sales are holding up well, although the past week witnessed a noticeable decrease over the first weeks in May.

Sewing Machines.—The movement during the past ten days shows a gradual decrease in orders. Spring weather is expected to stimulate demand. A recent shipment will care for immediate demand, but stocks as a whole are in poor condition. An early increase in prices is anticipated.

SAN FRANCISCO

Larger units of building are reported, but the number of jobs is somewhat smaller. Counter business and device sales have dropped off appreciably. As an indication of the trend of public expectation, all large department stores are announcing special sales to clear off their stocks before a drop which they seem to expect. Buyers announce that they are held to low budgets. Banks have decreased their loans to such sources, and the sales have been successful.

Collections have lengthened from five to ten days over the good mark of forty-five days set earlier in the year. Electrical credits, too, have tightened and are cautiously extended.

Wire.—Standard No. 19 twisted inside telephone wire is now selling for $15.50 per 1,000 ft. in 1,000 ft. lots. Stocks are fair and the demand is good because of the completion of certain big jobs requiring the runs.

Bell-Ringing Transformers.—A slight drop in price has taken effect, the standard styles now selling for $1.35 each in lots of a dozen, and about 10 per cent higher for singles. The call is good with sizeable export orders reported.

House Goods.—Annunciators, push-buttons, door openers etc., have jumped considerably in price, the average advance being 25 to 30 per cent. These articles are in good demand. The market for large return-call annunciators seems to have disappeared.

Non-Metallic Flexible Conduit.—Prices on non-metallic flexible conduit are constant. Stocks are poor, however, most jobbers having just a small quantity on hand for speed orders. A few customers who purchased large shipments are doling their surplus out among less fortunate competitors.

Insulating Tape.—Tapes have jumped about 15 per cent, friction now selling for about 70 cents per pound in 100-lb. lots, 8-oz. rolls. The demand is, of course, steady, and stocks are good.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

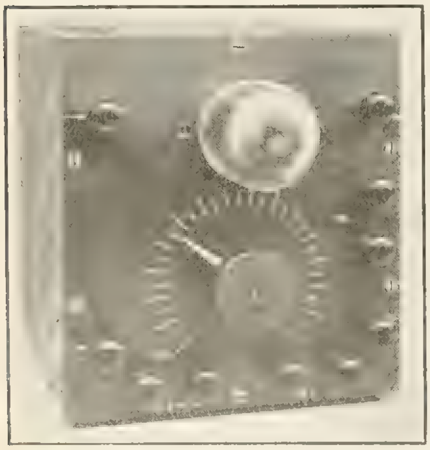
Heavy-Duty Toggle Switch

Harvey Hubbell, Inc., Bridgeport, Conn., has recently put on the market a heavy-duty toggle switch, No. 8102, of the surface type. It has a round base, 2⅝ in. in diameter, which can be furnished either slotted or solid and in composition or porcelain. A simple sturdy mechanism is employed, designed to make it prompt and positive in action. The switch is rated by the Underwriters at 10 amp., 250 volts.

10-AMP. TOGGLE SWITCH

Audion Vacuum Tube Detector

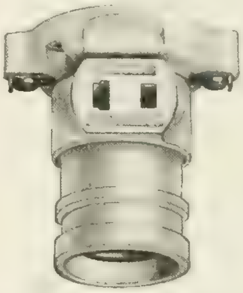
The International Radio Telegraph Company, 326 Broadway, New York City, is manufacturing for experimental and laboratory use a single-tube detector, type RTD-102-A. The size of its bakelite panel is 6 in. x 6⅜ in., and the instrument is made for interconnection and combination with any desired form of arrangement of receiving apparatus, according to the manufacturer. This type is intended for use with the Moorehead-deForest-Marconi Class I (soft) detector tubes. The sockets are of the standard Army-Navy VT four-contact receiving-tube design, and the instruments are so constructed that other vacuum tubes may be used. It is designed so that there will be little or no distortion inherent in the instrument and is said to be useful for receiving radio-telephonic messages.


SINGLE-TUBE DETECTOR OF UNIT TYPE

Standard grid condensers and grid leak-resistance units are furnished with each outfit.

Spartan Current Tap

For use in connection with the sockets and bases of the interchangeable porcelain line, the Bryant Electric Company, Bridgeport, Conn., has recently produced a current tap known as Cat. No. 78. This device is made of porcelain, glazed finish, and is designed for convenient insertion between the porcelain base or cap and the socket, to provide an extra outlet for connecting extension-cord devices. The tap part is of standard Spartan type for use with any standard parallel-blade plugs.


TAPS CURRENT FROM PORCELAIN SOCKET LINE

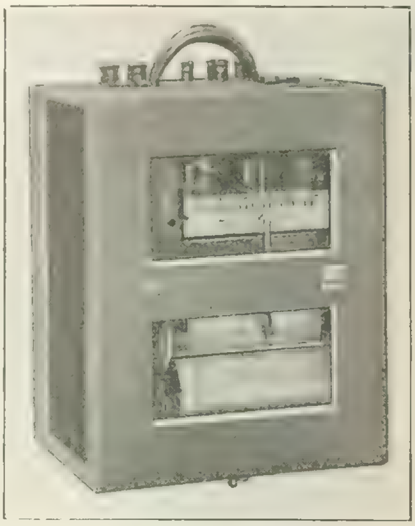
Battery Bell

Battery bells with 2½-in. and 3-in. nickel-plated gongs, for use as transportable calling devices, have been placed on the market by the Electric Signal Manufacturing Company, Inc., 31 Tremont avenue, Orange, N. J. Two-cell and three-cell flat-type dry batteries are used with the equipment.

DRY BATTERIES ARE IN THE BASE

Motor-Operated Switchboard and Portable Graphic Instruments

Improvements have been made by the Westinghouse Electric & Manufacturing Company on its line of type M switchboard and portable graphic instruments. Heretofore pens were driven by solenoids damped by dash pots, whereas they are now driven by a small motor actuated by contacts in the main circuit. Damping is accomplished by means of permanent magnets on an aluminum disk attached to the shaft of the pen-operating motor.


PEN IS MOTOR DRIVEN

The external resistance is in a compact unit form so that interconnections can be made to allow any instrument to operate on a control voltage of 110 volts direct current or 25 cycles or 60 cycles alternating current. A 220-volt, 25-cycle or 60-cycle control resistor may be used.

Rocking-Type Electric Brass Furnace

For pouring directly into molds in rolling mills, foundries, smelting and refining plants, the Detroit Electric Furnace Company, Detroit, Mich., has developed an addition to its series of rocking furnaces. The equipment is designed to eliminate certain metal losses due to cooling. This direct-power type furnace is made in 500-lb., 1,000-lb. and 2,000-lb. sizes, and these capacities may be increased 50 per cent, the manufacturer says, without decreasing efficiency or metallurgical characteristics, by the use of special refractories heretofore unobtainable.

METAL MAY BE POURED DIRECTLY INTO MOLDS

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE O. K. GIANT BATTERY COMPANY, Gary, Ind., is asking for bids for the construction of a one-story plant, 50 ft. x 400 ft., at West Gary, to cost about $60,000. The plans provide for the erection of ten other buildings of similar dimensions, which will make the total cost $660,000.

THE CENTRAL ELECTRIC & LOCK COMPANY, 12 North Thirteenth Street, Philadelphia, will remove its plant to 1309 Arch Street.

WILLIAM H. MATLACK, formerly assistant sales manager, has been appointed assistant to the president of the Bluebird Appliance Company, St. Louis, Mo.

THE ELECTRIC CONTROLLER & MANUFACTURING COMPANY, Cleveland, Ohio, has appointed M. D. Goodman manager of its new Boston office, which will soon be established at 49 Federal Street, Boston, Mass. Mr. Goodman has been connected with the New York sales office of the company.

THE BLAW-KNOX COMPANY, Pittsburgh, Pa., has issued Vol. I, No. 1, for April, and No. 2, for May, of its new magazine entitled *Blaw-Knox Life*.

THE WELLMAN-SEAVER-MORGAN COMPANY, Cleveland, Ohio, has elected John A. Penton, president of the Penton Publishing Company, director of the company to fill the vacancy on the board caused by the death of Samuel T. Wellman.

SLOCUM, AVRAM & SLOCUM LABORATORIES, Inc., 120 Pacific Street, Newark, N. J., announce the appointment of G. A. Unger as general "Flexite" sales agent and consulting engineer of its "Flexite" division.

THE MUELLER ELECTRIC COMPANY, Cleveland, Ohio, has moved its plant from 423-25 High Avenue to 2139-43 Fairmount Road, where it will occupy a two-story building. At the new location the company will have the necessary floor space for increased production of its line of battery clips, test clips and attachment plugs, and also for the manufacture of its new line of battery parts such as battery handles, terminals, etc.

THE AERO ALARM COMPANY, Seattle, Wash., is negotiating with the American District Telegraph Company of New York and Chicago to act as active agent for its products, covering 120 cities throughout the country. The Aero company will reserve New York, Boston, Philadelphia, Seattle and Spokane, where it has already established branches.

THE FEDERAL TRADE COMMISSION during the month of April served formal complaints on the Universal Motor Company, Oshkosh, Wis., and the Universal Products Company, Sandusky, Ohio, manufacturers of electric lighting plants, for "passing off of goods."

THE ESTERLINE COMPANY, Indianapolis, has appointed Ludwig Hommel & Company, Rose Building, Cleveland, Ohio, as exclusive representatives for that district. The Ludwig Hommel Company has for some time specialized in meter work. To cover the territory in eastern Pennsylvania, southern New Jersey, Maryland, Delaware and the District of Columbia, Linn O. Morrow of the Franklin Trust Company, Philadelphia, has been appointed for the Esterline Company. Mr. Morrow for a number of years has been connected with the sales department of The Cutter Company at Philadelphia and has been active in the technical affairs of the Association of Iron and Steel Electrical Engineers.

THE APEX ELECTRIC SPECIALTY COMPANY, 77 Orange Street, Newark, N. J., has filed notice of an increase in capital stock to $103,000 for general business expansion.

THE OTIS ELEVATOR COMPANY, New York, N. Y., is planning an extension to its foundry and forge shop and also improvements to existing buildings at its plant in Yonkers.

THE BENDER ELECTRIC COMPANY, 147 East State Street, Trenton, N. J., recently incorporated with a capital stock of $125,000, is considering the erection of a new building to cost about $25,000.

THE BUFFALO CHANDELIER COMPANY, Buffalo, N. Y., recently incorporated with a capital stock of $50,000, has acquired a building at Olak and Clinton Streets for its new plant.

WALKER AND PRATT TO MANUFACTURE ELECTRIC RANGES.—Electric ranges are to be placed on the market soon by the Walker & Pratt Manufacturing Company, 31 Union Street, Boston, Mass., following the establishment of a new department by this long-established house, known as the makers of the "Glenwood" coal and gas ranges. The company has been in business since 1865, when it was founded by George H. Walker, and the factory at Watertown, Mass., is one of the largest and best equipped stove plants in the industry. Albert L. Smith has been appointed sales manager of the company. Mr. Smith is also vice-president of the Aetna Electric Appliance Company, with offices at 40 Court Street, Boston, Mass., and for the past three years has been Eastern representative of the Rathbone-Sard Electric Company. He has resigned from the latter post. Prior to becoming a manufacturer's representative, Mr. Smith was for a time head of the electric range division of the Edison Electric Illuminating Company of Boston.

ALBERT L. SMITH

THE BOSTON WOVEN WIRE BRUSH COMPANY, has moved its offices and works from Lynn, Mass., to Reading, Mass.

THE WORTHINGTON PUMP & MACHINERY COMPANY, 115 Broadway, New York City, announces that, in addition to the lines of hydraulic machinery which it has manufactured since 1840, it has now completed preparations to furnish improved water-power machinery of all capacities for low, medium and high-head service, including oil-pressure systems, waterwheel governors and other auxiliaries. It is entering this field equipped to produce hydraulic turbines to meet the highest standards in design, efficiency and workmanship.

E. T. BRADLEY has been appointed sales manager of the E. H. Freeman Electric Company, 803 East State Street, Trenton, N. J.

THE FRANK ADAM ELECTRIC COMPANY, St. Louis, Mo., announces the opening of its Pittsburgh office and warehouse at 7-9 West Canal Street, N. S., in charge of J. E. Mair, electrical engineer. Stocks will be carried for local distribution.

THE PACKARD ELECTRIC COMPANY, manufacturer of transformers and auto cables, has moved its Chicago office from 19 South Wells Street to Room 1207, Fisher Building, 343 South Dearborn Street.

THE McCLELLAN REFRIGERATING COMPANY, Chicago, has increased its manufacturing capacity so that the output of hotel, restaurant and meat-shop refrigerating machines can be doubled in a short time. By next November the company expects to have an additional daily output of fifty household refrigerating machines.

THE BOOTH ELECTRIC FURNACE COMPANY, Chicago, has announced the removal of its executive and sales offices in that city to the building occupied by the engineering and producton office at 326 West Madison Street, where adequate office space and facilities have been obtained to take care of all departments. B. G. Tarkington, formerly industrial heating engineer with the Hodenpyl-Hardy Company, Jackson, Mich., is now at the Chicago office in charge of district sales. The Buckeye Products Company, 919 West Fifth Street, Cincinnati, which has charge of sales in the Cincinnati territory, has placed D. E. Carpenter, formerly of the Detroit office of the Westinghouse Electric & Manufacturing Company, in charge of sales of Booth furnaces in that district. Among the foreign offices recently opened by the company is one at 321 Pitt Street, Sydney, Australia, in charge of Bartholomew Bannon.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., contemplates in the near future the erection of a factory building, 900 ft. x 100 ft., for the manufacture of small motors.

W. C. ROTT is now associated with Barton R. Shover, electrical, iron and steel plant and steam engineer, Oliver Building, Pittsburgh, Pa. Mr. Rott has been connected with the iron and steel business for the past fiftten years in the capacity of operator, designer and chief engineer.

THE TRIANGLE CONDUIT COMPANY, 50 Columbia Heights, Brooklyn, N. Y., has filed notice of an increase in capital stock from $30,000 to $100,000.

THE DEXTER WASHING MACHINE COMPANY, Fairfield, Iowa, is planning an addition to its plant, 80 ft. x 140 ft. to cost about $30,000.

THE DELTA-STAR ELECTRIC COMPANY, 2433-2453 Fulton Street, Chicago, has removed its Salt Lake City (Utah) office from the Walker Bank Building to 59 Broadway.

THE BLACK & DECKER COMPANY, Baltimore, Md., announces the removal of its Philadelphia branch office from the West End Trust Building to 318 North Broad Street. W. C. Allen is in charge. The Cleveland branch office has been removed from 6524 Euclid Avenue to 6225 Carnegie Avenue with G. A. Dodge in charge.

Supply Jobbers' Notes

THE BALTIMORE ELECTRICAL SUPPLY COMPANY, 309 North Calvert Street, Baltimore, Md., is planning to erect a new building, [illegible] to cost about [illegible] 000, at 331-35 North Calvert Street.

L. E. TROTTER, assistant sales manager of the Post-Glover Electric Company, Cincinnati, Ohio, was elected a director at a recent stockholders' meeting of the company.

THE IOWA ELECTRICAL SUPPLY COMPANY, [illegible] Grand Avenue, Des Moines, Iowa, since the first of the year has extended its territory and has added three traveling salesmen to its force. C. E. Harding has recently been appointed purchasing agent of the company.

THE CONTINENTAL RADIO & ELECTRIC CORPORATION, 6 Warren Street, New York, recently incorporated, will engage in jobbing, dealing and retailing radio equipment and electrical supplies. The officers are: G. E. Burghard, president; John F. Grinan, vice-president; John Di Blasi, secretary, and Joseph Stantley, treasurer.

THE WESTERN ELECTRIC COMPANY is to build a $3,000,000 eleven-story concrete warehouse at 395 Hudson Street, New York City, 323 ft. x 340 ft., taking in the entire block. It is said that it will be the largest concrete building on Manhattan Island, and will be occupied jointly by the Western Electric Company and the New York Telephone Company.

Foreign Trade Notes

THE EUGENE F. PHILLIPS ELECTRICAL WORKS, LTD., Montreal, Can., is erecting an addition to its plant, to be used for the manufacture of enameled wire, in addition to its products of wire, cable, etc.

FOREIGN CREDIT INSURANCE EXCHANGE FORMED.—Announcement has been made of the organization of a mutual company for the insurance of credits in foreign countries, to be known as the American Manufacturers' Foreign Credit Insurance Exchange, Chamber of Commerce Building, Chicago. The purpose of this mutual exchange will be to supply adequate information on the financial status of foreign merchants and a reasonable safeguard in individual business transactions. The officers are: President, George R. Meyercord, president of the Meyercord Company, Chicago; treasurer, Samuel Hastings, president of the Computing Scale Company of America; secretary, John M. Glenn, secretary of the Illinois Manufacturers' Association. The general management is in charge of J. B. Benson, for many years sales and advertising executive with John and Joseph Drysdale & Company, Buenos Aires, Argentina, one of the largest importing houses in South America.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

The manager of a cement factory in the Straits Settlements (No. 32,851) desires to purchase a 1,000-hp. turbo-generator unit and two water-tube boilers.

A firm in Canada (No. 32,858) desires to purchase electrical washing and drying outfits.

A manufacturing company in Switzerland (No. 32,816) desires to purchase large quantities of varnish for use on handles of electric flatirons. It must be black and capable of withstanding heat.

New Incorporations

THE FARM LIGHT CORPORATION OF VIRGINIA-CAROLINA, Norfolk, Va., has been incorporated with a capital stock of $25,000 to manufacture electric lighting systems. J. C. Gurley is president, and T. A. Pope is secretary.

THE SWANSEA (S. C.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $20,000. The officers are: C. L. Rast, president; C. L. Brooker, vice-president, and A. P. Jackson, secretary and treasurer.

THE VICTORY STORAGE BATTERY COMPANY, Maryland Casualty Building, Baltimore, Md., has been incorporated by A. J. Thompson, Edward B. Masterton and Henry Stockbridge. The company is capitalized at $319,000 and proposes to manufacture electric storage batteries for automobile service, etc.

THE PRESTO ELECTRIC COMPANY, New York, N. Y., has been chartered with a capital stock of $5,000 by F. Kaiser, M. Altschuler and M. M. Goldschmidt, 299 Broadway, New York City. The company proposes to manufacture electrical goods.

WATT & COMPANY, Johnson Building, Pineville, Ky., has been incorporated with a capital stock of $15,000 to manufacture electrical apparatus. The incorporators are P. E. Nuckols, R. M. Watt and N. R. Patterson.

THE GILLIAM LIGHT & MOTOR COMPANY, Union, S. C., has been incorporated by D. Fant and J. Louis Gilliam. The company is capitalized at $25,000 and proposes to manufacture isolated light and power plants, etc.

THE HOME LIGHT & POWER COMPANY has been chartered with a capital stock of $150,000 to manufacture electrical appliances, etc. The officers are: S. O. Lindeman, Richmond, president, and L. R. Lindeman, Raleigh, N. C., secretary.

THE MIDWAY ELECTRIC COMPANY, Shipsewana, Ind., has been incorporated with a capital stock of $25,000 to supply electricity for lamps and motors. The incorporators are Jonathan Farver, Frank Bevington and E. A. Wolfe.

THE SOMERSET (Va.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $65,000 to distribute electricity in Orange, Madison, Green and Louisa Counties. W. G. Buckner is president and D. F. Weaver is secretary.

Trade Publications

LAVA.—The American Lava Company, Chattanooga, Tenn., is issuing a booklet entitled "Lava," describing the use of lava for mechanical and electrical purposes.

THE ROLLER-SMITH COMPANY, 233 Broadway, New York, N. Y., has issued bulletin No. 150, describing its type HA pocket portable ammeters, voltmeters and wattmeters for alternating current.

LIGHT FOR WORKSHOP. — Bulletin No. 85, issued by the Cooper Hewitt Electric Company, Hoboken, N. J., entitled "What Good Light Means To You," describes and illustrates the use of the Cooper Hewitt light in the workshop.

INSULATORS.—The R. Thomas & Sons Company, East Liverpool, Ohio, is distributing a fifteen-page booklet covering the Thomas Hewlett link-type insulator.

BELLS, BUZZERS AND SIGNAL GONGS.—Stanley & Patterson, West and Hubert Streets, New York, N. Y., has recently issued bulletin No. 31, in which it illustrates and describes its bells, buzzers and signal gongs, etc.

Construction News

Projects, Plans, Bids and Contracts,
Contemplated or Under Way

New England States

BRUNSWICK, ME.—Plans have been prepared for the construction of a new power plant by the Cabot Manufacturing Company, to be used in connection with the proposed new cotton mill, for which contract was recently awarded.

FORT KENT, ME.—The Fort Kent Electric Company contemplates the erection of a 33,000-volt transmission line to connect at Van Buren, Me., with the Maine & New Brunswick Electric Light & Power Company, a distance of 43 miles.

CHELSEA, MASS.—Bids will be received by Eli W. Hall, president for the trustees of the Soldiers' Home, Room 815, Kimball Building, Boston, until June 1, to construct and complete the addition to and the alteration of the power plant and new laundry building at the Soldiers' Home, Chelsea. Proposal blanks may be obtained at the office of the architect, Harrison H. Atwood, 61 Alban Street, Boston.

LOWELL, MASS.—Work has been started by Aberthaw Construction Company, 27 School Street, Boston, on the erection of a power house and manufacturing plant, to cost about $1,000,000, for the Lowell Weaving Company.

NEW BEDFORD, MASS. — The City Council has approved of changes in the lighting system on various streets of the city.

SPRINGFIELD, MASS. — The United Electric Light Company, 73 State Street, has awarded contract to the A. E. Stephens Company, 145 State Street, for the construction of a substation on North and Caren Streets, to cost about $100,000.

STAMFORD, CONN.—Plans of the Petroleum Heat & Power Company of Southfield Avenue include the erection of a foundry, for which estimates are now being received, and later the construction of a power house. The first unit of the plant is nearing completion.

Middle Atlantic States

ALBANY, N. Y.—The Consolidated Light & Power Company of Whitehall, N. Y., has applied for permission to erect transmission lines.

BUFFALO, N. Y.—The Niagara Machine & Tool Works, 633 Northland Avenue, are in the market for one 150-kw. motor-generator set to convert three-phase, 25-cycle, 2,000-volt alternating current to 230-volt direct current.

GENEVA, N. Y.—The Empire Gas & Electric Company contemplates improvements to its plant, including the installation of compressors, stokers, etc., to cost about $300,000.

GLENS FALLS, N. Y.—The Adirondack Electric Power Corporation contemplates the erection of an electric power plant in the vicinity of Cranesville. Negotiations are under way for a site for the plant.

LOCKPORT, N. Y.—Dumville & Company are in the market for a 3-hp., single-phase, 60-cycle, 110-volt, 1,200-r.p.m. motor.

NEW YORK, N. Y.—Contract has been awarded by the New York Edison Company to Clough Bourne, 101 Park Avenue, New York, for the construction of a three-story transformer station on East Sixth Street, to cost about $60,000.

WELLSVILLE, N. Y.—The village of Wellsville has voted on improvements to the municipal electric lighting plant, to cost about $35,000.

BUTLER, N. J.—Bids will soon be received for the construction of a municipal electric lighting plant, to cost between $50,000 and $60,000. Runyon & Carey, 845 Broad Street, Newark, N. J., are engineers.

GLEN RIDGE, N. J.—The installation of a "white-way" type street-lighting system on Bloomfield Avenue is under consideration.

HADDONFIELD, N. J. — Considerable electrical and mechanical equipment will be used in connection with the proposed new municipal disposal plant, to cost about $75,000.

JERSEY CITY, N. J.—Contract has been awarded by the American Butterine Company, 1 Montgomery Street, for the construction of a manufacturing building and power plant on Henderson Street, to cost about $100,000.

LAKEHURST, N. J.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., contemplates the erection of a power house and a distribution system at the local navy yard.

NEWARK, N. J.—Arrangements have been completed for extensions to the "white-way" type street-lighting system on Park Place and Broad Street.

ALLENTOWN, PA.—The Phoenix Silk Manufacturing Company is having plans prepared for the erection of an addition to the power plant at its local silk mills. Carl A. Baer & Company, Land Title Building, Philadelphia, are engineers.

PHILADELPHIA, PA.—Frank Schoble & Company contemplates the erection of a power house, to have an initial capacity of about 1,200 hp., at its local works on Tenth and Oxford Streets.

CUMBERLAND, MD. — Kelly - Springfield Tire Company has awarded general contract for the erection of its rubber tire plant, to cost about $2,000,000, to the Hunkey-Conky Construction Company of Cleveland, Ohio. The Riggs, Distler & Stringer, Inc., 216 North Calvert Street, Baltimore, has received contract for furnishing and installing equipment for boiler house, power house, pumping station and main factory building, to include 8,000-hp. boilers and two 5,000-kw. turbine generating sets.

LANSDOWNE, MD.—Bids will be received by P. C. Walsh, 3d, manager, 295 Passaic Street, Newark, N. J., until June 10, for the construction of a steel rolling mill for the National Steel Rolling Company, 203 Keyser Building, Baltimore, Md., to cost $100,000, including equipment. Electric motors will be installed.

MASSEY, MD.—The erection of an electric light plant is under consideration by the town officials.

FAIRMONT, W. VA.—Property of the Amos Coal Company has been acquired by M. R. Beerbower and others, who are planning to electrify the works and install considerable equipment.

WHEELING, W. VA. — The Wheeling Electric Company has completed plans to establish a new power loop to run through Fulton at Rudler's, where a substation will be erected, and continue on a straight line north to Windsor. The substation will supply the suburban district.

WASHINGTON, D. C.—Bids will be received at the office of the Chief Signal Officer of the army, Washington, D. C., until June 5, Proposal 3635-126CP, for furnishing 17,000 fuses. Further information may be obtained at the above address.

North Central States

CANTON, OHIO.—Bonds to the amount of $750,000 have been voted for the erection of a high school, to be known as the John H. Lehman School. Thayer & Thayer, Mercantile Building, New Castle, Pa., are architects.

CLEVELAND, OHIO.—The City Council has authorized a bond issue of $500,000 for the maintenance and necessary extensions along lines in territory served by the city. A similar amount, to be issued in the fall, will be asked for extensions into new territory.

CLEVELAND, OHIO.—The erection of two electric transmitting stations, one at West 103d Street and Western Avenue, and the other near Euclid Avenue and East 105th Street, is contemplated, at a cost of about $100,000 each. W. E. Davis, City Hall, is engineer.

EAST CLEVELAND, OHIO.—The East Cleveland Hospital Commission has had plans prepared by A. M. Allen & Company, 1900 Euclid Avenue, Cleveland, engineers, for the erection of a hospital, to cost about $600,000. Plans provide for electric lighting equipment and the installation of an electric elevator.

LODI, OHIO.—The Lodi Light & Power Company, recently organized, has taken over the local electric light plant and contemplates rebuilding the distribution system and the installation of a rotary converter to convert 25-cycle energy into 60-cycle.

MANSFIELD, OHIO.—The Kenny Foundry Company is planning the construction of a power house, foundry, etc.

MOUNT VERNON, OHIO.—The installation of a municipal electric power plant is under consideration. At present energy for street-lighting and driving pumps is supplied by the Ohio Power Company.

LOTHAIR, KY.—The Kentucky & West Virginia Power Company, Land Title Building, Philadelphia, Pa., plans extensive improvements, to include the extension of its 33,000-volt transmission lines to Yellow Creek, in Knott County, 6,600-volt lines from Blackey to Ulvah, Ky., etc. F. R. Weller, Washington, D. C., is consulting engineer.

PADUCAH, KY.—A local site has been acquired by the Southern Textile & Machinery Company, 433 South Third Street, for the erection of its new works. Plans for the first unit include construction of a power house.

INDIANAPOLIS, IND.—On petition of Virginia Avenue business men, the board of public works has ordered electric light standards placed on both sides of the Avenue from Washington Street to East Street.

TERRE HAUTE, IND.—Permission has been granted the American Car & Foundry Company to erect a brick and steel power house at its plant at Tenth and Crawford Streets, to replace the building destroyed by fire last fall. The cost is estimated at about $20,000.

WASHINGTON, IND.—The City Council has authorized the construction of a municipal electric light and power plant at East Side Park, to cost about $115,000.

NEWTON, ILL.—Bids will be received by Fuller Beard, engineer, Chemical Building, St. Louis, Mo., until June 15, for extensions to the electric light plant and waterworks and improvements to the pumping station, to cost about $50,000.

STERLING, ILL. — Request has been made by the Sterling Association of Commerce that the City Council consider extensions to the boulevard lighting system.

OSHKOSH, WIS.—Work has been started on the construction of a new plant for the Oshkosh Motor Truck Company. The first building consists of a machine shop and assembling floor, 102 ft. x 410 ft. An office building and transformer house will also be erected.

PESHTIGO, WIS.—The Peshtigo Pulp & Paper Company has applied to the Wisconsin Railroad Commission for permission to construct a dam at Potato Rapids, on the Peshtigo River, for power purposes, in connection with the operation of a new sulphite plant which the company plans to erect at Peshtigo, and also to operate the present paper mill.

PORT WING, WIS.—A company is being organized by T. N. Okerstrom of Port Wing and others for the purpose of constructing a hydro-electric power plant and a dam across Iron River, to cost about $200,000. J. C. Jacobson, 533 Metropolitan Bank Building, Minneapolis, Minn., is engineer.

BUFFALO, MINN.—Bids will be received by B. A. Bonstrum, village clerk, until June 4, for equipment, including two pumps and motors, one auto-starter for pumps, etc., in connection with the establishment of the deep well and water system in the village. The estimated cost of the project is about $60,000.

ST. LOUIS, MO.—Bonds to the amount of $1,000,000 have been voted to establish a new street-lighting system.

MOBRIDGE, S. D.—The construction of a hydro-electric plant at Mobridge on the Missouri River is under consideration. Plans also include erection of transmission systems, estimated at $1,000,000 and $7,000,000.

LOUP CITY, NEB.—Separate bids will be received by the county clerk of Sherman County until June 27 for the erection and completion of court house, heating and plumbing, electric wiring, electric fixtures, etc. Plans and specifications are on file with the county clerk and with the Heningson Engineering Company of Omaha.

CALLISON, KAN.—Bonds to the amount of $15,000 have been voted for the erection of a transmission line from Callison to Pratt, a distance of 9 miles. W. B. Rollins & Company, 209 Railway Exchange Building, Kansas City, Mo., are engineers.

Southern States

YOUNGSVILLE, N. C.—The construction of a municipal electric lighting station, to cost about $20,000, is contemplated. J. R. Pearce is mayor.

ANDERSON, S. C.—Improvements to the electric light and water systems in the mill village, to cost about $75,000, are contemplated by the Equinox Mills.

NEWBERRY, S. C.—Bonds to the amount of $18,000 have been voted for the installation of a municipal electric light plant. E. S. Blease is Mayor.

ADEL, GA.—Bonds to the amount of $12,000 have been voted for improvements to the electric light and waterworks system.

BAINBRIDGE, GA. — The Bainbridge Power Company has awarded contracts to A. Dallam O'Brien, 1641 Amelia Street, New Orleans, La., for the construction of a power house and a dam in connection with the proposed water-power development on Spring Creek. The cost of the project is estimated at about $75,000.

MADISON, GA.—Improvements to the electric light and water plant are under consideration. R. W. Parker is Mayor.

SANDERSVILLE, GA. — Bonds to the amount of $40,000 have been voted for proposed city improvements, to include rebuilding the light plant.

SOPERTON, GA.—Bonds to the amount of $10,000 have been submitted to the voters for the installation of a municipal electric light plant.

FORT PIERCE, FLA.—Additions to the municipal electric light and water plant are under consideration.

TALLAHASSEE, FLA.—Bonds to the amount of $175,000 have been authorized for the installation of electric light, gas and water plants.

KNOXVILLE, TENN.—The board of managers is having plans prepared for the construction of a new power plant and laundry building at the Fort Sanders Hospital.

MEMPHIS, TENN.—Receivers of the Memphis Gas & Electric Company have been granted a permit for the construction of a booster substation at the west end of Elzey Place, to cost about $25,000. Other improvements are contemplated by the company. J. F. Ramier is general manager.

FORT SMITH, ARK.—The plant of the Fort Smith Light & Traction Company, it is reported, has been destroyed by fire, causing a loss of about $10,000.

LITTLE ROCK, ARK.—E. L. Bruce & Company is in the market for a new or used 25-hp., three-phase, 60-cycle, 440-volt motor.

MINDEN, LA.—Bonds to the amount of $20,000 have been voted for improvements to the electric light plant. George S. Carroll is Mayor.

BEAUMONT, TEX.—Arrangements have been made by the Eastern Texas Electric Company for a bond issue of $1,500,000, of which a part will be expended for improvements to its plant, including the installation of a 4,000-kw. turbo-generator. C. F. W. Wetterer is president.

DALLAS, TEX.—The construction of an electric interurban railway from Dallas to Wichita Falls, a distance of 143 miles, is contemplated by a committee of Dallas citizens and the General Electric Company. Wiley Blair, of Dallas, is chairman of the committee.

DALLAS, TEX.—Bids will soon be asked by Martin C. Schwab, engineer, 30 North Michigan Boulevard, Chicago, Ill., for electric wiring of the merchandise building to be erected by Sears, Roebuck & Company, Arlington and Homan Avenues, Chicago, Ill., at a cost of about $2,000,000. George C. Nimmons & Company, 120 South Michigan Avenue, Chicago, are architects.

HOUSTON, TEX.—The city officials plan to construct a power house, barn, and improve shops; also install block signals and erect feed lines. Total cost is estimated at about $97,600.

HOUSTON, TEX.—The Houston Lighting & Power Company contemplates the erection of a 2,300-volt primary service line to West University Place. Cost is estimated at about $10,000.

TOYAH, TEX.—The City Council has granted a franchise to Jesse Knight for the construction and operation of an electric light and power plant in this locality.

VERNON, TEX.—Investigation is being made as to the necessity of an expenditure of $100,000 by the Texas Public Service Company for additions to its electric light and power plant. A. V. Foster is president of the Public Service Company.

Pacific and Mountain States

CENTRALIA, WASH.—The Kane Pneumatic Shock Absorber Company have had plans prepared for the immediate erection of a 750-kw. to 1,500-kw. power plant at Fords Prairie. Peter W. Kane is president of the company.

OLYMPIA, WASH.—Contract has been awarded to Albertson, Cornell Brothers & Simpson, Tacoma, for the construction of power and heating plants for the State Capitol group of buildings, at a cost of $155,263.

SEATTLE, WASH.—An ordinance authorizing an appropriation of $495,000 to complete the construction of a pipe line and the installation of a 15,000-kw. generating unit at the Cedar Falls plant has been passed. An ordinance appropriating $511,000 to complete the installation of a 15,000-kw. generating unit at the Lake Union steam plant has been referred to the Public Utilities Commission.

EL SEGUNDO, CAL.—The General Chemical Company, 25 Broad Street, New York, N. Y., has awarded contract to the J. G. White Engineering Corporation, 43 Exchange Place, New York, for the construction of a group of factory buildings here, to cost about $2,000,000.

LONG BEACH, CAL.—The Pacific Telephone Company plans to enlarge and improve its quarters, having leased the entire Giddings building. New equipment will be installed.

LOS ANGELES, CAL.—The Board of Public Service has authorized the purchase of two motors for the San Fernando unit of the aqueduct power system and one for the Franklin Canyon unit, to cost about $200,000. This installation gives the city an additional 10,000 hp.

MONTECITO, CAL.—The Santa Barbara Telephone Company has authorized the erection of a telephone exchange building and the installation of modern telephone equipment.

REDDING, CAL.—Pacific Gas & Electric Company plans an expenditure of over $3,000,000 on electrical developments in Shasta County, this season. The first items of construction will be two power houses in Hat Creek Valley, each developing 10,000 hp., and the erection of a pole line from the power plants to Cottonwood.

SUSANVILLE, CAL.—The State Railroad Commission has granted the Lassen Electric Company permission to issue $100,000 in bonds, of which $64,000 will be used for the erection of a 25-mile transmission line from Susanville to Westwood, to carry electric energy which the company proposes to purchase from the Red River Lumber Company.

ORDWAY, COLO.—The installation of an ornamental street-lighting system in District 1, is planned. J. B. Estes is clerk.

Canada

BRAMPTON, ONT.—Bids are being received by W. Treadgold of Brampton for furnishing and delivering a turbine pump with electric motor, rated at about 500 gal. per minute.

CHELSEY, ONT.—W. G. Durst desires to purchase 2, 3, 5, 10 and 15-hp. electric motors, three-phase, alternating current, 220 volts.

ELK LAKE, ONT.—W. H. Seamon, manager of the Matachewan Gold Mines, is considering the installation of a 100-ton crushing mill, to be electrically operated. The cost is estimated at about $50,000.

GRAND BEND, ONT.—A bylaw authorizing the installation of a hydro-electric system, will soon be submitted to the ratepayers.. Henry Eilber, Crediton, Ont., is clerk.

PETERSBORO, ONT. — The Canadian General Electric Company has awarded contract to John E. Hayes, 219 Park Street, for the construction of a factory, to cost about $500,000.

TORONTO, ONT.—Plans are being prepared by the H. M. Lane Company, engineers, Windsor, Ont., for the construction of a machine shop, 52 ft. x 180 ft., for the Grinnell Company. Electric lighting equipment and electric motors will be installed.

DANVILLE, QUE.—Plans are underway for the erection of an electric light plant in Danville. Mr. Brown is secretary-treasurer.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer of the Panama Canal, Washington, D. C., until June 12, Circular 1371, for furnishing electric welding outfit, vacuum exhaust outfit, steel, electric bells, marine connecting boxes, copper cable, conduit cutting tool, fiber conduit, condulets, cut-outs, electric fans, signal lantern, motor, lighting projectors, lead sleeving, transformers, etc.

PETERSBURG, ALASKA—Bonds have been authorized for the erection of an electric light and water plant. The development of a water power system is also contemplated.

Record of Electrical Patents

Notes on United States Patents

(Issued April 27, 1920)

1,338,324. Ignition and Lighting Device; Alfons H. Neuland, San Francisco, Cal. App. filed Sept. 6, 1916. Combines advantages of both battery and magneto ignition.

1,338,328. Clock System; Arthur F. Poole, Chicago, Ill. App. filed Sept. 10, 1917. Used with commercial alternating-current distribution systems.

1,338,333. Control System; Karl A. Simmon, Edgewood Park, Pa. App. filed Sept. 21, 1916. Electric vehicle motors operated through a number of resistance and field control positions when connected in series and in parallel relation.

1,338,334. Circuit Interrupter; Joseph Slepian, Pittsburgh, Pa. App. filed Jan. 14, 1918. Dissipates electromagnetic energy of circuit when interrupter is opened.

1,338,350. Telephone System; William Aitkên, London, Eng. App. filed March 20, 1917. Connecting means for each subscriber's line so that connection can be obtained with one of a number of different outgoing and incoming lines.

1,338,352. Electrical Process and Apparatus for Compounding Liquids with Gases or Other Components and the Products Thereof, Including Carbonating Beverages; Jacob E. Bloom, Brooklyn, N. Y. App. filed Sept. 30, 1919. Compounding by electric attractive forces or stress including electric absorption.

1,338,353. Electrical Process and Apparatus for the Dyeing of Furs and Other Materials and the Products Resulting Therefrom; Jacob E. Bloom, Brooklyn, N. Y. App. filed Sept. 30, 1919. Fastening of dyestuffs on hair or fur by electrical absorption.

1,338,359. Electric Singeing Furnace; Ora A. Colby, Larimer, Pa. App. filed Oct. 30, 1918. Uniform singeing of cloth.

1,338,367. Single-Phase Motor-Control System; Rudolf E. Hellmund, Swissvale, Pa. App. filed Oct. 3, 1917. Manual or automatic control of speed and power factor dependent upon load applied to motor.

1,338,368. System of Control for Alternating-Current Commutator Motors; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 28, 1917. Permits not only control of speed and of power factor but also of degree of compensation to insure proper commutation for various conditions of load on motor.

1,338,370. Automatic Telephone System; Harry E. Hershey, Whitewater, Kan. App. filed March 10, 1916. Single group of connector switches for each group of polystation lines.

1,338,380. Vibratory Converter; Oscar M. Leich, Genoa, Ill. App. filed Oct. 31, 1918. Telegraph sounders supplied from a common source of unidirectional pulsatory current obtained from an alternating-current source of supply.

1,338,408. Control System for Electric Furnaces; Frank Thornton, Jr., Mansfield, Ohio. App. filed June 29, 1918. Automatically varies current supplied to furnace in accordance with variations in temperature.

1,338,412. Primary Battery; Charles A. Xardell, Utica, N. Y. App. filed March 13, 1919. Current capacity of relatively high voltage for a given size of battery for all practical purposes non-polarizing.

1,338,439. Metallurgical Method and Apparatus; Guyon F. Greenwood, Georgeville, Quebec, Canada. App. filed July 19, 1918. System for roasting, reducing and refining oxide, carbonate and other ores.

1,338,440. Production of Lead; Guyon F. Greenwood, Georgeville, Quebec, Canada. App. filed July 23, 1918. Electric heating element in drum for roasting sulphide ores.

1,338,465. Galvanic Battery; Roscoe J. Smith, Newark, N. J. App. filed Dec. 22, 1915. Battery cell of considerable weight quickly moved and lifted without imposing undue strains on cells.

1,338,492. Art or Method of Producing Photographic Screens for Halftone Work; Harry A. Corbett, New York, N. Y. App. filed March 28, 1916. Master plate quickly and accurately duplicated.

1,338,497. Telegraph Instrument; Thomas J. Dunn, Jersey City, N. J. App. filed March 22, 1917. Sending devices for transmitting messages by element vertically upstanding from base and vibrating about one end as a center.

1,338,521. Ignition Detector and Spark Intensifier; Alexander Q. Nash, Kansas City, Mo. App. filed April 26, 1918. Indicates condition of controlling circuits for gasolene engine.

1,338,523. Advertising Apparatus; Jacon R. Osborne, Clinton, Mo. App. filed Aug. 23, 1917. Advances web and controls its movements to a predetermined point.

1,338,548. Electromagnet; Charles E. Avery, Trenton, N. J. App. filed March 27, 1917. Eliminates chatter of armature and secures an increased range of movement.

1,338,568. Electric Motor; Leonard Foote, Pedro Miguel, Canal Zone, Panama. App. filed Nov. 4, 1918. Large number of poles provided within a small space for low-speed motor the field structure of which is applicable to both alternating-current and direct-current motors.

1,338,611. Electrically Heated Draft Device; Warren A. Brown, Hempstead, N. Y. App. filed Jan. 6, 1919. Toy of revolving type operated by a draft or current of air.

1,338,631. Electric Furnace; Jonas Herlenius, Brooklyn, N. Y. App. filed Feb. 8, 1918. Aperture through which electrode projects into furnace sealed against air leakage.

(Issued May 4, 1920)

1,338,690. Battery Box; Thomas L. Moorman, Farmville, Va. App. filed Feb. 27, 1920. Protective casing for battery on Ford cars.

1,338,717. Process of Making Electrical Resistance Units; Charles Wirt, Philadelphia, Pa. App. filed Oct. 22, 1918. High resistance in proportion to its size.

1,338,718. Regulating System; Walter R. Woodward, Wilkinsburg, Pa. App. filed July 11, 1916. Combination of current transformers of different characteristics used with an automatic regulator.

1,338,734. Mineral-Manure Process; Woolsey McA. Johnson, Hartford, Conn. App. filed Feb. 2, 1915. Commercial process for utilizing feldspar in production of mineral manures by eléctric furnace.

1,338,756. Receiver for Wireless Telegraph and Telephone Circuits; Frank E. Summers, Memphis, Mo. App. filed April 28, 1916. Weak impulses from distant sending stations are amplified, so that the transmitted signals will be increased in intensity.

1,338,758. Impulse Starting Mechanism and Method of Operating the Same; Max Tost, Detroit, Mich. App. filed Jan. 2, 1918. Impelling spring restressed without turning the driving unit for that purpose.

1,338,762. Electrical Welding Machine; Edwin M. Bassler, Milwaukee, Wis. App. filed Oct. 6, 1919. For butt welding rods, bars, pipes and tubes, the pieces being forced together by hand or foot power applied by the machine operator.

1,338,812. Electrotherapeutic Apparatus; Wendell L. Carlson and Earl C. Hanson, Washington, D. C. App. filed July 12, 1919. Frequency currents for imparting beneficial effects to the body.

1,338,857. Engine-Starting and Automobile-Lighting System; Justus B. Entz, Cleveland, Ohio. App. filed March 11, 1912. Motor in starting engine has high starting torque and when driven by the engine serves at varying speed as a constant potential generator.

1,338,881. Production of Iron in an Electric Furnace; Guy J. Stock, Bradford, Eng. App. filed Feb. 13, 1920. Endothermic chemical reaction results in conversion of ore to metallic iron and subsequent melting of reduced metallic iron.

1,338,884. Transformer; Chester H. Thordarson, Chicago, Ill. App. filed Dec. 8, 1913. Separately wound winding sections spaced to insulate winding sections one from the other and to provide ventilating passages so that all turns of each section are exposed on opposite sides of section to action of cooling medium.

1,338,888. Method of Making Thermophones; Anthonius M. Van Doorn, Newton, Mass. App. filed March 21, 1919. Number of wires form loops between points of attachment to electrodes, being made by Wollaston process with a platinum core and a silver coating.

1,338,889. Apparatus for Radiosignaling; Roy A. Weagant, Roselle, N. J. App. filed Feb. 1, 1916. Cold element connected with indicator and a point upon filament.

1,338,952. Apparatus for Regulating the Strength of Electric Currents for Medical Purposes; Minos Nicoletis, Paris, France. App. filed July 17, 1918. Clock-driven mechanism for periodically and automatically varying resistance.

1,338,984. Combined Wave Changer and Wave Meter; Guy Hill, Washington, D. C. App. filed Oct. 7, 1918. For determining wave lengths and for simultaneously adjusting both wave changer and wave meter.

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician
Published by McGraw-Hill Company, Inc.

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Volume 75 New York, Saturday, June 5, 1920 *Number* 23

Congress Has Acted

WATER-POWER development, which for eight years has been pigeonholed, sidetracked and footballed in the halls of Congress, has triumphed. The Senate has passed the bill as amended by the conference committee and already accepted by the House of Representatives. Nothing save a presidential veto can now keep the measure off the statute books, and inasmuch as it was framed under administration guidance and met the approval of the Department of the Interior under Secretary Lane, there is little ground for apprehension regarding President Wilson's action. Indeed, his signature will very possibly have been affixed before this issue of the ELECTRICAL WORLD reaches its readers. It has taken a long time for public utilities to live down the trust-forming and exploiting ambitions unjustly attributed to them, following Gifford Pinchot's lead. Meanwhile the cost to the American public of non-use of at least 5,000,000 hp. in projects ready for development reaches for the eight years of delay a service value of $1,200,000,000. This veil of misrepresentation has now, as the result of a clean record of service during the great war and the serious consequences accompanying the national shortage of fuel, been completely removed, and water-power development is looked to as one of the agencies by which the stunted growth of American industries in sections where fuel is lacking can now be overcome. To the great West there is opened a new vista, for the national government is awakening from its long sleep and making it possible to retrieve the losses of the long-suffering public blessed by a national resource it has not heretofore been permitted to use. The ELECTRICAL WORLD, which has long made the cause of water power its own, congratulates the industry.

The Cost of Money and Utility Credit

THIS was the subject of an unusually comprehensive address recently made before a public utility convention by O. B. Willcox, vice-president of Bonbright & Company, a New York City banking firm. As will be seen by extracts from the address published elsewhere in this week's ELECTRICAL WORLD, Mr. Willcox enumerates as preponderating factors affecting the securities of public service companies franchises restricted to a limited term of years, fear of reappraisal and change of policy in fixing rates, insufficient protection against impairment through obsolescence, and the danger that resides in a rigid rate of earnings without provision for contingencies. In particular, he points to the inadequate margin above the requirements for interest and dividends. His advocacy of the indeterminate franchise will strike a responsive chord in the breasts of many utility men. Help in the present emergency, however, could be more quickly obtained through the allowance by the commissions of a rate of return which would afford an adequate margin over current expenses, this surplus either being carried as a cash reserve or invested in the property. Under such conditions Mr. Willcox holds that public utility securities would hold their own against other issues without public rights being in any way threatened. He might have gone further and said that the rights of the public to full and efficient service, the best that the utilities can give, themselves demand this measure of relief.

Team Work in Organizations

LITTLE that is worth while can be done today without team play, and so the tendency is to organize the world *ad infinitum*—there to stop in too many instances by failing to assign adequate authority to the trained, ardent and responsible men capable of actually accomplishing the major trumphs. Mere ensemble appointments get nowhere, but when individual service begins to function in qualified groups out comes the initiative that brings results.

Can Commission Proceedings Be "Speeded Up"?

TO SPEED up the material wheels of industry it is often necessary to accelerate also and first a good many other things. Among these are legislation and judicial decisions that bear on finance and profits. Without expressing any opinion on the merits of the appeal made to the federal courts by the Wisconsin-Minnesota Light & Power Company on the ground that the length of time taken by the Wisconsin Railroad Commission to determine for it a reasonable schedule of rates is depriving it of its property without due process of law, it is decidedly in order to urge upon commissions the importance of prompt hearings and decisions. Procrastination is the thief of other things besides time, and though the virtues of unanimity and promptness which characterize autocratic decisions do not outweigh those inherent in the slower and argumentative processes of democratic institutions, public service tribunals should none the less see in unnecessary delay and needlessly prolonged deliberation faults earnestly to be shunned.

Competitive Co-operation

AN INTERESTING development of recent origin is creation of associations with which manufacturers are identified to promote co-operative effort in the handling of trade problems. The war undoubtedly had a considerable influence in this development, owing to patriotic motives and the realization that for the maximum production of a necessary product combined effort is essential. Another reason, particularly for those industries not so closely connected with the production of raw material, was the necessity for protection in the matter of priority and for the full representation of their cases as a whole before the government officials. Since the war these associations have continued their work, and in practically every instance their plans for the future are to carry forward the work thus begun. Through meetings of competitors on a social and business basis a new spirit has come into being. This spirit has led to recognition of the fact that the other fellow is a human being after all and that only because of distortion and misunderstanding have competitive methods in general caused ill feeling. By getting together on a common ground, free from the price fixing and legal aspects that condemned such business association in the past, the industry as a whole is advanced and the field broadened. In individual effort selfish methods are apt to predominate and work of an educational nature cannot be undertaken to bring to the attention of the public the necessity for the use of group products. Moreover, American business is being promoted to a marked degree through these associations, which are doing splendid work. In the development of foreign commerce their activities will be indispensable, and by the clear-sighted policy that their co-operative efforts will promote the consumer will benefit through the high ethical business standards that are thus created.

Unbalanced Three-Phase Circuits

TRANSMISSION and distribution engineers are devoting increased attention to unbalanced three-phase systems. Unbalance in a three-phase system is often as objectionable, and as serious in its consequences, as low power factor. In fact, the irregularity of three-phase circuits is ordinarily a combination of unbalance and of low power factor. These two causes are distinct, but the trouble they produce are closely associated. It is shown in the article by Prof. Waldo V. Lyon on another page that an unbalanced three-phase circuit may contain three components of emf. and of current in each branch—namely, (1) a uniphase component, (2) a direct-phase component, and (3) a reverse-phase component. The uniphase component can only exist when the system is connected in some way with the ground or with some other system. A star three-phase system with grounded neutral and containing transformers is likely to develop uniphase components of emf. and current in each phase.

Simple rules, both geometrical and algebraical, are offered for measuring the uniphase, direct-phase and reverse-phase components in any given case. These rules are well worth noting and remembering. It is also shown that, in respect to power and power losses, the two systems of direct-phase and reverse-phase emfs. and currents behave as though they had different frequencies. That is, the power developed, on the average, is that which the direct-phase emf. system exerts on the direct-phase current system and also that which the reverse-phase emf. system exerts on the reverse-phase current system; but the direct-phase system does no work, in the long run, upon the reverse-phase currents, and reciprocally. Nevertheless, the effect of the two associated systems is to develop power dissymmetrically in the different phases.

It is suggested that unbalanced three-phase systems might be cured and brought back to symmetry by generating an opposing set of equal and symmetrical reverse-phase emfs. on the system, preferably at the generator end. Since an unbalance in which there is no uniphase component is due to the superposition of a symmetrical reverse-phase system upon a symmetrical direct-phase system, it follows that if we annul the reverse-phase system in any case, we restore the system to symmetry. A synchronous three-phase balancer is connected to the circuit, with the proper magnitude and phase of emfs. The balancer can be made to oppose and annul the reverse-phase system.

Demand for Technically Trained Men

MANY comments are being made concerning the efforts that employers are making to secure college men who will be graduated from engineering schools this June. The predominant note of these comments is one of deploring the situation. The unusual offers of these employers and the competition between them has given the young men the opportunity to choose their jobs leisurely and to hold out at will for the highest bidder. This, it is claimed, causes them to slacken in their last semester of work and to overestimate their ability. Though there is undoubtedly much truth in these statements, it is unfortunate that proper consideration is not given to other sides of the situation, which in the main is quite encouraging. At first it should be remembered that the accomplishments of engineers during the war brought from the nation the praise and appreciation that the profession, though deserving it before, had failed in some degree to receive. The present demand for young engineers is therefore only the expression of the fact that this appreciation once granted is not being withdrawn at the close of the war, but is being extended to times of peace. Engineers are now looked upon to produce in peace results equal in relative importance to those they achieved in war.

Furthermore, the entrance into the industrial field of a large number of young, inexperienced men at a rate of pay higher than was paid those that entered it in the past, though the average increase is lower than that accorded to other groups of skilled or unskilled workers, will have two results, both of which will in the main be good. The first result will be a tendency to increase the salaries of the technically trained men at present employed in the industrial field. It is a well known fact that the technically trained man has not known how to sell his services and is at present receiving less pay in return for his work than any other man in this country. An increase in pay will automatically lead the employer to expect more of technical men, to accord them more freedom in working out new ideas and methods, to depend on them more largely for results. The second result, which also will take place automatically, will be that those men whose minds have failed to gain what is called the engineering point of view will be found lacking and will be forced down to minor positions, while the promise of a more comfortable living will bring back to engineering work many good engineers who were forced out of their positions by insufficient remuneration.

After all, prestige commensurate with ability is a need of the engineering profession to make it productive. The present situation bids fair to bring to it the share that it should receive. There is no great danger that incompetence will not be detected in a man dealing with facts and truths as an engineer does, but there is great danger indeed of hampering his latent accomplishments by low pay, lack of trust and failure of recognition.

Employees Reflect Service Ideals

THROUGH the organization of a public utility section of the Industrial Relations Association at its annual meeting in Chicago central-station executives are furnished with another opportunity to gain recognition for the welfare work and similar undertakings now so general and accompanied with such marked results in creating interest on the part of employees in their work and the affairs of the company. Public utility men can indorse Sherman Rodger's strong appeal for a relationship between employer and employee on a man-to-man basis, with all the cards face up on the table all the time. For when laboring men are interested in company affairs through the establishing of a human contact with their superiors, and when the facts concerning their responsibilities and their own interests are set forth in a clear, understandable manner, laboring men will arrive at sane decisions and industrial unrest will terminate.

Such a relationship is of much importance to public utilities, since the physical limitations are such that executives can maintain personal contact with only a limited number of the people they serve. The employee is therefore the mirror in which the attitude of the utility executive is reflected. When the contact between executive and employee is on a basis of mutual understanding and respect the reflection to the public is a true interpretation of service ideals that is easily understood.

Interconnection by Convenient Stages

THE first cost of many industrial undertakings retards their initiation and advancement, but in the case of power-plant or system interconnections the benefits of the policy need not wait upon final completion. Thus a strong argument exists at the outset on behalf of this kind of co-ordination. The ultimate investment often need not be made to secure partial returns upon the outlay required to start and advance the project to a workable stage. The importance of this deserves reiteration, for the breadth of many plans for interstate and inter-district tie-line construction looks startling to those unfamiliar with the potentialities. In these programs the sure reward of intelligent development and skillful operation justifies a very large outlay, but the unusual assets which even piecemeal construction offer should be exploited without waiting for authority to launch a great undertaking.

Development of interconnection by convenient steps is wholly defensible as a part of a desirable general program. Changing loads and growth of plants and systems illustrate continuously the mobile character of electrical supply. Like a great railroad, work is never finished on a thriving central-station system or in a group of lines or stations within mutual electrical touch. Some changes would be necessary in carrying out a general interconnection program, no matter how carefully the conditions were analyzed. It may well be that the benefits of linking together contiguous or closely adjacent installations would offset the local savings possible in a larger scheme, in which estimates must allow for some variation in loads impossible to foresee with great accuracy, but whose completion awaits large-scale financing.

It is a good thing for the art that progressive central-station managers, public officials and bankers have in so many cases taken the view that there is no need of waiting for the last oil circuit breaker to be plotted and the last dollar bespoken in a grand program of district development before beginning to reap the rewards of tying together local properties for more efficient service. If the possibilities of the larger programs are always borne in mind during these earlier advances, interconnection will develop along very advantageous lines, gathering impetus as it goes and steadily approaching the theoretical ideal of the most far-sighted engineers and financiers. The field is large enough for both local and general activity.

Newest Stations of Southern Power Company

WHILE the extent and importance of the system of the Southern Power Company in the industrial growth of the Carolinas is well known, it is not equally well known that the demands for power have become so considerable, despite war-time conditions, that it was necessary approximately to double the hydraulic generating capacity of the system. The Southern Appalachian country, while blessed with a rather heavy rainfall, presents the unusual condition of having substantially no natural lakes; consequently the continuity of electrical service in full capacity depends on artificial storage. The streams in this territory, too, have their highest falls well back from the sea in the Piedmont country, and here the stations must generally be situated in order to get the advantage of reasonably high head. Seven out of the eight plants of the Southern Power Company are on the Catawba River. For feeding these stations and providing necessary storage a big reservoir near its headwaters at Bridgewater, N. C., somewhat over ten square miles (25.9 sq.km.) in area, has recently been provided by the building of two long and high dams of earthwork construction.

A new 25,000-kw. power plant at Bridgewater also takes water directly from these reservoirs through a short tunnel and penstock, at a working head of 115 ft. (35 m.), notable because it is entirely an artificial head in spite of its height. The Bridgewater station was finished and placed in operation last fall, almost simultaneously with a still larger station on the Wateree River, which was described in the May 8 issue of the ELECTRICAL WORLD. Here again the head, in this case of 72 ft. (21 m.), is chiefly due to the storage reservoir, which has an area of about 18 square miles (46.6 sq.km.).

These two generating stations are of particular interest not only on account of their adding large capacity to an important system, but by reason of the fact that they depend on artificial head obtained by storage reservoirs upon a large scale and embody features which represent the results of twenty years' study and experience in the operation of water-power stations of the South by W. S. Lee, one of the foremost hydro-electric engineers in this country.

Arthur W. Berresford

The new president of the A. I. E. E. is an engineer-executive well known for his constructive optimism and fullness of knowledge of engineering and business conditions in the electrical industry.

ON MAY 21 the American Institute of Electrical Engineers in annual business meeting declared Arthur W. Berresford elected president for the year beginning August, 1920. This honor comes to an executive who is not only classed as an electrical engineer but qualifies with ample margin. Mr. Berresford started his professional career by way of the "work for experience" route in general engineering work with public service companies. Then he obtained a position as designer with the Riker Electric Company, and in 1896 he took charge of the testing and design work for the Ward Leonard Electric Company. In 1898, in company with others, Mr. Berresford purchased from the receiver the assets of the Iron-Clad Rheostat Company, forming the Iron-Clad Resistance Company, of which he became vice-president and manager. In 1900 this company was purchased by the Cutler-Hammer Manufacturing Company. Mr. Berresford then entered the engineering department of the latter, and in 1901 he was appointed superintendent, in 1902 secretary, in 1905 general manager and in 1907 vice-president and general manager, the title which he now holds.

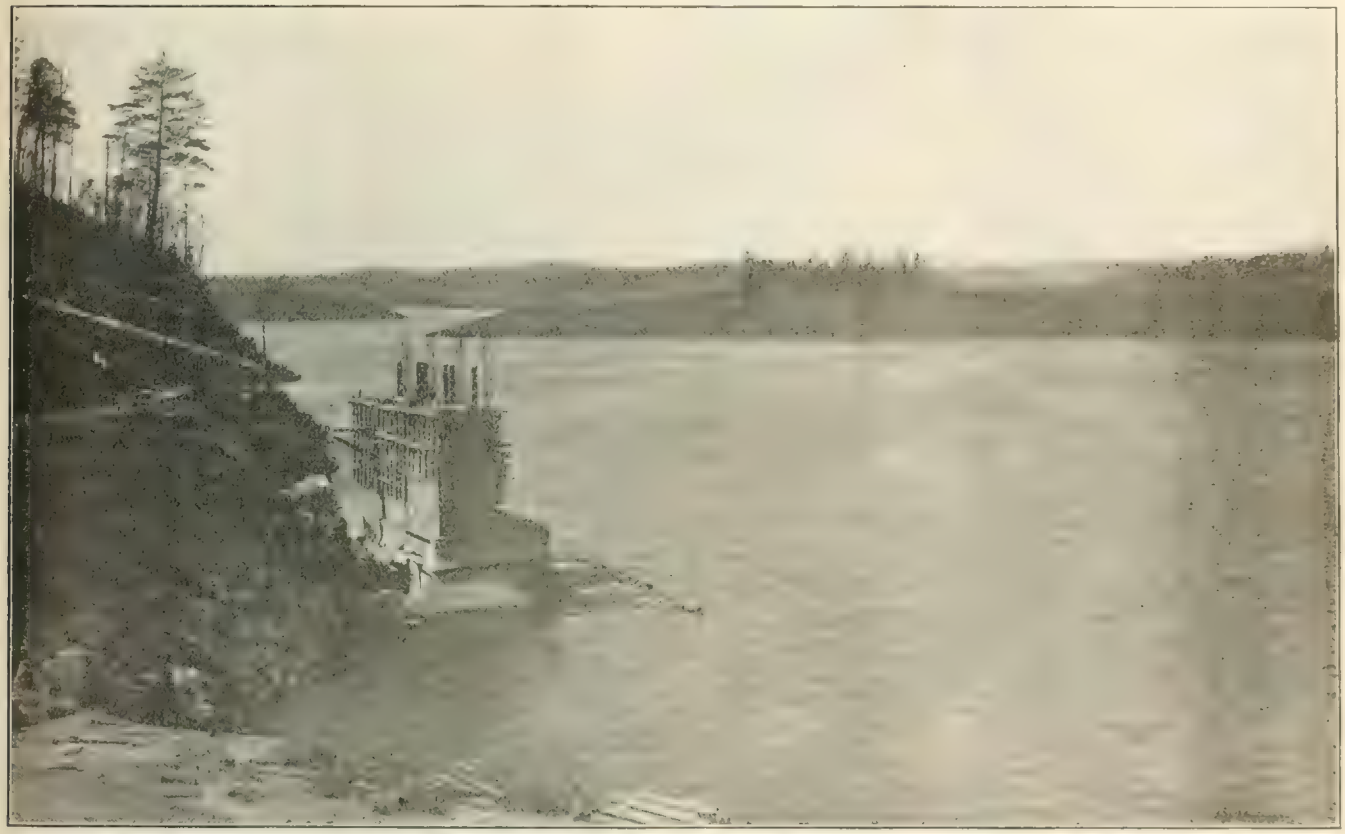
Mr. Berresford has been honored by other branches of the industry on account of his common-sense counsel and constructive optimism, which always has at its foundation a full knowledge of the industry as an engineer and as an executive. He has served as president of the Electrical Manufacturers' Club, and during the war he was elected as chairman of the General War Service Committee of the Electrical Manufacturing Industry and was as well chairman of the General War Service Committee of the Electrical Manufacturers of Electrical Supplies. He is a fellow of the A. I. E. E. and a past-vice-president and manager. Besides, he is a member of the American Society of Mechanical Engineers, the Naval Architects and Marine Engineers, the National Electric Light Association and the Society for Promotion of Engineering Education.

Mr. Berresford was born in Brooklyn, N. Y., July 9, 1872. He was graduated from the Brooklyn Polytechnic Institute in 1892 with the degree of bachelor of science, and from Cornell University the following year with the degree of M.E. in electrical engineering.

Master Storage Reservoir for Southern Power Company's System

Features of Bridgewater Reservoir Which Provides Storage for Seven Hydro-Electric Plants of the Southern Power Company and Details of the 25,000-Kva. Bridgewater Station at this Reservoir

By W. S. LEE[1] and RICHARD PFAEHLER[2]



INTAKE TOWER AT LINVILLE DAM FOR BRIDGEWATER STATION. AT THE LEFT IN THE BACKGROUND THE CHANNEL BETWEEN PADDY CREEK AND LINVILLE VALLEY IS SHOWN. IN THIS ILLUSTRATION THE WATER IS 50 FT. BELOW THE SPILLWAY CREST OF THE LINVILLE DAM

WITH the exception of the Ninety-nine Islands station, all of the hydraulic plants (eight in number) of the Southern Power Company of Charlotte, N. C., are located on the Catawba River. In order to increase the primary output of these stations, the Western Carolina Power Company, a subsidiary of the Southern Power Company, in August, 1916, started the construction of a large storage reservoir at Bridgewater, N. C., which would retain the high waters of the upper Catawba River and its tributaries and make storage available during periods of low water on the lower Catawba. This reservoir is at the foot of the Blue Ridge and Linville Mountains, in North Carolina. When full it covers 6,509 acres (16,077 hectares) with an available storage capacity of 12,581,843,000 cu.ft. (352,000,000 cu.m.). The water discharged from this reservoir is conducted to the Bridgewater power station by a short tunnel and penstock before it continues to flow in the old river bed. The Bridgewater station, which has a rating of 25,000 kva., was placed in operation in September, 1919.

The water discharged from the Bridgewater reservoir is available at the following seven stations operated by the Southern Power Company on the Catawba River:

Station	Rating in Kva.	Head in Feet	Placed in Operation
Catawba S. C.	6,600	24	1904
Great Falls, S. C.	30,000	69	1907
Rocky Creek, S. C.	30,000	61	1909
Lookout Shoals, N. C.	22,500	76	1915
Fishing Creek, S. C.	37,500	51	1916
Bridgewater, N. C.	25,000	115	1919
Wateree, S. C.	70,000	72	1919

The Ninety-nine Islands station of the company, on the Broad River in South Carolina, which has a capacity of 22,500 kva. under a head of 72 ft. (21.6 m.), was placed in operation in 1910. Four auxiliary steam stations have also been built, with a total rating of 36,500 kva., making the combined generator rating of the eight hydro-electric and four steam plants 280,900 kva. These stations serve 2,050 miles (3,300 km.) of high-voltage transmission lines and, through 201 outdoor substations with a combined rating of transformers of 445,500 kva., furnish energy to one-fourth of the number of cotton spindles of the South.

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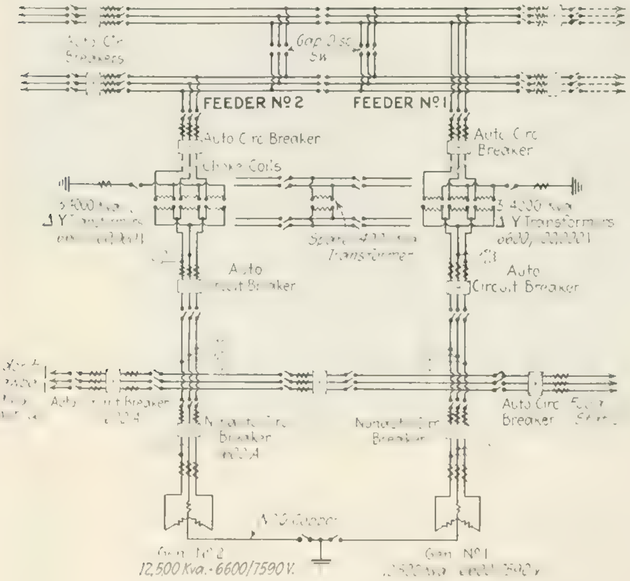
[1] Vice-president and chief engineer Southern Power Company.
[2] Hydraulic engineer.

[*] The engineering features of the Wateree station, which was placed in operation by the Southern Power Company on Oct. 7, 1919, were presented in the May 8, 1920, issue of the ELECTRICAL WORLD, page 1,072 to 1,075.

BRIDGEWATER RESERVOIR AND GENERATING STATION

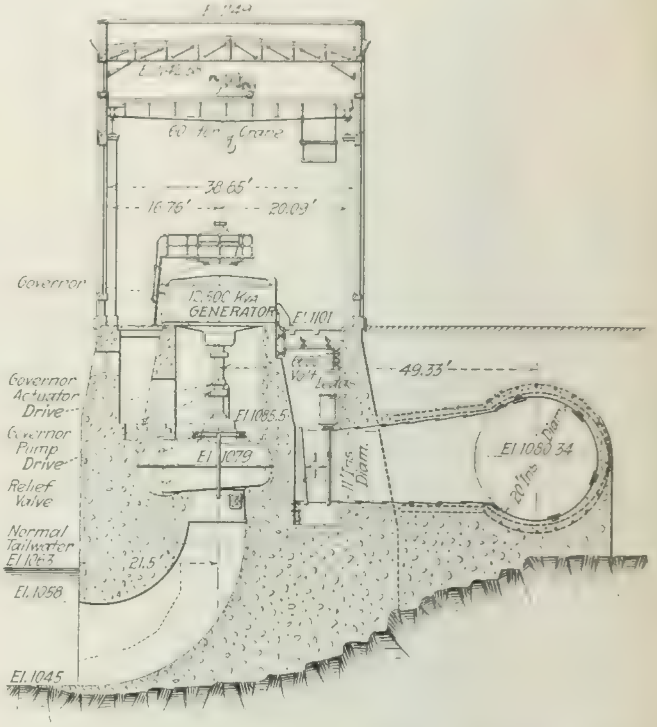
To create the Bridgewater reservoir it was necessary to build separate impounding structures in the Catawba, Paddy Creek, and Linville valleys. The Catawba work includes a 305-ft. (93-m.) long masonry spillway of 125 ft. (38 m.) height above the river bed, a masonry bulkhead, corewalls and earth-dam extensions. Both the Paddy Creek dam and the Linville dam are earth structures built by a combination of steam shovel and hydraulic sluicing method, and have a maximum height of 165 ft. (50 m.). The earth-fill materials involved in the entire work are estimated to amount to 4,520,000 cu.yd. (3,443,000 cu.m.).

The difference in water levels between the full reservoir and the Linville River below the dam site is 137 ft. (41.7 m.). To utilize this head the main outlet works of the reservoir were built immediately above the Linville dam and connected with the power house by means of a short tunnel and penstock. The concrete-lined tunnel has a horseshoe-shaped cross-section of 409.4 sq.ft. (37.6 sq.m.) along the first 230 ft. (70 m.) and then changes into a circular section of 20 ft. (6 m.) diameter. The penstock of the same diameter is built up of 1 in. (2.5 c.m.) thick plate steel provided with stiffening rings of 4-in. x 4-in. x $\frac{5}{8}$-in. (100-mm. x 100-mm. x 16-mm.) angles riveted to the outside of the pipe, the average spacing of the rings being 3 ft. (0.9 m.). Two branches decreasing from 14 ft. (4.2 m.) inside diameter to 11 ft. (3.3 m.) inside diameter lead from the penstock to the power house. The penstock end is formed by a reducer having an outlet of 6 ft. (1.8 m.) inside diameter. Two 6-ft. (1.8-m.) diameter gate valves are attached to the reducer in tandem, and a hinged cast-iron head, provided with a nest of seven cast-iron bursting plates of 18-in. (45-cm.) diameter and 0.391-in. (9.8 mm.) thickness, is bolted to the discharge flange of the gate valve furthest downstream. The bursting plates are designed to give away at a pressure of 80 lb. per square inch (5.6 kg. per sq.cm.) in the penstock arising from waterhammer, and with all seven plates blown out the discharge of water will be sufficient to prevent further rise of pressure in the penstock and turbine casing. It is, however, figured that this condition will exist only in case that the two turbine relief valves should become stuck and would not open.



ELECTRICAL CONNECTIONS OF BRIDGEWATER STATION OF WESTERN CAROLINA POWER COMPANY

On the indoor buses each circuit running from generators No. 1 and No. 2 to generator O.C. breakers No. 1 and No. 2, respectively, to consist of two 3-in. x $\frac{1}{4}$-in. copper bars per phase. Each circuit running from generator O.C. breakers No. 1 and No. 2 to line O.C. breakers No. 1 and No. 2, respectively, to consist of three 3-in. x $\frac{1}{4}$-in. copper bars per phase. Low-tension bus to consist of three 3-in. x $\frac{1}{4}$-in. copper bars.

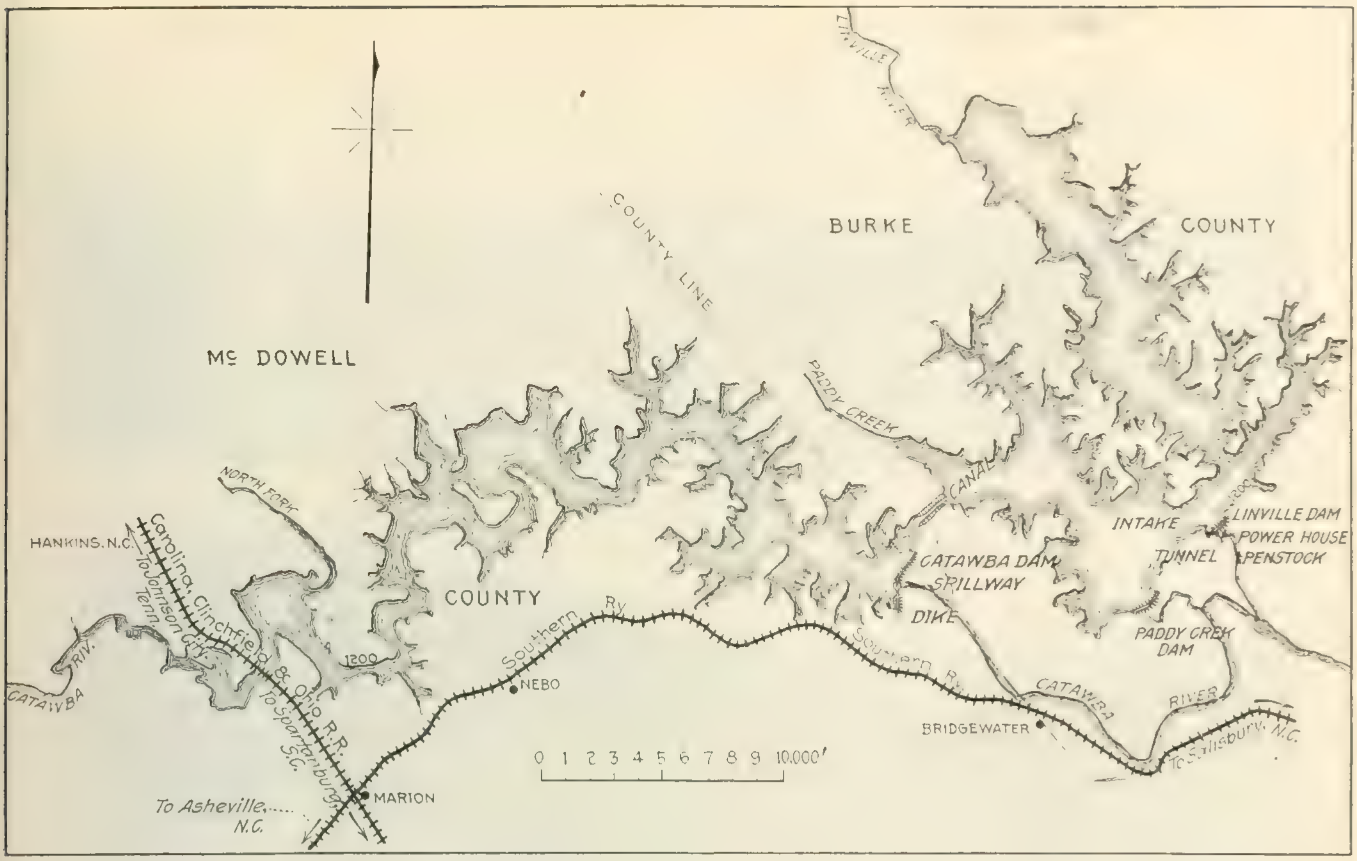


BRIDGEWATER STATION OF THE WESTERN CAROLINA POWER COMPANY—TYPICAL SECTION THROUGH POWER HOUSE

THE HYDRAULIC TURBINES IN BRIDGEWATER STATION

The two turbines installed in the power station are of the Francis vertical-shaft, single-runner, volute-casing type, operating at a speed of 171.5 r.p.m. Each machine is guaranteed to deliver 13,200 hp. to the generator shaft when operating under an effective head of 115 ft. (35 m.) with an efficiency of 85 per cent. The range in head on these waterwheels will be from 135 ft. to 85 ft. (41 m. to 26 m.), depending on the reservoir stage. The maximum output of each turbine considering the limits of head of 135 ft. and 85 ft. will be 16,800 hp. and 8,000 hp. respectively. Above an effective head of 115 ft. the turbine gates will, however, be blocked so that the power developed will not be greater than that corresponding to the rated output of 10,000 kw. of each generator.

The turbine casings are of cast iron and were subjected to a hydrostatic pressure of 95 lb. per sq.in. (6.6 kg. per sq.cm.), in the manufacturer's shops. Between each penstock branch and turbine casing a hydraulically operated butterfly valve is inserted. The lens-shaped valve disk is made of cast steel and has a diameter of 11 ft. (3.3 m.) The operating cylinder is supplied with oil taken from the governor system under a pressure of 150 lb. per sq.in. (10.5 kg. per sq.cm.). A locking device



290,000-ACRE-FT. STORAGE RESERVOIR FOR SEVEN STATIONS OF SOUTHERN POWER COMPANY ON CATAWBA RIVER

is connected with the operating cylinder, by means of which the butterfly valve may be kept in a closed position without the use of oil pressure. The minimum time required for completely closing the valve is fifteen seconds, this preventing an excessive rise of pressure in the penstock in the event that the pressure piping to the cylinder should break.

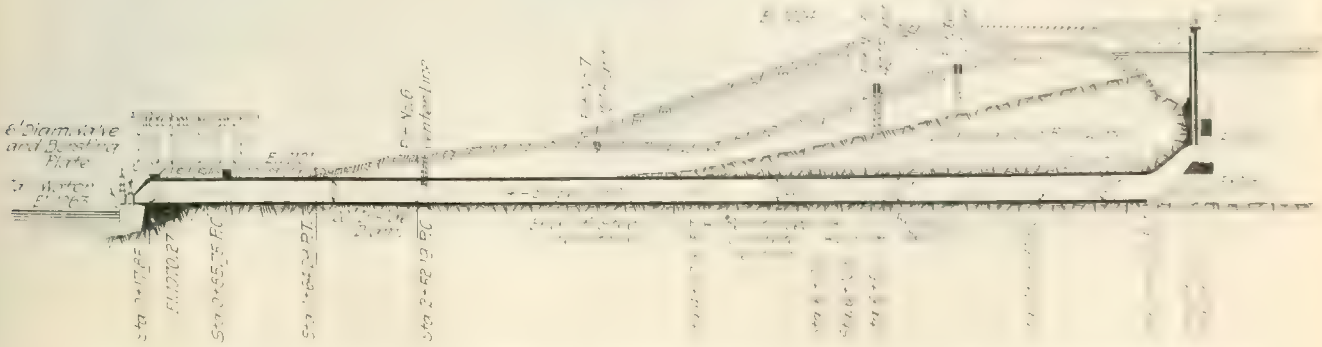
The governor system for the two turbines is interconnected, and the rotary oil pumps, of 125 gal. (473 l.) per minute capacity each, have mechanical drives. Each turbine is provided with a governor operated relief valve having an opening 4 ft. 6 in. (1.35 m.) in diameter between the turbine casing and the relief valve elbow and a discharge opening 5 ft. 6 in. (1.65 m.) in diameter below the relief valve. On the basis of the normal head being 115 ft. (35 m.) and full load suddenly thrown off one unit, the relief valve will discharge 35 per cent of the water capacity of the wheel. The governor is adjusted to close the gates in three and one-half seconds, and the guaranteed speed regulations based on a flywheel effect of 3,360,000 lb.-ft. (464,000 kg.-m.) squared in the rotor of the generator and on the dimensions and lengths of the tunnel and penstock are:

Load on:					
Per cent load changes	10	25	50	75	100
Per cent speed changes	1.5	3.6	8.0	15	30
Load off:					
Per cent load changes	10	25	50	75	100
Per cent speed changes	1.8	3.8	9.0	16.8	34

In view of the fact that the load taken up by the Bridgewater station is only a small portion of the load on the entire system of the Southern Power Company, these regulating conditions are considered satisfactory.

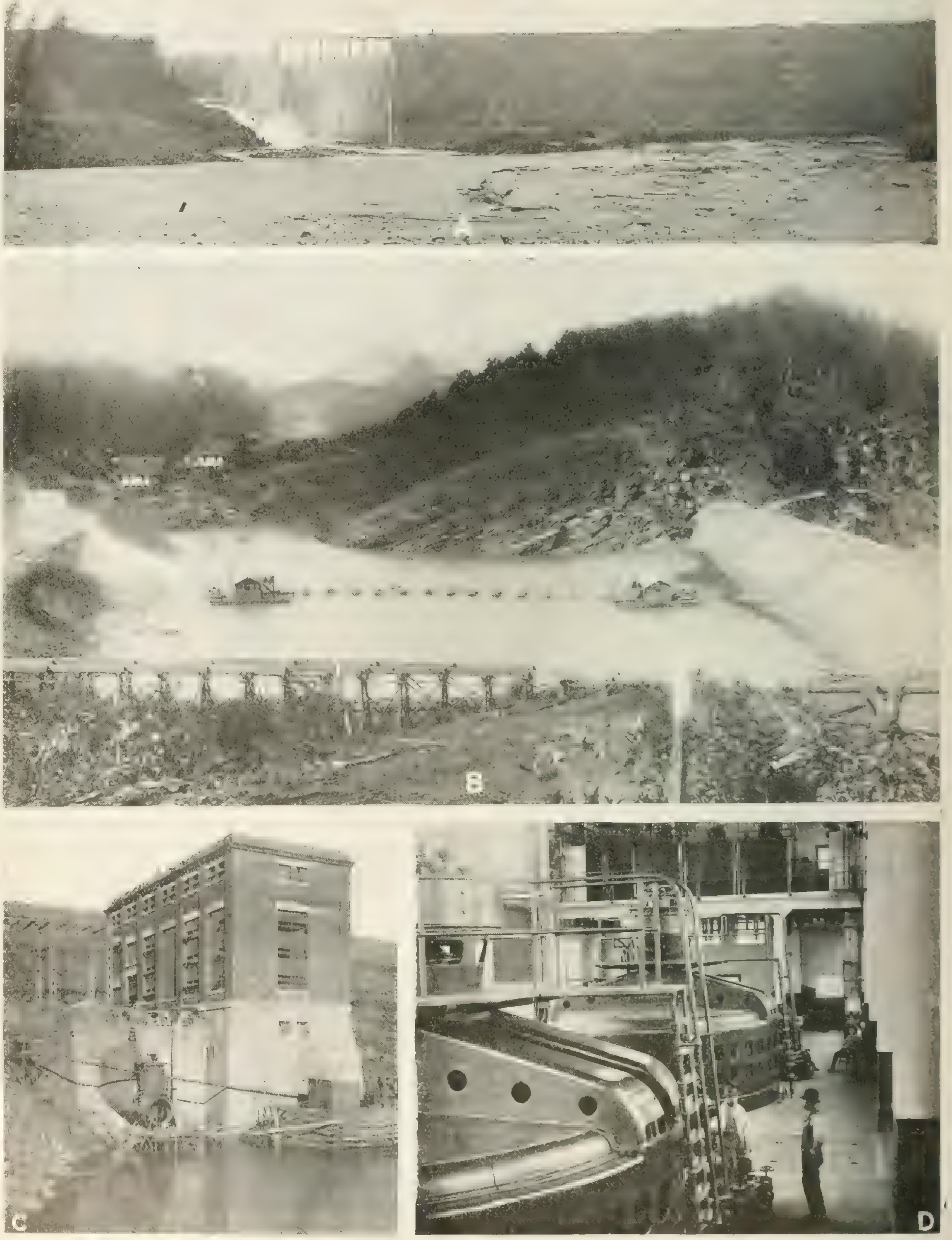
The draft tubes are built of concrete. The upper portion is, however, lined with ⅜-in. (9.6-mm.) thick plate steel, and the draft-tube ring connecting with the speed ring is built of cast iron. The water discharges from the draft tubes into the tailrace blasted out of the bed of the Linville River.

Two 6,600-volt, 60-cycle, three-phase vertical-shaft Allis-Chalmers generators are directly connected to the turbines operating at 171.5 r.p.m. Each machine is



LINVILLE TUNNEL AND PENSTOCK OF WESTERN CAROLINA POWER COMPANY LEADING TO BRIDGEWATER STATION

Two Dams and Bridgewater Station of the Southern Power Company



A—Downstream side of the Catawba River dam showing earthwork section and spillway. (See map on page 1301.)
B—Linville dam under construction, hydraulic sluicing outfit in operation.

C—Bridgewater power house showing penstock reducer with a 6-ft. diameter valve attached. The Linville dam is shown in the background.
D—Two 12,500-kva. generators in Bridgewater station.

designed for a normal output of 12,500 kva., and when operating continuously at the rated load and 80 per cent power factor the increase in temperature is guaranteed not to exceed 40 deg. C. in any part of the alternator. Including the exciter losses, the guaranteed generator efficiencies at 80 per cent power factor are: Half load, 93.4 per cent; three-quarters load, 95.2 per cent; full load, 95.9 per cent; 25 per cent overload, 96.4 per cent.

Each generator is provided with an exciter having a normal rating 120 kw. at 250 volts and 171.5 r.p.m. The exciter rheostats are motor-operated and no rheostats are placed in the alternator-field circuits. For the operation of the 60-ton capacity electric crane a 150-kw. motor-generator set is installed in the power house furnishing direct current at 250 volts. In the event that any of the individual exciters should break down the motor-generator set may be used as an exciter by running one flexible two-conductor No. 00 rubber-covered cable from the line switch for the crane to the respective generator-field terminals and by connecting the field-control terminals of the motor-generator set in series with the field-control terminals of the respective exciter by a flexible two-conductor No. 6 rubber-covered cable.

BRIDGEWATER POWER HOUSE AND OUTDOOR TRANSFORMER AND SWITCHING STATION LOOKING TOWARD LINVILLE DAM

For the control of the low-tension and high-tension circuit breakers a 7-kw. motor-generator set provides direct current at 250 volts, and in case of emergency power may be supplied by operating the 150-kw. motor-generator set. All the conduits for the indoor-control circuits are embedded in the generator floor and balcony floor. Upon this latter floor there are placed the seven low-tension oil circuit breakers and three 75-kva. 6,600/550 volt, single-phase transformers, which furnish the power for the two motor-generator sets, the 10-hp. motor-driven air compressor, the station and village lighting, and the 75-hp. alternating-current motor operating the headgate hoists at the Linville tunnel intake.

An outdoor transformer and switching station is connected with the power house by a galvanized steel structure 92 ft. (28 m.) long, which carries the two 6,600-volt circuits leading to the low-tension terminals of the two transformer banks. Each of the circuits consists of three 3-in. x ¼-in. (7.5-cm. x 6.4-mm.) copper bars per phase. Along the railroad track running into the power house the six station transformers together with one spare transformer are arranged. The transformer bases and their extensions are provided with rails engaging the transformer wheels so that any of the transformers may be rolled out to a carriage placed on the railroad track and transferred by a 60-ton crane. Each bank of transformers consists of three 4,000-kva. oil-insulated, water-cooled, single-phase, 60-cycle, 6,600/100,000-volt transformers, connected delta-star, with taps for additional voltages. The guaranteed efficiencies at 100 per cent power factor and at a temperature of 75 deg. C. are: Quarter load, 97.4 per cent; half load, 98.35 per cent; three-quarters load, 98.55 per cent; full load, 98.55 per cent; 25 per cent overload, 98.5 per cent.

At present four 300-amp., 100,000-volt type G-1 oil circuit breakers are in use, and provision is made for the installation of three additional circuit breakers to take care of extensions to the transmission system.

[The details of the complete Bridgewater project and the Wateree development (ELECTRICAL WORLD, May 8, 1920, page 1072) were executed under the direction of W. S. Lee, vice-president and chief engineer of the Southern Power Company. On the Bridgewater work Albert S. Crane of the J. G. White Engineering Corporation was retained as consulting engineer in connection with the design and construction of the earth dams and masonry structures. F. H. Cothran was the resident engineer.—EDITOR.]

Unbalanced Three-Phase Circuits

Analytical and Graphical Methods of Treating Problems Arising from Operation of Three-Phase Apparatus on Unbalanced Voltages—Examples Are Given to Illustrate the Theory

By **WALDO V. LYON**

Assistant Professor of Electrical Engineering Massachusetts Institute of Technology

THE normal operation of balanced three-phase circuits in which the voltages and currents are essentially sinusoidal is generally well understood. The study of harmonics or of unbalanced conditions in voltage and current has seemed to require so much mathematical analysis that their effects are less widely known. A method of considerable power, however, has been recently advanced for the analysis of problems involving unbalanced polyphase systems. Since three-phase circuits are more common and since certain details in their analysis are simpler, they alone will be discussed at this time. As we shall see, the majority of three-phase circuits operating under unbalanced conditions of voltage or current or both are equivalent to two balanced three-phase systems of opposite phase order superimposed upon each other. That is to say, it may be assumed that the real current in each of the parts 1, 2 and 3 of the three-phase circuit (Fig. 1) consists of two component currents. The first component is one of a balanced system of currents of which the current I_a (in 1) *leads* the current I_b (in 2) by 120 deg. The second component is one of another balanced system of currents of which the current, I_x (in 1) *lags* the current I_y (in 2) by 120 deg. In this illustrative case the values of these two components are respectively 44.5 amp. and 20 amp. The real currents in 1, 2 and 3 are $I_1 = 62$ amp., $I_2 = 29.5$ amp. and $I_3 = 48$ amp. respectively. In some special cases there is another component, the same in magnitude and phase in each of the three branches and for this reason called the uniphase component, of which more will be said later.

Applications and Limitations of Method

If the resistance, inductance or capacitance in the circuit are direct functions of the current, the method loses practically all of its usefulness. For a circuit whose "constants" vary cyclically with the current any method which decomposes the current into components is probably of little value, since the circuit constants are functions of the total current and not of the individual components. If the "constants" vary cyclically with the *time*, however, as does, for example, the inductance of a salient pole alternator, the method is a powerful one. In this case harmonics will be present, and their discussion lies beyond the scope of our paper. Furthermore, the three parts or phases of the circuit should either have no mutual effect upon one another, as do independent single-phase loads, or they should have equal mutual effects upon one another, as do symmetrical or balanced three-phase machines. If the equivalent resistances and reactances of independent single-phase loads are known, the currents they take from any voltage system can readily be determined by the well known principles of divided circuits, although for some purposes it may be advantageous to calculate the components. The method is most helpful in the analysis of balanced polyphase apparatus operating under unbalanced voltage conditions.

Thus the solution of unbalanced circuits generally involves nothing more difficult than the solution of two balanced circuits and their proper combination. When this principle is fully appreciated, the characteristics of unbalanced three-phase circuits should be as generally understood as the characteristics of balanced circuits.

It is the purpose of this paper to show how this idea has been developed and applied to the solution of such problems. The consideration of harmonics is omitted inasmuch as this would complicate the analysis and thus obscure the principles it is desired to discuss. It must be said, however, that an unbalanced condition in a polyphase synchronous machine may of itself develop harmonics.

The general principle is this: Each of any three vectors representing either harmonically varying voltages or currents may be considered as the sum of three component vectors. The first of these components is the same for each of the vectors and will therefore be called the "uniphase component." It will be designated by the subscript *u*. The second component is one of a three-phase balanced system which has the same phase order as the three original vectors; that is to say, the first vector of this balanced system leads or lags the second vector of this system by 120 deg., according to whether the first original vector is considered to lead or lag the second vector.[1] These balanced vectors will be called the "direct-phase-order components," or more briefly the direct-phase components. They will be designated by the subscript *d*. The third component is one of another three-phase balanced system which has the opposite phase order. That is to say, the first vector of this system lags or leads the second vector according as the first vector of the direct-phase system leads or lags the second vector of that system. This second system of balanced vectors will be called the "reverse-phase-order components," or more briefly the reverse-phase components. They will be designated by the subscript *r*.

The significance of these components of the unbalanced system of vectors is more readily understood by referring to the vector diagram Fig. 2. In this diagram V_u is the uniphase component that is common to each of the three unbalanced vectors, V'_1, V'_2 and V'_3. The direct-phase components, V_{1d}, V_{2d} and V_{3d}, are three equal vectors 120 deg. apart, thus forming a balanced system which has the same phase order as the resultant vectors; *i.e.*, V_{1d} leads V_{2d} by 120 deg. The reverse

[1] The phase order of the original vectors may seem uncertain if there is any considerable uniphase component. In such a case the correct phase order is the same as that of the vectors found by subtracting the uniphase component from each of the original vectors. Thus, referring to Fig. 2, the phase order of the original vectors, V'_1, V'_2 and V'_3, is the same as that of the vectors V_1, V_2 and V_3, which are found by subtracting the uniphase component V_u from V'_1, V'_2 and V'_3 respectively.

phase components, V_{1r}, V_{2r} and V_{3r}, are also three equal vectors 120 deg. apart, but their phase order is reversed; *i.e.*, V_{1r} lags V_{2r} by 120 deg. The vector equations are:

$$V'_1 = V_u + V_{1d} + V_{1r} \qquad (1)$$

$$V'_2 = V_u + V_{2d} + V_{2r} \qquad (2)$$

$$V'_3 = V_u + V_{3d} + V_{3r} \qquad (3)$$

Since the second and third components are parts of two balanced systems, their sums are each zero. That is

$$V_{1d} + V_{2d} + V_{3d} = 0,$$

and

$$V_{1r} + V_{2r} + V_{3r} = 0.$$

If the first three equations are added together, it then follows that

$$V_u = \tfrac{1}{3}\,(V'_1 + V'_2 + V'_3) \qquad (4)$$

That is, the uniphase component of any three-phase system is one-third of the sum of the vectors. If the uniphase component is subtracted from each of the original vectors, the sum of the resulting vectors is of course zero. In Fig. 2 these resulting vectors are represented by V_1, V_2 and V_3 and their sum is zero. There is no uniphase component when the sum of the vectors is zero. The sum of the line voltages or of the line currents when there is no neutral connection is zero, and thus they can have no uniphase component. Any three-phase system of line voltages or of line currents, provided there is no neutral connection, may therefore be considered as the sum of two balanced systems of opposite phase order. The magnitudes and phase relation of these two systems are readily determined as follows. We have:

$$V_1 = V_{1d} + V_{1r}$$

and

$$V_2 = V_{2d} + V_{2r}.$$

Let the phase order of the resultant vectors be such that V_1 leads V_2 by an angle less than 180 deg. The phase order of the direct-phase components is the same, and thus V_{1d} leads V_{2d} by 120 deg. and V_{1r} lags V_{2r} by 120 deg. Thus the second equation[2] may be written:

$$V_2 = V_{1d}\,\underline{/-120^\circ} + V_{1r}\,\underline{/120^\circ}.$$

If each of the vectors in this equation is rotated clockwise through 120 deg., we may write:

$$V_2\,\underline{/-120^\circ} = V_{1d}\,\underline{/-240^\circ} + V_{1r}.$$

Subtracting this from the equation for V_1 gives:

$$V_1 - V_2\,\underline{/-120^\circ} = V_{1d} - V_{1d}\,\underline{/-240^\circ}$$

or

$$V_1 + V_2\,\underline{/60^\circ} = \sqrt{3}\,V_{1d}\,\underline{/-30^\circ}.$$

From which it follows that:

$$V_{1d} = \frac{1}{\sqrt{3}}\left(V_1 + V_2\,\underline{/60^\circ}\right)\underline{/30^\circ}, \qquad (5)$$

or

$$V_{1d} = \frac{1}{\sqrt{3}}\left(V_1\,\underline{/30^\circ} + V_2\,\underline{/90^\circ}\right) \qquad (5a)$$

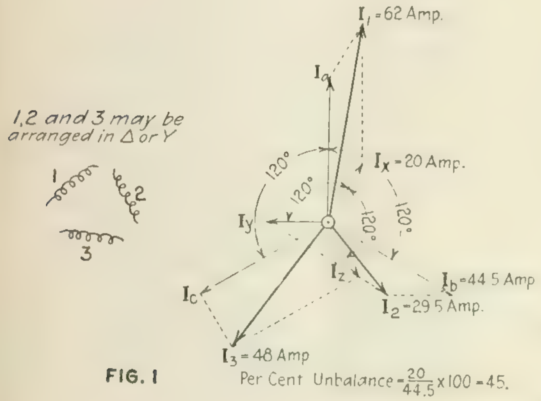


FIG. 1

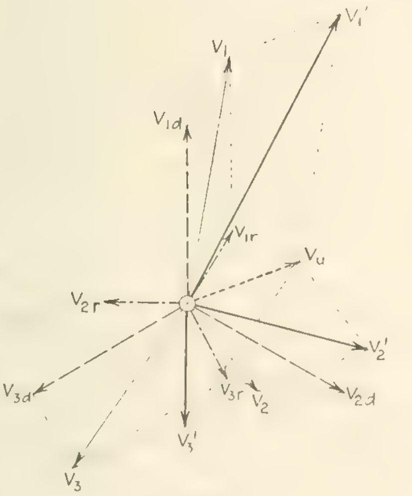


FIG. 2

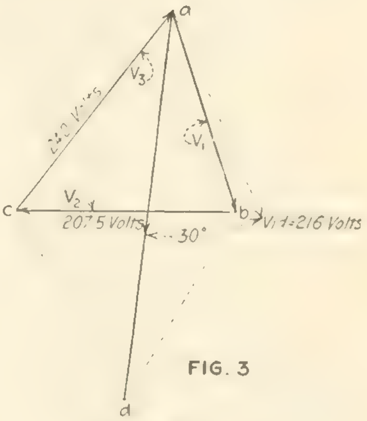


FIG. 3

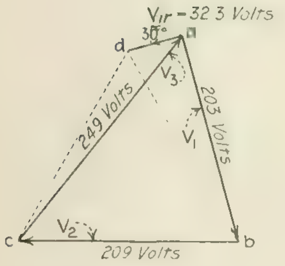


FIG. 4

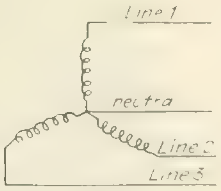


FIG. 5

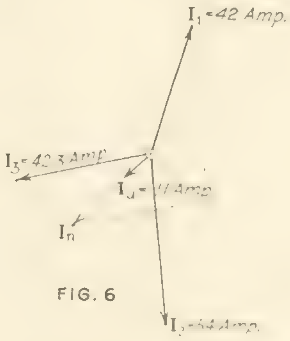


FIG. 6

FIG. 1—COMPONENT BALANCED CURRENTS REPLACING UNBALANCED CURRENTS IN A THREE-PHASE SYSTEM; FIG. 2—RELATIONS IN UNBALANCED THREE-PHASE SYSTEM OF VOLTAGES; FIGS. 3 AND 4—DETERMINATION OF DIRECT PHASE COMPONENT, AND DETERMINATION OF REVERSE-PHASE COMPONENT; FIGS. 5 AND 6—CURRENTS IN A THREE-PHASE FOUR-WIRE SYSTEM

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[2] There are several ways of indicating that one vector has the same magnitude as another but is displaced in phase from it by a given angle. Perhaps the simplest of these is the following: $V\,\underline{/\theta}$ represents a vector of the same length as the vector V after it has been rotated θ degrees from V in a positive or counter-clockwise direction. A minus sign before θ indicates that this rotation is in the negative or clockwise direction. Thus, in Fig. 2 $V_{2r} = V_{1r}\,\underline{/120^\circ}$, and $V_{2d} = V_{1d}\,\underline{/-120^\circ}$.

A similar expression may be deduced for the reverse-phase component:

$$V_{1r} \quad \frac{1}{\sqrt{3}}\left(V_1 \quad V_2 \quad \underline{60}\right) \quad \underline{30} \qquad (6)$$

Thus the magnitude of the direct-phase component V_{1d} is found by dividing by $\sqrt{3}$ the sum of V_1 and V_2 after the latter is rotated 60 deg. toward V_1. The magnitude of the reverse-phase component is found in the same way except that V_2 is rotated 60 deg. away from V_1. This suggests a very simple graphical method for obtaining the magnitudes of either of these components. Draw the resultant vectors to scale so as to form a closed triangle (see Fig. 3). Construct an equilateral triangle *bdc* on V_2 and draw the line joining the opposite vertices *a* and *d* as shown. The magnitude of V_{1d} is the length of this line *ad* to scale divided by $\sqrt{3}$. In order to obtain V_{1d} in its proper phase position, this line should be rotated through 30 deg toward V_1 as shown by the dotted line, V_{1d}, in the figure. The reverse phase component, V_{1r}, can be found in a similar manner by constructing the equilateral triangle on the other side of V_2 as shown in Fig. 4. The numerical value of V_{1r} is equal to *ad* dvided by $\sqrt{3}$. Its proper phase position is found by rotating the line *ad* through 30 deg. away from V_1 as is shown by the dotted line in Fig. 4. In problems where the accuracy of graphical methods is sufficient this construction gives perhaps the simplest means for obtaining the direct-phase and reverse-phase components of any three-phase vectors whose sum is zero.

MEASURING DIRECT AND REVERSE-PHASE COMPONENTS

This principle may also be made use of in measuring the magnitude of either the direct-phase or reverse-phase components. It is only necessary to construct apparatus that will, for example, combine a given portion of one of the line voltages with the same portion of another after rotating the latter through 60 deg. (see equations 5 and 6). The necessary phase displacement of 60 deg. can be obtained by the proper arrangement of series and parallel circuits. When referred to subsequently this will be spoken of as a voltage or current "mixer." Should it be desirable to give this combination its proper phase, it will be necessary to use such additional series or parallel circuits as will produce the correct displacement of 30 deg. (see equations 5 and 6). Or it may be simpler to design the "mixer" so that it will rotate one of the line voltages 30 deg. and the other 90 deg. before combining them (see equation 5a). Thus we are able, with little difficulty, to calculate or measure the direct-phase and reverse-phase components in either the line voltages or line currents of any three-phase system (without a neutral conductor).

The method and results of the analysis become much clearer on considering a few illustrative cases. In each of these except the first it will be assumed that there is no neutral conductor.

Case 1—Circuits Arranged as in Fig. 5.—The current in the neutral is the sum of the phase currents. The uniphase component is thus one-third of the neutral current. With three equal single-phase loads or with a symmetrical three-phase machine the uniphase component in the current is proportional to the corresponding component in the phase voltages to neutral. For single-phase loads having constant resistances and reactances the constant of proportionality is their impedance. The impedance of a symmetrical three-phase machine to the uniphase current, however, is quite different from the impedance to balanced three-phase currents of either phase orders.[3]

The vector diagram is shown in Fig. 6. With unbalanced single-phase loads there will probably be current in the neutral even when the phase voltages to neutral are balanced. There is then no definite relation between the uniphase current and uniphase voltage.

Case 2—Circuits Arranged in Y Without Neutral Conductor.—If the three phases of the load are balanced, there is no uniphase component in the voltages to the load neutral. With unbalanced single-phase loads—a very unusual arrangement—there will probably be a uniphase component in the voltage across each load. Practically this is the difference in potential between the neutral of the unbalanced load and the neutral of a balanced load connected across the same circuit. By a construction similar to that used in determining the direct-phase and reverse-phase components it can readily be proved that the position of the neutral of a balanced three-phase load connected in Y across unbalanced voltages is at the point *o* where *ao* is one-third of *ad* (Fig. 7). The voltages across the phases of this balanced load are *oa*, *ob* and *oc*. This point *o* may be called the true neutral of the system. This true neutral point is at the center of gravity of the voltage triangle; that is, it is at the intersection of lines drawn from the vertices to the middle of the opposite sides.

Case 3—Circuits Arranged in Δ.—The statements made in regard to voltages in case 2 are now true in regard to currents. These unbalanced loads, whether connected in Y or in Δ may give balanced line currents. For example, if the Y impedances are $\sqrt{3}K$, $K \underline{/\ 30^\circ}$ and $K \underline{/-30^\circ}$, or if the Δ impedances are K, $\sqrt{3}K \underline{/\ 30^\circ}$ and $\sqrt{3}K \underline{/-30^\circ}$, the line currents are equal and the load seems to be balanced when viewed from without.

In each of these cases there may be both direct components and reverse components in the voltages and currents. If the load is unsymmetrical, the relation between the direct-phase voltage and direct-phase current will depend upon whether or not there is a reverse-phase voltage. With such a load a direct-phase voltage will produce a direct-phase and a reverse-phase current. If the load is symmetrical, however, the direct-phase current is obtained by dividing the direct-phase voltage by the corresponding impedance, and the reverse-phase current is obtained by dividing the reverse-phase voltage by the reverse-phase impedance. With symmetrical stationary apparatus these two impedances are equal—that is, the phase order does not affect the current that the circuit takes from a given balanced voltage system. In rotating machines, on the other hand, the reverse-phase impedance is usually much smaller, so that these machines take more current per volt for reverse-phase voltages than for direct-phase voltages. Since Z_d may be large and Z_r small the former is much like an open circuit to V_d while the latter is much like a short circuit to V_r and thus removes it.

The following conclusions may be drawn: If there is no neutral, the sum of the line voltages or of the line currents is zero and neither can have a uniphase component. Thus the uniphase components cannot affect the voltmeters, ammeters or wattmeters connected in the lines, provided there is no neutral. If the line voltages are equal, there is no reverse-phase component in the voltages to neutral of any load. Likewise if the line currents are equal there is no reverse-phase component in the currents taken by any delta load. Any unbalance must in these cases be due to uniphase components in voltage or current. There can be no uniphase voltage or current in a symmetrical three-phase machine if it has no neutral connection. Any unbalance that then exists must be due to reverse-phase components in voltage and current between which there is a definite relation, viz., the reverse-phase impedance, Z_r.

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[3] To be discussed in a subsequent paper.

As an illustration of the usefulness of this principle, consider a three-phase induction motor operating on an unbalanced voltage circuit. The line voltages being V_1, V_2 and V_3 give direct-phase and reverse-phase components of V_d and V_r in each phase. The direct-phase and reverse-phase currents are:

$$I_d = V_d/Z_d,$$

$$\text{and } I_r = V_r/Z_r.$$

These impedances can be calculated readily from the motor constants and the slip.[4] At full load the reverse-phase impedance is in the neighborhood of 15 per cent of the direct-phase impedance. A small unbalance in the voltage will thus produce a large unbalance in the current. The torques exerted by the two components are opposite.

CALCULATING POWER AND LOSSES

Consider the case of a symmetrical three-phase machine operating without a neutral on an unbalanced circuit. The phase voltages and currents contain direct-phase and reverse-phase components. The power in any phase is then symbolically:

$$P_1 = (V_{1d} + V_{1r})(I_{1d} + I_{1r})$$
$$= V_{1d} I_{1d} + V_{1r} I_{1r} + V_{1d} I_{1r} + V_{1r} I_{1d}.$$

The symbols $V_{1d} I_{1d}$, for example, represent the product of the voltage and current and the cosine of the phase angle between them. Similar expressions may be written for the power in each of the other phases. In combining these expressions for the total power it will be found that the sum of the terms involving voltages and currents of reverse phase orders is zero. The total power is:

$$P_0 = 3V_dI_d + 3V_rI_r.$$

The power in at least one phase is greater than the average and in at least one other is less than the average. The effect of the reverse-phase components is to transfer load from one phase to another. The machine thus acts as a load balancer. The copper loss in one phase is symbolically:

$$I^2R = R(I_{1d} + I_{1r})^2$$
$$= RI^2_{1d} + RI^2_{1r} + R2I_{1d}I_{1r} \cos \text{ angle } I_{1d}, I_{1r}$$

The total copper loss is the sum of this and two other similar expressions for the loss in the other two phases. In combining these it will be found that the total loss is

$$\Sigma I^2R = 3R(I^2_d + I^2_r).$$

The loss will not be equally divided between the phases, but in the aggregate is the same as if the currents I_d and I_r were of different frequencies. It is important to observe that neither the total power nor the total copper loss depends upon the phase relation between the direct-phase and reverse-phase components but only upon their magnitude. The distribution of these totals between the phases, however, does depend upon this phase relation.

When line voltages or currents are unbalanced, owing to the action of reverse-phase components, balance may be restored by adding to the system other reverse-phase components which will wholly or partly neutralize those already existing. (Refer to Fig. 8.) The windings 04, 05 and 06 represent the main generator, while 14, 25, and 36 are the windings of the auxiliary balancer, which is also a synchronous machine. The voltages generated in the latter are of the opposite phase order; that is, where E_{04} leads E_{05} by 120 deg., E_{14} lags E_{25} by 120 deg. The magnitude and phase of these balancing voltages can be varied independently at will. If the unbalanced voltages are considered to be V_{24}, V_{35} and V_{16} and a voltage mixer is applied to them, the amount and phase of the unbalancing or reverse-phase voltage are determined. If the voltages of the auxiliary balancer are adjusted so that they are equal and in opposition to this reverse-phase voltage, the line voltages V_{12}, V_{23} and V_{31} will be equal, and perfect balance is obtained.

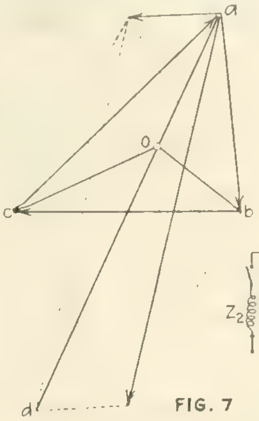

FIG. 7

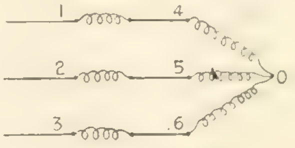

FIG. 8

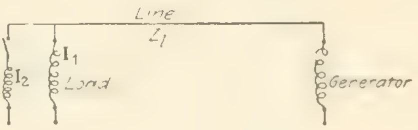

FIG. 9

FIG. 7 — FINDING THE NEUTRAL FOR BALANCED IMPEDANCES CONNECTED IN Y ACROSS UNBALANCED LINE VOLTAGES; FIGS. 8 AND 9—EFFECT OF A SYNCHRONOUS BALANCING MACHINE ON UNBALANCED LINE VOLTAGES, AND DETERMINATION OF AMOUNT OF CORRECTION FOR UNBALANCED LINE VOLTAGES

Neglecting any unsymmetry, due to the line capacitance and inductance, that may be present in a three-phase circuit, the line voltages and currents will be balanced if symmetrical three-phase machines only are connected to it. Any unbalance that may exist must be due to unsymmetrical three-phase apparatus or to single-phase loads. The unbalancing or reverse-phase currents taken by these loads will produce a corresponding drop in the line conductors, so that the voltages at the loads will also contain a reverse-phase component. If a symmetrical three-phase machine is now connected to the circuit, it will take a reverse-phase current that partly corrects the effects of the reverse-phase current taken by the single-phase loads. The amount of this correction can be determined in a simple case as follows: Fig. 9 illustrates one conductor of a three-phase circuit which supplies an unbalanced single-phase load. The line current, I_1, taken by this load consists of a direct-phase and a reverse-phase component which will be assumed to remain constant. That is:

$$I_1 = I_{1d} + I_{1r}.$$

The line drop from the generator, which for simplicity will be assumed to give balanced terminal voltages, is thus:

$$I_1Z_l = I_{1d}Z_l + I_{1r}Z_l.$$

The line impedance, Z_l, is the same to currents of either phase order. When the balancing machine which takes a line current $I_2 = I_{2d} + I_{2r}$ is connected to the circuit the line current is increased to

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[4] See article by J. Slepian in the ELECTRICAL WORLD, Feb. 7, 1920.

$$I_1 + I_2 = I_{1d} + I_{1r} + I_{2d} + I_{2r}.$$

The line drop now is:

$$Z_l(I_1 + I_2) = (I_{1d} + I_{2d})Z_l + (I_{1r} + I_{2r})Z_l.$$

The drop through the balancer due to the reverse-phase current is $I_{2r}Z_{2r}$, and since it is assumed that there is no voltage unbalance at the generator the total drop through the line and balancer due to the reverse-phase current must be zero. That is

$$(I_{1r} + I_{2r})Z_l + I_{2r}Z_{2r} = 0,$$

which may be written:

$$I_{1r}Z_l + I_{2r}(Z_l + Z_{2r}) = 0.$$

If the ratios of resistance to reactance should be the same for the line impedance and the reverse-phase impedance of the balancer, the reverse-phase current taken by the balancer would be in exact opposition to that taken by the single-phase loads. The ratio of the currents in any case is:

$$I_{2r}/I_{1r} = -Z_l/(Z_l + Z_{2r}).$$

The smaller the reverse-phase impedance of the balancer the more nearly equal are these reverse-phase currents and the more perfect is the balancing. The ratio of the reverse-phase line drops with and without the balancer may be called its regulation. The ratio is, in this simple case:

$$\text{Regulation} = Z_{2r}/(Z_{2r} + Z_l).$$

With zero reverse-phase impedance the regulation is zero, that is, perfect.

Trends in Substations and Lines

Development of Past Year in Some Phases of High Tension Work Where Strides Taken Have Been of Striking Character

BY ALFRED ALSAKER
Chief Engineer Delta Star Electric Company

A MOST significant development during the last year has been the rapidly increased recognition of outdoor-type construction for substations as well as for step-up stations and switching centers. This was not caused by any particularly new or remarkable development of outdoor apparatus, but it is partly due to the fact that many conservative central-station engineers were forced to install outdoor substations as a temporary expedient during the war. Such practical demonstrations of the utility of outdoor construction could not fail to give a favorable impression as to both the safety and the economy of the outdoor type.

But the strongest reason for the development undoubtedly is that the work of manufacturers and enthusiastic advocates of outdoor construction is bearing fruit. It is not an isolated case, but a typical one, that one of the largest suburban operating companies in the Middle West has definitely decided to build only outdoor substations, in spite of the fact that this same company has at present about forty large and small indoor substations connected to its transmission system. Another large operating company in the Northwest has swung over to outdoor construction for all voltages ranging from 110,000 to 13,200. One of the largest cities in the country has adopted the policy of supplying power customers with loads exceeding 300 kva. directly from its 13,200-volt feeder system, using outdoor substations installed on the customers' premises.

From the point of view of the outdoor substation enthusiast, the main resistance to outdoor construction is broken. What remains is to convert a lagging minority and—what is even more important—to warn overenthusiastic supporters against carrying the outdoor construction to a ridiculous extreme.

It is to be hoped that the general recognition of the outdoor substation as a permanent installation will result in a strong demand for neater construction than has been general in the past. Any one who has had occasion to observe a reasonable number of outdoor substations as installed by various companies will agree that a large number of the wood-pole substations are poorly built, carelessly wired and give the impression of being hastily put together by an inexperienced lineman rather than designed by a competent engineer.

NEED FOR INSULATOR RECORDS

No single device has caused central-station operators more trouble than high-tension insulators. This is due in the main to the large number used and to the fact that the failure of any one unit often means shutdown of the whole line. The high-tension insulator must therefore be more perfect than any other electrical device before it can begin to give satisfactory service.

It is rather gratifying to know that during the past year the manufacturers of porcelain insulators have made considerable progress in increasing the reliability of their products. In one type of insulator this has been accomplished by further use of sanded surfaces, instead of scored surfaces, and by the adoption of various means of relieving stresses in the porcelain due to unequal expansion of parts. Other types have been improved by better methods of burning heavy porcelain or by improvements in hardware.

In the past there has not been sufficient co-operation between insulator manufacturers and central-station operators. It may sound ridiculous, but nevertheless it is a fact that very few operating companies have kept a reliable record of insulator operation to enable the manufacturers to analyze the performance of their various designs over a period of years. Some progress has been made in this respect during the past year in that the operating companies are gradually recognizing the necessity of insulator performance records. By adopting uniform methods of keeping performance records it should be possible in a few years to collect data equally valuable to operators and manufacturers.

The past year has shown unmistakable signs that a new problem is confronting the central-station industry—a problem of no mean importance and one that has to be solved soon. The farmer is asking for central-station service in a voice that implies a demand rather than a request.

Some important work on rural service has been done during the last year, particularly in Kansas, Iowa, Illinois and Minnesota. In some cases it has been found practicable to distribute at 2,300/4,000 volts. The majority of farm lines, however, necessitate 6,600-volt or 13,200-volt construction. Important developments have been made in farm-line substations for these voltages, so that the engineering part of the problem can be readily solved by means of commercially standardized equipment. The problem now is one of financing. Several schemes are being tried for financing the farm-line extensions, but on the whole there is still much groping in the dark and shifting of responsibilities.

Cost of Money and Credit of Utilities*

Distinction Between Public Service Companies and Other Industries as Bidders for Capital—Factors Which Affect Utility Credit Analyzed—The Two Functions of the Rate of Return

By O. B. WILLCOX
Vice-President Bonbright & Company, Inc.

THE cost of money has increased to all industries and for all requirements. Public utilities have not been exempt. A high-grade electrical utility sold its 5 per cent bonds in November, 1916, to yield the investor 4.90 per cent, while in May, 1920, it sold a similar 6 per cent bond to yield the investor 7.03 per cent. Some typical smaller utilities sold their bonds in 1916 at a cost of money of approximately 6½ per cent and in 1920 at 7¼ per cent to 8 per cent. Short-time money in 1919 and 1920 has cost moderate-sized and typical utility companies 10¼ per cent to 11½ per cent. High-grade utility two-year to five-year notes have sold recently to yield the investor from 7 per cent to 8⅓ per cent. The yield to the investor is not, of course, the cost of money to the issuing company, which has to bear the additional discount or commission or handling charge of the distributing houses, ranging from 4 per cent to 10 per cent, spread over the period of the issue, and other additional charges.

The obvious distinction between utilities and other industries in competition for the investor's funds is that while other industries are subject only to the natural financial and economic laws in working out their financial problems, utilities in this country are subject to regulation, and under regulation are limited in the amounts which they may earn regardless of either the demand for or the value of their product. So, while other industries in these unsettled times have met the increased costs of labor, material and money by passing them along to the consumer in increased prices for their output, utilities have had to meet increased costs with fixed rates for their service and have reflected the results in decreased net earnings applicable to charges for money invested in their plants and lines until they could submit proof of actual loss satisfactory to the commissions as a basis for an increase in their permissible rates.

Nor is this the whole story. During the history of public regulation of utilities their net earnings have generally been less than the earnings demanded and expected in other industries, not permitting, except in rare instances, the accumulation of surplus and reserves adequate to tide over recurring periods of bad business or increased costs of operations. Therefore the decreased net earnings of the current period resulting from the high costs of fuel, materials, labor and money have meant not merely a shrinkage in surplus in many cases, but the inability to earn and pay full returns on the capital invested.

The result has been the impairment of the credit of utilities, the loss to the investors of a fair return on a part of the funds devoted to public use in utility enterprises, and decreasing confidence in the integrity of the investment and the assurance of unimpaired capital and certainty of return, which is the base of all credit.

Utility companies needing capital for their maturities or extensions of plants and lines have had to approach the investor with only that evidence which they present to the commissions in applications for increased rates, namely, a record of decreased net earnings and of inability to pay a fair return on the whole of the existing investment and with utter lack of evidence that the new money needed in public service, for which they beg the investor, could expect better treatment.

Basic Principles Recognized

The regulating authorities have recognized in principle the vital need to the people of efficient service and that efficient service is better economically than cheap service; that the welfare of the public demands constant expansion of service, requiring additional expenditures for plants and lines, and that new money for expansion can be had only on a record of good earnings and proof of good credit.

The recognition of these basic principles by the commissions and the many rate increases granted in the effort to meet the conditions required for successful appeal to investors for new money indicate decided progress in the practice of regulation and a flexibility in public supervision of utilities, promising that under regulation utilities may eventually be relieved of the shackles that in the form of inadequate return prevent them from rendering the most efficient service to the public. At the present moment, however, it is impossible for utility companies to obtain money for expansion or maturities except on most onerous conditions and then only for the companies most favorably situated, because under regulation the credit of utilities has been so seriously impaired.

Regulation under state commissions has gradually evolved into a body of standard principles far in advance of the original concept that its sole purpose was to reduce earnings, and has recognized that its fundmental function is to see that the public has adequate and efficient service, and from that foundation the commissions are now, while cautiously feeling their way, anxiously studying the causes of the credit conditions resulting from the practice of regulation and are seeking for light and help in remedying them. State regulation has done much to remedy two common evils of the utility business, in raising the industry out of local politics and in preventing strike competition. Its other problems are as important and today are most insistent for the protection and welfare of the public as well as the investor.

Attention may well be directed to a number of factors bearing directly upon the credit of utilities and the cost of money under regulation.

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*Part of an address delivered before the convention of the American Gas Association at New York, May 26, 1920. Mr. Willcox is chairman of the committee on public securities, Investment Bankers' Association of America.

The term franchise is always a menace; it often increases the cost of new money and sometimes makes it impossible to obtain. Theoretically, the whole utility investment should be amortized within the term of the franchise, which is inconsistent with cheap and efficient and expanding service. The mutual interests of the public and the investors, the commissioners and the operators should make common cause in making it possible, by legislation where necessary, to substitute the indeterminate franchise under reasonable provisions.

Uncertainties as to safety of principal or income add to the cost of money, and such uncertainties sometimes arise from reappraisal of property values and changes in policy in fixing the rate of return. Some of the commissions show an inclination to recognize outstanding capitalization, when once supported by appraisals, and to fix the rate of return so as to produce interest and dividends on the approved capital and additions made under the eye of the commissioners. This policy should be encouraged and its adoption facilitated by proper presentation of the subject matter in rate hearings.

Fear of the impairment of capital adds to the cost of money. Capital invested in utilities is entitled to protection against impairment through wear and tear and obsolescence in the public service.

The cost of money is increased by apprehension that public regulation may fix a rigid rate of earnings and not provide machinery flexible enough promptly to meet contingencies adversely affecting those earnings as they arise. This is one of the most serious complaints of the investor against utility regulation.

The cost of money is sometimes increased because the rates of return fixed by the commissions do not provide adequate margins above requirements for interest and dividends. Since those first days of war there have been many rate increases, but the lesson of those days has not been learned, and now the commissions are still endeavoring to fix the rate of return at just about the estimated or theoretical cost of money.

There is no good reason why money invested in utilities should earn less than in other industries, and since regulation prevents excessive profits, so it should make certain the limited earnings permitted. This can be done without danger to the public by permitting a rate of return allowing a fair margin above charges representing interest on bonds and dividends on preferred stock and a reasonable dividend on common stocks, and requiring the surplus earnings to be carried as a cash reserve fund or invested in the property.

No better safeguard to the public and the investor alike can be provided than by the holding of a large part of the securities of utilities in the communities served. Local stockholders who are also customers will examine utility problems from both points of view and help in their solution.

THE TWO FUNCTIONS OF THE RATE OF RETURN

The cost of money fixed by the law of supply and demand and the investor's appraisal of the risk is a very different thing from the rate of return fixed by the regulating authorities. The rate of return for utilities has two quite distinct but closely related functions. The most obvious purpose of the rate of return and the one most in the minds of the commissioners has been to provide and indeed to limit the earnings or compensation on the capital already invested in the utility. This the commissions can do within the limits against confiscation fixed by our constitutional provisions prohibiting the taking of property without compensation. If utilities were complete and perfect structures without change or growth and had no maturing debts, the purpose of the rate of return would be satisfied by the provision for fair return on the money invested.

The other, and in the interests of the public the more important, function of the rate of return is to provide such earnings and create such margins of protection and such confidence as will invite and attract new capital for the expansion of utilities to meet their maturing obligations and the tremendous demands upon them in these days of the growth and development of American industry.

In permanence of value, certainty of demand for product, consistent earnings resulting from the supply of necessities in the form of the various kinds of public service, the securities of our utility companies should be among the premier investments of America, and the regulating authorities can place them in that position by putting into practice the principles they have recognized and enunciated in many decisions.

I personally have confidence that the sense of fairness of the American public as well as its appreciation of its self-interest will afford the remedies. The re-establishment of the credit of the vital utility industries is essential to American prosperity, and in constructive co-operation in the successful solution of this great problem utility operators and the competent authorities will earn and receive approval and applause.

Simplifying Power-Station Wiring for Control Circuits

Standardizing on Conduit Size and Carrying Out a Definite Color Scheme in the Control Cables Eliminates Complications of Remote Control

BY FERDINAND N. BECHOFF

WHILE marked strides have been made in the standardization of methods and materials in almost every kind of work, the standardization of control cables and the related conduits has often been neglected. The simplification of these conduit runs and cables is not only desirable from a construction standpoint but also helps to reduce designing and drafting expense and at the same time improves the design of the entire conduit layout.

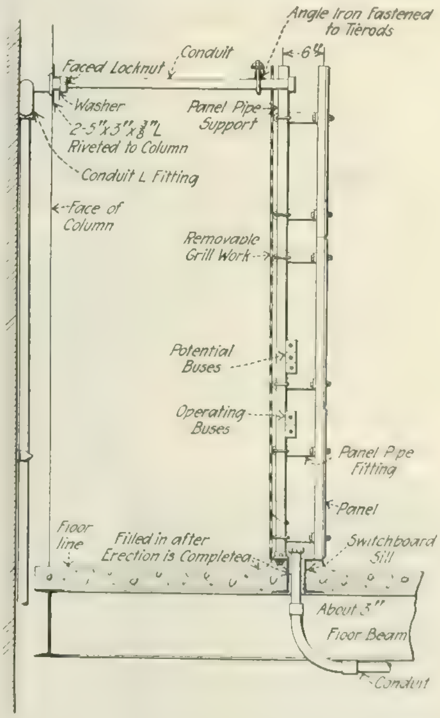
In working up the redesign of a control system for a power station of 175,000 kw. generator capacity the work was carried out with the view of simplification along the following lines: (1) Reduction of various control cables to a minimum in regard to a number of conductors and coloring; (2) reduction in the number of sizes of conduit types and also in the variety of materials and finish; (3) reduction in the number of fittings, which follows as a natural result of reducing the number of conduit sizes; (4) production of a uniform color scheme for the control cables and the uniform use of the particular colors for a certain purpose.

The conduit layout provides for a control of present and future installations of thirteen turbo-generators of 156-feeder circuit and for station auxiliaries. While most of the conduit pipes in the old layout were concealed in the floor, all the pipes of the redesign were exposed during the entire run and therefore easily mounted, inspected and maintained. In this particular case the changing over from one system to the other without interruption of service was facilitated by making these runs exposed.

Only one size of conduit was used in the work, namely 1¼ in. (3.1 cm.), and as a result the number of stock parts, such as condulets, bushings, couplings, lock-nuts, clamps, etc., was reduced to a minimum. The saving in handling of stock was noticeable.

STANDARDIZATION HAS KEPT INCREASE IN COST OF PIPE TO 20 PER CENT

While the expense for conduit was slightly increased because of the use of a standard 1¼-in. size, still it will be of interest to note that in October, 1919, the price of 1¼-in. conduit was 15 cents per foot, while the average cost of ¾-in., 1-in. and 1¼-in. (1.9-cm., 2.5-cm. and 3.1-cm.) was 11½ cents, showing an increase of only 20 per cent in the cost of material due to using the one size of pipe. The reduction in the time of making drawings and schedules of materials and also a great saving in labor more than offset the slight increased cost of material.



DESIGN OF SWITCHBOARD SILL THAT ALLOWS PLENTY OF ROOM FOR THE CONDUIT RUNS

The number of different control cables was reduced to three, namely, a four-conductor and an eight-conductor cable, with the following color scheme — black, white, red and green, or black green, or black and blue, white and blue, red and yellow, and green and yellow, for the four-conductor cable and a combination of the above eight colors for the eight-conductor cables. Although this color scheme was satisfactory, it is recommended that the four colors last mentioned be replaced by the following colors: black and red, white and red, green and white, and green and red. This reduces the variety of the different colors to four and at the same time removes the blue color, which is objectionable owing to the possibility of confusion with black. In attempting to standardize the control cables for power-house work, each job will have to be determined according to the most prominent features of the work. In this particular case it so happened that a four-conductor and an eight-conductor cable gave the best result because the greatest number of the cables were for sets of three instrument transformers which required four leads each, and the other circuits were for a pair of two-motor-operated oil circuit breakers which required eight leads. In all, about 90 per cent of the cables were used for the above purposes, the remainder of the job being of minor consequence. It might be possible that the standard arrived at in some cases would be different, but even at the expense of having a spare wire or two left over in a cable, it is thought that this method will prove to be economical in the end. As a matter of fact, it is very often the case that additional equipment or changes in type of equipment demand changes in the number of wires for the control cables.

In order to improve the appearance of the conduit run at the switchboard itself, a new design of switchboard sill was used as shown in the sketch. This sill consists of two 6-in. (15-cm.) channels or equivalent angle-iron construction. These channels are fastened to the floor beams in such a manner as to leave a space of 3 in. to 4 in. (7.5 cm. to 10 cm.), which extends the length of the switchboard. While the panel proper rests on one of the channels, the flange of the panel pipe is bolted to the other channel. The wide slot between the channels permits conduit pipes and also cables, if required, to reach the switchboard in a very neat and protective manner, giving the whole design a more finished appearance than was possible with the former switchboard sill. As shown in the sketch, the panel is connected to the panel pipes by means of standard fittings of a longer type than the usual fittings of this kind. This allows the mounting of all secondary buses, such as control, potential and synchronizing buses, inside the switchboard framing and permits the screening of the whole rear of the switchboard as shown. With the former switchboard sills it was necessary to fasten the pipe flanges to the sill before erection, but with the new sill it is possible to drill the holes for the flanges after the channels are in place. This feature is very convenient for the designing as well as the construction engineer, since it permits the rearrangement of panels after installation. The work is further facilitated by running all control conduit pipes beneath the floor instead of in the floor, for in this case construction work can be rushed and the pouring of the concrete floor especially can be speeded up without waiting for the conduit work to be completed.

GREAT QUANTITIES OF PIPE USED IN MODERN POWER PLANT

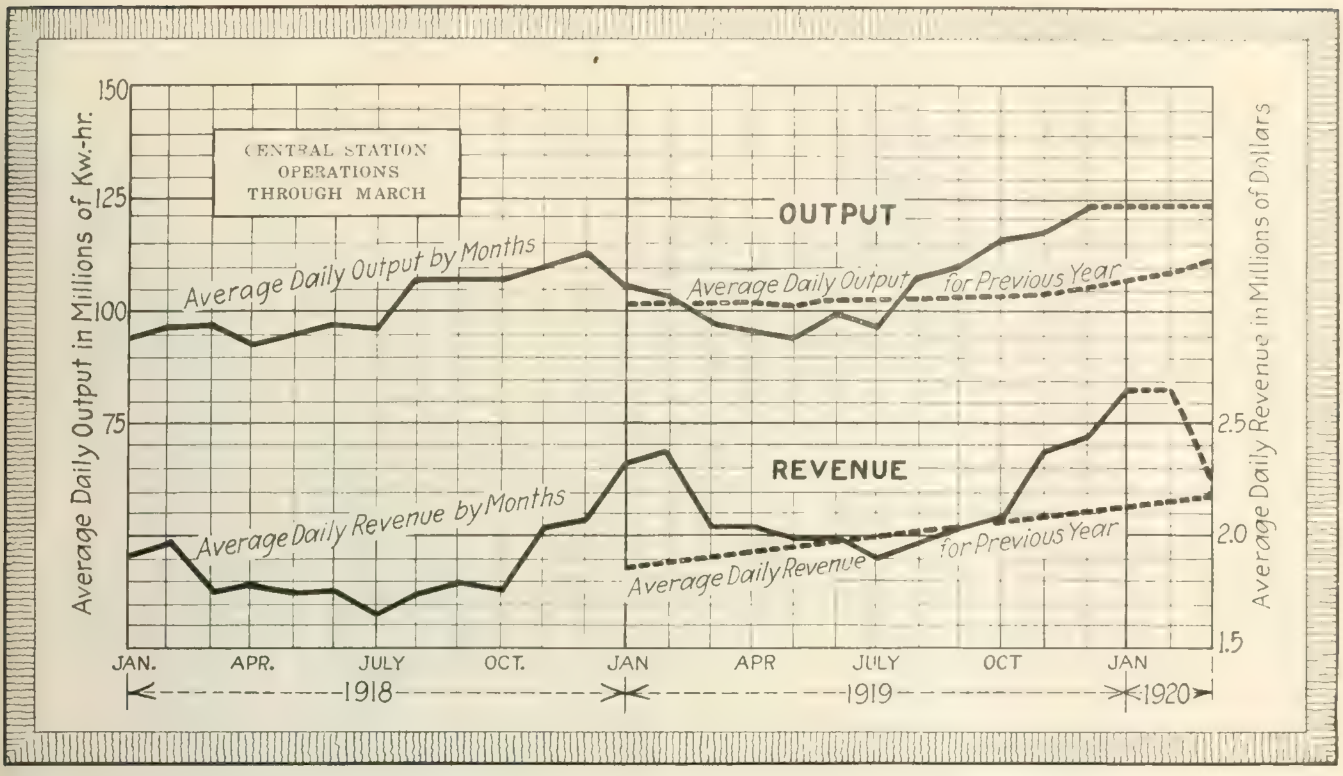
The modern power plant requires such a large number of small control apparatus that in running the conduits for these controls the rear of the switchboard becomes a mass of pipes. In such cases a certain amount of relief is afforded from this congestion by running the control pipes along the panel tie rods to the terminal boards at the top of the panel, as indicated in the sketch.

From experience in this work it would seem advisable in making drawings for conduit layouts to allow a scale of about ⅜ in. (9.6 mm.) to the foot in general and to draw certain typical views and sections to a larger scale. The cable and conduit schedules should preferably be drawn on printed forms or small size sheets and blueprints should be made on linen instead of paper. This more endurable form of the schedule facilitates the handling in the field, and in this connection it is recommended to leave a blank column in the schedule form for comment or remarks. In this particular installation it may be of interest to note that the bill of material for the whole job consisted of only twenty-five items.

Illumination of Gardens at Hotel Huntington During N. E. L. A. Convention

The Japanese gardens, in a natural canyon of approximately fifteen acres on the southwest side of the Hotel Huntington, which was the headquarters of the N. E. L. A. convention May 18-22, are shown here illuminated by floodlights on that occasion. Groups of Western Electric Davis floodlights were placed at different locations at heights of from 25 to 35 feet and focused to show distinctly the foliage of plants, shrubs and trees, which included different varieties of palms, Japanese ferns, dwarf oaks, bamboo trees, large oaks and eucalyptus trees, flower beds, and variegated fuchsias and cyclamen. A total of 93 floodlights of 30 kw. were used. This illumination was laid out and installed by A. G. Humphries, electrical engineer of the Southwestern Shipbuilding Company, East San Pedro, Cal., and J. G. Loomer, floodlight expert Western Electric Company, Los Angeles, Cal.

March Returns Surpass Records



CENTRAL-STATION operations during March exceeded those of any previous month. According to the returns received by the ELECTRICAL WORLD from companies having 70 per cent of the generating capacity of the entire electric light and power industry, the output for March was 3,858,000,000 kw.-hr., which is 3,000,000 kw.-hr. in excess of the previous record hung up in January last. These figures clearly tell of the continued growth in the utilization of electrical energy in American industry. Despite the largely decreased lighting requirements, the average daily output for March was approximately 100,000 kw.-hr. more than during January. On the other hand, the average daily revenue was about $280,000 less than that recorded during January. These two facts are reconcilable in that a larger percentage of the energy consumption during March was undoubtedly for power, which naturally takes the lowest rate.

New England is the only section of the country which has shown a distinct continuous drop in average daily consumption for the first quarter of the year. The manufacturing industries in this section are to a large extent fairly stable, and the energy consumption would probably not reflect any large industrial growth in so short a period. During the first three months of the year, also, most of the factories were running at capacity except for a short period of transportation tie-up. The fairly uniform drop in energy consumption due to seasonal variation in lighting requirements was therefore to be expected in this section.

The Atlantic States present quite a different picture both in the northern and southern portions of the section. New industries are growing up, and the old industries are expanding extensively to supply the calls of trade. Epecially is this true in the Southern States. According to the *Manufacturers' Record*, which collects detail statistics on industrial growth in the South, plans for the first quarter of the year throughout the cotton-growing states involved the installation of 487,799 spindles, indicating an investment of more than $34,145,930 as compared with 768,609 spindles with an investment of about $53,000,000 for the entire twelve months of last year. The looms for this year's first quarter exceed the total for 1919 by more than 6,000. This equipment of looms called for an investment of $5,188,200 as compared with $3,325,200 for the 11,084 looms reported during all of 1919. At least 90 per cent of these textile mills will be electrified. In the northern part of the Atlantic section the steel mills were working at from 90 to 100 per cent capacity during March, having apparently entirely recovered from the effects of the strikes of last year. The industrial cities reported excellent labor conditions and capacity operations, although poor transportation conditions were a disturbing element. All these maximum production activities called for record supplies of electrical energy. As a result this section consumed during March 1,200,000 kw.-hr. more energy daily than in February.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Installed Capacities Represented	Revenue from the Sale of Energy			Percentage of Installed Capacities Represented	Kw.-Hr. Output		
		1919 Thousands	1918 Thousands	Per Cent Increase		1919 Thousands	1918 Thousands	Per Cent Increase
Apr.	45	$27,740	$23,919	16.0	45	1,279,274	1,240,782	2.9
May	45	27,795	24,291	15.5	45	1,306,622	1,314,206	—1.0
June	47	28,175	24,701	14.1	47	1,399,951	1,367,908	2.3
July	44	25,794	22,568	14.1	44	1,309,301	1,281,874	2.0
Aug.	54	32,756	29,006	13.0	54	1,801,836	1,793,706	0.5
Sept.	53	32,344	28,336	14.0	53	1,761,582	1,695,862	4.3
Oct.	55	35,492	30,077	18.0	60	2,175,636	1,987,004	9.0
Nov.	53	37,439	31,927	17.2	58	2,055,428	1,895,693	8.2
Dec.	59	44,125	37,978	16.0	65	2,509,571	2,270,833	10.0
		1920	1919			1920	1919	
Jan.	57	46,614	39,002	19.8	67	2,581,096	2,186,732	18.0
Feb.*	63	45,859	37,491	22.8	69	2,494,275	1,986,426	25.1
Mar.†	65	45,892	36,784	24.7	70	2,698,930	2,088,150	29.1

* Includes estimates for seven companies, representing 1.2 per cent of the total installed capacity of all central stations.

† Includes estimates for sixty companies, representing 11.5 per cent of the total installed capacity of all central stations.

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Installed Capacities Represented.	New England States			Percentage of Installed Capacities Represented.	Atlantic States			Percentage of Installed Capacities Represented.	Central States			Percentage of Installed Capacities Represented.	Pacific and Mountain States		
			1919	1918	Per Cent Increase.		1919	1918	Per Cent Increase.		1919	1918	Per Cent Increase.		1919	1918	Per Cent Increase
REVENUE	Apr	71	$3,468,000	$2,942,000	17.8	43	$11,516,000	$10,213,000	12.3	36	$8,427,000	$7,009,000	20.3	56	$4,329,000	$3,755,000	16 5
	May	70	3,190,000	2,781,000	14.9	43	10,817,000	9,826,000	10.1	36	8,320,000	6,910,000	20.5	56	5,468,000	4,764,000	14.2
	June	71	3,317,000	2,904,000	14.1	43	10,605,000	9,537,000	12.0	38	8,757,000	7,504,000	16.2	63	5,496,000	4,767,000	15 2
	July	70	3,406,000	2,995,000	13.7	40	9,320,000	8,375,000	12.0	38	8,854,000	7,442,000	19.0	49	4,214,000	3,756,000	12 1
	Aug.	74	4,225,000	3,693,000	14.4	57	12,174,000	10,995,000	11.1	45	10,942,000	9,309,000	17.1	61	5,415,000	5,009,000	8 5
	Sept	73	4,019,000	3,536,000	13.6	53	11,429,000	10,069,000	13.5	44	11,395,000	9,766,000	16.2	63	5,501,000	4,965,000	10 9
	Oct	72	4,127,000	3,453,000	19.1	53	12,684,000	10,822,000	16.9	50	13,241,000	11,003,000	20.1	62	5,440,000	4,799,000	13.9
	Nov	71	4,432,000	3,800,000	16.2	56	14,738,000	12,761,000	15.7	44	12,604,000	10,383,000	22.1	63	5,665,000	4,983,000	13.9
	Dec.	73	4,908,000	4,254,000	15.1	57	15,926,000	13,806,000	15.8	51	14,156,000	11,903,000	18.5	77	9,135,000	8,015,000	14 2
			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan	78	5,635,000	4,718,000	19 8	59	17.659.000	14 625,000	20 9	53	15.932.000	13 337.000	20 1	75	7.388.000	6.322.000	16 1
	Feb	82	5.354.000	4,368,000	22 1	61	17.225.000	14,333,000	20 0	55	16.138.000	12.762,000	26.1	79	7.142.000	6,028 000	18 3
	Mar	82	5,080,000	4,079,000	24 1	63	17,655,000	14,293,000	23 8	58	16,008,000	12,669,000	26 0	79	7,149,000	5,743,000	24 2
KW.-HR. OUTPUT			1919	1918			1919	1918			1919	1918			1919	1918	
	Apr	71	123,111,000	116,411,000	5 7	43	431,572,000	424,049,000	2.0	36	382,779,000	358,858,000	6.9	56	341.812,000	341,464,000	0 1
	May	70	120,856,000	120,908,000	0 1	43	413,043,000	430,729,000	-3.9	36	390,667,000	377,525,000	3.6	56	382,056,000	385,054,000	-0.9
	June	71	127,260,000	119,217,000	6 7	43	408,335,000	419,060,000	-2.5	38	418,542,000	386,422,000	8.0	63	445,814,000	443,209,000	0.5
	July	70	141,551,000	130,393,000	8 2	40	373,105,000	378,053,000	-1.5	38	428,370,000	408,165,000	5 3	49	366,275,000	365,263,000	0 1
	Aug.	74	161,431,000	153,266,000	5 1	57	640,616,000	662,120,000	-3.2	45	555,763,000	513,591,000	8.1	61	444,026,000	464,729,000	-4 2
	Sept	73	153,837,000	146,209,000	4 5	53	610,254,000	610,179,000	0.1	44	573,835,000	518,767,000	11 0	63	423,656,000	420,707,000	0 5
	Oct	72	162,859,000	142,326,000	14 4	53	694,584,000	659,859,000	5.3	62	882,439,000	766,407,000	15 2	62	435,754,000	418,412,000	4 1
	Nov	71	153,171,000	140,240,000	9 2	56	724,607,000	707,347,000	2.4	56	754,838,000	657,362,000	14 8	63	422,812,000	390,744,000	8 2
	Dec	73	180,493,000	152,304,000	18 0	58	803,165,000	733,222,000	8.9	65	913,971,000	787,687,000	16.1	77	611,942,000	597,620,000	2 5
			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan	78	207,158,000	159,773,000	29.8	60	853.057,000	717,303,000	19 2	67	982,577,000	849.435,000	16.1	75	538,304,000	460 221.000	16 2
	Feb	82	187,264,000	148,103,000	26 2	62	809,376,000	672,769,000	20 0	69	989 412,000	761.621.000	29.7	79	508,223,000	403,933,000	26.1
	Mar	82	197,771,000	149,258,000	32.3	63	899,647,000	711,835,000	25 3	70	1,049,587,000	798,452,000	31 9	79	551,925,000	428,605,000	29.1

The Central States also showed a large growth in average daily energy requirements, especially in the North Central industrial section. The returns indicate that about 1,800,000 kw.-hr. were required daily in excess of the February daily consumption. The foremost steel interests and leading dependents in the Chicago district were producing at the rate of 90 per cent capacity or more, and other mills and furnaces in this district were on a basis of almost 100 per cent. The machine and metal trades, which use a large number of electric motors, were working nearly at capacity in practically all districts. The automobile industry was increasing production as fast as possible, and labor conditions were excellent. All of this accounts for the largely increased energy requirements. The South Central agricultural states reflected the seasonal variation due to decreased lighting requirements.

To a less extent the same conditions of industrial growth are indicated for the Mountain and Pacific States. The continued strike in the shipyards of California probably accounts for the retarded growth in energy consumption in the Pacific Coast. Practically all shipyards are completely electrified, and the elimination of a large part of this load is reflected in comparing the energy consumption of this section with that of eastern sections of the country. That this deficiency was overcome during March and an increased consumption shown over February is indicative of the sturdy growth in other lines of Western industry.

Electrifying Danish Farms

In Denmark there are more than 300 co-operative societies for the supply of electrical energy, one of which has 3,000 farmers on its lines. An instance of a typical farm of 800 acres is cited on which work formerly taking sixteen men, four boys and ten horses is now done with nine hands and one horse.

Hydro-Electric Development in the French Republic

A RECENT estimate of the hydro-electric resources of France puts them at from 8,000,000 hp. to 10,000,000 hp., about 4,000,000 hp. being in the regions of the Alps. In Massif Central, Vosges and Jura there is 1,500,000 hp., in the Pyrenees 1,700,000 hp., and in other regions 800,000 hp.

Between 1916 and 1918 it was estimated that 450,000 hp. was developed, bringing the total development up to the time of the armistice to 1,250,000 hp. Projects started in 1919, totaling 175,000 hp., and projects planned for construction in 1920-1921, developing 225,000 hp., will bring the total development in France by the end of 1921 to 1,650,000 hp., or about 20 per cent of the total available power.

The power development between the end of 1915 and 1921, about 850,000 hp., is divided among the several regions as follows: Alps, 428,000 hp.; Pyrenees, 185,000 hp.; Central France, 200,000 hp.; Jura and Vosges, 35,000 hp.; West, 2,000 hp.

Thus it will be seen that nearly 50 per cent of the power development of France will have been accomplished in six years. The purposes for which power was developed during this period were: Industrial uses, 308,000 hp.; electrochemistry, 216,000 hp.; electrometallurgy, 326,000 hp.

When completed these plants will represent a capital investment of $127,766,000. Prior to 1915 $154,400,000 was invested in power plants in France, making a total investment to date of $282,166,000.

At the same time that this development of hydroelectric resources is being carried out the electrical rehabilitation of the devastated districts of France and extensive plans for interconnection of electric systems in other parts of the nation are being pushed to the utmost.

Readers' Views and Comments

Softening Cooling Water for Transformers

To the Editor of the ELECTRICAL WORLD:

SIR: The article printed in the March 6 number of the ELECTRICAL WORLD entitled "Experience with Transformer Cooling Methods" is of interest to the writer. There is no question about the unsuitability for transformer use of a water carrying in solution salts that are readily precipitated as solids upon an increase in temperature. These salts are generally calcium or magnesium, appearing either as carbonates or sulphates. Other salts as a rule are not objectionable as they remain in solution regardless of temperature. The problem of the operating engineer is therefore to find a water free from the objectionable salts or to find a simple practical way of removing them before they are used in the transformer. Of these two ways, in the majority of cases, the engineer has but one choice, and that is the removal of the salts.

This can be cheaply and thoroughly done by softening the water by passing it over a bed of zeolite, which will remove all the calcium and magnesium salts so that the transformer can be used indefinitely without clogging from these deposits. There are several companies manufacturing softeners of this type. They are made in various sizes and are simple in construction and operation and positive in their results. One of the largest power companies in the West has recently installed a softener of this type for use on transformers, believing that prevention is better than cure.

The writer knows that the clogging of transformers by scale is unnecessary. It was only recently that it was generally believed that steam boilers could not be operated without the formation of scale accompanied by expensive boiler cleaning and repairs. We are living in a period when the world is looking for ways and means of conserving our natural resources—and also labor—and it is going to find them and adopt them.

GALE S. STRUNT,
West Coast District Manager Refinite Company.
San Francisco, Cal.

Primary Cut-Out for Line Transformers

To the Editor of the ELECTRICAL WORLD:

SIR: During recent years manufacturing companies have apparently used their best engineering talent in investigating the troubles with line transformers and in altering the designs and improving them, since the modern transformer of this type is a very satisfactory piece of apparatus and is the cause of a very small portion of line troubles. Improvements in primary cut-outs for line transformers have, however, not kept pace with the improvements in the transformers, with the result that at the present time the cut-outs available are the cause of more trouble than the transformers.

Some ten years ago one of the larger central-station companies discarded all types of primary cut-outs and lightning arresters that were inclosed in iron cases. The reason for this was that trouble developed on these devices during rainstorms and wet snowstorms, particularly when accompanied by high winds. In nearly every case of this kind of trouble the damage was confined to the cut-outs or lightning arresters and there was very little, if any, trouble on the transformers which they were intended to protect. The protection device had therefore become a hazard to the service instead of a protection.

After thorough investigations of the disturbances, the decision was reached that while the devices were perfectly satisfactory when the lines to which they were connected were supplied by stations having only a few hundred kilowatts in capacity connected to the bus at any one time, the difference in behavior of the devices was quite marked when the same lines were supplied from stations having a larger amount of generating capacity connected to the bus or when they were supplied by step-down transformers served by transmission lines of great current-carrying capacity connected to large turbo-generators. Formerly when an arc would start on such a device a drop in voltage would be experienced which would allow the arc to become extinguished, but with the reduced impedance and the increased generating capacity of recent years such a drop in voltage at the time of a disturbance would not now be experienced, with the consequence that the arc would be maintained and the device intended for the protection of the line transformers would itself be destroyed.

From the experience of a number of large companies the following six major points have become evident: First, the cut-out should be self-contained, that is, it should not require a wooden or iron box to protect the parts from the weather—this practically limits the inclosing case to porcelain or some kind of molded compound. Second, a brown fuse should be replaceable by a lineman and should consist of a suitable metal strip that is neither delicate nor fragile. Third, the replacing of a blown fuse should be possible by the use of the ordinary tools carried by a lineman or troubleman and should not require the use of special tools or devices for it. Fourth, the fuse terminals should be protected from the weather so as to avoid the corrosion of aluminum fuses which occurs when they are in contact with a brass screw, washer or terminal and exposed to the weather. Exactly similar corrosion occurs with outdoor types of aluminum lamp shades which are fastened to brass supports. Fifth, the maximum horizontal dimension of the cut-out should preferably be less than 6 in. and the vertical dimension not over 15 in., and it should be so designed that it can be connected to a line wire either to the right or to the left of the cut-out. Sixth, the cut-out should be so designed that the fuse terminals are in line with the cut-out terminals, so that the fuse can be properly inserted by a single, quick, unhesitating motion. The cut-out should be so designed that a lineman or troubleman cannot be injured by the blowing of a fuse with which he is replacing another one.

As it is a modern tendency to combine the smaller plants into larger systems with greater capacity in generators and transmission lines, it is advisable that these points should be brought to the attention of the manufacturers so that they will avoid selling to smaller companies devices which may later have to be discarded when they become parts of a larger generating and transmission system.

G. A. ARMSTRONG.
San Francisco, Cal.

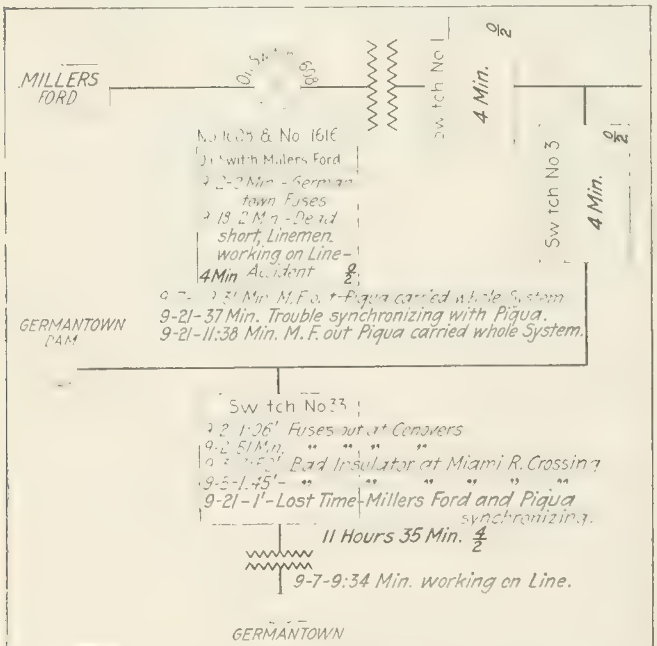
Station and Operating Practice

A Department Devoted to Problems of Installation,
Operation and Maintenance of Equipment for Economical Generation and
Distribution of Electrical Energy

Graphic Record of Outages on Transmission System

IN ORDER to visualize the outages on its system, an Ohio company has drawn up a map of its lines in which the position of every high-tension (33,000-volt) switch is indicated by a rectangle surmounted by the identifying number of the particular switch. The number and total duration of outages for the month, and whether the troubles originated at that point or elsewhere, are shown by figures placed in the switch rectangle.

When an outage occurs the district superintendent or members of the line department must place a record of the outage on a card form which is also used to tag the switch while the line is being worked on. At the end of the month this information is transferred to the map, of which a typical section for the month of September 1919 is shown. The actual time out at each switch appears in red ink and the time out with permission for working on the line or transferring is written in green ink. The number of outages appears as a fraction and is written in red. The numerator gives the outages caused by trouble at that point, while the denominator shows the number of outages caused by disturbances in some other place on the system. The sum of the two figures indicates the entire number of outages at that point. The reason for the outage is written in black ink at the source of the trouble or at the switch nearest to it.



MILLERS FORD
Switch No 1
4 Min.
0/2
Switch No 3
4 Min.
0/2
No 1635 & No 1616
Switch Millers Ford
2-3 Min - Germantown Fuses
19 2 Min - Dead short, Linemen working on Line - Accident
4 Min
2/2
Min. M. F. out Piqua carried whole System
9-21-37 Min. Trouble synchronizing with Piqua.
9-21-11:38 Min. M. F. out Piqua carried whole System.
GERMANTOWN DAM
Switch No 33
1:06' Fuses out at Conovers
9-2 51 Min. " " " "
Bad Insulator at Miami R. Crossing
9-5-1.45'- " " " " " "
9-21-1'-Lost Time-Millers Ford and Piqua synchronizing.
11 Hours 35 Min. 4/2
9-7-9:34 Min. working on Line.
GERMANTOWN

SECTION OF MAP SHOWING NUMBER AND DURATION OF OUTAGES

This is a section of a map showing the entire system of the Dayton Power & Light Company. Space is provided underneath the designating number of each switch for making a record of the outages during any month. Permitted outages and those for Sunday work are given in the notations beneath the rectangle in which the unannounced outages are recorded.

Each plant is furnished with the outage cards, and particular instructions are issued to keep a record of every outage that occurs on any feeder, although the map is used to record only the outages on the 33,000-volt lines. Outages on all other feeders are kept in a separate record made up at the end of each month.

Dayton Power & Light Co., O. B. REEMELIN,
Dayton, Ohio. General Superintendent.

Device to Inform Boiler-Room Attendants of Station Load

A METHOD of giving notice to boiler-room employees of the kilowatt load on a plant was described in the ELECTRICAL WORLD of Feb. 7, 1920. The writer has used an apparatus for the same purpose which is cheaper and is operated manually by the switchboard operator instead of electrically. This apparatus consists of a dial having the station loads from zero to the maximum painted on its face. This dial is fastened to a wooden roller which is mounted on a bearing consisting of a bolt supported by an iron stand at the switchboard. A clothes-line wire is wound four times around the roller, and to one end of the wire a weight is attached, while the other end runs on pulleys to the boiler room, where it is connected to a similar roller and dial.

When the load in the station varies it is only necessary for the switchboard operator to shift his dial in order to change the boiler-room dial correspondingly. By means of stationary pointers the load is indicated by each dial. A. L. VONCANNON.

Virginia Railway & Power Company,
Richmond, Va.

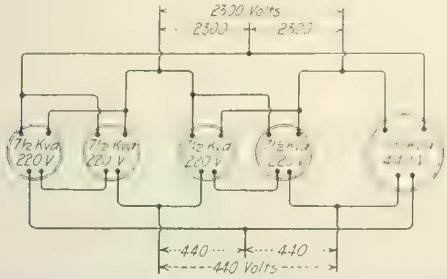
Resistance of Switches and Fuses Averages 0.025 Ohm

APPROXIMATELY 0.25 volt at full load was found by recent tests to be the voltage drop on fuses, switches and terminals in local wiring on the rear of switchboards where the usual form of construction is used. For apparatus designed to carry over 1,500 amp. the drop is practically nothing, as such apparatus is designed to account for the drop. With apparatus designed for currents of less than 100 amp. the drop is slightly over 0.25 volt, especially if cheap switches are used, the drop being chiefly in the contacts. For very small currents such as are used for instruments, switches and relays, instead of the voltage drop, the resistance was measured and was found to be 0.025 ohm for several types of contacts. The 30-amp. and 60-amp. knife switches used in ammeter circuits for switching meters to several different shunts were found to be of negligible resistance. H. E. WEIGHTMAN.

Chicago, Ill.

Four 7.5-Kva. Transformers Substituted for Two of 15-Kva. Rating

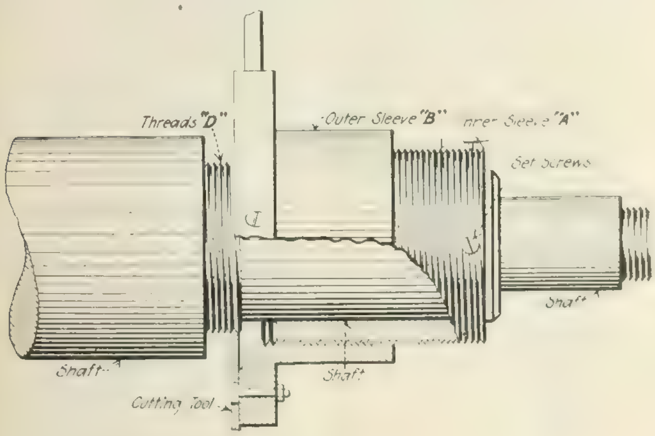
IN ORDER to give immediate service to a customer of the Central Illinois Public Service Company, four 7.5-kva. and one 15-kva. transformers were recently employed in a three-phase bank in place of three 15-kva. transformers because two of the latter were delayed in shipment. The delayed transformers were rated at 15 kva., 2,300/440 volts, and three of them were to be connected delta-delta. As only one of them was available, it was decided to use, in place of each, two 7.5-kva. transformers connected in parallel on the primary side and in series on the secondary. They were so connected and gave satisfactory service until the other transformers arrived. JAMES F. MEISTER.



EMERGENCY USE OF 7.5-KVA. TRANSFORMERS

Device for Cutting Threads on Shaft in Place

BY MEANS of a home-made cutter the shaft of a 2,500-kw. turbine at the McKinney plant of the Texas Power & Light Company was turned and threaded while in place on the machine. The threads of the thrust lock-nut and on the shaft were stripped so that it was necessary to turn down the shaft and rethread it. In order to avoid expense and the necessity of laying up the machine, which would be necessary if the shaft were sent to a machine shop, the device shown here was made. It consists of an inner sleeve *A* threaded on the outside and an outer sleeve *B* threaded on the inside and arranged to hold the cutting tool. The inner sleeve *A* was turned for an easy driving fit on the shaft, and threads were cut on the outside of the same gage as those desired on the shaft. For holding this sleeve in place two set screws were placed in the sleeve 90 deg. apart. The outer sleeve *B* was made of an extra-heavy 6-in. (15-cm.) T, which was faced, bored and threaded with one chucking in the lathe. In order to prevent chattering of the tool when using the device, *B* was made to fit very closely over *A*. A slot was cut in the face of the T for the cutting tool, which was held rigid by a wedge-bolt through the flange. In the rim of the flange four 1-in. (25-cm.) holes were bored for the insertion of a bar for turning the device.



METHOD BY WHICH SHAFT WAS TURNED AND THREADED IN PLACE

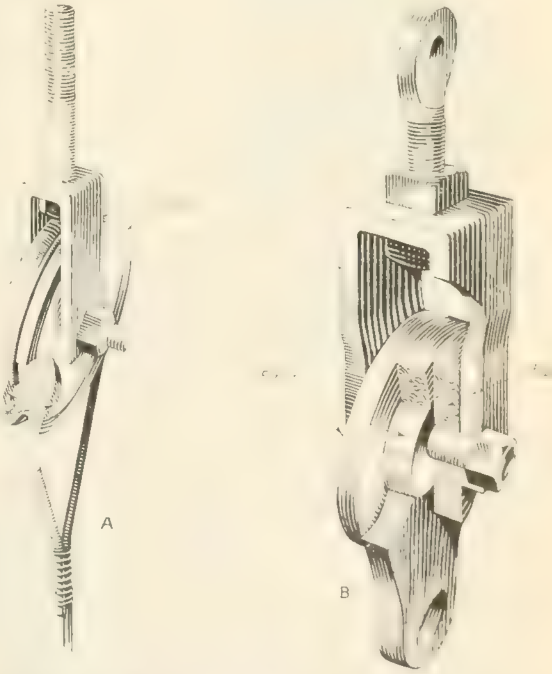
After the device was assembled and clamped to the shaft, leaving a $\frac{1}{2}$-in. (1.2-cm.) space between the shoulder *D* and the sleeve *A*, the shaft was turned down to the proper size, after which the same tool was reground for threading. A tapering counterbore on the sleeve *A* allowed chips to fall free. Special care was used to take only light cuts with the tool.

The work of turning and threading was done by two men in ten hours. The cost of making the device was $18. H. G. HYNDS,

McKinney, Tex. Texas Power & Light Company.

Home-Made Fiber Strain Insulators Withstand Heavy Load

HOME-MADE fiber insulators have eliminated considerable trouble which was experienced with the porcelain insulators used for stringing crane trolley wires in a Michigan mine. The porcelain insulators broke at frequent intervals, and while some manufacturers recommended substitutes no design was available which would last for any great length of time. After some experimenting, porcelain was discarded and a disk of fiber about 3 in. in diameter by $\frac{1}{2}$ in. thick (75 mm. x 13 mm.) was used. A hole is drilled through the center of the disk for a $\frac{5}{8}$-in. (16-mm.) bolt, and a groove turned in the periphery of the disk keeps the trolley wire from touching the iron frame. Twelve of these fiber strain insulators are in use on crane trolley-wire service and there has not been a failure in four years. The



HOME-MADE DESIGNS OF FIBER STRAIN INSULATORS

(*A*) Fiber strain insulator used on crane trolley wires. (*B*) fiber bushing and two fiber washers about $\frac{3}{8}$ in. thick insulate steel link under load fiber insulator was sometimes placed in the same yoke (Fig. A) that was originally supplied for the porcelain insulators.

These fiber strain insulators proved so successful on the crane trolley wires that the same material was tried and found equally serviceable on insulated crane hooks. This suggested the use of fiber insulators at the electrolytic copper plant where four insulated bolts support a weight of 14,000 lb. (6,350 kg.). The construction of this insulator is shown and described in Fig. B. In this instance also the locally made fiber insulators proved satisfactory. In the course of five years one of the eye bolts was broken by a side pull, but the fiber insulators have given uninterrupted service.

Calumet & Hecla Mining Co., FRED E. THERREIN,
Lake Linden, Mich. Chief Electrician.

New Employees Suffer Most from Accidents

EMPLOYEES of less than six months' service have suffered 35 per cent of the total number of accidents for the last five years in the Narragansett Electric Lighting Company, Providence, R. I. This is the outstanding feature of the chart shown here, which proportions the number of accidents in this company according to length of service of the employees injured. This chart shows clearly the need for the new man to study the precautions and safety measures that are employed by the older men. It serves also as a warning to foremen to use the greatest care in educating new employees, informing them of any particular hazard in their work, and to take special pains to discourage any employee, old or new, from the habit of "taking chances."

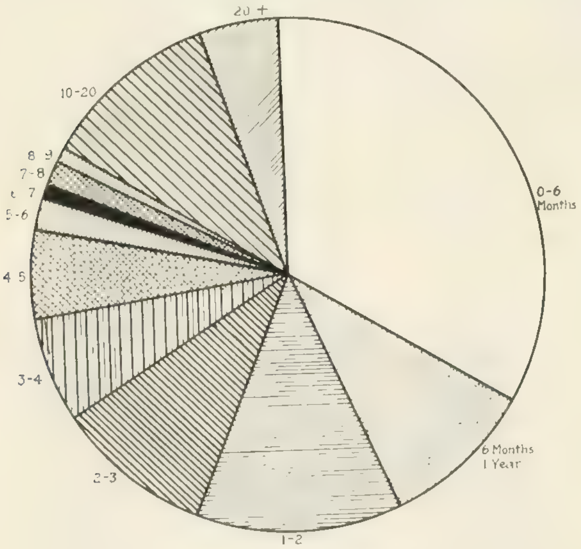


CHART SHOWS THAT NEW MEN SHOULD BE CAREFUL

Providence, R. I. R. H. WHEELOCK.

Armored Cable Carries Circuits Around Caved-in Line

BY LAYING armored cables around a caved-in section of ground carrying an important pole line, the Copper Range Company, Painesdale, Mich., was able to maintain continuous service over the line. The pole line was one carrying three three-phase, 2,200-volt power lines and a 220-volt, three-phase line and one seventy-pair telephone cable.

Although the caving proceeded quite rapidly after it once started, sufficient warning was had to cut the telephone cable clear for two spans and it was allowed to hang by the supporting messenger. Three reels of armored cable, No. 0, No. 20 and No. 2, of about 1,000 ft. (3,048 m.) each, were available, and these were strung out around the opening and cut into service, the original lines being cut clear. The work was finished before the original line went down, but with little time to spare, and these cables operated perfectly until a permanent pole line was built.

Enlargement of New Bedford Edison Plant

TO MEET its rapidly increasing business, the New Bedford (Mass.) Gas & Edison Light Company is enlarging its Cannon Street generating station to a total rating of 72,000 kw., the engineering and construction contract having been awarded to Stone & Webster, Boston. The plant is being extended sufficiently to house two 20,000-kw. turbo-generators, one of which has been purchased, and eight 755 hp. boilers with auxiliary equipment. The Cannon Street station was begun in 1916, the rating at that time being 37,000 kw., but the load increased so fast that a 15,000-kw. unit was soon added.

Included in the extension work now under way is the provision of better facilities for coal handling and an enlargement of the electrical end of the station. The total outlay for improvements now under way will be about $2,000,000. The building will be extended sufficiently to house additional feeder switchboard and control equipment as well as generating apparatus, and the coal wharf will be extended and the dock deepened. Two new reinforced-concrete stacks will be erected, and the intake and discharge tunnels will be extended sufficiently for two additional turbo-units. The estimated cost of the extension, excluding the generating unit, as filed by the company with the Massachusetts Department of Public Utilities, is given in the table:

INSTALLATION OF ONE 20,000-KW. UNIT AND EIGHT 755-HP. BOILERS.

Engineering cost	$ 30,000
Services of constructing engineers	82,395
Office at works	27,000
Insurance	15,000
Temporary construction	17,000
Shrinkage in construction equipment	8,000
Station yard	7,200
Building	208,075
Equipment foundations	25,150
Boiler plant	271,200
Draft system	73,500
Feed-water system	14,400
Condensing-water system	213,430
Piping and wiring	100,000
Coal and ash handling	36,600
Generator installation	8,800
Switchboard and wiring	132,940
Auxiliary equipment	9,000
Testing and preliminary operation	8,000
Duct line	3,400
Manholes	1,100
Contingencies	57,810
Total	$1,350,000
Note. Turbo-generator cost separately filed	$ 267,835

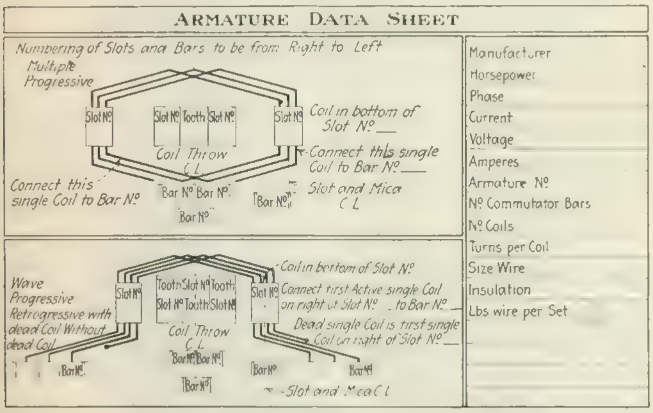
Various items in this extension filed with the commission include a 15,000-hp. feed-water heater, $4,600; one 55,000-cu.ft. (1,540-cu.m.) air washer, $2,440; condenser tubes, about 170,000 ft. (51,000 m.), $38,000; coal-weighing lorry, $11,250; eight soot blowers, $4,155; one 1,200-gal. (4,540-l.) per-minute boiler-feed pump, $4,975; eight 755-hp. water-tube boilers, $143,094; one turbo-driven forced-draft fan, $7,310; two sets underfeed stokers, $7,865; two superheaters, $5,890.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

Card Used for Filing Armature Winding and Other Data

IN THE Oct. 4, 1919, issue of the ELECTRICAL WORLD, page 763, were published diagrams to be used in checking the coil connections on armatures that are to be repaired. In order to have a permanent record of the data on an armature the writer has combined this scheme with other necessary information on a 5-in. x 8-in. filing card. This card contains two diagrams, one of which is used for any type of lap winding and another for any type of wave winding. In another column is placed the name-plate data on the machine, and in addition to this the number of commutator bars, number of coils, the turns per coil, the size of wire, the pounds of wire per complete set of coils, etc. By referring to this card when repairing the armature the required type of coil and the correct placing of the coil in the armature are easily obtained.



PERMANENT CARD RECORD OF ARMATURE INFORMATION

J. HELLENTHAL,
General Foreman Substation Construction.
Puget Sound Power & Light Company,
Seattle, Wash.

Grounding Neutral in Steel Mills Saves Many Burn-Outs

GROUNDING the neutral of a direct-current distribution system on which series motors are operating which may be driven by their load, such as a descending crane which outruns the motor, has another advantage besides that of safeguarding from shock. This practice has greatly reduced the number of burned-out motors and control devices in a Southern steel mill. In case a ground develops on such a motor an excessive voltage may be generated which will cause general damage to insulation on the system. This trouble is often encountered on motors driving such equipment as a hoist in a soaking pit or a mill table. Suppose such a hoist motor develops a grounded armature. When the grounded motor is driving, the voltage between the lines and the ground alternates from zero to line voltage, say 250 volts, as the grounded coil of the motor revolves. Suppose, however, that in lowering the crane the operator plugs the motor to slow it down. As he has reversed the field, the generated emf. of the motor is reversed. The voltage in this case between one line and the ground still alternates from zero to 250 volts, but the voltage between the other line and ground alternates from 250 volts to 500 volts. This holds in case the motor is generating 250 volts, but actually the motor may be generating a higher voltage because the motor voltage is now aiding the line voltage in sending current through the series field, thereby increasing the motor voltage and subjecting all insulation to a more severe strain than 500 volts. This caused the burning out of about 500 armatures per month in the mill mentioned, besides grounded fields and control apparatus.

After grounding the neutral in the mill with a heavy conductor it was three days before an armature was lost. The grounding was done on the alternating-current side of the rotary converters which supplied the system. However, systems fed with two-wire generators should be grounded with a balancer. In the experience of the author, a straight ground connection has been found satisfactory, although it is probably advisable to insert a resistor in the connection which will prevent the system being put out of commission by an accidental ground on one of the mains.

W. H. PRICE.
General Machinery Company,
Birmingham, Ala.

Clamps for Installing 2,000-Ft. Cables in Shaft Mines

THE work of installing power cables in shaft mines of the Cleveland Cliffs Iron Company has been made comparatively easy by the use of some special clamps for fastening the cable to the cage or skip rope during lowering and for permanently supporting them in position. The reels of cable were previously taken to the bottom of the mine and the cable was pulled up on a hook fastened to the hoist cage, but the clamps make it easier and more satisfactory to reel out the cable from the surface. Practically all the cable used in the mines is No. 2/0 (67.5 sq.mm.), lead-covered and armored three-conductor, insulated with varnished cambric for 5,000 volts. The reel is brought to the mouth of the shaft, and the end of the cable is fastened to the cage or skip rope with the clamps *A* in Fig. 1, which are placed at intervals of about 50 ft. (15 m.) as the cage and the cable are lowered into the mine. The clamps must be placed close enough together to keep the cable from bulging so much that it will touch the side of the shaft and become injured.

When practically all the cable is down the shaft the clamp *B* in Fig. 1 is placed near the top end of the cable and the wire armor is bent back into the clamps as shown in Fig. 2. When this supporting clamp has been bolted to the side of the shaft the cable is unfastened from the hoist rope and its entire weight is then supported by the clamps. The construction of the clamp causes its grip on the cable armor to increase with the weight supported. After the cable has been straightened out in position it is fastened to the side of the shaft with straps of ½-in. by 3-in. (13-mm. by 7.5-cm.) iron bent to fit the cable.

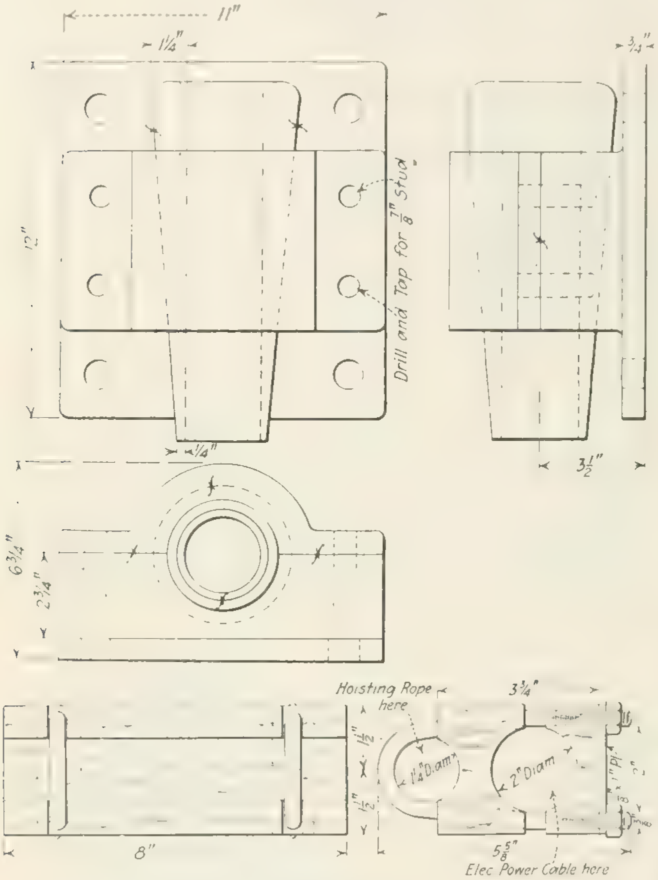


FIG. 1—CLAMPS FOR INSTALLING MINE CABLES

Above—Clamp from which armored cable is hung in vertical shaft. Cable slips through cone. Armor is bent back over cone and clamped into position shown in Fig. 2. Below—Clamp for fastening to steel rope when lowering cable into mine.

FIG. 2—CABLE ARMOR CLAMP IN POSITION

The Cleveland Cliffs Iron Company has had no failures in its vertical shaft cables that were not due to external conditions. These cables are in total lengths of from 500 ft. to 2,400 ft. (150 m. to 720 m.), and some of them have been in service for ten years. The lead sheathing seems to be sufficiently reinforced by the galvanized-steel wire armor to withstand any internal hydrostatic pressure which may develop in the cable. Armor of the proper size and strength is selected for the length of cable to be used. It is also important that the wire armor make not more than one turn for nine diameters of the cable. W. A. Rankin of the Copper Range Company, Painesdale, Mich., found a tendency for the cable to slip through the armor when there was only one turn of the armor in four diameters of the cable.

F. C. Stanford,
Cleveland Cliffs Iron Company, Electrical Engineer.
Ishpeming, Mich.

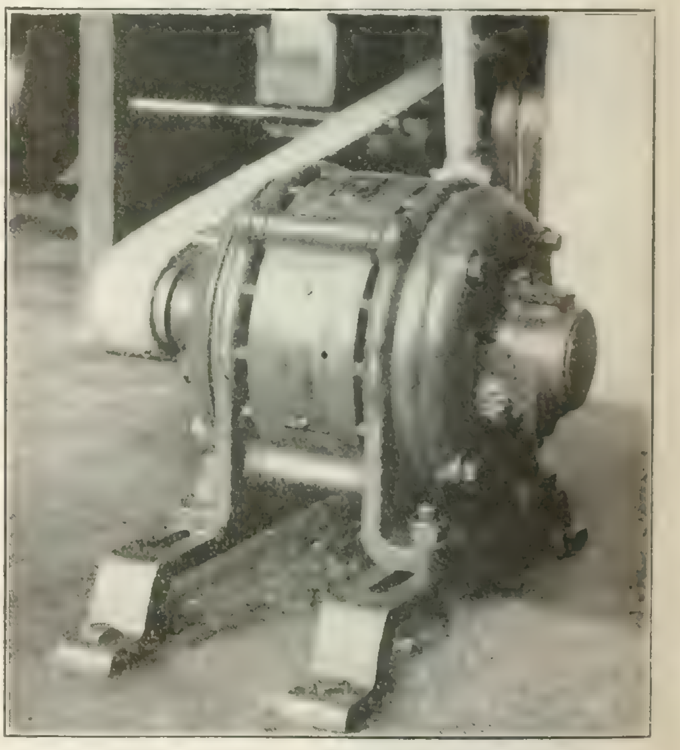
Preventable Breakage of Lamps Almost 20 Per Cent

Almost 20 per cent was estimated as the loss in incandescent lamps in a large industrial plant by preventable breakage and theft. In this plant artificial lighting was used on an average eighteen hours per day, 365 days in the year, and there were 3,865 sockets. Assuming a renewal every 1,000 hours, when the specific output of a lamp has dropped to about 85 per cent, there would have been required in the year 25,393 lamps. Actually, however, there were 26,302 bulbs drawn from the supply department. As there were some outlets without lamps at the time of the survey and as renewals had not been made in some places after burning 2,000 hours or more, it was estimated that the total loss of lamps was about 5,000. At the rate of about 60 cents per lamp, this loss due to breakage and theft amounted to $3.000 per year.

D. W. Blakeslee.
Pittsburgh, Pa.

Home-Made Bracket That Raises Motor Off Floor

In place of the "V" slide rails of the ordinary motor mounting, an improvised bracket of strap iron is employed in a Massachusetts industrial plant. The two iron straps, 1½ in. x ½ in. x 14 in. (3.8 cm. x 1.3 cm. x 35 cm.) in size, are bent as shown in the photograph to support the 0.5-hp. motor 2 in. (5 cm.) above the floor.



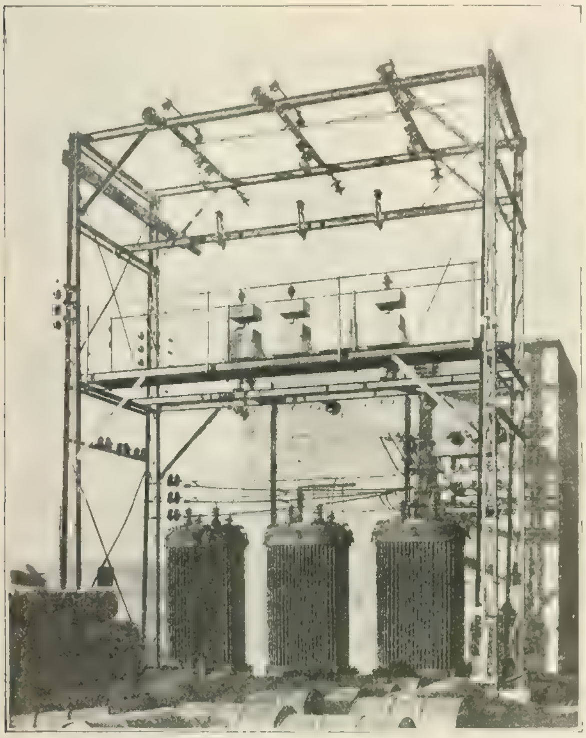
SLOTS ARE CUT IN BRACKET TO PERMIT BELT TO BE TIGHTENED

To permit belt adjustment the motor is fastened to the bracket by bolts passing through ½-in. (1.3-cm.) slots in the bracket. The straps themselves are bolted to the floor.

H. C. N. Ripley,
Chelsea, Mass. Everlastic, Inc.

Transformers Converted for Outdoor Use to Save Construction

IN ORDER to effect a saving in substation construction three 300-kva., 11,000/2,300/440-volt transformers originally designed for indoor service were converted to the outdoor type by installing new covers and weatherproof bushings. These transformers supply power to a connected load of about 2,000 hp. in motors of various sizes operating in the factory of the Perfection Tire & Rubber Company, Fort Madison, Iowa. The outdoor substation, which may be seen in the illustration, occupies a ground space of 22 ft. x 9 ft. (7 m. x 3 m.) and is 30 ft. (9 m.) high. The unit-type steel tower structure and high-tension equipment are of the standard Delta-Star construction, while the transformers and the electrolytic lightning arrester were supplied by the General Electric Company.

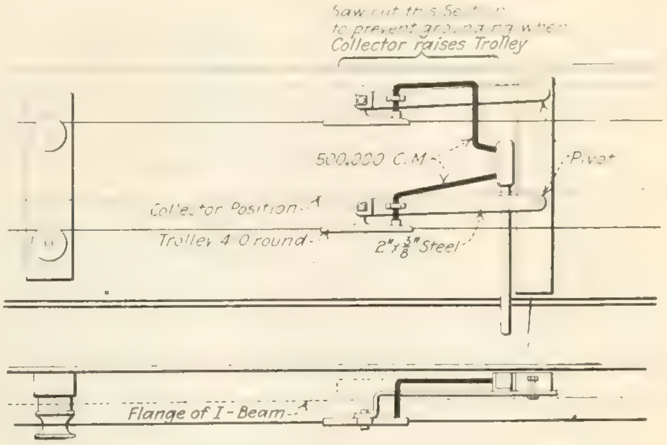


THESE TRANSFORMERS REBUILT FROM INDOOR TYPES

Two Methods of Attaching Crane Trolley Feeders

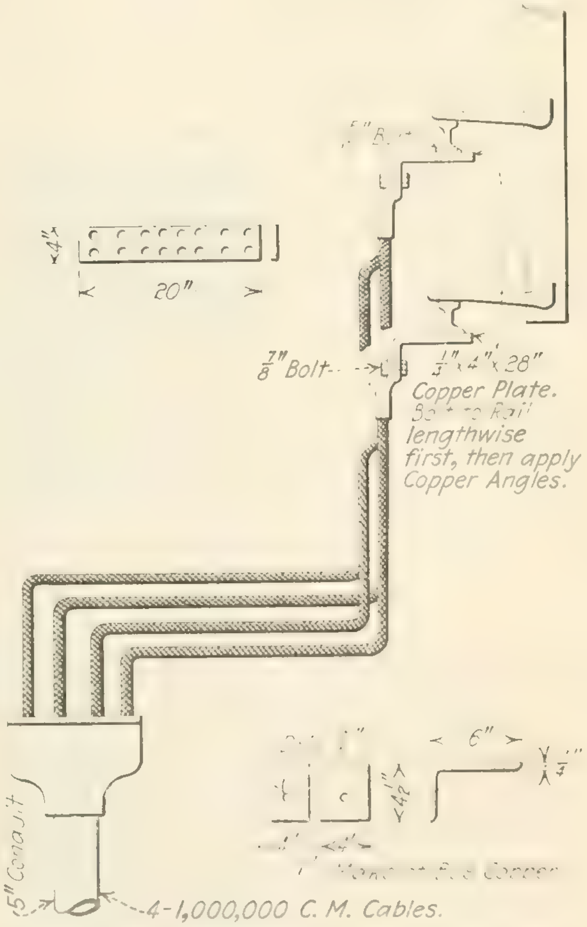
AN ECONOMICAL method of attaching feeder cables to a 10-ton crane trolley wire and a substantial way of connecting feeders to a 250-ton crane collector rails are illustrated in the accompanying drawings. By the first method about $1,500 was saved by feeding the trolley wire at the middle instead of the ends. In this case circuits to the ends of the trolleys in the 400-ft. (122-m.) building would have cost a trifle over $1,500. However, by soldering the trolley ears on the top of the wires it was possible to cut down the circuit length to less than 30 ft. (9 m.). Pivoted arms attached to an insulated support keep these ears upright so that the crane collector can pass underneath without tearing them off the wire.

The feed for the 250-ton crane shows an idea that was used for connecting four 1,000,000-circ.mil cables to the two 60-lb. (27-kg.) collector rails. The difficulty was that the ordinary 1,000,000-circ.mil copper cable lug has surface contact enough for a copper-to-copper joint but has not enough contact for a copper-to-steel joint. To get around this, copper plates were bolted to the bottom of the collector rails and copper angles were bolted to these plates. Then the lugs were bolted to the copper angles. This gave ample surface contact to handle the large crane with its entire equipment of 450 hp. in motors drawing current.



FEEDER ATTACHED TO TOP OF TROLLEY WIRE

Arms hold trolley ears upright.


4"
20"
7/8" Bolt
1/4" x 4" x 28" Copper Plate. Bolt to Rail lengthwise first, then apply Copper Angles.
6"
4 1/2"
4"
5" Conduit
4-1,000,000 C. M. Cables.

FEEDERS MAKE CONTACT WITH LARGE COPPER PLATE BOLTED TO RAIL

The Austin Company, Cleveland, Ohio.

H. L. CORNELISON, Electrical Engineer.

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

Insurance on Rural Lines

THE ordinary public liability insurance policy does not always give central stations adequate protection on rural lines which are owned by the farmers. To overcome this difficulty certain central stations, in co-operation with the Utilities Indemnity & Fire Exchanges of St. Louis, have worked out a plan which gives the necessary protection to the company at a nominal sum. The premium depends on conditions and in some cases is only $1 per customer. There are companies which have distributed the cost and billed it to their customers, while in other instances the utility has absorbed the premium itself in order to be relieved of all liability. The policies are issued in the name of the operating company, and when farmers subscribe to the line their names are added to the policy by indorsement as additional assurees.

"Straight Salaries" Advised for Power Solicitors

COMMISSIONS to power salesmen, when employed in a group by a central station, are not so satisfactory a method of compensation as the "straight salary" basis, declared L. R. Wallis, superintendent sales department Boston Edison Company, recently, before the New England Section of the N. E. L. A. "I do not believe in compensating power salesmen on a commission basis for various reasons," said Mr. Wallis, "chief of which is that it is not possible to deal equitably with two or more salesmen on any commission basis. Further, there are many conditions of business to consider in attempting to arrive at a fair commission schedule. I believe that where more than one real power salesman is employed a straight salary basis in proper recognition of the services rendered is the only just method of compensation."

Interconnected Steam and Hydro-Electric Plants Make for Economy

THE ADVANTAGE gained from the co-operation of great interconnected steam and hydro-electric plants, generating according to the dictates of economy and distributing their energy over great industrial fields, was demonstrated by obtaining data in 1918 from the larger generating stations in New England, New York, New Jersey, Pennsylvania, Delaware and Ohio. Including all the larger towns in New England, New York City, Buffalo, Rochester, Syracuse and other cities on the Niagara system, Cleveland, Lorain, Toledo, Pittsburgh and a number of towns near it in eastern Ohio, Philadelphia, eastern Pennsylvania towns, New Jersey, Wilmington and Baltimore, principal distributers of energy generated 6,605,000,000 kw.-hr. in 1918 according to Lieut.-Col. C. F. Lacombe, secretary of the N. E. L. A. committee on resources of the nation. This amount was produced from coal alone and does not include that also produced by water power in New England, New York and elsewhere. The fuel necessary to produce this energy totaled 8,621,000 tons and was valued at $42,788,000. The same amount of fuel in 1915 would have cost only $21,056,000. The increased cost due to present conditions was therefore $21,731,000.

There are a number of potential water powers in the area under consideration. In New England 600,000 kw. is possible of development, but it is believed feasible at present to develop only about 323,000 kw. on account of unsolved problems of storage and steam auxiliaries. Such a development would save about 1,378,000 tons of coal per year. The increasing demands for energy in New England will absorb this water-power capacity in about four years, and further energy production must depend upon the use of fuel or further possible hydraulic developments requiring extensive storage works.

Commission Viewpoint on Rising Costs

SOME of the Missouri Public Utilities have requested the state commission to change its practice of making valuations on a basis of the cost at the time of installation and to use present costs as basis. David E. Blair, a member of the Missouri Public Utilities Commission, told the St. Louis Electrical Board of Trade in the course of a recent address that he thought it much better to continue to base valuations of property on the cost at the time of installation and when shown necessary to grant the companies relief by changing the percentage of return on the investment. He admitted that the returns on utility investment should be made larger in order to attract capital, and he thought that increasing the rate of return was much simpler and more fair than permitting the valuation to rise or fall with fluctuations in current prices.

"Utility rates must be brought up to a substantial parity with present prices or bankruptcy and complete breakdown of service will be the ultimate result," Mr. Blair said. "For more than three years we have been referring to the rising costs as abnormal, but for how many years can these prices continue and still properly be called abnormal? Utilities doubtless have just grounds for complaint. The dollar the utility receives does not represent at most over 60 and possibly not over 50 per cent of its purchasing power in 1914. The increases in operating expenses have been cared for. Something additional should probably be done for the owners of the property. However, as the greater portion of any given utility investment is represented by money borrowed on long-time securities at low rates of interest and only a small portion of the property represents actual outlays of money by stockholders, the injustice is not so great as would at first appear."

Accurate Method of Showing Merchandising Costs

TO PROVIDE a method which will give a true account of the cost of operating the merchandising department of the central station a classification of merchandising accounts has been prepared by the accounting section of the National Electric Light Association. Merchandising departments have been conducted usually in connection with the other new business activities of the company, and the expense of their operation has been lost in the total expenses of the new-business department. Consequently the manager of such a department is usually unable to determine definitely whether the sale of electrical merchandise is resulting in a profit or a loss.

The classification proposes an index of various items which are properly chargeable to the cost of selling electrical merchandise, and it can be adapted to the operations of a very extensive electric shop or to the requirements of the merchandising branch of a central station operating in a small community. This classification is supplemental to the N. E. L. A. standard classification of accounts and will become a part of and be subsidiary to "Account 508—Electric Merchandise and Jobbing Revenue." Following is the proposed index to the merchandise accounting classification, with a method of numbering each item and connecting it definitely with the master account:

- 508.1 Revenue from Merchandise Sales
- 508.2 Cost of Goods Sold
  - 508.21 Cost of Merchandise
  - 508.22 Storeroom Salaries and Expenses
  - 508.23 Defective Merchandise Replaced
- 508.3 Cost of Installation
  - 508.31 Labor and Material
    - 508.311 Labor
    - 508.312 Material
  - 508.32 Installation Expenses
- 508.4 Selling Expenses
  - 508.41 Sales Department Salaries and Commissions
    - 508.411 Salaries
    - 508.412 Salespeople's Commissions
    - 508.413 Solicitors' Commissions
  - 508.42 Sales Department Supplies and Expenses
    - 508.421 Store Supplies and Expenses
    - 508.422 Traveling Expenses
    - 508.423 Sales School Salaries and Expenses
    - 508.424 Miscellaneous Expenses
  - 508.43 Delivery Department Expense
  - 508.44 Store Demonstrations
  - 508.45 Rentals of Stores
- 508.5 General Expenses
  - 508.51 Clerical Salaries and Expenses
    - 508.510 Inventory Expense
    - 508.511 Merchandise Department
    - 508.512 Cost Accounting Department
    - 508.513 Accounting Department
    - 508.514 Auditing Department
    - 508.515 Bookkeeping Department
    - 508.516 Collection Department
    - 508.517 Credit Department
    - 508.518 Purchasing Department
    - 508.519 Stationery and Printing

      The amount to be charged to the Merchandise Department under the sub-accounts 513 to 518 inclusive will be a flat monthly charge covering the proper proportion of the salaries and expenses of these departments agreed upon between the heads of the respective clerical departments and the head of the Merchandise Department, after a careful analysis of the cost and value of the work performed by these departments for the Merchandise Department.
  - 508.52 Executive Salaries and Expenses
    - 508.521 Salaries and Expenses
    - 508.522 Traveling Expenses
  - 508.53 Advertising
    - 508.531 Salaries and Expenses
    - 508.532 Newspapers, Booklets, etc.
    - 508.533 House Demonstrations
  - 508.54 Rentals
  - 508.55 Insurance and Taxes
  - 508.56 Uncollectible Merchandise Bills
  - 508.57 Non-Payment Recovered Merchandise
- 508.6 Fixed Charges
  - 508.61 Interest on Investment—Furniture and Fixtures
  - 508.62 Interest on Working Capital
    - 508.621 Merchandise Stock
    - 508.622 Accounts Receivable

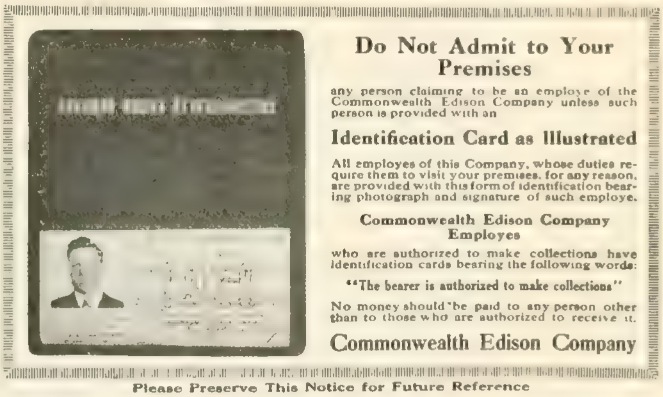
The smaller companies may desire to use only the main classification consisting of the six accounts. Those desiring more than the six accounts may use the first subdivision of twenty accounts, while the larger companies may avail themselves of all subdivisions. This extends the classification to a total of thirty-nine accounts.

Adequate Identification of Employees Protects Customers

EMPLOYEES of the Commonwealth Edison Company, Chicago, are provided with means of identification which are considered more complete than those ordinarily required by banks or the money order department of the United States Post Office. An examination of the identification card carried by the company's employees should leave no chance of unauthorized persons claiming to represent the company gaining admittance to customers' premises. During the five years that the present card system has been in effect there is no record of the identification cards having been successfully used by other than the company's employees.

The employee's photograph is pasted on the left side of the card, as shown in the illustration, and the company's seal is placed over a part of the photograph and a part of the exposed portion of the card, so that the photograph cannot be replaced by another one.

All the identification cards are issued by the employment bureau and sent to the men in charge of those for whom they are intended, who see that each employee signs the card in ink. A customer in doubt as to the identity of a man presenting the card can ask him to sign his name for comparison. Erasure or change of writing is easily apparent. Furthermore, the signature is written across the large figures representing the year, printed in red ink, and if the signature were erased the lines of the figures would be broken also. The employee's name is typewritten on the card, also across printing, so that the name cannot be changed without detection.



Do Not Admit to Your Premises

any person claiming to be an employe of the Commonwealth Edison Company unless such person is provided with an

Identification Card as Illustrated

All employes of this Company, whose duties require them to visit your premises, for any reason, are provided with this form of identification bearing photograph and signature of such employe.

Commonwealth Edison Company Employes

who are authorized to make collections have identification cards bearing the following words:

"The bearer is authorized to make collections"

No money should be paid to any person other than to those who are authorized to receive it.

Commonwealth Edison Company

Please Preserve This Notice for Future Reference

NOTICE MAILED TO CUSTOMERS CALLING ATTENTION TO THE NEW ISSUE OF IDENTIFICATION CARDS

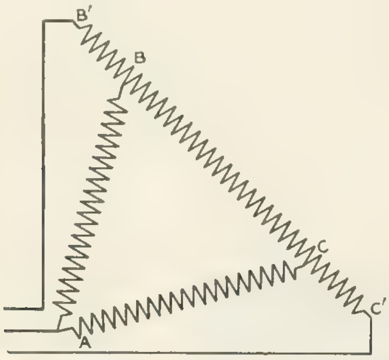
On the first of each year new cards are issued to replace the old ones, which the company is careful to collect and destroy. Notices calling attention to this fact are sent out with every customer's bill, and customers are told to look for the new date on all identification cards presented. The employees are required to deposit 50 cents for a leather case in which the identification card must be carried. The leather cases are renewed without charge as they wear out, and the 50 cents is refunded when an employee leaves the company or has no further need for the card.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

A New System of Three-Phase-Two-Phase Transformation.—K. SACHS.—When it is desired to change from three-phase to two-phase distribution, or vice versa, static transformers in the so-called Scott connection are usually employed. This system has the disadvantage of giving an unsymmetrical voltage drop at load. The author describes a new mode of connection due to J. Kübler, which will give a fair symmetry of voltages even at high load. A standard three-phase transformer, according to this system, may be changed into a two-phase-three-phase transformer simply by adding certain auxiliary coils on the two-phase side, as the figure shows.



SCHEME FOR THREE-PHASE-TWO-PHASE TRANSFORMATION

ABC is a normal three-phase secondary winding, while BB' and CC' are auxiliary coils, which lie on the same leg as the winding BC and are so connected that three-wire, two-phase voltages may be tapped off at $B'AC'$. A thorough analysis is given of the distribution of current and of the losses in this new type of winding, and it is also shown that the transformation from three-phase to quarter-phase may be obtained by a similar arrangement.—*Elektrotechnik und Maschinenbau*, March 7, 1920.

Lamps and Lighting

Calculation of the Illumination of Closed Spaces.—G. PERI.—A given surface inside a closed space is illuminated both directly by the lamps and indirectly by the light reflected by the walls, the ceiling, etc. The calculation of the illumination by the reflected light is rather vague, though interesting methods exist for making it. In the present article the author sets forth a method which, though less rigorous, is practically sufficient. According to this method the mean illumination of a surface S by n lamps, each of which emits a luminous flux Φ is $E = \theta n\Phi/S$, where θ is a coefficient, less than unity, depending on the dimensions of the room, the color of the walls, etc. A table of the values of θ as dependent on these circumstances is given. A diagram allows graphical determination of the distance and the number of the lamps, when the flux of each lamp, the required illumination and the coefficient θ are known—*Science Abstracts, Section B*, Oct. 31, 1919. (Abstracted from *Elettrotecnica*, Aug. 5, 1919.)

Generation, Transmission and Distribution

Design of Transmission-Line Foundations.—G. D. BALSILLE.—A mathematical investigation of the mechanics involved in the calculation of pressure on transmission-line power foundations.—*Commonwealth Engineer of Australia*, April 1, 1920.

The Tocopilla Power Plant in Chile.—Strange operating conditions prevail at the Chile Exploration Company's 50,000-kw. power plant at Tocopilla, on the harborless desert coast of Chile, about 100 miles (160 km.) north of the Tropic of Capricorn. The plant is equipped with five 10,000-kva., 50-cycle, three-phase, 5,000-volt turbo-alternators, which are run at about 150 to 175 per cent of rated output. There is no fresh water available, and therefore the boilers must be fed by distilled sea water. Oil is used as a fuel, and is pumped by means of a floated pipe line from boats anchoring off the shore. The electric power is transformed to 110.000 volts and transmitted 90 miles (145 km.) across the desert to the copper mines and refinery of the Chile Copper Company at Quicamata. For the first 10 miles (16 km.) from the shore the transmission line is built in duplicate, one line being in service while the insulators on the other line are washed to remove salt deposit which results from the sea mist and soon would cause flashovers. At the mine are installed some of the first electrically operated shovels in use. There are four 100-ton and one 200-ton shovels, driven by wound-rotor alternating-current motors. The motors are provided with current-limiting devices to prevent the equipment from being abused. The shovels are giving very satisfactory service and compare well with steam-operated shovels.—*Power*, March 30, 1920.

Traction

High-Speed Electric Locomotives, Type "Baltic."—LUCIEN PAHIN.—The Italian Railroad Administration has put into service eighteen of these locomotives, which were built by the Italian Brown-Boveri Company, and are used for high-speed service in the mountainous regions of the country. The locomotives are fed from a three-phase power system, at 3,300 volts and 16.7 cycles, two phases being supplied over the aërial contact wires, while the third phase is grounded and supplied through the rails. The locomotives are equipped with two three-phase induction motors. Speed regulation is obtained by (1) connecting the motors in parallel or in concatenation, (2) by changing from six-pole to eight-pole connections. Thus four synchronous speeds are provided, corresponding to 37.5, 50, 75 and 100 km. an hour (23.3, 31.1, 47.7 and 61.2 miles an hour). Intermediate steps of speed are obtained by connecting resistances into the rotor circuits. The controlling elements are operated by means of compressed air. The locomotives weigh 92 tons and are capable of giving a draw-bar pull of 9 tons at medium speed, with a maximum of 12 tons at start.—*L'Industrie Electrique*, Nov. 25, 1919.

Railway Electrification in the Super-Power Zone.—W. B. POTTER.—This is the author's contribution to the proposal for a super-power zone recently discussed before the American Institute of Electrical Engineers. The conclusions reached in this paper are as follows: (a) Of the whole mileage included in the zone, not a very large proportion has been electrified, but main-line electrifications now in operation are of sufficient extent and carry tonnage of such character that data now at hand can be applied to the traffic of the whole district. (b) The traffic within the zone now handled by steam locomotives would, if handled electrically, require an average output of less than 750,000 kw., and if produced entirely by coal-burning electric power stations would reduce the coal requirements for transportation purposes from 21,000,000 tons to 7,000,000 tons annually. (c) As a certain proportion of the electric power will be produced from hydraulic power stations, this coal requirement will be reduced in proportion as advantage is taken of hydraulic operation.—*General Electric Review*, April, 1920.

Electrophysics and Magnetism

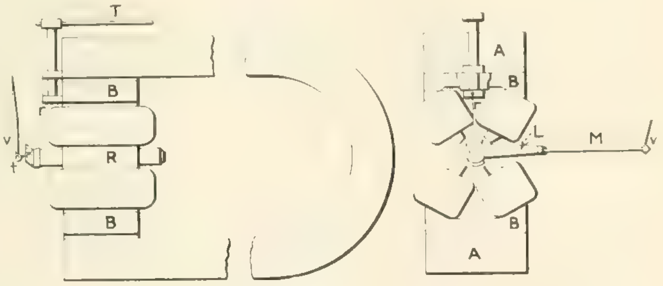
Electromagnetic Valves at a Surface of Discontinuity.—KARL ULLER.—An electromagnetic wave which in its path finds a surface of discontinuity, such as the boundary between two media of different electric or magnetic properties, shows a tendency to bend off from its initial direction of propagation and thus let itself be guided by the discontinuity. This phenomenon is announced by the writer from a theoretical analysis of the structure of so-called "two-media waves." If a second surface of discontinuity exists in the neighborhood, a still higher energy concentration may result, particularly if the surfaces converge. The abnormally great distances covered in radio-telegraphy thus seem to find a theoretically well-grounded explanation. According to the author the energy dispersion is prevented (1) by the guiding action of the earth's surface and (2) by the guiding and concentration action of the boundary strata of the atmosphere. From the many inhomogeneities in the ground considerable scattering and bending may result, which should be expected to cause deviations in radio direction finding.—*Jahrbuch der Drahtlosen Tel. und Tel.*, February, 1920.

Units, Measurements and Instruments

A Sphere Photometer for Routine Testing.—K. SCHMIDT.—In illuminating engineering the total flux of light given out by a lamp—the mean spherical candlepower of the lamp—is being more and more used for defining the useful illuminating power of the lamp. The only method which permits of a satisfactory and direct measurement of this quantity is that based on the use of the Ulbricht integrating sphere. A photometer outfit based on this principle has recently been put on the market by the Siemens Halske Company and is described in this article. The photometer, it is claimed, is rugged and simple enough to be used in factory routine testing. An integrating sphere of 1.5 m. (4.9 ft.) diameter is used, which is pressed in two halves of zinc plate. The illumination on the inside of the sphere is compared, by means of a Lummer-Brodhun photometer head without telescope, with the intensity of the light from a translucent screen, illuminated by a standard incandescent lamp.—*Helios*, Oct. 5, 1919.

Telegraphy, Telephony and Signals

High-Speed Radio Messages Graphically Recorded by Means of Amplifiers for Very Low Frequency.—ABRAHAM and BLOCH.—Although some attempts were made in the earliest days of radio-telegraphy to obtain graphical records of the received signals, the simplicity and extreme sensitivity of telephone reception very soon caused the universal adoption of the latter system. The oral reception works very well for moderate speed of signaling, such as ten or fifteen words a minute. Financial considerations and the continually increasing volume of traffic, however, necessitate the use of higher signaling speed up to fifty words a minute. The sending, then, is made by automatic transmitting machines, and it is necessary to return again to automatic registration of the received signals. Photographic registration has been used for scientific purposes, and attempts have been made to employ the dictaphone principle, thereby utilizing the extreme sensitivity of the telephonic reception. However, the real solution seems to lie in the application of vacuum-tube amplifiers. By this means the authors have obtained the most remarkably clear records, not only of most European stations of considerable output, but also of Sayville, Tuckerton, New Brunswick and Annapolis. In these experiments a threefold amplification was used. The incoming high-frequency oscillations were first sent through a multi-stage radio-frequency amplifier. The signals were then transformed to an audio-frequency current, which in its turn passed through several stages of amplification. Finally the audio signals were "detected" again and changed into dots and dashes, which, after passing a special amplifier for very low frequency, were impressed upon the recorder. In some experiments a modified Morse inker was used, in other cases reception was made by means of a peculiar moving-iron galvanometer or oscillograph (see illustration) with a light pointer resting on a sooted paper-strip. The current to be recorded was supplied to the four coils on the laminated pole pieces *BB* of a permanent magnet *AA*. *R* is a pivoted soft-iron piece. The action is similar to that of the quadrant electrometer. Difficulties were sometimes experienced from static, but by running the last amplifier bulb up to saturation and by use of special filter circuits very clear records could be obtained. The article forms an extensive report of a long series of investigations on graphical reception and allied subjects.—*Revue Générale d'Electricité*, Feb. 14 and 21, 1920.



MOVING IRON RECORDER FOR RADIO-TELEGRAPHY

News in Brief

Summary of Market Conditions and of Recent and Approaching Happenings of Importance to the Industry

THROUGHOUT the country a more general movement of electrical freight is reported during the week just past. No general yard clean-up has been completed, but the roads are making progress in that direction. At the same time fresh shipments are coming through from manufacturers in better volume and they in turn are a little better off for raw materials. This latter condition, however, is clearing probably the worst of all.

EVERY section of the country reports labor disturbances in the face of curtailed factory operation in many non-electrical trades—principally cotton, woolen, silk and leather. It is very noticeable in the latter. Two and three days' operation per week is getting more common in these industries.

STOCKS are still in bad condition all over the country, steel and porcelain materials being reported as the worst. At the same time orders are coming in to jobbers in good shape in hope that deliveries will soon follow. Long-term buying is not so popular as it was several months ago.

EXCEPT in Chicago, building construction is going on in good volume—at least as fast as building materials and electrical supplies will permit it.

TURBINE buying has fallen off in the central-station field, and some large appropriations for extensions have been cut. Deliveries are near the end of 1921 on large sizes, and prices as a rule are moving upward.

ELECTRIC utilities in Massachusetts can continue to establish new rate schedules subject to appeal to the state commission, as legislation aimed to prevent freedom of action in this respect has failed to pass the State Senate.

THE MUNICIPAL electric light plant at Danvers, Mass., said to be the oldest in the country, has begun to take energy from the Tenney companies on a ten-year contract, holding the steam installation in reserve.

CAPITAL for the current year's requirements of the Commonwealth Edison Company has been obtained from an issue of $5,000,000 five-year 7 per cent gold notes secured by first mortgage bonds.

GOVERNOR ALLEN of Kansas and Samuel Gompers, president of the American Federation of Labor, held a joint debate in New York City on the new Kansas Court of Industrial Relations, Governor Allen upholding and Mr. Gompers attacking the anti-strike provisions of the law.

WHETHER to spend $400,000 for enlargement or to purchase electrical energy from the central stations in its territory is the question that confronts the municipal plant of Taunton, Mass.

A BILL designed to invest the Department of Public Utilities with the duty of passing upon all rate changes of electric and light companies, whether or not an appeal against such changes is taken, has been defeated in the Massachusetts State Senate.

THE ADVISABILITY of its participation in the investigation of inductive interference is being considered by the Bureau of Standards at Washington.

E. M. HERR, president of the Westinghouse Electric & Manufacturing Company, and L. A. Osborne, president of the Westinghouse Electric International Company, have been decorated with the Order of the Rising Sun by the Emperor of Japan.

FURTHER proposed changes to the grounding rules of the National Electrical Safety Code have been issued.

THAT the public service commission may be likened to a board of arbitration every member of which is appointed by the other side was the view expressed by P. S. Arkwright, president of the Georgia Railway & Power Company, in a recent address.

APPRAISAL and valuation of public utilities was the topic of one session of the recent St. Louis convention of the American Society of Mechanical Engineers.

DECISIONS have been handed down by the United States Circuit Court of Appeals holding that the Hubbell patents relating to concealed contacts in attachment receptacles were not infringed by the General Electric Company and the Bryant Electric Company.

CONTEMPLATED hydro-electric developments by the Southern California Edison Company will have an ultimate rating of 868,000 hp. and will include eight plants and a total head of 5,720 ft.

BY A VOTE of forty-five to twenty-one the United States Senate has passed the water-power bill as amended by the conference committee and sent it to the President for his approval. With the affixing of the President's signature an eight years' struggle for a law to promote hydro-electric development will come to a successful end.

IT IS REPORTED that John I. Beggs was elected president of the Milwaukee Light, Heat & Traction Company at the meeting of the North American Company on May 25.

TESTIFYING before the Public Utilities Commission of Illinois in a hearing on credit conditions, G. M. Reynolds, director of the Federal Reserve Bank of Chicago, said that unless there is a change in public sentiment it will only be a question of time when the utilities will cease to function, which would "break up our cities."

TWO SETS of tentative rules governing the supply and maintenance of electric service have been issued by the Public Utilities Commission of Illinois. A hearing has been set for June 10.

J. L. HECHT of Chicago was elected president of the National District Heating Association at its meeting in Chicago last week.

GROUND has been broken for the new Calumet Lake power plant of the Commonwealth Edison Company, which will have an ultimate capacity of 180,000 kw. A boiler pressure of 325 lb. and 250 deg. superheat will be a feature of the plant.

GOVERNOR COOLIDGE of Massachusetts has asked the Legislature for authority to appoint a coal administrator for the state.

AN ISSUE of $6,000,000 in five-year 6 per cent gold notes has been placed on the market by the American Light & Traction Company.

AN ORGANIZATION to appraise managerial efficiency, to be known as the Bureau of Commercial Economics, Inc., has been organized by Samuel Insull and others.

CENTRAL-STATION problems in operating steam and hot-water heating systems were discussed at the Chicago meeting of the National District Heating Association.

News of the Industry

Chronicle of Important Events and General Activities in the
Technical, Commercial and Manufacturing Fields With Announcements and
Reports of Association Meetings and Conventions

Manufacturers on N. E. L. A. Executive Committee

THE executive committee of the National Electric Light Association for the new association year includes for the first time representatives of the electrical manufacturers, who are Class D members. The manufacturing representatives on this committee are E. W. Rice, General Electric Company; E. M. Herr, Westinghouse Electric & Manufacturing Company, and W. A. Layman, Wagner Electric Manufacturing Company. Members-at-large of the new executive committee follow:

One-Year Term—E. W. Rice, General Electric Company, Schenectady; Paul Spencer, United Gas Improvement Company, Philadelphia; W. H. Atkins, Edison Electric Illuminating Company of Boston.

Two-Year Term—E. M. Herr, Westinghouse Electric & Manufacturing Company, Pittsburgh; Walter Neumuller, New York Edison Company; D. H. McDougall, Toronto Electric Power Company.

Three-Year Term—E. W. Lloyd, Commonwealth Edison Company, Chicago; W. A. Layman, Wagner Electric Manufacturing Company, St. Louis; J. R. Owens, Oklahoma Gas & Electric Company, Oklahoma City, Okla.

Utilities May Secure Assistance in Case of Coal Shortage

THE acting secretary of the National Committee on Gas and Electric Service reports that the Washington representative of the committee is in daily touch with the Interstate Commerce Commission, presenting the individual cases reported by gas and electric light and power companies of shortage in the coal supply. Cases requiring action should be reported direct to the offices of the committee, at Room 950, Munsey Building, Washington, D. C., but, it is stated, that action can only be secured where full information is given, including the amount of coal actually on hand and the rate of daily consumption, the name of the contractor or shipper, the location of the mines and the railway or railways over which delivery is made.

Increase in Rates Granted to Idaho Power Company

A UNIFORM increase of 10 per cent was on Wednesday granted the Idaho Power Company by the Public Service Commission of the state on all rates except for cooking, domestic water heating and railway service. New irrigation loads will be subject to a 20 to 25 per cent increase because of the cost of serving this business. The increases will be applied as a surcharge upon undiscounted bills based on existing schedules. They took effect June 1 on all services except irrigation pumping, which will be subject to the increase for the entire season of 1920. In its decision the commission said that increases in rates when necessary to enable a utility either to keep its service at the point of efficiency which the public demands or to attract new capital for needed increases are justified.

Ground Broken for New 180,000-Kw. Commonwealth Edison Plant

THREE hundred and twenty-five pounds pressure and 250 deg. superheat are to be used on the boilers of the 180,000 kw. Calumet Power Plant, for which the Commonwealth Edison Company, Chicago, has bought about forty acres in the heart of the Calumet Lake region. Ground has been broken for construction of the plant, which should be in service by the fall of 1921. The initial turbine installation of two 30,000-kw. units has been ordered, the Westinghouse Electric & Manufacturing Company and the General Electric Company each supplying one machine. Four Babcock & Wilcox boilers, each with 15,000 sq.ft. of heating surface, will be installed for each turbine. The economizers will each have a surface of 10,000 sq.ft.

Gompers and Allen Debate Right to Strike

KANSAS' new Court of Industrial Relations was the subject of a lively debate at the Carnegie Hall, New York City, on Friday evening of last week between Gov. Henry J. Allen of Kansas, to whom the inception of the court was due, and Samuel Gompers, president of the American Federation of Labor. The argument dealt particularly with the anti-strike provisions of the Kansas law and aroused much interest not only among the crowded audience but also in public utility circles everywhere and on the part of the general public.

Governor Allen based his argument on the paramount nature of the public right to uninterrupted service in things necessary for its safety and comfort, instancing the conditions brought about by the strike in the Kansas coal mines and the suffering inflicted by it on many thousands of citizens unconcerned in this dispute. Mr. Gompers' attack on the law was general in its character. He championed labor's right to strike, and held that to take it away would be unconstitutional.

Governor Allen twice put the following question to Mr. Gompers:

"When a dispute between capital and labor brings on a strike affecting the production or distribution of the necessaries of life, thus threatening the public peace and impairing the public health, has the public any rights in such a controversy, or is it a private war between capital and labor? If you answer this question in the affirmative, Mr. Gompers, how would you protect the rights of the public?"

This question Mr. Gompers declared unfair or misleading and refused to answer.

Water-Power Bill Is Passed by Senate

Conference Committee Report Is Adopted by a Vote of Forty-five to Twenty-one—Presidential Approval Confidently Expected—History of the Eight-Year Agitation—Provisions of the Amended Measure

BY A VOTE of 45 to 21, the United States Senate on May 28 adopted the conference committee report on the water-power bill. It had been adopted by the House on May 4 by a vote of 259 to 30. The bill then was sent to the President for his approval, which is confidently expected.

The threatened filibuster on the measure collapsed when it became evident that an overwhelming majority would vote for the conference report and that Senator Wesley L. Jones of Washington, who was in charge of the legislation, was prepared to hold the Senate in continuous session until the report was voted upon. Even Senator King of Utah, after having stated that he would require at least eight hours to present his analysis of the legislation, contented himself with twenty minutes. Senator Fernald of Maine spoke at length against the bill, but it was apparent that his opposition was perfunctory.

Views of the Bill's Opponents

Further opposition to the bill was voiced by Senator Thomas of Colorado, who, however, did not vote against it; Senator Lenroot of Wisconsin, who, while praising some of its features, thought that the public was not adequately protected against excessive profits and that the licenses would in effect be perpetual; Senator Nugent of Idaho and Senator Hale of Maine. Senator King, however, was the chief spokesman in opposition, basing his contentions on the doctrine of states' rights.

The objections of Senators Fernald and Hale of Maine were based largely on the definition of navigable waters. As Senator Hale put it: "In my state we have many valuable water powers, developed and undeveloped. These water powers we regard among the principal assets of the state. We desire to handle them, as far as is possible, for the use of the people of the state of Maine, under state instead of federal regulations. Many of the streams in my state are used for lumbering purposes. Temporary dams and obstructions constantly are being put in these streams for logging purposes. Often the need for action is very immediate. To have to go to the Water-Power Commission in each case for permission to do so would be intolerable."

In regard to the renewal of license, the bill reads: "That, in the event the United States does not exercise the right to take over, or does not issue a license to a new licensee, or issue a new license to the original licensee upon reasonable terms, then the commission shall issue from year to year an annual license, etc."

In this connection Senator Jones said: "I think that it clearly means that at the end of fifty years, if the commission issues a new license upon reasonable terms and the licensee refuses to take it, then of course his right terminates. If he contends that it is not on reasonable terms, the matter will be decided by the court. If the court says that it is based upon reasonable terms, he having rejected it, he is out. If the court holds that the terms are reasonable and the licensee has accepted it, of course he goes on then under the provisions of the bill." Senator Jones also pointed out that the final wording of the paragraph was suggested by the Secretary of War and had the approval of the Secretary of Agriculture.

Following the adoption of the conference report, Senator Jones introduced a concurrent resolution to the effect that the short title of the act is to be "The Federal Water Power Act." In filing applications it will be necessary to refer to the act by that title.

It is regarded as highly probable that Oscar C. Merrill will be chosen by the Secretaries of War, the Interior and Agriculture as executive secretary of the commission. It was he who drafted the bill which, with some changes, was finally approved. At present Mr. Merrill is chief engineer of the Forest Service, and as such he has had much to do with administering water powers in the forest reserves. He is regarded as an authority on water-power matters in general. So far as is known, no other name has been considered for the secretaryship.

The Senatorial Line-Up

The Senators who voted for the conference report and made possible the enactment of this legislation before the summer recess were: Beckman, Kentucky; Brandegee, Connecticut; Chamberlain, Oregon; Colt, Rhode Island; Dial, South Carolina; Elkins, West Virginia; Fall, New Mexico; Frelinghuysen, New Jersey; Gay, Louisiana; Gerry, Rhode Island; Glass, Virginia; Jones, New Mexico; Jones, Washington; Kellogg, Minnesota; Kendrick, Wyoming; Knox, Pennsylvania; Lodge, Massachusetts; McCumber, North Dakota; McLean, Connecticut; McNary, Oregon; Myers, Montana; Nelson, Minnesota; New, Indiana; Overman, North Carolina; Page, Vermont; Poindexter, Washington; Pomerene, Ohio; Ransdell, Louisiana; T. Robinson, Arkansas; Sherman, Illinois; Simmons, North Carolina; Smith, Arizona; Smith, Georgia; Smith, South Carolina; Smoot, Utah; Spencer, Missouri; Sterling, South Dakota; Sutherland, West Virginia; Swanson, Virginia; Townsend, Michigan; Underwood, Alabama; Wadsworth, New York; Walsh, Montana; Warren, Wyoming, and Williams, Mississippi.

The Senators who voted against accepting the conference report were: Borah, Idaho; Capper, Kansas; Fernald, Maine; France, Maryland; Hale, Maine; Harrison, Mississippi; Henderson, Nevada; Kenyon, Iowa; Keyes, New Hampshire; King, Utah; Lenroot, Wisconsin; McCormick, Illinois; McKellar, Tennessee; Moses, New Hampshire; Norris, Nebraska; Nugent, Idaho; Phelan, California; Reed, Missouri; Sheppard, Texas; Trammell, Florida, and Walsh, Massachusetts.

Other members of the Senate were either paired or absent from the chamber when the vote was taken.

History of the Legislation

The effort to secure comprehensive water-power legislation really dates from 1890, when Congress provided that no bridge or breakwater or pier or abutment could be constructed beyond the harbor lines where it was established and that where they were not established such obstructions could not be made without the previous consent of the Secretary of War.

In 1899 further legislation provided that the consent of Congress was required for the putting of obstructions in navigable waters. Where such obstruction was on intrastate navigable water, notwithstanding the fact that the Legislature gave consent, the Secretary of War had to pass upon the plans, specifications and the location.

There was no further legislation until the general dam act of 1906. This act also required the consent of Congress before a dam could be constructed over a navigable water and required the approval of the specifications, plans and location of the site by the Secretary of War and Chief of Engineers. This act of 1906 further required the grantee to construct locks requested by the government at his own expense; also that he must light the locks, furnish the operative power and establish such fishways as the Secretary of Commerce and Labor might require. All rights granted under this act ceased upon failure to comply with the stipulations and penalties prescribed for failure to comply with the orders and regulations of the Secretary of War and Chief of Engineers.

Under this act of 1906 Congress passed a special act in 1908 for a dam across the Rainy River, an international boundary stream. While this special act complied with the provisions of the general dam act of 1906, it was vetoed by President Roosevelt in a message sent to Congress April 3, 1908.

In a letter dated April 13, 1908, President Roosevelt, in a communication addressed to the Senate committee on commerce, gave notice that he would not sign any bills hereafter which did not provide specifically for a charge and a definite limitation in time of the rights conferred. Notwithstanding the veto message and this letter from the President, Congress passed a bill for the construction of a dam on the James River in Missouri and on Jan. 15 President Roosevelt vetoed this bill.

These vetoes in 1908 and 1909 practically put an end to the introduction of water-power bills. Under the act of 1906 twenty-five special bills were passed by Congress, but of that number only six were carried to completion.

Owing to the veto messages of President Roosevelt and a growing interest in the conservation of our national resources, the committee on interstate and foreign commerce passed the general dam act of 1910. This act virtually incorporated the provisions already contained in the act of 1906 but added provisions which had been insisted upon by the President in his veto message.

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MEMBERS OF THE SENATE AND HOUSE TO WHOM ESPECIAL CREDIT IS DUE FOR THEIR EFFORTS TO BRING FORTH COMPREHENSIVE AND CONSTRUCTIVE WATER-POWER LEGISLATION

Under the act of 1910 there were fourteen special acts passed by Congress and out of the fourteen only two went to completion and became working projects, so that under the acts of 1906 and 1910 there have been a total of twenty-nine special acts passed and only eight dams have been constructed thereunder, developing total horsepower of 140,000, an amount quite inconsequential when the enormous possibilities of water power available are considered.

AN EIGHT-YEAR-LONG STRUGGLE

Owing to imperfections in the act of 1910 and the omission of any suitable recapture clause and the failure to construct dams thereunder, Congress for eight years has been seeking to enact legislation which, while encouraging private enterprise and the investment of private capital, yet would safeguard the public interest but these efforts on the part of Congress were not coordinated.

The committee on the public lands, having jurisdiction of water-power development on the public domain, sought to perfect legislation regarding the construction of dams on streams over which the government had ownership and jurisdiction, while the committee on interstate and foreign commerce sought to perfect legislation regarding the construction of dams and the development of water power on the navigable streams. All efforts to secure legislation either on the part of the committee on interstate and foreign commerce or the committee on the public lands failed.

The Ferris bill reported by the committee on the public lands and which passed the House Aug. 24, 1914, relating to water powers on the public domain, failed of passage, as did a like bill reported by the same committee and passed by the House Jan. 8, 1916. The committee on interstate and foreign commerce had no better success with the Adamson bill providing for the construction of dams on navigable waters, which passed the House Aug. 4, 1914, and a like bill which passed the House July 14, 1916. Each of these four measures, which received the approval of the House in prior Congresses, contained virtually every one of the provisions and requirements set forth in the veto messages of President Roosevelt, but not one of them received the approval of the Senate, owing to objections based largely on the ground that Congress has no right to exact a charge for the development of water power and with special reference to power developed on navigable streams.

The increasing need of power, resulting through the nation's participation in the war and growing shortage in certain sections of the coal and oil supply, compelled attention to the urgency of immediate and comprehensive water-power legislation. President Wilson in December, 1917, laid the matter before members of the committees of the House having jurisdiction of water-power legislation, and at the same time presented the draft of the bill which had been turnished by a departmental committee and had the approval of Secretaries Baker, Lane and Houston. The bill was killed in the last hours of the Sixty-fifth Congress by a filibuster conducted by Senator La Follette.

Early in the present session the bill which has just been finally approved was introduced by Representative Esch of Wisconsin. The House reported it favorably June 24, 1919. It was passed by the House on July 1. The Senate, however, did not report the bill until Sept. 12. Another long delay took place before the bill was brought up, and it was not until Jan. 15 of this year that it was passed by the Senate. It was sent to conference on Jan. 17. The conferees had the greatest difficulty in reaching an agreement, but finally, on April 30, reported out their conference bill, the measure which has been acted upon finally.

The need for the active development of our water-power resources was set forth clearly by Secretary Houston, now at the head of the Treasury Department, when he was Secretary of Agriculture.

Provisions of the Bill

The bill in its final form provides for a Federal Power Commission, to be composed of the Secretaries of War, the Interior and Agriculture, and to have authority over all matters pertaining to the development of water powers in which the federal government has jurisdiction or is interested as the owner of property involved. The commission is empowered to appoint an executive secretary and prescribe his duties and may request the President to detail an officer of the Engineer Corps of the army to serve the commission as engineer officer. His duties also are to be prescribed by the commission.

The commission may issue preliminary permits allowing applicants three years in which to make examination of water-power projects, to prepare plans and to make financial arrangements. The commission may also issue licenses for a period of fifty years from the expiration of preliminary permits, may reserve projects the development of which in its opinion should be undertaken by the United States itself and report its opinions to Congress, and, other things being equal, must give preference to states and municipalities over private companies as developers of water powers. The building of headwater storage reservoirs to prevent floods is encouraged, and there are provisions designed to aid irrigation and for the construction of locks to promote navigation where this is possible. At the expiration of the fifty-year license the government is to have the option of purchasing the hydro-electric plants by paying the licensee his net investment, or it may issue a new license to the original licensee upon reasonable terms, or to a new licensee who shall in that event pay the original owner his net investment in the plant. The commission is authorized to make reasonable charges and to take up excess profits which cannot be reached through regulation. Licensees are placed under the supervision of state public service commissions as to rates to be charged consumers for power and also as to regulation of service. Severe penalties are provided for infraction of the law.

Commission's Duties and Functions

The duties and functions of the commission, as prescribed by the bill or implied in its provisions, come under these general heads: (1) General administration of water-power; (2) design, construction and operation of project works; (3) regulation of financial operations; (4) regulation of rates and service; (5) valuation of properties of licensees; (6) general investigations; (7) special investigations.

In the general administration of water powers, the bill places the following duties upon the commission:

(a) To give notice to "any state or municipality likely to be interested" of the filing of any application for a license, and to publish notice of such application for eight weeks.

(b) To file with local land offices notice of any application for a license together with a description of the lands of the United States affected thereby.

(c) To investigate all projects proposed to be constructed on any stream over which Congress has jurisdiction, but which is not defined as "navigable waters," whenever declaration of intention to construct such project is filed with the commission.

(d) To hold hearings when desirable or necessary in connection with any application for a permit or license.

(e) To issue preliminary permits for power projects.

(f) To issue licenses for power projects and transmission lines on navigable waters, public lands and reservations of the United States.

(g) To investigate and approve all voluntary transfers of licenses.

(h) To investigate and approve all contracts for power made by a licensee which will extend beyond the termination of the license.

(i) To provide for the proportionate distribution of annual costs of headwater improvements between owner and licensees benefited thereby.

(j) To assess against all licensees benefited the annual cost of any headwater improvement constructed by the United States.

(k) To prescribe rules for and to fix annual license charges, and to determine the relation of such charges to prices to consumers.

To put the above provisions into effect, the commission is authorized to make rules and regulations for administration of the act and is required to submit annually to Congress on or before the first Monday in December a classified report showing permits and licenses issued, the parties thereto, the terms thereof and the moneys received.

The commission has authority to pass upon the general scheme of development of power sites, upon the plans and specifications of the works and upon certain features of maintenance and operation of project works; and it is its duty:

(a) To require that "the project adopted shall be such as in the judgment of the commission will be best adapted to a comprehensive scheme of improvement and utilization," and that plans be modified when necessary to secure such scheme.

(b) To approve maps, plans and specifications of project works.

(c) To pass upon and approve prior to construction any substantial alteration in project plans.

(d) To require that project works be properly maintained and kept in efficient operating condition.

(e) To prescribe the time within which projects shall be begun and completed.

(f) To keep in touch with conditions of the power market tributary to every development in order to require extensions as rapidly as conditions warrant.

(g) To prescribe rules and regulations for the protection of life, health and property in connection with the construction or operation of project works by licensees.

FURTHER DUTIES OF THE COMMISSION

Under the provisions of the act, it is also the duty of the commission:

(a) To prescribe a system of accounting for licensees.

(b) To require the submission of financial statements and reports.

(c) To prescribe rules for the establishment and maintenance of depreciation reserves by licensees.

(d) To devise principles for the proper apportionment of surplus earnings to amortization reserves.

(e) To regulate, under certain conditions, the amount and character of securities which may be issued for the financing of power projects and to hold hearings in connection therewith.

Jurisdiction over the regulation of rates and service is conferred upon the commission:

(a) In intrastate business whenever the state has not provided an agency with power of regulation.

(b) In interstate business whenever the states concerned have not the power to act individually or cannot reach mutual agreement.

It is a fundamental principle of the act that valuations for purposes of rate making or of purchase at the termination of the license period shall be based upon the "net investment" in the property and that this amount shall be determined currently either through the system of accounting or through physical valuation. For this purpose it is the duty of the commission:

(a) To require the filing of statements showing the cost of construction of project works and the price paid for water rights, rights-of-way, lands and interests in lands.

(b) To make valuation of all projects brought under license which have been constructed in whole or in part prior to the application for license.

(c) To make valuations in case of condemnation of the properties of a licensee by the United States.

(d) To determine the net investment and severance damages in the event that properties of a licensee are taken over by the United States at the termination of a license period.

GENERAL AND SPECIAL INVESTIGATIONS

In addition to its duties of general administration and regulation of water-power developments, the commission is authorized, or the performance of certain of its duties will require it, to undertake general investigations and to collect and record data concerning:

(a) The utilization of the water resources of any region to be developed.

(b) The water-power industry and its relation to other industries and to interstate or foreign commerce.

(c) The location, capacity, development costs and relation to market of power sites.

(d) Whenever the power from government dams can be advantageously used by the United States for its public purposes and what is the fair value of such power.

(e) Lands of the United States reserved as power sites to determine whether they may be operated to entry subject to a reservation of the power rights of the United States.

(f) Deterioration of structures and equipment, for the purpose of establishing rates of depreciation and amount of annual depreciation reserves.

In connection with such investigations the commission is authorized:

OSCAR C. MERRILL

who, it seems likely, will be chosen executive secretary of the Federal Water Power Commission

(g) To hold hearings and to require the attendance of witnesses and the production of evidence.

(h) To make public from time to time the information secured and to provide for the publication of its reports and investigations.

(i) To co-operate with state and national governments in its general power investigations.

In addition to the general investigations which the commission is authorized to undertake, it is required to make special investigation and to submit to Congress:

(a) Reports in all cases where it finds that a government dam may advantageously be used by the United States for public purposes in addition to navigation.

(b) The results of its examinations and surveys together with plans and cost estimates in connection with any project which it believes should be undertaken by the United States.

(c) Reports with cost estimates on all projects on navigable streams in which it appears that the construction of suitable navigation structures cannot be undertaken by applicant.

(d) On or before Jan. 1, 1921, a report on "the cost and, in detail, the economic value" of the Great Falls power project, and "plans and estimates of cost necessary to secure an increased and adequate water supply for the District of Columbia."

(e) The commission would also be required to make special investigations and assist in the conduct of legal proceedings brought for cancellation of licenses or for requiring specific performances of the provisions of a license or of the act.

Public Utility Appraisal and Valuation Methods Outlined

SESSIONS of unusual interest at the spring meeting of the American Society of Mechanical Engineers, held in St. Louis at the Hotel Statler from May 24 to 27, were devoted to "Appraisal and Valuation." Five papers were presented, the four first named having been introduced at the December meeting: "Rational Valuation," by J. R. Bibbins; "Price Levels in Relation to Value," by Cecil Elmes; "Cost of Organizing and Financing a Public Utility," by F. B. H. Paine; "The Construction Period," by H. C. Anderson, and "Appraisal and Valuation Methods," by David H. Ray.

The paper by Mr. Bibbins was a comparative study of valuation practice illustrated by a complete economic analysis of a large public utility since the Civil War. The second paper traced the history of price levels and the purchasing power of money for several centuries back. Mr. Elmes pointed out that the appraisal which did not specify the dollar on which it was based must necessarily be confusing. From 1896 the dollar had shrunk from 100 units of purchasing power to 26 units in 1920. In his opinion the only dollar that could be used for the fixing of rates was the dollar of today and the valuation of the property must be in the same dollar.

The title of the third paper indicates its contents. Mr. Paine, now deceased, separated these initial costs into development of the project, the cost of money and the promoter's remuneration, concluding upon the basis of his investigation that the proper percentage to be set aside for each in the order named should be 2½, 5 and 5 per cent. In Mr. Anderson's paper various methods in use to determine the length of the construction period, with a view to making proper allowances for interest and taxes during this time, were discussed. In the paper last named Mr. Ray compared various methods of appraisal and their varying exactness.

A wide divergency of opinion was evident in the discussion of Mr. Elmes' paper. One delegate held that if rates fluctuated with the value of the dollar no harm would result. The simplest method would be to maintain the value of the property in dollars of a certain date and allow a rate in keeping with this dollar. If the dollar value was reduced by one-half, then the earnings should be increased from 6 to 12 per cent on the same valuation. Another speaker thought that if the rates were made on an equitable basis it was immaterial whether the valuation was made on actual cost or present-day prices. It was pointed out that the rate of return was not so easy to adjust since the dollar had two values—one its buying power in commodities and the other its renting value. In making a decision it would first be necessary to find the reproduction cost and then the renting or loan value of the dollar must be considered. Others present insisted on a historical survey for utilities. As rates should change with any material fluctuation in the value of the dollar, it was argued that money was not a satisfactory standard. It was suggested that a commodity unit be the standard, but this plan was criticised as too complicated.

In a written discussion on Mr. Bibbins' paper B. J. Denman emphasized the fact that going-concern value should be included in a valuation. It ranges from 12 to 40 per cent of the physical value and should be equal at least to the earnings for one and one-half years. R. H. Nexen spoke of the difficulties of determining price levels for fluctuating values. Using a case involving copper wire, he showed that a ten-year progressive average compared closely with the true weighted price paid.

The question arose as to whether in the valuation only the physical property in daily use should be included or all that the company has bought and paid for, such as a whole tract of land that it was necessary to buy to obtain a diagonal right-of-way instead of the narrow strip in use. The investment that was brought fairly and properly to public use should enter into the valuation and the making of rates.

New Vice-Presidents A. I. E. E.

E. H. MARTINDALE
President Martindale Electric Company, Cleveland, Ohio

COMMANDER C. S. McDOWELL, U. S. N.

CHARLES S RUFFNER
Vice-President North American Company, New York, N. Y.

L. T. ROBINSON
Engineer, Standards Laboratory, General Electric Company, Schenectady, N. Y.

The six vice-presidents-elect of the A. I. E. E. take office on Aug. 1. In addition to the five whose photographs are here shown is Charles Robbins, assistant sales manager Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., whose photograph was not available.

C. E. MAGNUSSON
Professor of Electrical Engineering University of Washington, Seattle, Wash

Standardizing Washing-Machine Motors

THE standardization of motors for use with washing machines was the subject of discussion in Chicago on Tuesday, June 1, at a meeting of a committee of the Washing Machine Manufacturers' Association and representatives of eleven manufacturers of fractional-horsepower motors. Mechanical standardization and interchangeability of motors of different manufacture are the principal objects of the work that is being undertaken. A committee of the Power Club together with the committee of the Washing Machine Manufacturers' Association will collect the necessary data. It is expected that a report will be issued by the committee in thirty to sixty days.

New Corporation to Acquire California-Oregon Company Properties

REORGANIZATION of the California-Oregon Power Company is to include the formation of a new corporation which will acquire the properties and assume the liabilities of the present company with the exception of the 5 per cent bonds, which will be exchanged for $500 par value new first preferred stock and $1,000 common stock for each thousand-dollar bond plus the unpaid coupons. A new bond issue of $10,000,000 is planned, of which $3,000,000 will be offered at once to retire present underlying bonds. The remainder of this issue will be sold to provide new capital and pay expenses of reorganization. Reorganization will effect a reduction in outstanding securities of more than $6,000,000. The valuation of the properties of the company is $7,430,000, to which will be added the value of additions and betterments from the application of moneys resulting from the sale of the new bonds. Last year the net revenue of the company increased from $257,000 to $406,000. The estimated revenue for 1920 is $480,000.

Bureau of Standards May Study Inductive Interference

W. J. CANADA, in charge of the new engineering department of the N. E. L. A., has been in conference with the engineers of the Bureau of Standards recently regarding the investigations contemplated on the subject of inductive interference. The bureau is considering whether or not it can participate in any of this work and, if so, to what extent experimental activities will be possible. The basis for any such investigation if undertaken by the bureau will be similar to that observed in the electrolysis prevention investigations, in which the bureau did not participate directly with any one agency but undertook to bring its activities to bear upon all aspects of the problems in order to assist utility interests concerned.

Commonwealth Edison Finances Current Capital Requirements

CAPITAL for the current year's requirements of the Commonwealth Edison Company, Chicago, has been obtained from an issue of $5,000,000 five-year 7 per cent collateral gold notes secured by $7,143,000 of the company's first mortgage 5 per cent bonds. The notes are handled exclusively by a syndicate of fourteen Chicago banking houses which offered the securities to the public this week at a price of 97. This yields the investor up to about 7¾ per cent. The denominations are $100, $500 and $1,000.

Samuel Insull, president of the Commonwealth Edison Company, said $5,000,000 was about the amount of new capital required by the company every year and that the company was in a very strong financial condition. He said that both the gross and net earnings were larger this year than they were during the same period last year, and that the company has no intention of asking for higher rates.

May Central-Station Financing Over $35,000,000

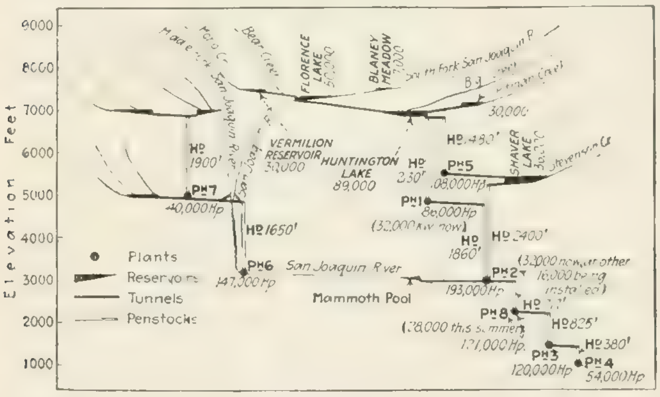
IN SPITE of the fact that the yield for electric public utility bond and stock issues continues in the neighborhood of 8 per cent, the total issue for May of $35,352,000 is the highest that has been reached in any one month since January. It is also noticeable that the short-term notes of two or three years that have predominated in previous months form less than a quarter of this total. Five-year periods and longer are prevalent, and in three instances blocks of long-term notes have been put on the market. These are an issue of $5,000,000 of the Southern California Edison Company due in 1944, $10,000,000 in gold bonds of the Detroit Edison Company due in 1940, and $246,000 in gold bonds issued by the Pacific Gas & Electric Company of Phoenix, Ariz., to fall due in 1931. The fact that each of these three long-term issues bears only 6 per cent interest is counterbalanced by the extremely low selling price, which in each case brings the yield above 7.3. The table gives in detail the seventeen issues that have appeared during May.

CENTRAL-STATION ISSUES OF SECURITIES IN MAY, 1920

Company	Amount of Issue	Period	Class of Security	Rate of Interest	Per Cent Yield	Offered at
Utah Power & Light Company	$656,000	five-year	First lien and general mortgage gold bonds	7	8.13	96
Alabama Power Company	1,000,000	five-year	Secured gold notes of 1917	6	8.8	96
Rochester Gas & Electric Corp.	500 000	...	Cumulative preferred stock	7	7	100
Eastern Texas Electric Company	1,500,000	five-year	Gold notes	7	8.13	96
Monongahela Valley Traction Company	600,000	five-year	General mortgage bonds due July 1, 1923	7	7.37	96
American Gas Company	2,200,000	two-year	Secured gold notes	7	8.17	98
American Public Service Company	250,000	five-year	Gold notes	7½	8.09	98
Los Angeles Gas & Electric Corp	1,000,000	four year	General mortgage bonds	7	7.57	98.30
Narragansett Electric Lighting Company	1,700,000	three-year	Convertible notes	7	7	100
Salina Light, Power & Gas Company	600,000	three-year	First mortgage bonds	7	[illegible]	97¾
Southern California Edison Company	5 000,000	twenty-six-year seven-month	General mortgage gold bonds, due Feb. 1, 1944	6	7.35	88
Monongahela Valley Traction Company	2,000,000	one-year	Gold notes	7	8.38	98½
Northern Ohio Traction & Light Company	2,000,000	six-year	Secured gold bonds	7	7.99	96
Detroit Edison Company	10,000,000	twenty-five-year	Gold bonds, due July 1, 1940	6	7.32	89
Pacific Gas & Electric, Phoenix, Ariz.	246,000	twenty-year	First mortgage gold bonds, due Jan. 1, 1931	6	7.48	91
American Light & Traction Company	6,000,000	five-year	Gold notes	6	7.52	94
Public Securities Company	100,000	two-year	Gold notes	7	7	100

Series of Plants to Develop 868,000 Hp. from Total Head of 5,720 Ft.

CONTEMPLATED hydro-electric development by the Southern California Edison Company on the San Joaquin River will have an ultimate rating of 868,000 hp. and will involve eight plants and a total head of 5,720 ft. (172 m.). It is estimated that one kilowatt-hour can be generated with 10 cu.ft. (0.28 cu.m.) of water when this development is completed. On account of the storage facilities planned it will be possible so to regulate the flow that all peak loads or daily variations in load can be carried with water power. The relative positions of the power sites as regards elevation are shown in the accompanying drawing. On the Upper San Joaquin River, commonly known as South Fork, water will be stored at Blaney Meadow, and further down stream at Florence Lake. Water will also be directed to Florence Lake from Mono and Bear Creeks. Through a tunnel line from Florence Lake to Huntington Lake the Upper San Joaquin waters become available at Huntington Lake, at the head of the successive chain of Big Creek plants. At present the inflow to Huntington Lake is mainly from Big Creek, but in the near future the waters of Pitman Creek will also be diverted to Huntington Lake.



RELATIVE ELEVATIONS OF PLANTS, AND RESERVOIRS INVOLVED IN 868,000-HP. DEVELOPMENT

Through the building of a dam on Stevenson Creek at Shaver a large reservoir will be created which not only will take care of Stevenson Creek waters but also during the flood season will store any surplus water which may pass through Huntington Lake after the latter has been filled, and which otherwise would go over its spillway and be lost to control. To accomplish this, power house No. 5 will be built approximately 500 ft. (150 m.) in elevation above the present power house No. 1, so that the tailrace water coming from power house No. 5 will flow into Shaver Lake.

The general scheme of operating the Big Creek power houses Nos. 1, 5, 2, 8, 3 and 4 with waters coming from Upper San Joaquin, Big Creek, Pitman Creek and Stevenson Creek will be as follows: During the flood season, for the months of April to July inclusive, the waters of the South Fork of the San Joaquin River, Mono and Bear Creek, in addition to rapidly filling the reservoirs, will supply a continuous flow through Florence Lake Tunnel into Huntington Lake. Water also comes from Pitman and Big Creek. The utilization of water from Huntington Lake will be principally through power house No. 1 according to demand. The surplus water, which would otherwise go over the spillway, will be used through power house No. 5, after which it will be diverted to Shaver Lake to be stored, together with water coming from Stevenson Creek. This storage will be used in the latter part of the season through power houses Nos. 2, 8, 3 and 4 in successive series of operation.

OTHER DEVELOPMENTS ON THE SAN JOAQUIN RIVER

Among the power locations above Mammoth Pool, the first, which is referred to as power house No. 6, is located so as to discharge its tailwater into Mammoth Pool. It will take water from both sides of the river, diverting the South Fork near Hoffman Creek and the middle fork near Junction Butte. Power house No. 7 will receive its water from the northwestern part of the watershed at an elevation of about 7,000 ft. (2,100 m.). There are some good reservoir sites in this drainage. From Mammoth Pool the waters of the main San Joaquin River are diverted to the tailrace waters of power house No. 2 and, with the water coming from power house No. 2, are used in power houses Nos. 3 and 4.

At present power houses Nos. 1 and 2 are operating with an installed capacity of 32,000 kw. each. A 16,000-kw. unit is being installed at power house No. 2 and other projects are under way. Huntington Lake reservoir, to a capacity of 88,000 acre-ft. (108,240,000 cu.m.), is in operation now. Camps, roads, railroads, inclines, etc., have been constructed, reservoir sites, timber lands and power and water rights secured, and transmission lines to Los Angeles through the San Joaquin Valley have been erected.

The general plans to complete the power resources shown on the accompanying diagram are: (1) To complete the utilization of water of Big Creek and Pitman Creek in power houses Nos. 1 and 2 to a development of three units in each power house; (2) to develop storage possibilities on Shaver Lake and to construct a water conduit therefrom to power house No. 2 to augment the water supply from Big Creek and Pitman Creek; (3) to divert the water of South Fork of San Joaquin River at Florence Lake to Huntington Lake through Florence Lake Tunnel; (4) to divert the water of San Joaquin River at Mammoth Pool for use in power house No. 3; (5) to develop the water-power resources north of Mammoth Pool on the San Joaquin River, or tributaries through power houses Nos. 6 and 7.

Federal Reserve Bank Director Shows Fallacy of Low Utility Rates

UNLESS public sentiment changes from its traditional attitude toward increases in public utility rates, it will only be a question of time before the utilities will be unable to function, and if that should happen it will "break up our cities," it was said by G. M. Reynolds, president of the Continental and Commercial National Bank of Chicago and director of the Federal Reserve Bank of Chicago, at the continuation of the general hearing on utility credit before the Public Utilities Commission of Illinois at Chicago last week. Harry J. Dunbaugh, attorney of Chicago, said that the very fact that commissions have not met changing financial conditions in a prompt and businesslike way has had much to do with impairing the sale value of securities and credit of the companies.

The hearing has been adjourned subject to the call of the commission.

Massachusetts Electrical Interests Do Not Agree on Power Competition

On THE ground that no power customer has ever been denied service by it, the Webster & Southbridge Gas & Electric Company appeared before the Massachusetts Department of Public Utilities on May 10 in opposition to a location grant by the Selectmen of the town to the New England Power Company. E. W. Burdett represented the Webster & Southbridge company and Henry I. Harriman, president New England Power Company, appeared for that organization, the hearing was marked by an unusually interesting discussion of the economic aspect of competition in the power field.

In the celebrated Fitchburg and Worcester appeals against the Connecticut River Transmission Company before the Massachusetts Gas and Electric Light Commission about a decade ago, the Transmission company was authorized to enter these localities and take on power customers whose connected load reached 300 hp. or which yielded an annual energy input of 460,000 hp.-hr. The Fitchburg and Worcester companies in those days were unprepared to solicit large power business and the entrance of hydro-electric energy proceeded, large totals being developed. Mr. Burdett contended that in the case of the Webster company the local management prefers to develop the power business of its territory without entering into contractual or competitive relations with the New England Power Company, successor of the Connecticut River company. The power sales of the Webster company have increased since 1908 from 114,591 kw.-hr. to 7,077,921 kw.-hr., and at present 83 per cent of the output and 53 per cent of the company's revenue are derived from sales to power users. In 1908 there were seven motors on the system, with 126 hp. connected load. Today there are 423 motors with a connected power load of 3,578 hp. The largest customer, the Slater Mills, has a connected load of 1,700 hp. Not a new steam plant has been started in the territory for many years. The present net lighting rate is 10.8 cents.

Economic Benefits of Interconnection Urged by Harriman

Mr. Harriman stated that the Selectmen granted authority to his company to build a transmission line by which the Montville steam plant of the Eastern Connecticut Power Company, on tidewater near New London, could be connected with the remainder of the New England system. He held that the Webster company was entirely within its rights in preferring to "play the game in its own way," but that it would gain more in the long run if it would enter into contractual relations with the New England company to sell energy to the latter at times of low water. "Our system," said the speaker in part, "now handles a business of 500,000,000 kw.-hr. annually. Sixty per cent of this is hydro-electric and the rest steam-generated energy. We are selling power in Vermont, New Hampshire, Massachusetts and Rhode Island at 14 to 15 mills per kilowatt-hour and have developed a water power twice over in magnitude that of any developed by a Massachusetts utility. The Fitchburg and Worcester companies have prospered although we entered their territories, and we have not secured all the large power business by any means. Worcester has about 40,000 kw. of installed steam-plant capacity, and I question whether that city is not as well adapted to develop its power load as smaller companies are. I see no distinction in favor of Webster and Southbridge as compared with Worcester.

"Our chief source of steam relay power is the tidewater station of the Narragansett company at Providence, R. I. In high-water times, when we are not taking much of that, their price per kilowatt-hour to us goes up 2 to 3 mills above the production price when we are giving them a very large load. Nobody can afford to develop water power in New England without steam auxiliaries. At our Vernon hydro-electric plant, for example, the average output exceeds 400,000 kw.-hr. per day, but in low water this drops to 60,000 kw.-hr. We have followed the policy of avoiding capital investment in new steam plants. This has been done by entering into interconnection contracts with existing installations. As soon as financial conditions warrant we expect to develop a five-million-dollar hydro-electric plant to add to our system's resources, but if the commission should hold that the power business is not competitive, it would be a serious blow to the financial standing of our company."

Chairman Attwill intimated that he favored the entrance of hydro-electric energy into industrial districts in competition with steam power, in view of the conservation aspect, but looked with less favor upon the sale of energy from a steam plant in competition with the established company. Decision was reserved by the board.

Restricted Rate-Making Bill Fails in Massachusetts

Despite vigorous efforts of certain local interests to restrict the rate-making powers of gas and electric utilities in Massachusetts, the bill designed to throw the burden of investigating all rate changes upon the Department of Public Utilities was killed last week in the State Senate. Under the Massachusetts law, gas and electric utilities may change their rates subject to appeal to the Public Utilities Commission, except that where the commission has fixed a rate its approval must be had before revisions can be put into effect. The Stone bill, introduced early in the session, attempted to force the commission to investigate and pass upon all rate changes.

Chairman H. C. Attwill and Commissioner A. R. Weed of the Department of Public Utilities opposed this legislation on the ground that it would not only heavily increase the cost of the commission's regulation of the companies of the state, but in effect would almost certainly result in the abandonment of voluntary rate reductions. House Chairman William Plattner of the committee on public lighting also opposed the bill, both in the House and before the ways and means committee. Mr. Plattner showed that in the last ten years the gas and electric companies of Massachusetts put into effect 126 voluntary rate reductions against twenty-three ordered by the commission. From 1910 to 1919 the electric companies' voluntary reductions averaged 10 per cent, those ordered by the board averaging 6.5 per cent. In 1919 thirty-six electric companies increased their rates 14 per cent on order of the board and forty-six made no increases. An attempt was made to create a recess commission to investigate the whole subject of utility rate-making, but the project fell by the wayside.

Westinghouse Officials Decorated by the Emperor of Japan

ON MAY 12 the Emperor of Japan decorated with the Order of the Rising Sun E. M. Herr, president of the Westinghouse Electric & Manufacturing Company, and L. A. Osborne, president of the Westinghouse Electric International Company, who have been in Japan for several months studying Oriental industrial conditions. The Westinghouse company supplied Japan with a great deal of power machinery. It has also undertaken the training of a number of Japanese students at its works.

The Order of the Rising Sun is the highest honor the Emperor can bestow. Mr. Herr received the third class and Mr. Osborne the fourth, the higher classes being awarded only to Japanese national heroes.

New Tentative Electric Service Rules for Illinois

TWO sets of tentative rules governing the supply and maintenance of electric service were issued by the Public Utilities Commission of Illinois on May 12, and a general hearing has been set for a full discussion of these rules in Chicago on June 10. One of the sets of rules governs the construction, ownership and maintenance of distributing lines. It also sets forth the practices and regulations which in the opinion of the commission should be the basis for the rates at which rural service is supplied. These rules specify that the title to all rural lines shall rest with the utility company, which shall also be responsible for the maintenance, operation and replacement of these lines. The rates are to consist of an energy charge plus a service charge, which should be higher than the town or city service charge in order to cover the increased cost of supplying the rural customers. Persons along a line who want to be connected after the line has been completed must be taken on at non-discriminatory rates.

The other tentative set of rules establishes standards of service for all the electric utilities in the state. These rules apply particularly to meter testing and records, frequency and voltage regulation, conditions under which line extensions must be made and records of complaints and interruptions to service.

Steam Heating Should Be Profitable for Power Companies

PROBLEMS of central stations in operating steam and hot-water heating systems as a necessary adjunct to their electric business were discussed at the eleventh annual convention of the National District Heating Association, held in Chicago last week. The opinion was freely expressed that a steam-heating department could and should pay, and a number of suggestions were made in the reports, papers and discussions for making the steam-heating business more profitable than it has been.

The problem of separating the steam and electric accounts of utilities was discussed in the report of the accounting committee. The officers elected for the ensuing year were: President, J. L. Hecht, Chicago; first vice-president, J. H. Walker, Detroit; second vice-president, E. L. Wilder, Rochester, N. Y.; third vice-president, W. G. Carlton, New York; secretary-treasurer, D. L. Gaskill, Greenville, Ohio.

Georgia Utility Executive Declares Commission Regulation to Be One-Sided

SPEAKING before the Atlanta Federation of Trades recently, P. S. Arkwright, president of the Georgia Railway & Power Company, assumed a somewhat critical position on the matter of commission regulation of utilities and the attitude of the general public in that regard. Alluding to the large increases in wages that have taken place since the war, Mr. Arkwright said:

> Could you meet the 1920 living cost with only the same small percentage of increase in your wages as we have received for our service? But you can help yourselves. You can move to another town, or you can resign, or you can quit. Suppose you couldn't. Suppose you had to stay here and keep on at the job and receive the wages of 1914 and pay the cost of living of 1920. What would be the inevitable effect? You would starve to death.
>
> This company cannot move away, cannot resign and cannot quit. It has got to keep on working and it has got to pay 1920 costs. If it receives only 1914 wages for its work it, just like the workingman, will starve to death. Picture to yourselves what would happen to this community with the street railroads, the electric light and power and the gas all gone. In the process of starving, the company, just like the workingman, grows weaker and weaker, and less and less able to perform the work, and the service deteriorates and gets worse and worse until it finally disappears.
>
> There is only one avenue of relief for us and that is to go to the Railroad Commission. This may be likened to a board of arbitration every member of which was appointed by the other side. How would you like to submit your wages to a board of arbitration of that character? And yet not only does the public insist that our wages cannot be increased except by the approval of such a board of arbitration, but on top of that it uses every influence and every means and every threat in its power to prevent even this board of arbitration from doing what it finds is the just and proper thing that ought to be done. Let me say here that we cannot increase our prices of our own accord, that we must prove our case before the Railroad Commission, and that our rates are based upon our costs.

Pioneer Geographic Section Office, N. E. L. A.

Headquarters of the New England Section, N. E. L. A., at 149 Tremont Street, Boston, Mass., are shown above in the first photograph of this office ever to be published. Miss O. A. Bursiel, secretary of the section, is seated at the desk in the rear and her assistant, Miss Davis, in front.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Electrifying Czecho-Slovakia. — The government of Czecho-Slovakia has under consideration the electrification of the whole state by means of 100,000-volt lines supplied from new generating stations.

American Electric Trucks in Christiania.—According to a British contemporary, there are now 854 motor trucks in Christiania, Norway, of which 615 are of American manufacture. Weight up to 13,220 lb. is carried.

Long-Distance Wireless at Sea.—Nine of the large Cunard and White Star Atlantic passenger boats have been or are rapidly being equipped with the new long-distance Marconi wireless sets, which permit direct intercommunication with land over a distance of 1,400 miles.

Electric Railway Census.—From the Bureau of the Census come the statistics for 1917 covering electric railways, which show a national total of 1,307 companies, with 44,835 miles of single track, 102,603 cars, 294,826 employees, an electrical capacity of 2,924,779 kw. and an output of 12,187,850,931 kw.-hr. Fourteen and one-half billion passengers were carried, including those using transfers and carried free, and the total income from all sources is placed at $730,108,040.

Plans of the Ontario Hydro-Electric Power Commission.—Announcing that the 50,000-hp. steam reserve plant which the Hydro-Electric Power Commission of Ontario is to build during the coming year will upon its completion be enlarged to 100,000 hp., Chairman Adam Beck says that the first 50,000 hp. will be ready by September, 1921, when the city of Toronto is to take over the local street railway. A steam reserve plant is a necessity, the chairman says, because of the chronic shortage of power from Niagara. It will, besides, obviate winter and spring troubles from ice.

Chile's Nitrate Industry Versus the Synthetic Process.—According to a report by the Chilean Consul-General at Hamburg, the Haber process for the manufacture of synthetic nitrogenous products has been abandoned in Germany owing to the prohibitive cost of raw materials. The natural product under present commercial conditions is apparently in no danger of displacement. However, a syndicate has purchased the plant established during the war by the British government for the manufacture of nitrates and is planning to carry on its operations on the scale originally contemplated.

Potomac Electric Power Company's New Bond Issue.—Permission has been granted by the Public Utilities Commission of the District of Columbia to the Potomac Electric Power Company to issue $1,150,000 general mortgage 6 per cent five-year gold bonds, dated July 1, 1918, and completing an authorized issue of $5,000,000. The proceeds are to be used to pay for extensions and improvements already made and to be made.

Hartford Company Increases Stock by $1,750,000.—By unanimous vote on May 24 stockholders of the Hartford (Conn.) Electric Light Company decided to increase the company's capital stock from $8,250,000 to $10,000,000. The proceeds will be used to finance the new generating station to be built on the South Meadows site. Rights to subscribe to the new shares, issued at par, are granted to present stockholders in the ratio of seven shares of new for each holding of thirty-three shares of old stock.

Material-Handling Machinery at the New York Electrical Show.—Practically every type of machine used in handling freight shipments at the steamship piers and railroad terminals will be exhibited at the electrical exposition to be held at the Grand Central Palace, New York, in October. These exhibits, which are to be a special feature of the show, will be presented and demonstrated under the auspices of the Material Handling Machinery Manufacturers' Association, which has spared no pains or trouble in making this big industrial exhibit comprehensive to the last detail. The whole third floor will be given over to this purpose.

How Electric Companies Meet Catastrophes in Texas.—Two instances of energetic action by electrical distribution companies suddenly confronted by disaster are reported in *Texas Utility News*, house organ of the Texas Power & Light Company, Dallas. When the town of Grandview was nearly wiped out by fire this spring the company lost a large part of its distribution system, including virtually all lines in the commercial district and the main lines through the best residential district, though the substation escaped. Poles and transformers were rushed by truck from neighboring towns, and the day following the fire service was restored to that part of the town that escaped the flames and street lighting was resumed. A week or two after this the power-plant building of the W. H. Painter Electric Company at Bowie bore the first brunt of a tornado, which scattered parts of the building in every direction, severely injuring the night engineer. The equipment escaped with comparatively little damage, though the switchboard was ruined. Immediately after the storm had passed repair work began, and by late afternoon of the following day the first unit was put back into service with temporary switchboard and housed in a temporary structure, and in another twenty-four hours a permanent new building was under way.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Associated Manufacturers of Electrical Supplies.—This association will hold its summer meeting at New London, Conn., June 26 to June 30.

Outing of Philadelphia Engineers.—Members of the Philadelphia Sections of the American Institute of Electrical Engineers and the Illuminating Engineering Society will hold a joint outing at Howard McCall Field, Highland Park, Pa., on Monday, June 14.

Electric Club of Chicago.—A new constitution was adopted by this club at the regular meeting on May 11, a procedure made necessary by the change in the character of the organization from a lunch club to a permanent quarters club at the beginning of this year. On the second Wednesday of each month all the club rooms will be at the disposal of ladies between the hours of noon and midnight.

A. I. E. E., Seattle Section.—Some of the papers to be presented before this section in the near future are to deal with "Methods Used in Laying Submarine Cables," "Experimental Demonstration of Radiation" and "Recent Developments in Radio Engineering." The meetings of the section are well attended, owing largely to the energy of the program committee in arranging interesting and timely papers.

Institute of Radio Engineers.—The next meeting of the Institute of Radio Engineers will be held on Thursday evening, June 10, at 8:15 p.m., at the Engineering Societies Building, 29 West Thirty-ninth Street, New York. A paper on "The Wave Balance and Some of Its Applications" will be presented by Prof. Michael I. Pupin of Columbia University. This paper will deal with the study of the electric waves produced in antenna systems and will describe a new method of measuring the conditions at each point.

Radio Section of Western Society of Engineers.—A section of the Western Society of Engineers of Chicago to be known as the Telephone, Telegraph and Radio Engineering Section was formed in the society's rooms on the evening of May 24. Fred L. Baer read the first paper before this section on the subject of the transition from manual to automatic switching of telephone traffic in large metropolitan networks. The balloting for officers of the section resulted in the election of F. F. Fowle as chairman, Stanley R. Edwards as vice-chairman and Montford Morrison, Morris A. Frye and Fred L. Baer as directors.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Jury's Right to Decide Facts in Dispute Over Employment.—In a suit against the Pacific Power & Light Company by the wife of a pumping-plant operator who claimed nearly $3,000 for work done in assisting her husband during four years under an alleged oral agreement of an unusual nature with the company, the Supreme Court of Washington sustained the right of the jury to decide on the facts and denied the right of the lower court to override the verdict and dismiss the action. (188 P. 514.)

"Acts of God" Not Defense in Suit for Injury from Flood Unless Sole Cause.—An unprecedented rainfall and resulting flood, to absolve a corporation from responsibility for the overflowing of a water course embanked by it, on the plea that this was an "act of God," must, according to a judgment of the Supreme Court of Oklahoma, not only be the proximate cause of the damage but the sole cause. If the injury would not have occurred except for the negligence of the corporation, liability rests upon it. (188 P. 1058.)

Employer's Responsibility to Protect Employee from Employee's Own Negligence.—In refusing to sanction a verdict against a mining company caused by an employee's continuing to operate a defective electric motor propelling cars, the Kentucky Court of Appeals held that although an employer may not refuse to exercise ordinary care to save an employee from a perilous situation brought about by the latter's own negligence, the employer, in order to be charged with this duty, must have knowledge of such perilous situation. (219 S. W. 1074.)

Breakdown Service to a Competitor Not Compulsory.—Summarized findings of the Appellate Division of the New York Supreme Court in People ex rel. New York Edison Company vs. the Public Service Commission for the First District (see Electrical World, April 3, page 806) are as follows: (1) Where electricity generated by a private plant was not only used for the benefit of the owners of the plant and their tenants but sold to others in the same block at 15 per cent less than the schedule rates of relator company, the owners are a competitor of relator and an order of the Public Service Commission requiring relator to furnish to the said owners "breakdown service" not only for its own use and that of its tenants but for the benefit of others is not authorized. (2) In refusing to furnish such breakdown service the relator company was not guilty of discrimination. (3) One engaged in selling electricity to others than its own tenants cannot demand service of a competing company for the purpose of underselling such company and taking away from it its customers. (181 N. Y. S. 259.)

United States Supreme Court on "Frivolous" Appeal Under Fourteenth Amendment.—The Piedmont Power & Light Company having appealed to the United States Supreme Court against the adverse finding of a district federal court in North Carolina in its suit to prevent the town of Graham from granting a franchise to a rival company, the federal Supreme Court declares: "The grant to appellant not being an exclusive one, the contention that competition in business, likely to result from a similiar grant to another company, would be a violation of appellant's contract or a taking of its property in violation of the Constitution of the United States is so plainly frivolous that the motion to dismiss for the want of jurisdiction must be sustained."

Applicant Cannot Be Forced to Furnish Underwriters' Certificate.—In a case where an applicant for electric service refused to pay $2.50 to the Board of Fire Underwriters for a certificate of safety, tendering only the certificate of the city authorities, the Court of Appeals of New York State found that the central-station company had not the legal right to refuse service and that the plaintiff could recover damages. (See Electrical World April 10, page 863.) Nor did the plaintiff's failure for three years to sue prevent him from recovering the penalties imposed. While an electric company may require approval of equipment by competent authorities, the court said, the term "constituted authorities" does not include the Board of Fire Underwriters. (126 N. E. 729.)

Illinois Municipal Plants Not Subject to Public Utilities Act.—In denying a rehearing of the suit of the Springfield Gas & Electric Company against the city of Springfield to compel the municipal electric plant of that place to file its schedules and accept the jurisdiction of the Public Utilities Commission of Illinois, the Supreme Court of that state again declared that the public utilities act does not apply to any utility owned by a city, the law expressly exempting such utilities from its operation and neither the state nor the federal constitution being violated by this exemption. The Legislature, the court holds, has the right and power to authorize municipalities to own and operate public utilities, as it has done in the municipal ownership act, and has the right and power to delegate to the municipalities the regulation and control of such plants, but all their rates and charges are subject to review by the courts to a like extent with the rates fixed by the Public Utilities Commission for privately owned utilities. (126 N. E. 739.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Rates for Different Departments of Utility Must Be Determined on Separate Bases.—In harmony with decisions by other public service commissions, the Arkansas Corporation Commission has declared that no consideration should be given to the receipts from the electrical department or the gas department of a utility in determining the reasonableness of street railway rates.

Charges for Meters and Requirement of Deposit Must Be Uniform.—The Public Utilities Company of Illinois in passing upon a complaint against the Henderson County Public Service Company has declared that it is discriminatory for an electric utility to make a charge for meters in one vicinity while furnishing them free to the consumers in other communities, and that a rule requiring deposits to insure payment for service must be enforced alike in all communities served by it. A utility, however, cannot be blamed for failure to make service connections applied for where it has been unable to procure the necessary material.

Transmission-Line Versus Local-Plant Service.—In a complaint of inadequate service made by the city of Olney against the Central Illinois Public Service Company, the Public Utilities Commission of Illinois held that if electric service over transmission lines is to be substituted for service from local plants, the burden is upon the utility to show that this service would be as satisfactory and as efficient as that furnished from the local station. The issuance of a certificate for the construction of a transmission line does not commit the commission to approval of the method by which service may be rendered over such line.

Free or Reduced-Rate Service to Municipalities Is Discrimination.—In finding against the city of Franklin, which complained that the United Natural Gas Company had threatened to discontinue supplying the municipality free or at reduced rates, as required by its contract, the Pennsylvania Public Service Commission said: "The free service provided for in the contracts between complainant and respondent, or service at less than the field rate, if rendered, would work an unjust discrimination against other patrons. The provisions of the public service company law prohibit the rendering of free service where the same works an unjust discrimination, and the law in its application to such a situation makes no distinction between a municipality and an individual."

Men of the Industry

Changes in Personnel and Position—Biographical Notes

J. C. Martin, who for the past fourteen years has been identified with the engineering organizations of central stations in the Far West, Middle West and East, has joined the editorial staff of the ELECTRICAL WORLD and recently taken up his duties at its Chicago office as Western editor. Mr. Martin entered the utility field in October, 1903, when he joined the operating staff of the Cedar Rapids & Iowa City Railway & Light Company. During eight years with this company he served in nearly every department, receiving a thorough training in work involving power-plant operation, distribution-line construction, operating accounting and stores accounting and power-plant construction on a small scale. In 1911 he became engineer with the Pacific Power & Light Company of Portland, Ore. In the fall of 1912 he became assistant to the chief engineer and in March, 1914, succeeded the retiring chief engineer. In this position he had considerable experience in the design and operation of hydro-electric plants and the construction of high-tension and low-tension transmission lines and substations. In October, 1917, Mr. Martin was transferred by the Electric Bond & Share Company, which also controls the Pacific Power & Light Company, to Allentown, Pa., and took charge of engineering work for all of its properties in the State of Pennsylvania. These include the following: Northumberland County Gas & Electric Company, Sunbury, Pa.; Columbia & Montour Electric Company, Bloomsburg, Pa.; Harwood Electric Company, Hazleton, Pa.; Schuylkill Gas & Electric Company, Shenandoah, Pa.; Lehigh Valley Light & Power Company, Allentown, Pa.; Lehigh Transit Company, Allentown, Pa.; Lehigh Industrial Power Company, Allentown, Pa., and Northern Central Gas Company, Williamsport, Pa., and Hagerstown, Md. During the past two and a half years he has been engaged in engineering work connected with the consolidation of these operating companies and construction of transmission lines for their interconnection. Mr. Martin succeeds L. C. Spake, who for the last six years has held the position of Western editor of the ELECTRICAL WORLD in Chicago. Mr. Spake has been promoted to a responsible position on the advertising staff of the ELECTRICAL WORLD, with headquarters in New York City. Mr. Martin will be assisted in the Chicago office by S. N. Clarkson, who has been promoted from assistant editor to associate Western editor.

J. C. MARTIN

A. J. Tobin, formerly chief inspector of the Ottawa (Ont.) Electric Railway Company, has been appointed superintendent of the company.

F. D. Burpee, formerly superintendent of the Ottawa (Ont.) Electric Railway Company, has been promoted to the position of manager.

J. M. Ahearn has been appointed assistant manager and purchasing agent of the Ottawa (Ont.) Electric Railway Company. He was formerly assistant superintendent and purchasing agent.

B. L. Hopkins, an electrical engineer of the staff of the United States Geological Survey, has resigned to accept a position with the Central Maine Power Company, Augusta, Me.

Mark Mellor, district manager of the Chesapeake & Potomac Telephone Company at Hagerstown, Md., for the past seven years, has been made manager of the Wheeling (W. Va.) district.

C. O. Culver has been appointed general superintendent of the Eastern Shore Gas & Electric Company, with offices at Salisbury, Md., succeeding F. W. Woodcock, recently transferred to the Philadelphia offices of the company.

William B. Greeley, who was appointed to succeed H. S. Graves as Chief Forester at Washington when the latter retired on May 1, is a native of California and thoroughly familiar with Western forest reserves and their relation to the development of hydro-electric energy in that section. He is a graduate of the University of California and the Yale forestry school. Upon graduation he entered the Forestry Service and in 1908 was placed in charge of District No. 1, with headquarters at Missoula, Mont. Soon after the big forest fire of 1910 he was called to Washington as Assistant Forester, which title he held until the outbreak of the war, when he organized the Twentieth Engineers of 21,000 men, was made lieutenant-colonel and operated ninety-five sawmills in France. For his effective work he was decorated with the French Legion of Honor and the British Distinguished Service Order. At the close of the war Colonel Greeley returned to his post in the Forestry Service in Washington.

E. K. Bibb has resigned from the Westinghouse Electric & Manufacturing Company to accept the position of assistant electrical engineer of the Jeffery-Dewitt Insulator Company. Mr. Bibb will be in charge of the factory testing and inspection for this company.

L. B. Stillwell, past-president of the American Institute of Electrical Engineers and the American Institute of Consulting Engineers and a consulting engineer of New York City, was selected as one of two engineers appointed directors of the United States Chamber of Commerce at its annual meeting April 26-29. Howard Elliott, chairman of the board of the Northern Pacific Railroad, was the other engineer appointed.

L. B. STILLWELL

S. C. MacCalla, who was recently appointed manager of the Rochester works of the General Electric Company, was from 1903 to 1918 vice-president and general manager of the Washington Water Power Company at Spokane, Wash. Then he joined the manufacturing staff of the General Electric Company. Previous to his connection with the Washington company he was associated with the foreign department of the General Electric Company for two years at Sydney, Australia, and was for four years with the Brooklyn Edison Company. Mr. MacCalla was graduated from Lehigh University in 1896.

Obituary

John Wesley Hyatt, inventor of the Hyatt roller bearing, died at his home in Short Hills, N. J., on May 10. Mr. Hyatt was a well-known inventor of mechanical processes and the discoverer of celluloid. He was in his eighty-third year at the time of his death.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler
and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities
and Business Methods

Blue Bird Mfg. Co. Expected to Survive Receivership

ON the request of a stockholder the Blue Bird (washing machine) Manufacturing Company, St. Louis, Mo., was placed in the hands of receivers last week on account of alleged mismanagement and misuse of funds. The book assets are said to be considerably in excess of the company's liabilities, but these assets are frozen and consist principally of raw materials, washing machines in process of manufacture, tools, plant and so forth. The company lacked working capital, and the old management was unable to raise more money.

The receivers were still examining into the affairs of the company at the time of going to press and no definite statement could be made as to the future of the organization. However, every one connected with or interested in the company seems to feel sure that the factories will soon be back in production, either under the direction of the receivers or under new management. The Blue Bird Manufacturing Company controls the Bluebird Appliance Company, which is the organization through which the products of the manufacturing company are marketed.

Raw-Material Stocks Present Famine Conditions

WITH the slow inflow of raw materials, manufacturers are beginning to feel the real pinch of famine. Surplus stocks have been fast eaten away, and in many instances the bins are bare. Curtailed production in the electrical trade is becoming serious, and without a prompt resumption of the inflow of raw materials and coal—and of coal to utilities to supply power to the industries—shutdowns are bound to become more prevalent than they are at present.

Greatly reduced output, because of lack of orders, in the silk, cotton and leather industries is having a telling effect upon them, and many are operating as low as two and three days a week. This may have some effect on the labor market by enabling some of these operatives to go over to the electrical industry, where labor is so badly needed.

Retrenchment Seen in Ordering of Turbo-Units

DURING the last few weeks reports from manufacturers have indicated that the heavy volume of turbine orders which has been coming in since the first of the year has dropped off. In particular this refers to central-station buying rather than to industrial buying, and the drops vary in amount. It seems to indicate a retrenchment on the part of public utilities in view of present economic conditions and the outlook for conditions in the next twelve months.

The let-up in turbine orders is quite pronounced in the case of one prominent manufacturer of units, and varies on down through other producers to the point where the let-up is not very noticeable. A large central station which has just cut its twelve-million-dollar program about 30 per cent attributes the reduction to the difficulty of financing such projects, the inability to get the material needed and the unrest in the building trades. Vitally necessary extensions are being pushed on to completion, however, although the more remote additions are being permitted to rest for a while.

Manufacturers are running their plants at full capacity in an endeavor to fill the orders on hand, and in some cases manufacturing capacity is rather heavily overbooked. Large units around 30,000 kw. could with difficulty be booked for shipment before late in the year 1921, so heavy has been the demand. That brings schedules up to from twelve to eighteen months on these large sizes, depending on the manufacturer, and from that time on down to eight months is being quoted for the smaller station units, say 500 kw. For industrial work, shipments from five months to a year are being quoted; one large organization, it is reported, will soon have a productive capacity of 300,000 kva. per month in turbo-units.

Turbo-unit prices have been rather unstable during April and May, virtually all prices having been revised upward in that time, some almost every two weeks, and in one case a 5 per cent advance in April having been followed by two of the same amount in May. Prices in representative cases are reported about 84 per cent above pre-war prices, and production costs are declared to be above this figure.

Orders on turbine auxiliaries have kept up and are expected to continue for a time, in keeping with the time lag by which this class of apparatus always follows orders on the large units. Shipments on turbo-auxiliaries are quoted from eight weeks to four months. Some units are still to be heard from, although the large units to which they apply have been ordered for some months.

Few Manufacturers Allot for Foreign Business

A RATHER serious condition in the electrical export market was brought out six weeks ago at a luncheon of the American Manufacturers' Export Association. Among the questions that were asked of the electrical equipment group present was this: "Is your company allocating to its foreign business a definite percentage of its total estimated products?" With but one exception the answer was negative, and that one exception was to the effect that it was the company's practice practically to allocate a certain part of its production for export business. There still was a qualifying note, however, in this one affirmative answer.

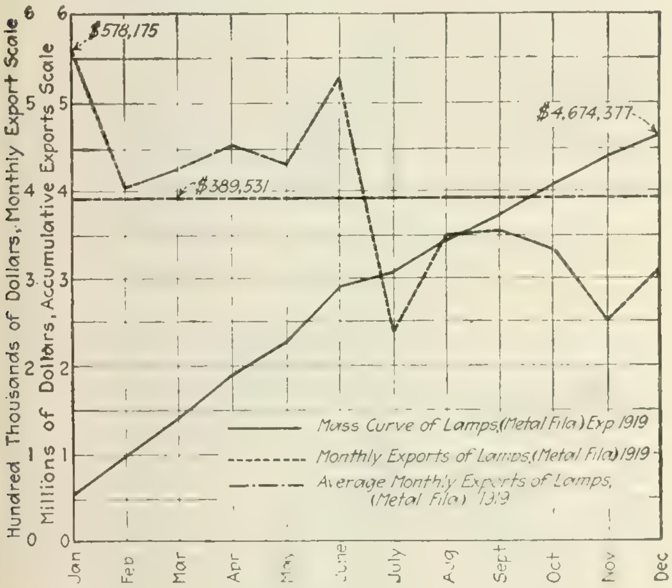
Further investigation along this line bore out in general this same attitude of electrical manufacturers. Of course, there are some producers in this field in America that have realized the necessity for developing and holding foreign markets, no matter how heavy the domestic demand on their products, and have set aside a certain quota for this purpose. The benefits of this market are future rather than immediate. Frequently exporters are able to make contracts with their manufacturers to supply a certain percentage of their output to the exporter concerned. The amounts range from 10 to 25 per cent. It is believed that the exporter has had to do considerable work to sell this idea to some manufacturers.

An analysis of the loss of business in the foreign field, because of non-allocation of product, was made by one manufacturer. He found the loss was caused by too long delays, perhaps because of the inability of the factory to ship promptly, and he changed his policy. He also found that exchange was unfavorable, but from the volume of export orders now being taken, the exchange feature does not seem to be such a factor. Local credits, however, were a factor, and steps are now being taken to permit manufacturers to overcome this feature.

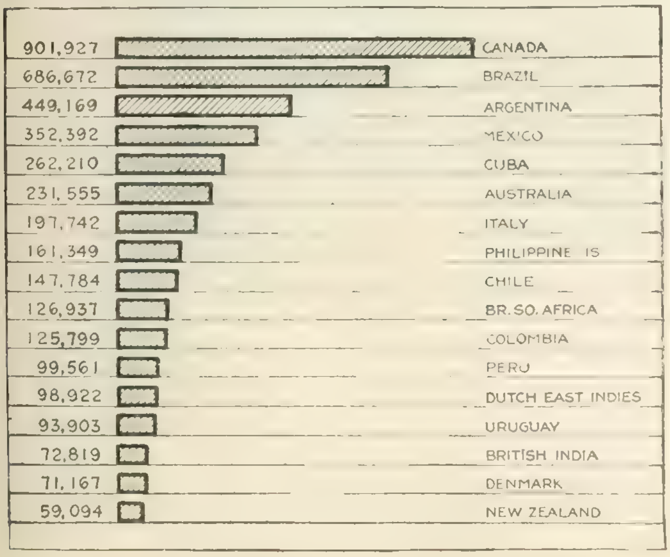
English manufacturers are keenly alive to this problem, and it is understood that they are allocating about 15 per cent of their electrical products to export markets and selling at a price which is really competitive. The American market has not been overlooked in this connection. British manufacturers have no trouble in selling their entire electrical output in their home market and expect this condition to continue for two or three years at least. They are making every attempt to maintain an exportable surplus.

Analysis of 1919 Metal-Filament Incandescent Lamp Exports

THE VALUE of metal-filament lamps exported from the United States during 1919 ranked fifth as regards classes of electrical apparatus exported, last year's exports of this product amounting to $4,674,377. The highest monthly value was recorded in January, amounting to $578,175. The average monthly rate of exportation was $389,531. Probably the most striking fact to be drawn from the exportation curves is that during the first part of the year the monthly value of this class of electrical exports was without exception above the average for the year, while subsequent to June the monthly value was below the average for the year. This more or less uniform decrease from $578,175 in January to $253,903 in November was probably due to a large extent to the re-entrance into the market in full force of British and French lamps.



METAL-FILAMENT LAMP EXPORTS BY MONTHS



METAL-FILAMENT LAMP EXPORTS BY COUNTRIES

Data compiled by the ELECTRICAL WORLD indicate that 20 per cent of this class of exports was consigned to Canada, with a total of $901,927. Brazil and Argentina were second and third, with $686,672 and $449,169 respectively. Curve 2 indicates the large extent of the South American market for this class of electrical goods. Six of the countries of that continent imported American metal-filament incandescent lamps valued at more than $50,000, or a total of $1,602,888, which is about 34 per cent of the total value of this class of exports to all countries. To Canada, Mexico and Cuba exports of these goods totaled $1,516,529, or about 33 per cent of the total of these exports. Taking into consideration, therefore, only such countries as imported $50,000 or more of this class of American electrical goods, continental American trade accounted for $3,119,417 worth, or about 68 per cent, and European imports totaled $268,909, or 5.5 per cent; Australian and New Zealand imports totaled $299,649.

The above figures are based on export statistics issued by the Bureau of Domestic and Foreign Commerce for 1919.

"No Infringement" Held in Attachment Receptacle Suits

TWO decisions have just been handed down by the United States Circuit Court of Appeals for the Second Circuit in connection with attachment receptacles. With reference to the suits brought by Harvey Hubbell, Inc., against the General Electric Company and against the Bryant Electric Company upon the Hubbell patents Nos. 774,250 and 774,251, the court filed an opinion holding that the open contact devices sold by the defendants do not infringe upon the Hubbell patents, on the ground that these patents are limited to the use of concealed contacts. The defendants consequently are permitted to manufacture devices of the "wide-open contact" type.

In the suit of the Bryant Electric Company against Harvey Hubbell, Inc., upon the Burton patent No. 1,169,613, relating to a double receptacle adapted to take either parallel or tandem blades, the same court has held the Burton patent invalid. Consequently the plaintiff is permitted to continue the manufacture of its four-window type of double receptacle, while the defendant has the same privilege with its double-T line of receptacle.

Cotton Cloth for Tape Is Short and Price Is High

MANUFACTURERS of friction tape are making an uphill fight to fill orders. Purchases for electrical uses are heavy, one leading manufacturer having done 40 per cent more tape business so far this year than for the first quarter of 1919. Raw-material shortage presses harder than labor conditions. For some time cotton sheeting, the chief material used in tape production, has been very scarce and high priced to boot. Before the war this material sold around 5 or 6 cents per yard and could be had in ample quantities. Today 30 cents per yard must be paid, or about $1.08 per pound, and as this material is uncertain in regard to future supply in the quantities needed for satisfactory deliveries, it is entirely within the bounds of reason that a further price advance may be forced in the not distant future.

Present prices for ½-in. and ¾-in. sizes range in general about 58 cents to 70 cents per pound, depending upon quantity and quality. In urgent cases shipments can be made from jobbers' stocks practically on receipt of order, and some manufacturing plants can fill such orders within three or four days. By and large, however, four or five weeks represents manufacturing delivery for new orders placed direct, one of the larger plants being at this time just about a month and a half behind on its orders. Not long since this factory had seventy carloads of finished material in its works awaiting shipment, but conditions have improved materially, so that today carload shipments are going forward pretty well in comparison with the late period of extreme congestion. Of course, jobbers located near the factories, especially in New England, have had the benefit of freight embargoes and have taken the opportunity to fill up their stocks.

There has been a severe shortage in paper cartons and in cores used in the center of tape rolls, and this is slow to improve. Gum and rubber are fairly plentiful, but shoddy used in making up compound is short in supply, the usual Russian sources being no longer dependable. None of these difficulties, however, compares seriously with the hardships entailed in procuring cotton sheeting, and the demands of the automobile industry for this material are cutting heavily into the supply available for tape manufacture. Labor conditions in some plants are more satisfactory than in many other branches of manufacture. Wages are high and increases have been general during the past three or four years, but the quality of labor and the productivity of employees is excellent, in one of the most extensive establishments, at any rate. Material costs represent over 80 per cent of the expense of manufacturing tape, according to recent information.

Metal Market Situation

ALTHOUGH there is little activity in the metal markets, the general tone is strong. In the coppers the London market has been recovering well in the past week from a value of £88 on May 25 to a present price of £95 2s. Speculative operations are not especially strong there, but the market is much stronger.

Domestic copper is still quiet. The feeling is that the traffic situation is primarily responsible for this condition. The situation is clearing gradually, and electrical manufacturers are receiving their supplies in better volume. Refineries are in better condition than they were a week ago, it is reported, and they are doing better on the shipping end.

Producers are quoting 19 cents as a nominal price for June copper, but consumers have not entered this market to any extent. Some few of the small producers are cutting this figure to 18.50 and 18.75 cents, and are getting some results from consumers. These figures are more in keeping with those of the outside market, where prices are ranging around 18.25 cents delivered. These low values are finding some consumers willing to enter the market in hope that deliveries can come through. With all the comparative slackness in the domestic product, the producers have held their price levels strongly, with the result that there has been no general tumbling of prices.

May exports of copper reached a high mark, nearly 16,500 tons having been reported shipped to Germany, France, Belgium, England, Holland and Scandinavian countries. It is felt that exports to Japan will be low till economic conditions improve in that country.

Little inquiry is felt in the zinc market, but the tone is firm. Sellers do not seem to be anxious to dispose of their holdings at this time. Futures in zinc are uncertain.

NEW YORK METAL MARKET PRICES

	May 25	June 2
Copper	£ s d	£ s d
London, standard spot	88 0 0	95 2 6
	Cents per Pound	Cents per Pound
Prime Lake	18.50 to 18.75	18.75
Electrolytic	19.00	19.00
Casting	17.75	17.75
Wire base	22.50-23.00	22.50-23.00
Lead, trust price	8.50	8.50
Antimony	9.00	8.75
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Zinc, spot	7.90	8.00
Tin	51.25	51.50
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.75 to 16.00	15.75 to 16.00
Brass, heavy	9.00 to 10.00	9.00 to 10.00
Brass, light	8.00 to 8.50	8.00 to 8.25
Lead, heavy	7.00 to 7.25	7.00 to 7.25
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

MOVEMENT of electrical freight is reported in slightly better volume in the week just past. Much pent-up material has been released and a fair amount of new stuff is coming through from the factories. Jobbers are limited, however, in the amount which they can ship in some localities. Trucking is still being used, but not to the extent of a few weeks ago.

Far-off points are still suffering from shortage of stocks on virtually all goods. Main centers are getting better supplies on this and that material, but not always of the same material. Wiring material stocks are spotty. Porcelain and steel goods are in the worst shape, although weatherproof wire is in poor supply rather generally. Lamp supplies are spotty, but, as a whole, present demand is being cared for. This demand is good.

Labor disturbances are on the books in almost every section in spite of the curtailing of production in the cotton, silk, woolen and leather industries.

Small price advances are reported on steam turbines, safety switches, some heating appliances and on some materials generally where trucking charges are being passed on. Credits are getting tighter and are being carefully watched in the trade.

NEW YORK

Incoming freight shipments of electrical goods are better now than for many weeks past, although conditions in this respect are still far from normal. Harbor traffic, which has been greatly hampered, is now more than 65 per cent of normal, with the result that the accumulation of freight is gradually being reduced.

With shipments becoming better and better, the only deterrent to improved transportation conditions is the threatened trouble between the coastwise longshoremen, freight handlers and truckmen on one side and the commercial organizations of Greater New York on the other.

Most jobbers are not affected to a great extent by the coastwise tie-up which has been in effect since March 12, although in a typical case one large jobber has had goods which he has been unable to move at the piers of four different steamship companies. This material, however, is all from New England, and the jobber is now receiving shipments by truck, although at greater expense.

Price changes are noted on metal molding and on conduit fittings.

Demand is keeping up, largely because of remodeling shops and dwellings in the city proper and because of heavily increasing suburban building programs.

Fans.—Movement of fans has been brisk. Stocks are in good shape and all orders are being filled promptly. Shipments from the Middle West have been slow, but this has not displeased jobbers as demand heretofore has been only fair.

Metal Molding.—A price increase amounting to 5 per cent has been made by the American Wire Mold Company. Stocks are short, although quantities are being received each week.

Flexible Armored Conductor.—Several carloads have been received and the situation is easing up, although it will be some time before the market is fully supplied. Price on No. 14 double-strip ranges from $115 to $125 per 1,000 in 1,000-ft. lots or over.

Lamps.—Lamp stocks are in fair shape, with steady demand. In addition to spotty stocks in 75, 100 and 200-watt sizes, some jobbers report their stocks of 10-watt and 60-watt sizes getting low.

Conduit Fittings.—Within a period of several days, practically all manufacturers have advanced prices about 8 per cent. Stocks generally are low and shortages are causing hold-ups in suburban building.

Heating Appliances.—Demand holds well and supplies are coming in in better shape. The electrical trade is not shading prices, although certain large department stores are offering standard appliances at reduced prices.

Turbines.—Prices on Allis-Chalmers steam turbines took their second 5 per cent advance in May at the end of the month. Industrial demand is holding well.

Wire.—Manufacturers of rubber-covered wire have been holding their base prices rather steady for several weeks. Bookings are still below those of two months ago. Jobbers have good stocks, but their prices are reported as high as $14 per 1,000 ft. for No. 14.

CHICAGO

It is hard to determine exactly how business is in Chicago at present so far as the jobbing trade is concerned. Inquiries continue to come in in heavy volume, but the lack of stocks in all hands is so great as to cause far more duplication in these orders than formerly. The dealer or contractor who for years did 90 per cent of his buying through one house is now trying every jobber he can think of in his effort to get needed supplies. Not alone is it difficult to get electrical goods, but in the case of the contractor, frequently, work for which supplies can be found cannot be done on account of construction delays due to building material shortage.

Transport seems but little improved; indeed, it is a question if the electrical trade is moving any more goods today than it was the first of the month. Stocks are ridiculously low. Of almost any line in which inquiry is made it is stated that supplies are practically exhausted. Power apparatus, line material, schedule material, household appliances, sundries are all the same—apparently business would be good if goods were obtainable.

Construction, both industrial and residential, continues at a low ebb. Cancellation of projects and postponements continue and are encouraged by the experience of interests having construction under way. The week's building permits amounted to $1,500,000. Credit conditions are reported as being "increasingly tight," which condition is attributed more to the slow movement of goods than to general financial conditions.

Bare Copper Wire.—Selling on a 24-cent base, demand keeps up in excellent shape, but stocks are practically exhausted. In lots of 200 lb. or more No. 8 is priced at $24 per 100 lb., No. 10 at $24.25 per 100 lb.

Weatherproof Wire.—In spite of comparatively light demand on account of slow building progress, stocks are in bad shape, the most popular sizes being unobtainable. List on No. 6 triple-braid is 31 cents per pound and on No. 12 is 34 cents per pound, in lots of 500 lb. or more.

Power Apparatus.—Motors, generators, controller apparatus, station transformers and similar items are almost entirely out of stock. Occasional carload shipments which manage to get through the tangle are immediately applied on long-standing orders. Local manufacturers are also in a bad way owing to raw-material shortages.

Pole-Line Material.—Inquiries and orders continue to pour in and stocks have become seriously depleted. Crossarms are unobtainable owing to inability of Western shippers to get cars. Porcelain is almost entirely out of the market. Some items of line hardware can be had, but in the main jobbers are existing from hand to mouth. Prices are unchanged.

Outdoor Transformers.—Heavy demand noted earlier in the season continues, with most makers able to make deliveries in from eight weeks to three months. Manufacturers are seriously handicapped through lack of materials.

Safety Switches.—The Square D Company has issued a new list with changes in both list prices and discounts. The net result is a slight increase in price.

Circuit Breakers.—Stocks are badly broken and demand has been rather slack recently. Delivery is being promised in from eight to ten weeks.

Household Appliances.—Dealers are receiving some shipments and are able to fill current demand, which has fallen off slightly. Tardy spring has continued the call for heaters and delayed the sale of fans. The American Beauty Company has issued new quotations. The 6½ lb. iron is now $10, the three-heat grill $17.50, the nine-cup percolator $28.50 and the toaster $9.50.

BOSTON

The flow of orders was well maintained up to the weekend holiday. Stocks are very uneven and the shortage of rigid conduit and porcelain continues acute. Freight conditions are loosening up somewhat, but deliveries as a whole are far from satisfactory. No price changes of importance are announced. Collections are being carefully watched. Building contracts from Jan. 1 to the middle of last week in New England total $143,535,000, against $55,404,000 for the corresponding period of 1919. This is the largest total by over 70 per cent in the last fifteen years. Labor is on strike in the Waterbury (Conn.) brass mills, but complete failure appears near at hand. In the textile and rubber field there are some strikes, but conditions in electrical factories are good in the main.

Transformers.—The demand is heavy for both power and lighting outfits. Deliveries are quoted at five to six months, with firm prices, although in odd cases shorter shipments are promised.

Meters.—A slight falling off in demand is reported.

Vacuum Cleaners.—Trade is not quite so brisk in some circles. Prices are firm.

Wire.—Stocks are substantial, with healthy demand. Prices are steady with bare on 24 cents base, weatherproof 29 cents, slow-burning 29.5 cents, and No. 14 rubber-covered $12 per 1,000 ft. in 5,000-ft. lots.

Lamps.—Business continues at record-breaking volume. Sign lamps are moving faster and a large trade in miniatures is being handled. Stocks are fair as regards immediate needs, but are not up to normal.

Motors.—The country is being combed for smaller sizes. Express shipments, even of large motors, for distances of 500 to 1,000 miles reflect conditions. Plant expansion for fractional-horsepower production continues.

Flexible Armored Conductor.—Jobbers are well caught up on stocks. Prices are steady with good demand. No. 14 single-strip is quoted at $110 per 1,000 ft. in 1,000-ft. lots.

Fans.—Sales are very sluggish, owing to cool weather. Jobbers are anxious to move their stocks, but little is heard of special price inducements.

Rigid Conduit.—Boston is on a famine basis. Occasional rail shipments come in but are instantly absorbed. Prices are shot to pieces and are based on conditions prevailing at time of delivery.

Nail-it Knobs.—A few are coming in and quotations run around $37 to $39 per 1,000 in barrel lots.

Toasters.—The market is very short and the demand is extremely active. Delivery promises range from two or three months up. Cheaper and less well-known makes are a little more plentiful in the market than are the representative lines. Summer vacation trade is beginning to appear.

Washing Machines.—A huge business is being handled, with firm prices.

Asbestos-Covered Wire.—Business is very brisk, with depleted stocks. One factory has 11,000,000 ft. of heater cord on order, nearly half being sold on the "price-at-delivery" basis. A well-known house has $750,000 worth of orders on its books and could run over a year filling these. Stocks of asbestos and copper are ample, with steady prices, but cotton stocks are unsatisfactory. Base price, magnet wire, 45 cents per pound.

SEATTLE—PORTLAND

Further decreases in sales volumes marked the past week's business activities. This applies particularly to electrical jobbers. Retailers state that the former week's volume is being sustained. Demand for schedule materials, wiring devices, etc., shows a decline, due to the June 1 strike of Seattle's building mechanics and laborers. The Seattle district is still short of cars for handling lumber and other Pacific Northwest products, but conditions are improving from week to week. Lumber mills are continuing steady production and probably will run full blast until the midsummer period in the Seattle district. Electrical jobbers report the stock situation to be showing no improvement over previous weeks. While prices are trending upward, there have been no decided increases recently.

Manufacturing and jobbing interests of Portland report a continued slump in business. Usually at this time of the year there is an appreciable increase, but the past week marked a continuation of the downward tendency. The retail trade also reports a marked falling off in business, while the sales still are in excess of the same period last year. Retailers report that since the first of the month there have been advances ranging from 10 to 15 per cent on Edison and Westinghouse ranges and on many lines of appliances.

Ranges.—Jobbers and central stations report increased impetus in range movement in the past two weeks, apparently all makes sharing equal popularity. Tentative plans for proposed range campaigns have been dismissed for the time being. An increase of from 10 to 15 per cent on certain makes was recently announced. Stocks are in poor condition.

Domestic Appliances.—The local sale of electric washers and household equipment was considerably augmented by the campaign of dealers in local newspapers to advertise this equipment. Stocks are very low, however, and sales have been handicapped by inability to deliver promptly. Toasters and percolators have been fairly active and are expected to show increased movement during the month of June, as dealers are making special efforts to attract attention to them for wedding gifts.

Switches.—Seattle dealers particularly report stocks of switches in very poor shape. Snap switches are especially hard to get, and push-button switches are very scarce. Demand is good.

SAN FRANCISCO

The past week has been rather quiet, and the electrical industry seems to be marking time, with the exception of a few lines of call. The heavy program of electrical expenditures culminating in the Pitt River project of the Pacific Gas & Electric Company promises marvelous possibilities for the industry during the next few years. The local yardmen's strike causes a certain amount of dislocation of service and the pinch of Eastern embargoes is beginning to be felt on the Coast.

Household Devices.—Business is rather slow because this is the dull season and the summer exodus is well under way. Local stocks are spotty. There is visible a decided effort on the part of some distributers to make exclusive territorial arrangements, but this policy is not universally accepted.

Conduit.—Metallic flexible conduit, which was temporarily authorized by the governing electrical bodies of the state, because of the shortage of rigid conduit during the war, has been allowed to retain the temporary approval granted to it and has been found so convenient for certain installations that a constant exhaustion of stock is reported. All jobbers have big back orders and small shipments are ineffective in meeting this demand.

Lamps.—Lamp deliveries so far have been excellent, far better on the Coast than in the Eastern factories, so that a certain amount of diversion is not unlikely. Some agents are stocked out of proportion to their sales, and a systematic effort is being made to proportion this stock fairly.

Fuses.—National Code fuses have dropped slightly and are now selling in standard packages, 0 amp. to 30 amp., 250-volt size, for $12.60 per 100. The call is good; the great number of motor installations has accentuated the demand for big sizes. Renewable fuses are fairly steady, although as a whole the preference is for National Code style.

Rubber-Covered Wire.—After many months of big call and small stocks Pacific Coast supplies have reached the point where they are far higher than the present demand warrants.

ATLANTA

Except for a few days, the unfavorable weather conditions have continued. Planting throughout the Southeast has been delayed from three to four weeks as a result, and all states but Louisiana report a reduction of 3½ to 6 per cent in cotton acreage, which, coupled with poor weather, the boll weevil and the farm labor shortage, will in all probability reduce the yield appreciably. The fruit crop, however, is reported as above the average. The coal production in the Birmingham district is being hampered by the shortage of cars, but the pig-iron production shows a healthy gain over the corresponding period of last year. The Southern Pine Association reports lumber production 20 per cent below normal, and this, with the car shortage, is interfering with building operations.

Electrical jobbers, as is true of all other lines, state that volume of sales continues to hold up well, although great difficulty is being experienced in obtaining materials, particularly steel and porcelain, in sufficient quantities to begin to meet the demand. Building permits for the Sixth District for April number 2,096, valued at $3,776,702.00, an increase of $1,500,000 over the preceding month. Permits in Atlanta to May 28 total $1,102,687, a slight decrease under April. Collections from the city trade are reported fairly satisfactory, though tightening up, while the country district collections are not coming in as well as might be wished.

Fixtures.—The demand for residential fixtures has eased off considerably, although an increase in orders for industrial and commercial goods is noted. Stocks are in fair shape, but glassware is still very scarce.

Schedule Material.—A fair shipment was received this week, insufficient, however, to do more than ease the situation, as back orders absorbed all items promptly. Stocks are very poor and shipments uncertain.

Wire.—Fair stocks of No. 14 rubber-covered are reported on hand, but there is no supply of No. 12 rubber-covered available, and weather-proof in popular sizes is almost unobtainable. Stocks of both varieties are very spotty.

Poles.—Poles are hard to obtain, principally because of the car situation, but there is a limited supply of white cedars to be had.

Conduit.—There are no stocks of moment in the territory. Such shipments as have been received are quickly absorbed, and the demand remains apparently unabated. One jobber reports a large quantity in transit which should arrive by June 1. Prices, less than 2,500 lb., ½-in., $8.89; ¾-in., $11.80; 1-in., $17.44; 1½-in., $28.22.

Flexible Armored Conductor.—This is very scarce, no shipments having been received in some time, and no shipments of any size are promised for the near future. Such receipts as materialized are promptly snapped up. Price, No. 14, two-wire, lots of 250-1,000 ft., $12.22.

Metallic Flexible Conduit.—The situation in this line is practically identical with that existing in armored conductor. Price, ½-in., coil to 1,000 ft., $11.50 per 100 ft.

Metal Molding.—Demand is on the increase, and jobbers report their stocks moving satisfactorily. Stocks of molding and fittings are in fair shape, with shipments quoted at three to four weeks.

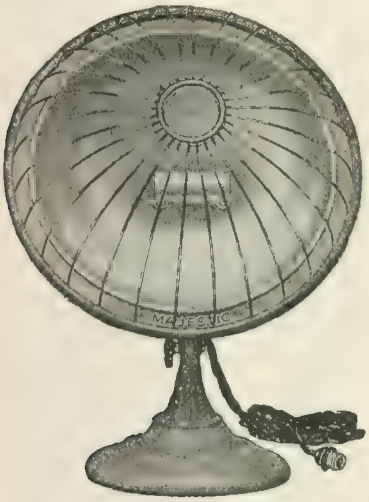
Flexible Non-Metallic Conduit.—Receipts continue to show improvement, although the supply is still unequal to the demand. Shipments are being allotted on back orders in an effort partially to satisfy the trade. Price, $\frac{5}{16}$-in., lots of 250 ft. to 1,000 ft., $6 per 100 ft.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Electric Heater

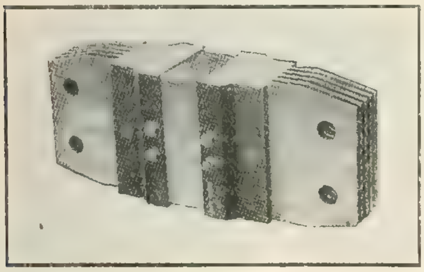
A constantly larger heater, with increased element efficiency, has been added to the Majestic line by the Majestic Electric Development Company, San Francisco, Cal. This No. 11 has a steel back behind the copper reflector and additional guard wires over the reflector. The diameter is 14½ in. and weight 7½ lb.



EXTRA BACK AND ADDITIONAL GUARD WIRES

Switchboard Ammeter Shunts

Although the type G ammeter shunts recently developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., are designed for use on horizontal busbars, the manufacturer states that they will operate in any position without overheating. The terminal castings of 300 amp. are slotted to receive one ¼-in. copper bar per slot. Sizes ranging from 10 amp. to 300 amp. are mounted on a light micarta strip. These shunts operate at a temperature rise of 30 deg. C. if connected to busbars of ample conductivity when carrying two-thirds of their rated current. They are adjusted for 50 millivolts drop at full rated current and are said to be interchangeable with other standard makes of the same rating. The resistance plates are designed to have a negligible temperature coefficient and thermo-electromotive force.



HORIZONTAL BUSBAR SHUNT

Candle Socket

The Peerless Light Company, Washington Boulevard, Chicago, has recently developed its No. 3890 candle socket, made up of only seven parts, including the sealing wax. No binding posts and screws are necessary in order to wire it, the manufacturer says, and no assembly of the socket is required. The E.-Z. wire socket has a plier-grip extension piece with a ⅛-in. thread at its base, designed to reduce the work of attaching. The cylinder is made of highly insulative material, and the screw shell is standard with heavy porcelain base. The contact point is of hard copper with a spring to assure positive lamp contact.

100-Watt, 200-Volt Type C Lamp

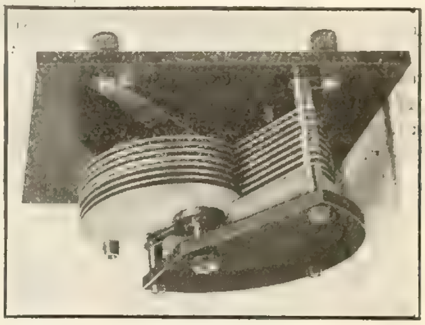
The newest type C lamp for 200-volt service is the 100-watt lamp manufactured by the Westinghouse Lamp Company. It is equipped with medium screw base and uses a concentrated coil filament.

Tailors' Irons with Inclosed-Coil Type Element

A new type of tailors' irons, covering all sizes and weighing from 10 lb. to 20 lb., and with shapes which include special broad and oval-nose standard tailor irons, has been brought out by the Simplex Electric Heating Company, Cambridge, Mass. The particular feature of these irons is the inclosed-coil type of heating element. This construction has been used in the company's household-type irons for about three years. It consists of a coil of wire suspended on mica set edgewise in the grooved bottom casting so that the heat is conducted directly to the working surface without having to pass through any insulations. By the use of these coils, the manufacturer says, twice as much wire can be used as formerly, with less overloading of the wire.

Square-Law Radio Condenser

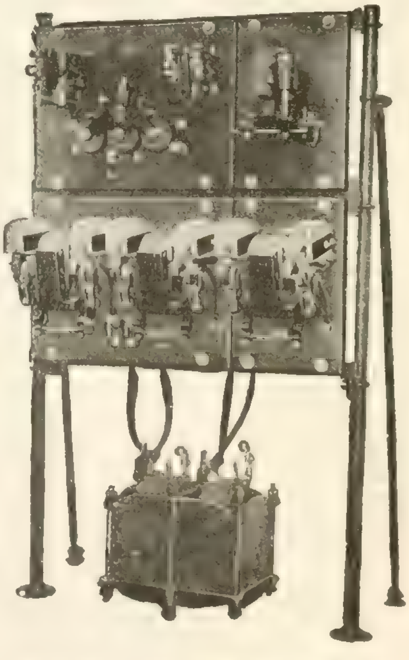
Special variable condensers in which the capacity varies directly as the square of the angle through which the handle is turned are being manufactured by the International Radio Telegraph Company, 326 Broadway, New York City. This series RXC-200 is designed so that the wave lengths shall be evenly distributed over the entire scale. The apparatus is housed in the company's standard interchangeable bakelite panels, 6 in. by 6⅜ in., and is built in two sizes. The capacity ranges from 0.000008 mfd. to 0.00105 mfd., and the weights of the two sizes are 4 lb. and 4½ lb.



WAVE LENGTHS EVENLY DISTRIBUTED OVER ENTIRE SCALE

Automatic Starter for Squirrel-Cage Motors

For automatic starting of polyphase squirrel-cage induction motors driving loads of great inertia the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has developed a control panel. It is of the auto-transformer type, consisting of three double-pole magnetic contactors, two auto-transformers, current-limit relay, time-limit relay and necessary auxiliary magnetic switches. By combining both types of relays the manufacturer endeavors to assure correct starting operation under virtually all conditions of load and line voltage, with the dash-pot relay acting after the current relay has functioned.



COMBINES BOTH CURRENT AND TIME LIMIT RELAYS

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution
Together with Trade Personals and Notes on Foreign Trade,
Jobbers' News and New Trade Literature

J. N. LAPOINT has been elected president of the Arnold Electric Tool Company, 902 Chapel Street, New Haven, Conn., succeeding Frederic Levere, who recently resigned. Mr. Lapoint is president of J. N. Lapoint, New London, Conn., manufacturer of broaching machines.

THE J. M. CARPENTER TAP & DIE COMPANY, Pawtucket, R. I., at the beginning of 1920 passed its fiftieth anniversary as a manufacturer of taps.

THE HOME ELECTRIC APPLIANCE COMPANY, Pittsburgh, Pa., has increased its capital stock from $50,000 to $250,000 for general expansion.

FRANK SUTTON, consulting engineer, has removed his office from 80 Broadway to 140 Cedar Street, New York.

THE W. J. MURDOCK ELECTRIC COMPANY, Chelsea, Mass., is making arrangements for the erection of a two-story factory, 50 ft. x 80 ft., on Everett Avenue, to be used for the production of electrical specialties.

THE EDISON LAMP WORKS of the General Electric Company, Harrison, N. J., is having plans prepared for the erection of a new plant at Wyoming Avenue and Walnut Street, Scranton, Pa., to cost, including equipment and machinery, about $500,000.

COMBINATION TELEPHONES AND SERVICE BUZZERS FOR SALE.—Two thousand regulation Signal Corps combination telephones and service buzzers in leather-covered aluminum cases are to be sold by the War Department at a fixed price of $8 each. The original cost to the government was $35 each.

FRANK CLARK, who has been with the Rome Brass & Wire Company, Rome, N. Y., for the past twenty-six years, has resigned and will become associated with the National Conduit & Cable Company, Hastings, N. Y.

THE COOPER-HEWITT ELECTRIC COMPANY, Hoboken, N. J., has recently purchased property adjoining its plant which will eventually double its present floor space. The demand for industrial lighting systems as well as motion-picture apparatus has more than doubled since the General Electric Company took over the control of the company last June.

THE GLOBE ELECTRIC COMPANY, 193 Broadway, Milwaukee, Wis., is planning to erect a new plant at Keefe and Humboldt Streets, to cost about $150,000.

THE UNION ELECTRIC MANUFACTURING COMPANY, 110 Reed Street, Milwaukee, Wis., has filed notice of an increase in capital stock from $50,000 to $80,000.

THE PREMIER RUBBER & INSULATING COMPANY, Dayton, Ohio, has increased its capital stock from $100,000 to $250,000 for expansion purposes. The company manufactures hard rubber and bakelite products.

THE ALUMINUM COMPANY OF AMERICA, 120 Broadway, New York City, is contemplating building an addition to its plant at Massena, N. Y., to cost about $200,000.

THE SELECTED ELECTRIC APPLIANCE COMPANY, 251 Weybosset Street, Providence, R. I., has filed notice of an increase in capital stock from $60,000 to $125,000.

THE S. HELLER ELEVATOR COMPANY, 250-256 Milwaukee Street, Milwaukee, Wis., has been incorporated with a capital stock of $100,000 to take over the partnership business conducted under a similar name, as manufacturer of electric, hydraulic and hand-power freight and passenger elevators and hoists. The company has recently increased the capacity of its plant 100 per cent. Siegfried Heller is president.

THE HAMILTON-BEACH MANUFACTURING COMPANY, Racine, Wis., contemplates increasing the capacity of its main plant at Racine by 50 per cent. The company has recently established a branch plant at Waterbury, Conn., which will specialize in the production of an electric carpet-washing machine. It will also manufacture the main line of goods.

THE CAROLINA STATES ELECTRIC COMPANY, 218 West First Street, Charlotte, N. C., was organized in February, with a capital stock of $100,000, as a distributing jobber of electrical apparatus and supplies in the States of North and South Carolina. Eugene Graham, president of the company, is also vice-president and general manager of the Charlotte Supply Company; H. T. Long vice-president, was formerly in charge of the lamp sales of the Westinghouse Lamp Company in North and South Carolina; J. P. McMillan, secretary, formerly handled the supply business for the Westinghouse Electric & Manufacturing Company in the two states; W. A. Emerson, treasurer, has been handling industrial work in South Carolina for the Westinghouse company.

CAROLINA STATES' NEW HOME

The SIMMONS ASSOCIATES, INC., 117 North Dearborn Street, Chicago, has been organized to succeed Cross & Simmons. No change will be made in the operation of the company or its personnel, with the exception that John H. Cross, formerly president, becomes vice president, and J. H. Simmons, formerly secretary and treasurer, has been elected president. A. E Warner is vice-president, Harold L. Brown secretary and Paul A. Florian, Jr., treasurer. Mr. Cross will devote part of his time to Cross, Neal & Company, recently organized, which will serve manufacturers in the lines of business organization, industrial development, financing, management.

THE KING MANUFACTURING COMPANY, St. Joseph, Mo., has doubled its factory space. The additional space will be used for the manufacture of ornamental lamp posts, ornamental brackets and commercial lighting units.

THE KOHLER COMPANY, Kohler, Wis., is planning to build an addition, 105 ft. x 300 ft., to its gray-iron shop to provide additional space required by its new department for the manufacture of motor-generator units for farm-lighting and power purposes.

THE W. L. FRANK MANUFACTURING COMPANY, Forty-fourth Street, Rock Island, Ill., manufacturer of electric appliances, etc., is planning for the construction of a one-story factory, 90 ft. x 108 ft., to cost about $50,000.

THE FORT-IFIED MANUFACTURING COMPANY, Gumbel Building, Kansas City, Mo., manufacturer of electrical heating devices, is building a new factory which will soon be completed and which will increase the capacity of its plant at least 500 per cent. Recent orders have been very heavy.

THE WIRT COMPANY, St. Joseph, Mo., manufacturer of electric lighting appliances, announces that it is now established in its new two-story factory and offices at 5221-27 Greene Street, Germantown, Phila.

THE ELECTROMECHANICAL COMPANY,, 432-434 North Calvert Street, Baltimore, Md., has increased its capital stock from $15,000 to $50,000. In addition to the construction and repair departments the company has recently established a sales department.

THE GENERAL LEAD BATTERIES COMPANY, 4 Lister Avenue, Newark, N. J., has awarded contract for the erection of a two-story reinforced-concrete building, 60 ft. x 100 ft., at Lister Avenue and Chapel Street, to cost about $150,000.

THE BLAW-KNOX COMPANY, Pittsburgh, Pa., manufacturer of transmission towers, steel buildings, etc., a New Jersey corporation, has filed notice with the State Department of an increase in capital stock from $3,000,000 to $14,000,000 to provide for general business expansion. Arrangements have been made by the company for issuing $2,000,000 of preferred stock.

M. H. AVRAM & COMPANY, Woolworth Building, New York City, management engineers, have assumed the management and development of the business of the Simplex Utilities Corporation, manufacturer of farm-lighting and power units.

THE CONTRA-POLE ELECTRIC COMPANY, 1231 Prospect Place, Brooklyn, has filed notice of increase of capital stock from $100,000 to $155,000.

THE CLEVELAND WELDING & MANUFACTURING COMPANY, West 117th Street and Berea Road, Cleveland, Ohio, contemplates building an addition, 90 ft. x 155 ft., to its factory, to cost about $75,000.

THE HAMMOND STEEL COMPANY, INC., Syracuse, N. Y., announces the election of Clyde E. Dickey as first vice president and general manager. He is president of The Dickey Steel Company, Inc., New York City.

THE F. J. KLENCK COMPANY, 55 New Montgomery Street, San Francisco, is manufacturing fiber sheets, rods, tubes and washers, and paper in sheets of from 0.004-in. to 0.125-in. thickness for insulation.

Supply Jobbers' Notes

W. A. WOLFF, advertising department of the Western Electric Company, 195 Broadway, New York City, has been elected vice-president of the Technical Publicity Association.

THE CENTRAL ELECTRIC SUPPLY COMPANY, 204 West Randolph Street, Chicago, has been organized by Herman Landerman, formerly of the Washington Light Company, Chicago, and by Harry London, formerly of the Peerless Light Company, New York and Chicago. The new company is a distributor and jobber of electrical merchandise, including chandelier and fixture parts.

H. S. WALMSLEY has resigned from the Sargent & Lundy organization to take charge of the new refrigeration department of the Post-Glover Electric Company, Cincinnati, Ohio. The Post-Glover company has become distributor for Isko refrigerating machines in Cincinnati and contingent territory, and is developing a complete organization, comprising installation service departments to promote this business. A demonstration store has been opened at 232 West Fourth Street. Associated with Mr. Walmsley is F. F. Turner, formerly connected with the Isko organization.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm in Brazil (No. 32,829) desires to purchase and secure an agency for electrical fittings, lamps, etc.

An importer in Switzerland (No. 32,863) desires to secure an agency on a commission basis for the sale of electrical apparatus, etc.

An electric company in India (No. 32,865) desires to purchase and secure an agency for cable, 220-230 volt lamps, 12-in. and 16-in. alternating-current fans, oscillating and other types, and electrical fancy goods.

A firm in France (No. 32,867) desires to secure the representation of American firms for the sale of motors, transformers and generators.

A commercial agent in England (No. 32,874) desires to secure an agency for the sale of electric transformer sheets, etc.

A telephone company in the Netherlands (No. 32,875) desires to purchase and secure an agency for private automatic telephone exchanges, electric dictaphones and lead-covered cables for interior use.

The governor of a city in Palestine of 300,000 inhabitants (No. 32,879) desires to receive bids for the establishment of a telephone exchange.

The proprietor of an import company in China (No. 32,885) desires to be placed in connection with American Pacific coast firms for the purpose of importing electrical supplies, etc.

A firm of importers in India (No. 32,891) desires to secure an agency for the sale of electrical appliances and supplies.

The general agency is desired by a man in Switzerland (No. 32,902) for the sale of motors, parts of electrical equipment, etc.

New Incorporations

THE BALTIMORE BATTERY SEPARATOR COMPANY, 23 East Center Street, Baltimore, Md., has been chartered with a capital stock of $10,000 to manufacture electric batteries, etc. The incorporators are: Thomas H. Snowden, Edward A. Garlock and Lawrence Thompson.

THE SANDHILLS ELECTRIC SERVICE COMPANY, Aberdeen, N. C., has been incorporated with a capital stock of $25,000 by T. J. and Harris Fletcher, both of West End, N. C., and W. H. Mumford, Southern Pines, S. C.

THE A. & R. LAMP COMPANY, Newark, N. J., has been incorporated with a capital stock of $125,000 to manufacture lighting fixtures, etc., by Arthur J. and William J. Rainaud.

THE EAST BERNSTADT (KY.) LIGHT COMPANY has been incorporated with a capital stock of $5,000 by Charles A. Davidson, C. A. Casteel and W. J. Chesnut.

THE NEWLAND (N. C.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $10,000. E. C. Guy is manager.

THE STANDARD BATTERY MANUFACTURING COMPANY, Fort Worth, Tex., has been incorporated with a capital stock of $75,000 by Albert Kramer, J. J. King and A. F. Hawkins.

THE AJAX ELECTROTHERMIC CORPORATION of Camden, N. J., has been incorporated by E. F. Northrup, H. D. Porter and Dudley Willcox, all of Trenton, N. J. The company proposes to deal in electric heating apparatus, etc.

THE GRANITE CITY ELECTRIC COMPANY, St. Cloud, Minn., has been incorporated with a capital stock of $50,000 by William C. Johnson, Hugh F. Pennock of St. Cloud and Gustav J. Andres of St. Paul, Minn.

Trade Publications

LEATHER BELTING.—The Edward R. Ladew Company, Glen Cove, N. Y., has issued a fifty-six-page catalog covering its leather beltings and other leather products.

POWER TRANSMISSION.—The Fairbanks Company, Broome and Lafayette Streets, New York, has issued a 256-page catalog (cloth-covered) describing and illustrating its complete line of power transmission appliances and elevating and hoisting machinery.

LIGHTING SYSTEMS FOR INDUSTRIAL PLANTS.—The National Lamp Works of the General Electric Company, Nela Park, Cleveland, Ohio, has published a booklet entitled "Modern Lighting," describing its new lighting systems for industrial plants.

POWER FACTOR.—The Esterline Company, Indianapolis, Ind., has recently issued a new book entitled "Power Factor." in which it explains the causes of low power factor in central stations and industrial plants.

MOTOR-DRIVEN CENTRIFUGAL PUMPS.—Bulletin S, recently issued by the De Laval Steam Turbine Company, Trenton, N. J., describes the use of the De Laval motor-driven centrifugal pumps for sugar-house service.

BUSBARS, DISCONNECTING SWITCHES AND CHOKE COILS.—The Lewis & Roth Corporation, Philadelphia, has issued a special bulletin, No. 28, covering its outdoor bus supports, combination outdoor disconnecting switch and choke coils, porcelain base choke coils (indoors), etc Bulletin No. 29 describes and illustrates the Fisher-Chase fuse and disconnecting switch.

INDEXES.—The General Electric Company, Schenectady, N. Y., has issued indexes to its descriptive bulletins and sheets and supply-part bulletins, both dated April, 1920.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

FALL RIVER, MASS.—Application has been made by the Fall River Electric Company for permission to construct underground conduits on various streets.

LUNENBURG, MASS.—The Fitchburg Gas & Electric Company of Fitchburg has been granted permission by the department of public utilities to generate and furnish electric light and power to Lunenburg. It has been voted to sell the municipal lighting plant of the latter town.

ORANGE, MASS.—At a recent town meeting it was voted to install an electric light plant and a distribution system in Orange.

TAUNTON, MASS.—The City Council is considering an appropriation of $400.000 for the installation of a new generating unit at the municipal electric light plant.

WORCESTER, MASS.—The New England Power Company has been granted permission to extend its service to Auburn, Berlin, Blackstone and other adjoining towns.

EAST HAMPTON, CONN.—The Central Connecticut Light & Power Company is planning the erection of additional lines to supply light and power to the mills and to other communities.

HARTFORD, CONN.—The Public Utilities Commission has granted the petition of the Hartford Electric Light Company to erect an 11,000-volt electric transmission line from Dutch Point to South Manchester. The company has also applied for permission to construct an 11,000-volt transmission line from East Hartford to Glastonbury, having received approval of the Southern New England Telephone Company to cross lines of the latter.

NEW BRITAIN, CONN.—The American Hardware Corporation contemplates the erection of a new transformer station at its local plant.

Middle Atlantic States

LOCKPORT, N. Y.—The Lockport Light, Heat & Power Company has been authorized to issue $350,000 preferred stock, proceeds to be used for contemplated extensions and improvements

NEW YORK, N. Y.—Contract has been awarded to James A. Henderson, 30 East Forty-second Street, for the erection of a transformer station on Elizabeth Street, to cost about $100,000, by the United Electric Light & Power Company.

NEW YORK, N. Y.—The New York Edison Company is having plans prepared by William Whitehill, 55 Duane Street, for the erection of three substations, two of which will be on the Bowery and Seventy-third Street respectively, and the third at Dunwoodie, N. Y. Cost of each is estimated at about $150,000.

NEW YORK, N. Y.—The New York Telephone Company, 15 Dey Street, has arranged a construction program involving an expenditure of $26,000,000. The work covers a total of sixty-eight building operations, including new exchange stations, extensions to present stations, etc., of which twenty operations are under way, at a cost of $6,000,000.

OAKFIELD, N. Y.—The Genesee Light & Power Company of Batavia has petitioned the Public Service Commission for permission to issue $56,000 preferred stock and $50,000 common stock for additions to the Oakfield plant and extensions to its electric transmission lines to Alexander and other towns.

OSWEGO, N. Y.—Extensions to the ornamental street-lighting system on East Bridge Street are contemplated by Commissioner of Works Collins.

POTSDAM, N. Y.—The St. Lawrence Transmission Company has increased its capital stock from $3,000,000 to $3,250,000.

POUGHKEEPSIE, N. Y.—Steps are being taken by F. C. A. Richardson, director of the Research Bureau of New York, for the establishment of a power plant in Roachdale. Mr. Richardson has made a survey of the current of the Wappingers Creek and reports that by utilizing the fall of water at the dam a turbine can furnish sufficient power to light the settlement and supply power for mechanical purposes.

BLOOMINGDALE, N. J.—The installation of a new street-lighting system is being planned by the Borough Council.

BOONTON, N. J.—The Boonton Electric Company has applied for permission to the township committee for the extension of its lines in the Lincoln Park district of Pompton Plains.

DOVER, N. J.—Bids have been received by the Ordnance Department for the erection of a new power plant for general operating service at the Picatinny Arsenal at Dover.

HOBOKEN, N. J.—The White Metal Manufacturing Company has had plans prepared for the erection of a power house to cost about $60,000.

KEARNEY, N. J.—Bids will be received by the Board of Education until June 15 for electrical work at the Lincoln School. M. J. Malnati is secretary.

HARRISBURG, PA.—Negotiations are being made by the Harrisburg Light & Power Company with the City Council to utilize the pole line in Derry Street, formerly used by the Western Union Telegraph System for a distribution system. The installation of an arc-light street-lighting system in the Allison Hill district is also under consideration by the City Council.

JERSEY SHORE, PA.—Contract has been awarded by the Susquehanna Silk Mills to the Foundation Company, Fulton Building, Pittsburgh, for the erection of a power plant to cost about $150,000, at its local mills.

PITTSBURGH, PA.—The West Penn Power Company is planning extensions to its transmission system, to include a crossing over the Allegheny River in the vicinity of Lock 3.

SCRANTON, PA.—Plans are under consideration by the Edison Lamp Works of General Electric Company, Harrison, N. J., for the erection of a new works at Wyoming Avenue and Walnut Street, Scranton, to cost about $500,000.

WAMPUM, PA.—Application will be made for permission to organize a company under the name of the Wampum Borough Electric Company to generate and supply electricity in the Borough of Wampum.

BALTIMORE, MD.—Bids will be received until June 7 by the Consolidated Gas & Electric Company, Lexington Building, for the erection of a substation at Port Covington, to cost about $80,000.

BALTIMORE, MD.—The Maryland Color Printing Company, Holliday and Hillen Streets, has awarded contract to the Consolidated Engineering Company, 243 Calvert Building, for the construction of a seventeen-story building, to cost about $2,000,000. Electric light and power equipment will be installed.

CUMBERLAND, MD.—W. J. Morley, 98 Bedford Street, has been awarded a contract by the Crystal Laundry Company, Baltimore Street, for the erection of a laundry, garage and power house, to cost about $200,000.

EASTON, MD.—The Borough Council contemplates the installation of new electrically operated centrifugal pumps at the municipal waterworks, rated at from 150 gal. to 600 gal. per minute.

NORFOLK, VA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 7, for furnishing certain materials for the construction of the main hospital, transformer building, gas house, and an extension to the present boiler house for the U. S. Public Health Service Hospital at Sewell's Point (Norfolk), Va., including plumbing, heating and electric work, etc. Drawings and specifications may be obtained from the medical officer in charge of the United States Public Health Service Hospital, Custom House, Norfolk, or at the Washington address.

SOMERSET, VA.—The Somerset Light & Power Company, recently organized with a capital of $75,000, contemplates erecting and equipping an electric power plant in Somerset to furnish light and power to the towns and villages of Orange, Green and Madison Counties. The Somerset Milling Company has also been incorporated under the same management, and it is planned to establish a local electrically operated flour mill. W. G. Buckner is president of both companies.

WASHINGTON, D. C.—Bids will be received at the office of the Chief of Construction Division, Room 1-212, Building C, Seventh and B Streets, Washington, D. C., until June 21, for the erection of steel hangars, generator houses and miscellaneous construction at Forts Williams and McKinley. Further information may be obtained at the above address.

North Central States

DETROIT, MICH.—Contract has been awarded by the Ewing Bolt & Screw Company, Farwell Building, for the construction of a factory, to cost about $350,000. Electric light and power equipment will be installed.

DETROIT, MICH.—John H. Kunsky, Madison Theatre Building, is having plans prepared by C. H. Crane & E. G. Kiehler, architects, Huron Building, for the erection of a ten-story office building on Broadway Avenue. Equipment for electric lighting and electric elevators will be installed.

AKRON, OHIO.—Bids will be received by Henry & Murphy, architects, 523 Second National Bank Building, until June 10, for the erection of a hotel for the Hotel Company, to cost about $2,500,000. Electric wiring, motors, electric elevators, etc., will be installed. Mayer & Valentine, Bangor Building, Cleveland, are engineers.

ANDERSON, IND.—An crdnance appropriating $350,000 for additions to the municipal electric light and power plant has been passed by the City Council.

INDIANAPOLIS, IND.—The Westinghouse Lamp Company, 165 Broadway, New York, N. Y., has acquired a local site on which it contemplates erecting a plant for the manufacture of incandescent lamps, to cost about $2,500,000.

JOLIET, ILL.—The Illinois State Penitentiary has had plans prepared by R. W. Zimmerman, architect, 64 East Van Buren Street, Chicago, for the erection of a one-story power plant, to cost about $50,000. H. W. Tomlinson, Woodruff Building, Joliet, is in charge.

GLENWOOD, WIS.—The installation of a "white-way" street-lighting system is under consideration by the city officials.

GREEN BAY, WIS.—Bids will be received by W. Kerr, city clerk, until June 8 for the installation of an ornamental street-lighting system in the business district, to cost about $35,000. Vaugn & Meyer, Security Building, Milwaukee, Wis., are engineers.

LA CROSSE, WIS.—No bids were received for the reconstruction of the "white-way" street-lighting system on the south side.

NEW LONDON, WIS.—The Little Wolf Power Company has been granted permission to construct and operate a dam on Little Wolf River in Waupaca County, near New London.

WEST BEND, WIS.—The West Bend Heating & Lighting Company has been authorized to construct and operate an electric transmission line and distribution system on certain highways in the towns of Barton and Addison.

DULUTH, MINN.—The Great Northern Power Company, Superior Street and Fifth Avenue, West, has been granted permission to proceed with the construction of a dam across Boulder Lake for the purpose of developing an additional capacity of 50,000 hp., to supply Duluth and towns on the Minnesota iron ranges. The cost is estimated at about $500,000. W. N. Ryerson is manager.

DAVENPORT, IOWA.—The People's Light Company is planning the electrification of the grounds of the Mississippi Valley Fair and Exposition on West Locust Street. A power line and transformer stations will be erected.

ASH GROVE, MO.—Plans have been started for the organization of a corporation to erect an electric transmission line, to cost about $170,000. It is planned to tap the Empire District Company's line at Dorchester and run a line to two miles north of Walnut Grove, where a substation will be erected to supply various adjoining towns. Senator S. E. Bronson of Ash Grove is chairman of the executive committee.

WATERTOWN, S. D.—Bonds to the amount of $200,000 have been voted for the installation of an electric distribution system and improvements to the street-lighting system.

MOUNT HOPE, KAN.—The construction of a new municipal electric power plant, to cost about $15,000, is under consideration by the Borough Council.

Southern States

GREENSBORO N. C.—At a special election to be held on June 26 a proposal granting the Southern Power Company permission to establish an electric distribution system in this locality will be submitted to the voters.

RED SPRINGS, N. C.—Improvements, to include erection of a municipal electric light plant, extensions to the waterworks, etc., to cost between $50,000 and $75,000, are contemplated. Gilbert C. White, Durham, N. C., is engineer.

PARIS ISLAND, S. C.—Improvements to the power plant at the local navy yard to cost about $75,000, are contemplated by the Bureau of Yards and Docks, Navy Department, Washington, D. C.

SAVANNAH, GA.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., contemplates the erection of a radio building and mast, to cost about $6,000.

FAIRFIELD, ALA.—The Birmingham Railway, Light & Power Company of Birmingham contemplates the installation of an electric lighting system.

FLORENCE, ALA.—Bids will be received at the office of the United States Engineer, Florence, until June 15, for furnishing and delivering four electric generators, each of 25,000-kva. capacity, with five exciters and accessories. Further information may be obtained on application.

LAUREL, MISS.—At an election to be held on June 11 a proposal to issue $50,000 in bonds for the construction of a power plant and waterworks, will be submitted to the voters. F. A. Smallwood is city clerk.

SHUBUTA, MISS.—The Town Council is considering calling an election to submit to the voters the proposal to issue bonds for the installation of an electric light plant. J. P. Spinks is Mayor.

MONROE, LA.—The Cumberland Telephone & Telegraph Company plans to rebuild its telephone system, to cost about $75,000.

SHREVEPORT, LA.—The Great Southern Producing & Refining Company of Indianapolis, Ind., contemplates the construction of a new oil refinery to include machine shop, boiler plant, electric power house and other departments, to cost about $2,000,000, including equipment. J. E. Moore, Euclid Building, Cleveland, Ohio, is construction engineer.

DALLAS, TEX.—The City Commission has approved an expenditure of $51,700 for extensions to the street-lighting system, calling for the installation of 200 electric street lamps in Dallas, by the Dallas Power & Light Company.

FORT WORTH, TEX.—The Standard Battery Manufacturing Company, 1103 North Main Street, recently organized, contemplates additions to its plant. Plans include the installation of electric machinery, generators, motors, etc. Albert Kramer is president.

McKINNEY, TEX.—Bids will be received by C. H. Page & Brother, architects, Austin National Bank Building, Austin, until June 8, for the construction of a sanitarium, to cost about $110,000. Separate bids will also be received for electric light equipment and an electric signal system. H. A. Finch is Mayor.

WHARTON, TEX.—The electric light plant of the Texas Gas & Electric Company has been destroyed by fire, causing a loss of about $125,000.

Pacific and Mountain States

FREEWATER, ORE.—Application has been filed by H. S. Murray with the state engineer to divert 150 sec.-ft. of water from the Walla Walla River, near Freewater, for power purposes.

BURBANK, CAL.—A special meeting will be held on June 14 for the purpose of submitting to the voters a proposal to incur an indebtedness for improvements to the electric light and power plants, etc.

BURBANK, CAL.—The Carbasemo Company of Los Angeles contemplates the erection of a steam-operated electric power plant, to be used in connection with its new soap production plant. Total cost is estimated at about $200,000. H. J. Knauer, 1129 Story Building, Los Angeles, is architect.

REDDING, CAL.—The third unit of electrical developments in Shasta County by the Pacific Gas & Electric Company will be a power plant at Fall River Mills to generate 68,000 hp.

SAN FRANCISCO, CAL.—The installation of a signal system for the detection of automobile bandits in outlying districts is under consideration by the Police Commission at a cost of about $30,000. The installation of overhead lights at certain points in the outlying district is also contemplated.

WOODLAND, CAL.—Arrangements are being made by officials of Reclamation District 8 for the construction of a steam-operated electric power plant in the vicinity of Knight's Landing, to cost about $80,000.

Canada

TORONTO, ONT.—The Department of Public Works contemplates the installation of fire-alarm and telephone systems and electric wiring in hospitals owned by the Ontario government at various places, as follows: Brockville, fire-alarm and telephone systems, estimated cost $2,500; Hamilton, electric system, rewiring and fixtures, $1,500; Kingston, fire-alarm and telephone systems, $3,000, and improvements to the electric light system, $5,000; London, fire-alarm and telephone systems, $5,000; Mimico, fire-alarm and telephone systems, $1,500; Orillia, extension and renewal of electric light system, $2,500, and fire-alarm and telephone systems, $5,000; Woodstock, fire-alarm and telephone systems, $1,500, and wiring and lighting of the grounds, $1,000. A. J. Halford of Toronto is engineer.

ST. MICHEL DES SAINTS, QUE.—The installation of an electric lighting system, to cost about $7,000, is contemplated. Alexandre Menard is secretary and treasurer.

REGINA, SASK.—Approximately 700 miles of long distance telephone line will be built by the Saskatchewan government this year, in accordance with the program of the Department of Telephone, involving the use of 28,000 poles and 1,200 miles of wire.

Directory of Electrical Associations

Printed in the First Issue of Each Month

Alabama Light and Traction Association. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

American Association of Engineers. Secretary, C. E. Drayer, Nepeenauk Bldg., 63 East Adams St., Chicago, Ill.

American Electric Railway Association. Secretary, E. B. Burritt, 8 West 40th St., New York City. Annual convention, Atlantic City, N. J., Oct. 11-15.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, Bethlehem, Pa.

American Institute of Consulting Engineers, Inc. Secretary, F. A. Molitor, 35 Nassau St., New York City.

American Institute of Electrical Engineers. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country. Annual convention, White Sulphur Springs, W. Va., June 29-July 2.

American Physical Society. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

American Society for Testing Materials. Secretary-treasurer, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting, Asbury Park, N. J., June 22-25.

American Welding Society. Secretary, H. C. Forbes, 29 W. 39th St., New York City.

Arkansas Utilities Association. Secretary, W. J. Tharp, Little Rock, Ark.

Associated Manufacturers of Electrical Supplies. General secretary, C. E. Dustin, 30 East 42d St., New York City. Annual meeting, New London, Conn., June 26-30.

Association of Edison Illuminating Companies. Secretary, Preston S. Millar, Electrical Testing Laboratories, New York City.

Association of Iron and Steel Electrical Engineers. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

Association of Municipal Electrical Utilities of Ontario. Secretary, S. R. A. Clement, 190 University Ave., Toronto. Annual convention, Niagara Falls, June 10 and 11.

Association of Railway Electrical Engineers. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago, Ill. Annual meeting, Chicago, Ill., Oct. 28-31.

British Columbia Association of Electrical Contractors and Dealers. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C. Annual meeting, Vancouver, B. C., Oct. 19.

Canadian Electrical Association, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St., East Toronto, Ont. Annual convention, June 16-18, Montreal, Quebec, Can.

Colorado Electric Light, Power and Railway Association. Secretary-treasurer, F. O. Safford, Denver Gas & Electric Co., Denver, Col. Annual convention, Glenwood Springs, Col., September.

Conference Club. Secretary, Sullivan W. Jones, 19 West 44th St., New York City. Annual meeting, White Sulphur Springs, W. Va., June 17-19.

Commercial Section, N. E. L. A. Secretary, R. H. Tillman, Baltimore, Md.

Eastern New York Section, N. E. L. A. Secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

Electric Hoist Manufacturers' Association. Secretary-Treasurer, E. Donald Tolies, 52 Broadway, New York City.

Electric Furnace Association. Secretary, Dr. C. G. Schluederberg, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Electrical Manufacturers' Club. Secretary, F. L. Bishop, Hartford Faience Co., Hartford, Conn.

Electrical Safety Council. Secretary, Dana Pierce, 25 City Hall Place, New York City.

Electrical Supply Jobbers' Association. General secretary, Franklin Overbaugh, 411 South Clinton St., Chicago, Ill.

Electrical Supply Jobbers' Association, Atlantic Division. Secretary, E. Donald Tolles, 52 Broadway, New York City.

Electrical Supply Jobbers' Association, Pacific Coast Division. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

Electrical Trade Association of Canada. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Canada.

Electric Power Club. Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

Electric Vehicle Section, N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York City.

Empire State Gas and Electrical Association. Secretary, Charles H. B. Chapin, Grand Central Terminal Building, New York City.

Florida Engineering Society. Secretary, J. R. Benton, Gainesville, Fla.

Illinois State Electric Association. Secretary-treasurer, R. V. Prather, Springfield, Ill.

Illuminating Engineering Society. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

Indiana Electric Light Association. Secretary, Thomas Donohue, Lafayette, Ind. Annual convention, Sept. 15-17, French Lick, Ind.

Industrial Electric Heating Association. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

Institute of Radio Engineers. Secretary, Alfred N. Goldsmith, College City of New York, New York.

International Association of Municipal Electricians. Secretary, C. R. George, Houston, Tex.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria Street, Westminster, London, S. W., England.

Iowa Section, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa. Annual convention, June 23-25, Colfax, Iowa.

Jovian Order. Jupiter (president), Arthur J. Binz, Houston, Tex.

Kansas Public Service Association. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

Michigan Section, N. E. L. A. Secretary, Herbert Silvester, Ann Arbor, Mich. Annual convention, Ottawa Beach, Mich., Aug. 24-26.

Mississippi Electric Association, affiliated with the N. E. L. A. Secretary, E. S. Myers, Vicksburg, Miss.

Missouri Association of Public Utilities. Secretary-treasurer, F. D. Beardslee, 315 N. 12th St., St. Louis, Mo. Annual convention, Jefferson City, Mo., June 3-5.

National Association of Electrical Contractors and Dealers. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin. Annual convention, Baltimore, Md., Oct. 4-8.

National Council of Lighting Fixture Manufacturers. Secretary, C. W. Hoffrichter, 8410 Lake Ave., Cleveland, Ohio.

National Association of Electrical Inspectors. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

National Electric Light Association. Executive assistant to president, M. H. Aylesworth, 29 West 39th St., New York City.

National Electrical Credit Association. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

National Fire Protection Association. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

Nebraska Section, N. E. L. A. Secretary-treasurer, B. H. Conlee, Nebraska Gas & Electric Co., Beatrice, Neb.

New England Electrical Credit Association. Secretary, Alton F. Tupper, 15 State St., Boston, Mass.

New England Section, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass. Annual convention, Kineo, Me., Sept. 14-16.

New Mexico Electrical Association. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

New York Electrical Credit Association. Secretary, E. Donald Tolles, 52 Broadway, New York City.

New York Electrical Society. Secretary, George H. Guy, 29 West 39th St., New York City.

North Central Geographic Division, N. E. L. A. Secretary, M. Barnett, St. Paul, Minn. Annual convention, Minneapolis, June 16 and 17.

Northwest Electric Light and Power Association, affiliated with N. E. L. A. Secretary, L. A. Lewis, Washington Water Power Co., Spokane, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 13-16.

Ohio Society of Mechanical, Electrical and Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

Oklahoma Utilities Association. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City.

Pacific Coast Section, N. E. L. A. Secretary, A. H. Halloran, Rialto Bldg., San Francisco, Cal.

Pennsylvania Electric Association, State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa. Annual convention, Bedford Springs, Pa., Sept. 8-11.

Public Service Association of Virginia. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

Public Utilities Association of West Virginia. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

Radio Club of America. Secretary, T. J. Styles, 1112 S. Curtis Ave., Richmond Hill, Queens Borough, N. Y.

Rocky Mountain Association of Municipal Electricians. President, Lawrence Stone, Denver, Col.

Society for Electrical Development, Inc. General manager, J. M. Wakeman, Guaranty Building, 522 Fifth Ave., New York City.

Society for the Promotion of Engineering Education. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa. Annual Meeting, Ann Arbor, Mich., June 29-July 2.

Southeastern Section, N. E. L. A. Secretary-treasurer, Charles A. Collier, Georgia Railway & Power Co., Atlanta, Ga. Annual convention Sept. 17-19, Asheville, N. C.

Southern California Electrical Contractors and Dealers' Association. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

Southwestern Electrical and Gas Association. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

Southwestern Society of Engineers. Secretary, C. E. Barglebaugh, 721 First National Bank Building, El Paso, Tex.

Technical and Hydroelectric Section, N. E. L. A. Secretary, W. C. Anderson, 29 West 39th St., New York City.

Toronto Electrical Contractors' Association. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

Tri-State Water and Light Association. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C.

Vermont Electrical Association. Secretary-treasurer, A. B. Marsden, Rutland, Vermont.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

Western Society of Engineers, Electrical Section. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

Wisconsin Electrical Association. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis.

Record of Electrical Patents

Notes on United States Patents

(Issued May 4, 1920)

11,853 (Reissue). Automatic Stop for Elevators; Peter L. Manlet, St. Paul, Minn. App. filed Oct. 26, 1915. Cuts off power and uses current generated by operating motor to brake elevator.

1,338,990. Combined Generator and Timer-Distributer Bearing Head; Albion D. T. Libby, East Orange, N. J. App. filed March 22, 1917. Timer drive and support readily adjusted.

1,338,997. Electrically Operated Fluid Heater; Antonio Papini, Philadelphia, Pa. App. filed Aug. 11, 1919. Outlet valve for receiver operated by inflow of fluid.

1,338,998. Current-Regulating Plug and Socket; Antonio Papini, Philadelphia, Pa. App. filed Jan. 29, 1920. For medical batteries.

1,339,001. Cross-Bar Switch; John N. Reynolds, Greenwich, Conn. App. filed April 11, 1917. Longitudinal displacement of bar causes contacts to engage those on another bar.

1,339,010. Telephone-Exchange System; Joseph L. Wright, Cleveland, Ohio. App. filed March 3, 1916. Calls originated over lines automatically transferred to an idle operator, who extends calls by switching mechanism and control devices.

1,339,061. Battery-Plate and Terminal Connection; Alda F. Hawkins, Fort Worth, Tex. App. filed Oct. 3, 1919. Unites plate lugs and terminal by melting the two together.

1,339,100. Spark Coil; John F. Cavanagh, Meriden, Conn. App. filed Aug. 15, 1918. Coil, primary and secondary windings and condenser, all mounted on single base, to be handled and tested as a complete electrical unit.

1,339,111. Electrode Holder; Einar Kaaten, Eydehavn, near Arendal, Norway, App. filed May 8, 1918. Adjustable electrode holder.

1,339,175. Two-Wire Multiple Automatic Telephone System; Bert G. Dunham, Hawthorne, N. J. App. filed Aug. 30, 1915. Bridges containing operating relays are not removed from line after connection is made.

1,339,191. Radio-telegraphy; Leonard F. Fuller, San Francisco, Cal. App. filed Sept. 4, 1917. Signaling involving interrupting and re-establishing arc by varying length of arc gap.

1,339,192. Reverse-Phase Relay for Use in Connection with Polyphase Alternating-Current Circuits; Ernest L. Gale, Sr., Yonkers, N. Y. App. filed Dec. 30, 1915. Automatically opens circuit by a fuse blowing in supply line or by reverse or interchange of a phase or phases of circuit.

1,339,221. Locking Device for Derailed Trolley Arms; Charles E. Pigache and Pierre Pigache, Paris, France. App. filed May 18, 1917. Retarding upward movement of a derailed trolley pole.

1,339,225. Process of Manufacturing Gaseous Fuel; James R. Rose, Edgeworth, Pa. App. filed April 25, 1918. Gas contains 85 per cent of hydrogen and 15 per cent of hydrocarbons produced in electric furnace.

1,339,258. Power Transmission; James K. Delano, N. Y. App. filed July 21, 1917. Eliminates greater part of objectionable noise by utilizing gear surfaces adapted for strength and for quiet running.

1,339,300. Process for the Magnetic Sizing and Grading of Ore; Walter G. Swart, Fred A. Jordan, Edward W. Davis and Theodore B. Counselman, Duluth, Minn. App. filed Sept. 11, 1917. Belt conveyors and gravity for magnetic separation.

1,339,312. Grinding, Polishing and Buffing Machine and the Like; Henry F. Albright, Oak Park, Ill. App. filed Oct. 27, 1916. Manually adjusting the speed of motor through a rheostat in conjunction with indicator to show operator desired speed for abrading wheels of any diameter.

1,339,333. Extension-Base Lamp Bulb; Paul P. Hein, New York, N. Y. App. filed Nov. 5, 1918. Lamp bulb adjusted for use with any ordinary reflector.

1,339,314. Aluminous Composition and Method of Making the Same; Otis Hutchins, Niagara Falls, N. Y. App. filed Sept. 18, 1919. Aluminous abrasive containing oxides of iron, silicon, titanium and strontium fused in an electric furnace.

1,339,351. Lamp Base; William I. Kemble, San Francisco, Cal. App. filed May 26, 1916. Prevents lamps from being removed by unauthorized persons.

1,339,381. Efficiency Recorder; Mois H. Avram, New York, N. Y. App. filed June 29, 1915. For controlling the working time, the output of machines, etc., without having to rely upon judgment of foreman.

1,339,393. Electric Furnace; Johnson Hughes, Philadelphia, Pa. App. filed Oct. 11, 1919. Burning out of lining prevented at places where heat cannot radiate freely or readily.

1,339,417. Bonded-Wire-Cable Structure and Method of Making the Same; Robert C. Pierce, Akron, Ohio. App. filed Oct. 20, 1919. Cuts desired length from a cable, preventing the fraying of the strands at ends, and joins such a cable end to another part.

1,339,428. Method of Operating an Electric Furnace; Max R. Tremboud, Watervliet, N. Y. App. filed March 24, 1916. Prevents carbonization of charge and dissolution of contacting electrode.

1,339,429. Spark Plug; George L. Truesdell, Redwood Falls, Minn. App. filed Sept. 23, 1918. Consists of an iron shell having a removable diamagnetic end head formed with a central neck constituting the stem of spark plug.

1,339,466. Controlling Means for Electric Circuits; Walter O. Lum, Amsterdam, N. Y. App. filed Feb. 27, 1911. Electromagnetic switch with actuating winding holds switch open when exciting current is high and closes it when exciting current is lower.

1,339,515. Manufacture of Electrodes for Soldering and Depositing Metals by the Electric Arc; Ernest H. Jones, Islington, London, England. App. filed Feb. 18, 1920. Electrodes manufactured of metal wire or rod covered with a slag-forming material.

1,339,518. Attachment to Telephones; Carl E. Krueger, Glenwood Springs, Col. App. filed March 23, 1918. Clarifies or intensifies sound.

1,339,549. Telegraphy; Thomas B. Dixon, New York, N. Y. App. filed Dec. 5, 1913. For amplifying telegraphic signals through circuits of great retardation such as submarine cables.

1,339,550. Telegraphy; Thomas B. Dixon, New York, N. Y. App. filed July 29, 1916. Submarine cable-telegraph systems in which zero displacement is automatically corrected.

1,339,551. Telegraphy; Thomas B. Dixon, New York, N. Y. App. filed Dec. 5, 1913. Means for amplifying signals by which speed of transmission is greater than that heretofore possible over corresponding lines.

1,339,553. Electromagnetic Chuck; Leon W. Dunbar, Worcester, Mass. App. filed June 21, 1918. Entire area of working face magnetized.

1,339,559. Horn; Louis G. Hartdorn, Brooklyn, N. Y. App. filed Aug. 11, 1918. Diaphragm is vibrated and driven mechanically from engine and can be wired up to operate electrically.

1,339,566. Electric Sign; Malcolm E. Launbranch, Chicago, Ill. App. filed Aug. 10, 1917. Circuit through lamps directly controlled through contact terminals without interposition of any relays or other auxiliary devices.

1,339,575. Machine-Switching Telephone-Exchange System; Lipa Polinkowsky, Hyde Park, London, England. App. filed July 16, 1918. Exchange network made up of two or more central switching points, the connecting lines being preferably of two-wire type.

1,339,610. Weld-Testing Device for Chains; Edmund J. von Henke, Milwaukee, Wis. App. filed Aug. 8, 1918. Two magnetic circuits established through two joints of link at once and a varying magnetic flux produced through each joint simultaneously.

1,339,655. Magneto-Governor; Theron J. Kresky, Marysville, Cal. App. filed Jan. 19, 1917. Combining a universal coupling, an automatic spark-advancing device and an impulse starter.

1,339,694. Electrical Conductor; Harry A. Douglas, Bronson, Mich. App. filed Feb. 4, 1918. Terminal for flexible conductors for lamp sockets, electrical connectors, and in wire plugs.

1,339,772. Radio-Signaling Apparatus; Fritz Lowenstein, Brooklyn, N. Y. App. filed Jan. 19, 1918. Changing the operating wave length by actuating simultaneously a reactance varying device in each of two co-operating oscillation circuits.

1,339,793. Telephone Transformer; Virgil L. Smith, Chicago, Ill. App. filed March 1, 1917. With phantom repeating coils, duplex auto-transformers and similar transformers used in telephone circuits.

1,339,804. Spark-Coil-Testing Apparatus; Edwin C. Ballman, St. Louis, Mo. App. filed July 19, 1918. Coil provided with vibrator adjusted to required position.

1,339,814. Telephone Set; Henry C. Egerton, Passaic, N. J. App. filed Jan. 28, 1918. Loud-speaking or announcing type for use on naval vessels for transmitting orders.

1,339,817. Motor Control for Sewing Machines; William Forsberg, New York, N. Y. App. filed July 25, 1917. Drum mounted on bracket underneath table of sewing machine and forms supporting means for resistance winding and for rock shaft carrying rheostat arm.

1,339,824. Telegraph System; Raymond A. Heising, East Orange, N. J. App. filed May 12, 1915. Multi-frequency transmitter for selectively impressing upon a transmission line various combinations of electric currents, comprising a number of controller switches.

1,339,835. Celluloid Insulation; Meachem D. Sweet, Alliance, Ohio. App. filed June 28, 1919. Reduces inefficient action of battery by short circuiting of corner plates as a result of plate buckling.

1,339,853. Separator for Storage-Battery Plates; Joseph O. Luthy, San Antonio, Tex. App. filed Sept. 15, 1919. Prevents free active material from increasing the internal resistance or short-circuiting the cell by accumulation between the separator and the plate.

1,339,897. Shaft Oscillator; James R. Kenney, Braddock, Pa. App. filed Sept. 7, 1917. Adjustable oscillating device may be removed and replaced in machine without interruption.

1,339,902. Electrical Device; Paul MacGahan, Pittsburgh, Pa. App. filed May 25, 1914. Contact-making measuring instrument with means for adjusting contact members.

1,339,907. Electrolytic Alternating-Current Chemical Rectifier; Leonard E. Seeley, Wellington, Ohio. App. filed June 23, 1919. Provided by the ignition magnetos of Ford automobiles to transform an alternating current into a periodic direct current for charging storage batteries.

1,339,910. Dynamo-Electric Machine; John L. McK. Yardley, Pittsburgh, Pa. App. filed March 28, 1913. Substantially exact compensating means for obtaining good commutating conditions in rotary converters under all conditions of load.

1,339,935. Electrical Radiator; Cecil V. Stevenson, Sydney, Australia. App. filed June 12, 1918. Cone of refractory material with helical groove in which is wound a coil of high electrical resistance.

1,339,927. System of Ether-Wave Control; John Hays Hammond, Jr., Gloucester, Mass. App. filed Dec. 27, 1910. Provides a sending station at which intensity of emitted waves or impulses may be modified by sound waves.

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician
Published by McGraw-Hill Company, Inc.

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Volume 75 New York, Saturday, June 12, 1920 *Number* 24

A Census of Distribution

EXPRESSION was given to an eminently practical idea by Edward N. Hurley when in his paper before the Indianapolis convention of the Associated Advertising Clubs of the World he suggested that the national government should take a census of the jobbing and retailing industries of the country in the same way that it does of the manufacturing industries. Mr. Hurley pointed out that there are no statistics on distribution corresponding to those on production, although distribution is far more important to the consumer. The cost for such a survey, in his opinion, would be small compared with its benefits. Assuredly if it led to the detection of the real profiteers while acquitting those unjustly accused it would be welcomed with popular acclaim.

Uneconomical Operation as Costly as Bad Management

EXCEPT that it can be corrected, uneconomical operation of a plant is as costly as bad management, yet too few companies consider both conditions from their true aspects of unfairness to investor and consumer. Some of the more progressive companies are adopting every method that will improve economy sufficiently to warrant the investment, but there are still instances where economies are yet to be made that only an intensive study and analysis of operating results can reveal. In the same way that the shrewd business man in other industries finds ways to spend one dollar to get back a dollar and a quarter, so in the operation of public utility plants there are opportunities for such an investment in the station and along the line. Obsolete equipment, deferred maintenance, heat losses in steam lines, wattless energy that limits maximum load on generators and kindred subjects demand attention in plants both large and small from the standpoint of ascertaining what records are necessary to study the possible economies, what facilities are needed to obtain these records and, after analysis, what basis should be used to evaluate the economies. For the average company such information is the greatest operating need of the present day, a need which can be supplied only by corporate effort and willingness to publish findings both good and bad.

Standardized Tests for Home Electrical Devices

IN THE report of the standardization and testing division of the Merchandise Sales Bureau presented at the National Electric Light Association convention emphasis was placed on the need of standardized tests for electrical household devices. The objects of this committee are constructive and its recommendations have been approved by the Heating Appliance Section of the American Manufacturers of Electrical Supplies. The need for the proposed tests is shown by the committee through the statement that out of eighty-two devices offered to one particular central station forty-one were rejected after being tested. However, it would be a great waste of time and money for every central station to conduct its own testing laboratory for devices of this kind, and it would be annoying and most uneconomical to compel manufacturers to make their devices pass the tests specified by different central stations. Still, at the present time the great majority of central stations, contractors and dealers simply use their own judgment as to whether or not a device will stand up in service. The ultimate consumer knows nothing about the subject, and as most of the dealers from whom he can buy the apparatus are not in a position to speak with authority as to the merits of the many devices now being sold, some method must be worked out to protect the public against devices poor in quality and service. This is a problem that cannot be solved by the central stations alone; it requires the co-operation of all interested in the establishing of a method whereby an authoritative stamp of approval can be placed on those devices that have passed searching standard tests.

A Pocket Veto That Needs Explanation

WATER-POWER development has met another setback, as unnecessary as it was unexpected. Among the legislative provisions in the United States Constitution is one to the effect that an act duly passed by both houses of Congress and not vetoed by the President within ten days (excluding Sundays) from the date of its presentation to him shall become law without his signature, provided that Congress shall not have adjourned in the meantime. The water-power bill passed the Senate on May 28. Congress adjourned on June 5. The President did not sign the bill, and for the present it is dead. Had Congress remained in session only three or four days longer, it would now be law with or without Mr. Wilson's signature unless he had vetoed it in that space of time, and in that case the majorities it had already received—259 to 30 in the House and 45 to 21 in the Senate—would have been more than ample to repass it over the veto. Again, had Congress taken a recess instead of an adjournment, only a speedy veto could have prevented the measure becoming law, and in the event of a veto it could have been passed again immediately on reassembly.

Why did not the President sign the bill? The best information obtainable at this writing is to the effect that, finding it impossible in his enfeebled state of health and with the rush of work thrown on him by the precipitate adjournment to give the measure in its final form the careful scrutiny that was his duty, he referred it to the three members of his Cabinet who under the terms of the bill would form the first national water-power commission. Secretary of War Baker and Secretary of Agriculture Meredith are said to have approved it, but the new Secretary of the Interior, Mr. Payne, if report be true, maintained that the national parks were not protected by the proposed legislation. Influenced, it is said, by Mr. Payne's opinion, the President allowed the bill to die. If this report be accurate—and the ELECTRICAL WORLD is not vouching for it—Mr. Payne has incurred a very heavy responsibility unless he can make it clear to the nation that at the eleventh hour and fifty-ninth minute he discovered a real, tangible defect that had been indiscernible by all the astute minds before which the provisions of the bill had previously come. For, whatever wild charges may be made against the outside advocates of water-power development, who will accuse its Congressional and executive sponsors of a willingness to injure the national parks?

A keener sense of its obligations, it seems to us, would have kept Congress in session—or at least have substituted a recess for an adjournment—until the President had signed, vetoed or allowed to become law without his signature this and other measures that met the same fate. The fiasco shows clearly that the Congressional agents of the American people were more interested in the Chicago and San Francisco conventions and in repairing their own private political fences—possibly even in their mileage allowance—than in seeing through the tasks with which their constituents intrusted them. The episode, the joint product of fate and politics, is one more added to the farces, comedies or tragedies—as one chooses to view them—that are yearly enacted under the dome of the Capitol. A speedy repassage of the bill when the Congress reconvenes in December, with an amendment to protect the parks if Mr. Payne shall succeed in making his alleged objection good, and its prompt enactment into law, with or without the Presidential approval, now becomes the objective of the friends of water power. In the meanwhile the national election will take place, and the fate of water-power development will not be the least of the issues that will shape its outcome.

Industrial Lighting Intensities

APPARENTLY the maximum of industrial lighting intensities has not been reached, nor will it be reached until each industry has collected more data from which to obtain the relation between high intensities and production efficiency. While in making changes from a high intensity to one even higher the lead must be taken by industrial plants themselves, and the conclusions be based on observation of particular operating conditions, the central station can do much to promote a thorough understanding of the value of lighting in relation to productive efficiency.

In a very instructive article elsewhere in this issue O. R. Hogue has pointed out how the Commonwealth Edison Company of Chicago is aiding in this campaign. In a typical machine shop layout actual working conditions are very closely approximated and the lighting units are arranged so that seven combinations may be obtained with a variation of from 3 to 114 foot-candles. The machine shop is in actual operation, giving an opportunity for observation of the effect of lighting on the work. In this way the effect of glare and the application of diffused and directional lighting is strikingly shown. Twenty-four foot-candles was determined as the best productive intensity in this case. However, installations of 50 foot-candles intensity are now in use and with excellent results where the design is such as to eliminate glare. Each year sees a development toward making artificial lighting compare very favorably with daylight, and it is quite possible that in the near future production under high lighting intensities will be fully the equal of that under natural light.

The Federated American Engineering Societies

LAST week at Washington, D. C., as reported in this issue, the engineers of this country set up a form of federation of engineering and allied technical professions that is both unique and far reaching in its influence. In the public affairs of the city, the state and the nation, where engineering experience and technical knowledge are involved, the engineer has through individual service in his chosen field gained a high order of recognition. Through the engineering organizations, national and local, he has likewise established a high standard in engineering and technical matters. However, the influence of these group organizations has never been adequately developed or utilized in matters of state or in social matters relating to the welfare of the engineer and the development of his profession. This new and larger work the federation will initiate and conduct with the joint interest and support of engineers as a class irrespective of the particular branch of engineering they may represent or be affiliated with.

Before calling the conference in Washington it was known that the proposed federation as an all-embracing organization, with membership formed by existing engineering societies rather than by individuals, would overlap in some measure the work of the American Association of Engineers, which is a growing society, built up on individual membership and for the advancement of the engineer and his profession. In the deliberations of the conference that organization was represented and showed a spirit of co-operation that was most admirable and won great praise from the entire delegation. In being the first to vote in the affirmative on the fundamental principle of the federation, that it should be an organization of societies and affiliations and not of individuals, the American Association of Engineers effectively removed any feeling of antagonism toward the new movement which might otherwise have existed and, besides, made the vote of the fifty-two societies represented unanimous. In the debate on the adoption of the constitution the same spirit of co-operation was displayed, but the A. A. E. emphasized its desire to function independently along welfare lines. Although it did not vote on the constitution, the way for an affiliation as a member is still left open to that organization, since the vote or non-vote of the delegates did not commit the body represented. There is ample room for both the A. A. E. and the new federation to perform their work either separately or by affiliation through membership. However, the greatest good will come through affiliation. It is hoped that when the permanent organization is created and functioning a mutually satisfactory basis for co-operation on a society basis of membership in the federation can be established.

The scope of the constitution of the Federated American Societies reflects the broad viewpoint of the large committee to which its form was intrusted. Through it the management of the organization is vested in a body to be known as the American Engineering Council, and it will be under this name that the work of the federation will be generally known. While this council will consist of representatives of member societies and be a large body, formed on the basis of one representative for a membership of 100 to 1,000 inclusive and one additional representative for every 1,000 members, provision is wisely made for an executive board to consist of thirty members of the council charged with the conduct of the business of the organization under the direction of the council.

Another provision of the constitution which is contained in few such documents is an article providing for open meetings, a wide publicity for the results of deliberation and full co-operation with the technical and general press of the country. This particular provision applies a remedy for many of the ills of the national organization and effectively overcomes the reticence that has kept from the general public knowledge of much of the good work for which engineers as a group have been responsible. It also opens the door to co-operation on the part of the technical press on the basis of mutual interests in the problems undertaken and makes effective use of the agencies that exert a powerful influence through the thousands of engineers included among their readers.

Engineers everywhere should realize the magnitude of this organization movement on their behalf. It is not enough to indorse it. There is an obligation of affiliation and support, for from its work there will be a return far in excess of the small cost which the breadth of the plan makes possible.

Electric Versus Steam Drive for Auxiliaries

AN INTERESTING study of the relative economy of driving station auxiliaries by motors and by steam derived somewhere from the plant is presented in this issue by E. E. George. Many opinions have been expressed on this subject, and practice varies in a way that suggests very forcibly that the matter still is somewhat indeterminate. Considering the situation in broad terms, electric drive has the advantage by reason of the fact that the efficiency of utilization of steam is enormously greater in the large main turbines than in small turbines or reciprocating engines, although the exhaust steam can sometimes be used for heating to full advantage. There is a good deal to be said for its use, but when it comes to heating the feed water the question raised by Mr. George is whether it is not desirable to bleed an intermediate stage to the turbine sufficiently for this use and to work the auxiliaries entirely by motors.

In analyzing a concrete case Mr. George makes out a small but material gain by using steam at intermediate pressure directly for the feed-water heating, rather than by passing it through the turbines of steam-driven auxiliaries, which produce only a certain fixed amount of exhaust steam, the amount depending on the extent of the service. So far so good; but the uncertain factor in the matter is the possible effect of the necessary amount of bleeding on the economy of the lower stages of the turbine. The whole amount of fuel saving figured out in the article before us is only from 1 to 2½ per cent, a quantity apt to be lost in the shuffle in determining actual turbine efficiencies. Here is the crux of the whole matter. Does bleeding to the necessary amount tend to lower the main turbine efficiency to an extent which would compensate the gain in operating as Mr. George suggests? From a purely thermodynamic standpoint steam applied to heating purposes would seem to have advantage in efficiency due to utilization over the same steam worked in any kind of a heat engine, the boiler and furnace being by far the most efficient part of the train of energy transformation. It would be interesting to see extensive comparative data drawn from experiments on the effect of bleeding on the main turbine efficiency and also on alternative methods of heating feed water. We think most engineers would agree, however, that on the whole the electrically driven auxiliaries under average conditions of service have at present fuel costs a material advantage.

A Record Regulator Installation

IN THE control of alternating stations the induction regulator has long been on a small scale an extremely useful standby. For larger work synchronous apparatus has been freely used, but there are occasions when the simple regulator affords cheaply and conveniently all the give and take necessary to maintain voltages. Such a case found in the practice of the Philadelphia Electric Company is described by Raymond Bailey in this issue. The problem to be solved was a fairly straightforward one, requiring, however, rather drastic treatment. The load of the company is handled by two generating plants, the Schuylkill plant and that at Chester, about 14 miles (22.5 km.) apart and connected by a pair of 66,000-volt tie lines. To meet the growing load it became necessary to increase the kva. rating of these lines and to make the two generating stations pull together as efficiently as possible by keeping their bus voltages to about the same normal figure.

To meet the requirements two 1,750-kva. 9 per cent polyphase regulators equipped for outdoor installation were put into the service. They, rather than synchronous boosters, were chosen, because of their being cheaper and of more rugged construction while accomplishing the same result. The conditions on the lines necessary to voltage control were worked out on the customary vector diagrams and the regulators were planned accordingly.

To load the lines in any required manner it was necessary to know the phase relations of the regulator voltages with respect to each other and the lines, and this was accomplished by a special phase indicator connected to each regulator and so installed as to be in full view of the station operator standing at the regulator control panel. In the design of the regulators particular care was taken to secure mechanical immunity against the possible effect of short circuits, a serious matter when capacities such as those involved are considered. Operating experience with this installation shows the complete correlation between theory and practice that is to be expected and that it is possible by this means to obtain any desired loading conditions on the high-voltage tie lines while at the same time maintaining equal the bus voltages at the two distant generating stations.

Calvert Townley

who as president of the A. I. E. E. and chairman of the organizing conference of engineering societies ushered into being The Federated American Engineering Societies, is a resourceful engineer-executive, for many years identified with large engineering projects

BEGINNING with the Brush Electric Light Company on the construction force of the Cincinnati (Ohio) lighting plant in 1887, Calvert Townley has been associated with many large commercial and engineering developments in the last thirty-three years. Since October, 1887, with the exception of six years, he has been associated with the Westinghouse Electric & Manufacturing Company in combined engineering, commercial and executive capacities. His first connection with that company was as erecting engineer. Later he was placed in charge of the design of the Gaulard & Gibbs alternating-current lighting system. From 1888 to 1895 he was assigned to commercial and executive work as assistant to Messrs. Pease, Byllesby and Bannister, vice-presidents of the company. As manager of the Boston office of the Westinghouse company from 1895 to 1900, Mr. Townley was closely associated with large engineering work throughout New England. From 1901 to 1904 as general agent, with headquarters in New York, he was in charge of Westinghouse relations with the large transportation interests of New York City.

In December, 1904, Mr. Townley was appointed fourth vice-president of the New York, New Haven & Hartford Railroad and was placed in executive charge of the electrical work of the system. Under his direction the largest and most important electrification of that road, from Woodhaven to Stamford, was completed. In the fall of 1905 he became first vice-president of the Consolidated Railway (later the Connecticut Company) and consulting engineer for the New Haven railroad on electrical work. These relations were continued until 1911, when he returned to the Westinghouse company as assistant to the president, the position he now holds. In this capacity Mr. Townley has been given responsible charge of the company's outside interests and of its subsidiaries. In 1913 in the interests of his company he toured Europe and in 1914-15 South America. During the war he was engaged in the building of the Essington factories and the new town of South Philadelphia. In addition to his other duties, Mr. Townley has devoted much time to affairs of the Institute and of the Engineering Council. His appointment as chairman of the recent Washington conference of engineering societies, when in a masterly fashion he ushered into being The Federated American Engineering Societies, is a just recognition of the service he has rendered. His exceptional ability, resourcefulness and clear thinking have won great admiration and have brought to him many honors. Mr. Townley was born at Cincinnati, Ohio, Oct. 18, 1864, and was graduated from Yale with the degree of Ph.B. in 1886, and M.E. in 1888.

Huge Induction Regulator Installation

In Order to Work Transmission Lines at Maximum Load the Philadelphia Electric Company Installs, Out of Doors, Two 1,750-Kva., Three-Phase Regulators—Chart Shows How Transmission Line Characteristics Were Determined

By **RAYMOND BAILEY**
Engineering Department Philadelphia Electric Company

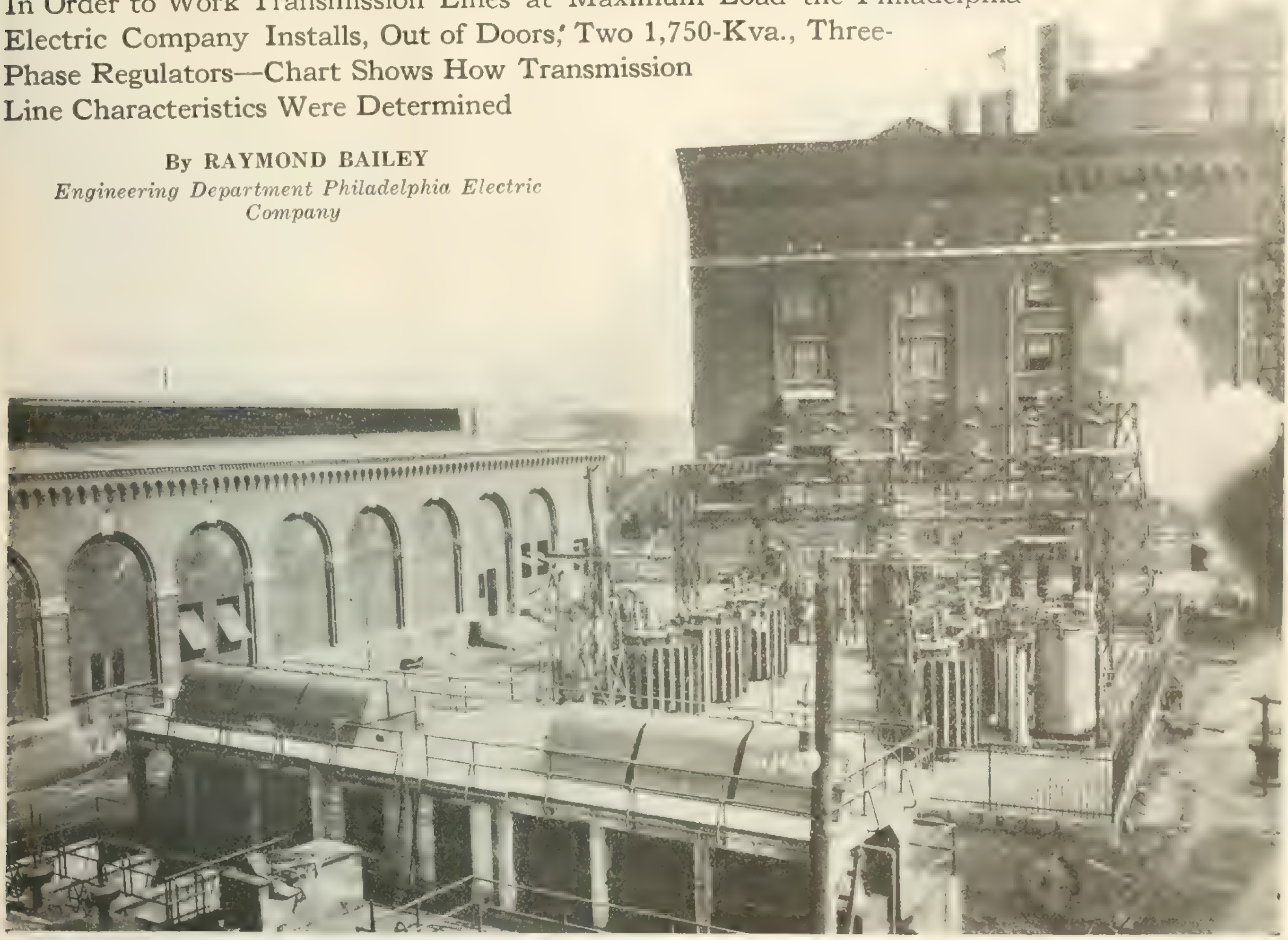


FIG. 1—66,000-VOLT OUTDOOR SUBSTATION IN WHICH TWO 1,750-KVA. REGULATORS ARE INSTALLED AT PHILADELPHIA

BY FAR the largest induction regulators ever built have been installed by the Philadelphia Electric Company in order to permit the operation of the 66,000-volt transmission lines from the Chester generating plant at maximum load under all conditions. The regulators, rated at 1,750 kva., are of rugged construction and are installed in the outdoor substation at the Philadelphia end of the lines. A chart has been worked out for the purpose of giving the proper regulator setting for different conditions of load. This is described in detail to show how the maximum loading of the lines is effected.

Fig. 2 is a single-line diagram showing the tie lines in which the regulators are connected and layouts of the outdoor substations connected thereto. The Schuylkill and Chester generating stations, in Philadelphia and Chester respectively, are connected by these two lines and are about 14 miles (23 km.) apart. The generating-station bus voltage—13,600—is stepped up in the outdoor substation for transmission at 66,000 volts, three-phase, 60 cycles, over lines of approximately 20,000 kva. rating each.

In order to supply the rapidly increasing demand for power in the Philadelphia district it was found advisable to make use of available generating capacity in Chester, which necessitated loading the two 66,000-volt tie lines to the maximum. The rate at which the power demand throughout the system of the Philadelphia Electric Company has grown is indicated by Fig. 3, which shows the yearly peaks in kilowatts since 1904.

It was decided that it would be necessary to increase the kva. rating of the two tie lines and to install voltage-regulating equipment so that the generating-station bus voltages would not differ greatly even when the lines were carrying full rated kva. at system power factor (approximately 85 per cent).

No trouble was experienced in increasing the rating of each 66,000-volt line from 15,000 kva. to 20,000 kva., as there was sufficient copper in each line to carry the increased current. The 13,200-volt to 66,000-volt transformer banks were rated at 15,000 kva., with a temperature rise of 40 deg. C., but are good for 55 deg. C. rise and 10 per cent overvoltage, at which rating they have the desired capacity. The capacity of the 13,600-volt cables from the generating stations to the outdoor substations was increased by pulling in an additional 1,000,000-circ.mil cable for each phase.

The matter of voltage regulation was not so quickly disposed of, owing mainly to the fact that, as these lines were to act as part of the additional generating capacity, it was decided to connect no equipment to them except that of the greatest reliability and sturdiness of construction.

The power demands of the consumers' substations tapped to the 66,000-volt lines (refer to Fig. 2) are such that one line is usually supplying from 10,000 kva. to 15,000 kva. more to these consumers than the other line. The vector diagram (Fig. 4) shows the impedance drop in each line under certain loading conditions to be such that one line supplies 15,000 kva. to the consumers and the other line transmits its full rated kva. all the way through to Philadelphia.

Fig. 4 shows clearly that in order to load these lines to the best advantage it is necessary to use a voltage-regulating device which will permit a variation of the phase relations of its voltage and the line voltage. E_b and E_e are the regulator voltages referred to. Both the synchronous booster (equipped with a frame-shifting device) and the polyphase induction regulator fulfill the requirements.

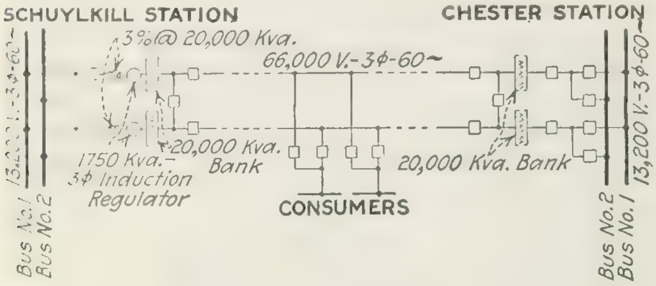


FIG. 2—LAYOUT OF THE TWO 66,000-VOLT LINES
All instrument transformers, disconnecting switches, etc., are omitted.

The synchronous booster, equipped with a frame-shifting device, is more flexible than the polyphase induction regulator in that its voltage may be varied both in magnitude and phase relation. The polyphase induction regulator was selected for this service, however, because it is superior to the synchronous booster in so far as simplicity, ruggedness and ability to resist short-circuit stresses are concerned, and on account of its adaptability to outdoor installation and its lower cost as compared with the synchronous booster.

A detailed analysis of the induction regulator proposition was made, using a circle diagram as shown in Fig. 5 in order to determine just what percentage of "buck" or "boost" would best meet the operating conditions. This circle diagram is arranged with scales to read total kva., kw., reactive kva., power factor, total amperes, reactive amperes and kw. line loss of the untapped line for certain assumed loading conditions of the line that is carrying the consumers' substations. In order to make sure that the regulators selected for these lines would take care of the worst conditions possible, it was assumed in the analysis that one line carried all of the load tapped off along the line.

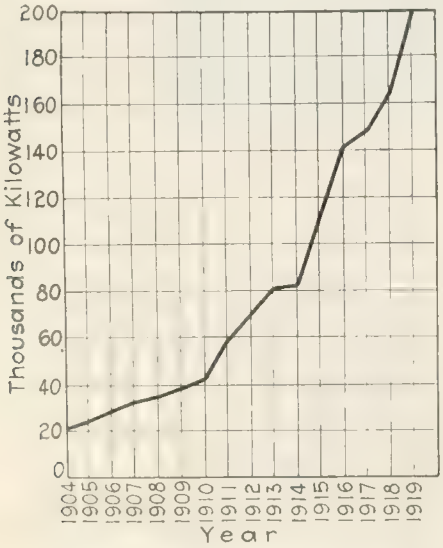


FIG. 3—YEARLY PEAKS OF THE PHILADELPHIA SYSTEM

The circle diagram may be more readily understood by first referring to Fig. 4. Consider the following conditions: E_c, the Chester bus voltage, 14,000; load from Chester to the tapped line, 20,000 kva. at 0.85 power factor; load to consumers, 15,000 kva. at 0.90 power factor (referred to consumers' voltage). The impedance drop from Chester to consumer in the tapped line is IZ_1; the impedance drop from consumer to Philadelphia is IZ_2. If Schuylkill station is carrying 13,800 volts at the bus, the regulator in this line will be placed in such a position that its voltage will be represented by the vector E_b. If the regulator in the second line is placed in a position corresponding to the vector E_e and the governors of the turbines are adjusted so as to maintain the phase relation shown on the diagram for the generating-station bus voltages, then the current through this line will be of such a magnitude and phase relation as to give an impedance drop X.

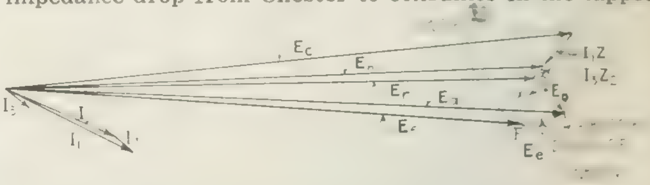
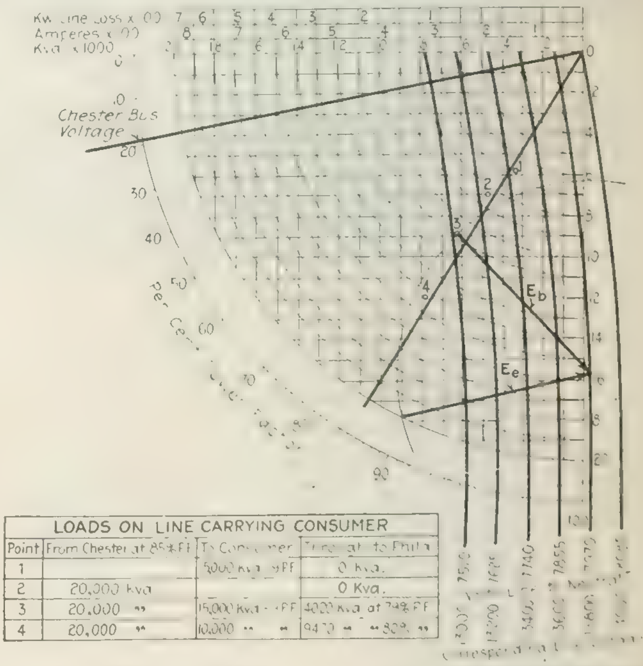


FIG. 4—VOLTAGE RELATIONS ON THE TWO TRANSMISSION LINES
E_c—Chester bus voltage. E_h—Consumers' voltage. E_r—Voltage at regulator (tapped line). E_a—Schuylkill bus voltage. F_b—Regulator voltage (tapped line). F_e—Regulator voltage (untapped line). E_f—Voltage at regulator (untapped line). I_a—Current in untapped line at unity power factor. Z_1—Impedance, Chester to consumer (tapped line). Z_2—Impedance, consumer to Philadelphia (tapped line). Z_3—Impedance (untapped line). I_1—Current, Chester to consumer (tapped line). I_2—Current taken by consumer. I_3—Current, consumer to Philadelphia (tapped line). X—Drop in untapped line for regulator position shown.

The scales given on the circle diagram are based on the fact that the magnitude of the impedance drop in the untapped line can be used as the measure of the kva. transmitted over the line and that the phase relation between the impedance drop in the line and the generating-station bus voltage has a definite relation to the power factor of the line. Therefore a



LOADS ON LINE CARRYING CONSUMER			
Point	From Chester at 85% PF	To Consumer	Through to Phila
1		5000 kva [illegible] PF	0 kva.
2	20,000 kva		0 Kva.
3	20,000 "	15,000 kva - [illegible] PF	4000 kva at 74% PF
4	20,000 "	10,000 " "	9470 " " 30% "

FIG. 5 — CIRCLE DIAGRAM FROM WHICH THE PERFORMANCE CHARACTERISTICS OF THE TWO TRANSMISSION LINES WERE OBTAINED

scale that will read the length of the impedance drop vector in any position can be marked to read the total kva. transmitted over the untapped line. At unity power factor this vector—*i.e.*, the vector of impedance drop over the untapped line—will read the kw. transmitted as well as the kva. The position of this line at unity power factor is given by I_aZ_s (O-D) (Fig. 4). As the current lags from its position at unity power factor the impedance drop vector will move from its position at unity power factor through the same number of degrees. Therefore the projection of this line on *O-D* will be proportional to the projection of the line current on the line voltage and therefore proportional to the kw. transmitted over the line. A scale can now be placed on the line *O-D*, which will read kw. transmitted over the untapped line. At zero power factor the current will have swung through an angle of 90 deg. and the impedance drop through an equal angle to the position *O-G*. The arc *D-F-G* may now be drawn and divided so that it will read per cent power factor, 100 per cent being at the intersection of the arc and the line *O-D* and 0 per cent being at the intersection of the arc and the line *O-G*. By similar reasoning the power component of the current can be read from a scale on the line *O-D* and the projection of the impedance drop in it, and the reactive current and kva. by a scale on the axis *O-G* and the projection of the impedance drop on it.

The kw. line loss scale is placed above the scale giving the total current and is based upon the fact that the watt loss in the line is equal to a constant times the square of the line current ($3 \times I^2R$). The kw. line loss includes the resistance loss in the transformers but does not include the transformer core loss.

The circle diagram is made up much the same as Fig. 4, except that several of the vectors are omitted and the necessary scales with the subdivisions are added.

In order to use this diagram to determine what loading conditions can be obtained on the untapped line with a certain assumed load on the tapped line, it is necessary to compute the impedance drop in the tapped line for the loading conditions assumed. This impedance drop is laid off on the diagram and the point obtained to work from. In this case point 3 will be taken. Reference to the table (Fig. 5) will show that point 3 has been figured for 20,000 kva. at 0.85 per cent power factor out of the Chester station and 15,000 kva. into the consumers' substation at 0.90 power factor. The position of the regulator in the tapped line is now determined by the Schuylkill station-bus voltage. Assuming 13,800 volts, the regulator voltage will be E_b. With the end of this vector (regulator vector in tapped line) as a center a circle may be described and the conditions of loading which may be obtained in the untapped line are read at points on this circle. For example, consider the point where the circle intersects the 20,000-kva. arc. The position of the regulator in the untapped line is then E_e. The loading conditions are 20,000 kva., 17,900 kw., 0.89 power factor; reactive kva., 9,000; power component of current, 740 amp.; reactive component of current, 375 amp.; line loss, 700 kw. As another example assume that it is desired to have Chester supply kva. to the untapped line at system power factor, 0.85. Note the point at which the regulator circle intersects the 0.85 power-factor line. The regulator voltage will then meet this point. Reading the loading condition, we have 17,500 kva., 0.85 power factor, 14,900 kw.; reactive kva., 9,300; power component of current, 620 amp.; reactive component, 385 amp.; total current, 725 amp.; line loss, 530 kw.

It should be noted that all kva. and kw. values, power factor, etc., are given with respect to the Chester generating-station bus voltage. If the Chester station is assumed to be operating at any bus voltage other than 14,000, proportional correction must be made in the readings taken.

It was found that the desired loading conditions could be obtained by means of 1,750-kva., 9 per cent polyphase regulators, and two such regulators were accordingly purchased from the Westinghouse Electric & Manufacturing Company.

That the manufacturer's engineering organization has made every effort to build a regulator of the most rugged construction will be evident after referring to Fig. 6, which shows photographs of one of these regulators. Fig. 6 shows the complete regulator before

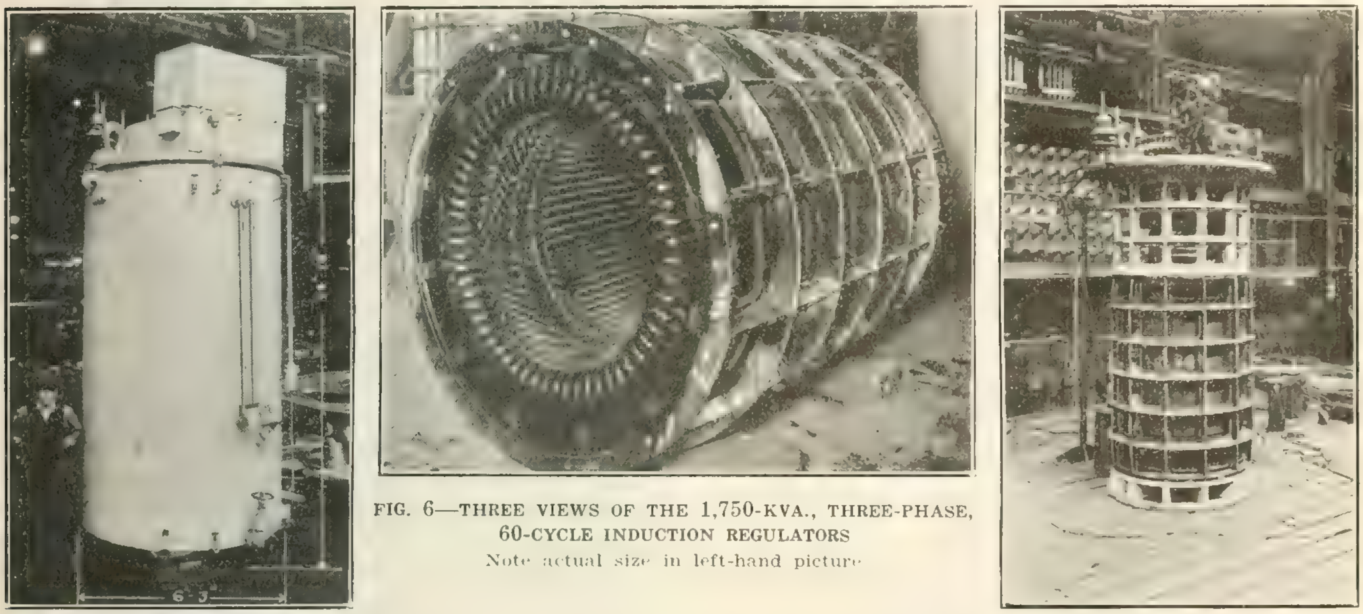


FIG. 6—THREE VIEWS OF THE 1,750-KVA., THREE-PHASE, 60-CYCLE INDUCTION REGULATORS

Note actual size in left-hand picture

being placed in its boiler-plate tank. The complete regulator assembled in the tank is shown by Fig. 6. This photograph shows the pipe connection for the water-cooling coils and the breather. The weight of each regulator filled with oil is 56,000 lb. (25,000 kg.). The arrangement of the stator coils is shown by Fig. 6. Standard generator construction is used throughout, and the windings are braced to withstand short-circuit currents as great as fifteen times rated full-load current.

The photograph of Fig. 1 shows the Philadelphia 66,000-volt outdoor substation in which the regulators are installed. The cable connections to the regulators are arranged so that it is possible to disconnect them from the lines by loosening several clamped joints, swinging the cables over to other terminals and reclamping.

It was shown in another part of this paper that in order to load these lines as desired it is necessary to know the phase relations of the regulator voltages relative to each other and to the line voltages. This was taken care of by providing each regulator with a position indicator, which consists of a 360-deg. power-factor indicator remodeled for this service. Two of the potential coils of this instrument are connected to the line-potential transformers, and the third is connected through a potential transformer to the terminals of one of the secondary windings of the regulator. The position indicators, together with the instruments for the two transmission lines, are installed so as to be in full view of the station operator when standing in front of the panel on which the regulator operating motor control is placed.

Operating experience gained since the regulator installation has been completed shows that it is possible to obtain the desired loading conditions on these lines and at the same time maintain equal generating-station bus voltages.

Quantitative Investigation of Piezo Emfs.

High Emfs. Are Produced Mechanically by Axial and Torsional Stresses—A Reversible Process—Experiments Were Conducted with Rochelle Salts

THE Piezo electric effect is an electro-elastic property of certain crystals by means of which mechanical energy may be converted into electrical energy and vice versa. An interesting investigation of certain Rochelle salt crystals was reported by A. McL. Nicholson at a recent meeting of the American Institute of Electrical Engineers.

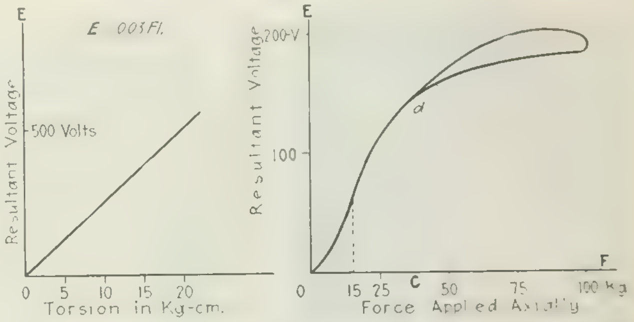
It was found that emfs. were developed at the ends of the crystals when either an axial or a torsional stress was produced and that conversely the application of emf. to the crystal produced mechanical movement. The quantitative results are shown in the figure.

Analysis of the direction of applied stresses to the sensitive regions described has shown that for the composite structure a twisting couple about the principal axis excites the greatest potentials between the crystal electrodes.

The electric charge measured by twisting the crystal is much greater than the charges produced by applying axial or diagonal forces, not only for very reduced torques and stresses but for magnitudes of stress approaching saturation in the case of the axial and diagonal forces. In the case of torsion there exists the advantage of the couple, since the force is applied at a given radius from the polar axis.

On plotting the relation between electric potential and various loads applied by axial compression to the composite crystal, the approximately quadratic curves shown in the figure are obtained. It has been found advantageous to apply permanent static compression and obtain thereby greatly increased effect. The value of the applied static pressure for maximum change in slope corresponds to an absolute force of approximately 15 kg. At this point in the curve a variation of applied axial force of 1 kg. will produce in a good crystal 8 volts. Beyond this point the curve becomes less steep. The static pressure may be applied permanently to the crystal without apparent fatigue.

A special microphone was applied to a crystal pole in various positions with respect to the crystallographic axis. The microphone, being in a local battery circuit operating a thermocouple, was actuated by the dilating crystal when the constant alternating potentials of various frequencies were applied. The measurements showed conclusively that the crystal twisted or moved the microphone button to the greatest degree when the axis of the microphone was attached tangentially to one of the crystal poles. The motions applied to the microphone were much smaller when they were diagonal or axial in character.



VOLTAGES RESULTING FROM TORSIONAL AND AXIAL FORCES IN ROCHELLE SALT CRYSTALS

The relation between piezo-electric charge and torsion is linear (see the illustration) and is given by

$$E = KFL,$$

where $K = 0.03$ for several crystals tried,

$L =$ force in grams,

$E =$ potential in volts.

Since, with these composite crystals, a given force produces its chief piezo effect when it is applied in such a way as to twist the crystal about its principal axis, and, conversely, an applied electrical force produces the maximum mechanical response in the form of twisting motion, it is apparent that whether we are interested in producing electrical or mechanical results from the crystal the diaphragms should be so attached as to make maximum use of the torsional effect.

Applications of the piezo-electric effect in such crystals to the transmission and reception of sound were described and demonstrated.

Since the presentation of Mr. Nicholson's paper the suggestion has been made that sufficient piezo-mechanical stresses may be set up in the microporcelain of high tension insulators actually to loosen the crystals, and thus render the porcelain less capable of resisting moisture absorption.

Federation of Engineering Societies

Report of the Organizing Conference at Washington, D. C., Which Resulted in the Formation of The Federated American Engineering Societies—Its Prominent Objects and Plan of Organization

AT WASHINGTON, D. C., on Thursday and Friday of last week, at a conference of the national, local, state and regional engineering and allied technical societies, the foundation was laid for the most comprehensive organization of engineers in this or any other country. Under the title of The Federated American Engineering Societies there has been set up a form of association embracing all the engineering professions, with the definite object of establishing machinery whereby engineers as a group can render service in the public affairs of the city, the state and the nation whenever engineering experience and technical knowledge are involved and to consider and act upon matters common to the engineering and allied technical professions. Delegates from fifty-seven societies were present from all sections of the United States out of a scheduled representation of sixty-seven.

The form of the new organization, based upon membership of societies and affiliations instead of individuals, which has been under consideration for some time, was planned under the direction of Richard L. Humphrey as chairman of the joint conference committee of the four founder engineering societies and member of the American Society of Civil Engineers. In opening the first session on Thursday morning at the Cosmos Club, Mr. Humphrey reviewed the work of the joint conference committee and explained the activities of the Engineering Council, which has in a limited way during the past three years functioned along lines similar to those proposed for the more comprehensive organization. His remarks are abstracted on page 1360.

The Preliminary Resolution

Formal presentation of the following resolution by Gardner S. Williams, member of the American Society of Civil Engineers, opened the debate on the plan of organization:

> *Resolved,* That it is the sense of this conference that an organization be created to further the public welfare where technical knowledge and engineering experience are involved and to consider and act upon matters of common concern to the engineering and allied technical professions, and
>
> *Resolved,* That it is the sense of this conference that the proper organization should be an organization of societies and affiliations and not of individuals.

Opposition to the principle of membership by societies instead of individuals came largely from members of the American Association of Engineers. That organization, which is made up of more than 18,000 individual members, has during the past five years had a rapid growth based upon its activities in welfare work of benefit to engineers in all professions. In accepting the invitation to send delegates to the Washington meeting this association contended that the organization of a national association of engineering organizations with representatives widely chosen by local affiliations and national organizations would duplicate the effort of the A. A. E. and add useless machinery. It was along these general lines that arguments pro and con were advanced. The debate, however, was brief, and when the resolution was put to a vote the seventeen representatives of the American Association of Engineers, on account of the alphabetical position of that body in the list of participating organizations, cast the affirmative votes. This action effectively dispelled any feeling of antagonism toward the new movement, and the resolution was unanimously carried by 119 votes from representatives of fifty-two of the fifty-seven societies present. With this point settled, the order of business of the first session was completed by the appointment of committees on program, credentials, constitution and by-laws, and resolutions.

Constitution and By-Laws

The sessions on Friday morning and afternoon were largely devoted to a discussion of the form of constitution and by-laws drawn up by the committee. In the vote on the constitution, eighty-eight representatives of forty-nine societies voted in the affirmative, with representatives of eight societies reporting "not voting." Among the latter was the American Association of Engineers. William J. H. Strong, the chairman of the delegation, in reporting its vote made a statement in part as follows:

> The American Association of Engineers has stood for co-operation. Our delegates came to this conference in good faith; we have acted there in good faith, and we wish to continue to act in the future with equally good faith for the welfare of the public and the engineers as a profession, as well as for the individual engineer.
>
> The latter part of yesterday's resolution, upon which our delegates unanimously voted aye, specifically states that the new organization shall not receive individual members. If you will turn to page 1 of the first draft of the constitution, Article III, Section 3, you will note that it reads that the membership "shall consist of affiliations consisting of any one or of a combination of the following constituents," and paragraph 3 thereunder states "local engineers and members of allied technical professions and their associates." We regard that phraseology as capable of a construction contrary to the latter part of yesterday's basic resolution.
>
> We would call your attention to the fact that while our vote of today will be a disappointment to you, yet we have in every way sought to co-operate with you, if not on one basis, then upon another. We sought in the first place to show you that the form of organization which you have planned is historically wrong and cannot be made to function properly, and we have recited valid historic precedent for this judgment. The structure also seems cumbersome and certainly the relations between the council and the board will have to be either altered or ignored. Such discrepancies, however, are usually present in new endeavors and under able management will no doubt ultimately be ironed out. We would also state that the constitution as presented is contrary to a well-accepted American principle, that "taxation without representation is tyranny," and therefore if for no other reason the delegates of the American Association of Engineers cannot ratify this constitution with the basis of representation therein outlined. Such representation under this constitution would work out for the American Association of Engineers about as follows: Under this constitution the American Association of Engineers would shortly be called upon for $32,000, and its voting representation would be on a basis of only one to sixteen. In other words, the dollar of dues paid by the small units of the federated societies would have sixteen times more voting power than the dollar paid by the American Association of Engineers. We stand unalterably on the principle of a dollar of vote for each dollar of dues.
>
> Further, our association offered to you its own organization established, proved and in successful operation, subject to such modifications as would make it sufficiently comprehensive to carry on the work it is now successfully doing and to include the fields of activity which the new federation chiefly aims to cover, as evidenced in the resolution of June 3. This you declined.
>
> We then, as is known to some of you, offered to divide

the field of co-operative engineering effort, we to take the welfare work pertaining to the individual engineer as an individual, and you to take the work outlined in the first part of the resolution of June 3. This you also have refused.

In accordance with the practice of our association in times past to make special appropriations of funds to attain special objects of interest to the engineering profession, we then offered a suggestion that you specially provide in your constitution the channel for such special appropriations, so that we might respond financially should you desire such support from us and we make the necessary appropriation. This also was rejected in the form in which we suggested it.

Up to the present the engineer has evidenced very little of the real co-operative spirit. We are teaching it in the American Association of Engineers, and while we at present recognize, as is evidenced by this conference, that two societies are necessary at the present time, it is our earnest hope that as time passes and the ability of engineers to co-operate successfully is developed ultimately there may be one large society covering all interests of engineers and all technical men, but while we await that ideal condition be assured that we shall in no point fail to co-operate with you within the limitations which we have outlined.

We again express our appreciation for the entertainment which you have so generously extended to us, and we particularly appreciate the words uttered by Mr. McGraw in his able address of June 3. Such words by him and others of the members of this conference have placed a burden of responsibility upon us to keep the faith and that we ring true to you and to ourselves, and it is therefore in the light of the above that I announce seventeen delegates of the American Association of Engineers present but not voting.

MANAGEMENT THROUGH AMERICAN ENGINEERING COUNCIL

The constitution as adopted is presented in full below. It provides for three main classes of membership: (1) National engineering and allied technical organizations; (2) local, state or regional engineering or allied technical organizations other than local associations, sections, branches or chapters of national organizations, and (3) affiliations consisting of local sections of engineering associations, clubs and local engineers. Management of the organization is vested in a body to be known as the American Engineering Council and an executive board. The former, made up of representatives of the member societies, will be the name under which the work of the federation will be generally known and will co-ordinate the activities of the state councils and the local affiliations. It will be a large body made up on the basis of one representative for a membership of from 100 to 1,000 inclusive and one additional representative for each additional 1,000 members of each national, local, state or regional organization of affiliation.

The executive board will consist of thirty members of the council and be charged with conducting the business of the organization under the direction of the council. Six of the thirty members will be officers chosen by the council and twenty-four selected by the national societies, local, state or regional organizations or affiliations according to districts.

The financial needs of the organization will be derived from the member societies on the basis of $1.50 per year per member of the national societies represented on the council and $1 per year per member of local, state or regional organization or affiliation. On this basis a revenue of $75,000 per year is estimated at the start.

A noteworthy feature of the constitution is the article on publicity, which was incorporated largely at the suggestion of James H. McGraw, president of the McGraw-Hill Company and a delegate from the A. I. E. E., as a result of his address on the "Value of Publicity for the Engineer" and his exposition of the ways in which the technical and general press can serve the association and lay before the thousands of engineers included among their readers the program of work which the association will pursue.

The section of the by-laws dealing with publicity as referred to in Article X of the constitution is as follows:

Chapter 4—Publicity

SEC. 1. The privilege of attendance of all meetings of the American Engineering Council, of the executive board and committees, when not in executive session, shall be extended to any proper person, but this privilege does not extend the right to speak or vote. Any proper person shall have the right to inspect and make true copies of the record of all meetings of the council, executive board and committees.

SEC. 2. The committee on publicity and publications may employ a publicity secretary, whose duty under the direction of the executive board shall be to prepare and supply to the engineering, technical and general press news from the Federated American Engineering Societies and of the engineering world and to co-operate with the editors of engineering and technical publications in disseminating information in regard to this organization and its activities. The committee on publicity and publications may appoint a co-operating board of engineering editors to counsel or assist in any or all of its activities.

The following resolutions adopted by the conference indicate the activity which it will immediately pursue:

1. Urging the payment of adequate salaries for the teachers of engineering in our technical institutions in order that adequately trained young engineering talent may be made regularly available.
2. Advocating the immediate adoption of appropriate measures to give effect to the recommendations made to Congress by the commission, which recently reported upon a more adequate salary schedule for the engineering and other technical services of the federal government.
3. Indorsing the bill which has for some time been under consideration by Congress for the creation of a Department of Public Works.
4. Expressing the appreciation of the organization conference for the valuable work of the Engineering Council, especially its offers of assistance in making effective and operative the newly devised plan of organization, and expressing thanks to the Washington Society of Engineers and the Cosmos Club for their courtesy and assistance afforded during the sessions of the conference.

Harmony on Fundamentals, Not Details, the Object Sought

Chairman Humphrey Sketches History of the Movement and Predicts Successful Outcome for the Conference

IN OPENING the conference Richard L. Humphrey, chairman of the joint conference committee, reviewed briefly the causes that had led to calling the delegates together to consider what he termed some of the most important questions that have ever confronted the engineering and allied technical professions in this country. The convention, he said, must decide whether there should be formed a comprehensive organization that could speak for these professions in public affairs where technical knowledge and engineering experience are involved, as well as on other matters that are also of common interest, or whether the respective societies should, as heretofore, pursue their separate ways and only occasionally co-operate in matters of common concern. The problem was of national as well as of local importance, and because of this importance any decision reached should reflect the judgment of all those represented.

This meeting marked the culmination of many years of efforts to bring about the formation of an all-inclusive organization, and these efforts had been crystallized during the last two years by the work of the joint conference committee, representing the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. The first step toward such an organization had been taken June 27, 1917, when the representatives of the four societies named organized the Engineering Council "to provide for consideration of matters of common concern to engineers, as well as those of public welfare in which the profession is interested, in order that united action may be possible."

Subsequently the joint conference committee was organized by the four great societies, and in January last the governing boards of these societies, the American Society for Testing Materials and the trustees of the United Engineering Society unanimously requested the joint conference committee to call a conference of representatives of the national, local, state and regional engineering organizations of this country for the purpose of bringing into existence a comprehensive organization. In compliance with this request the joint conference committee issued an invitation to

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CONSTITUTION OF

The Federated American Engineering Societies

Article I. Name

The name of this organization shall be the Federated American Engineering Societies.

Article II. Object

Service to others is the expression of the highest motive to which men can respond, and duty to contribute to the public welfare demands the best efforts that men can put forth, therefore it shall be the object of this organization to further the interests of the public through the use of technical knowledge and engineering experience and to consider and act upon matters common to the engineering and allied technical professions.

Article III. Membership

Sec. 1. Scope.—The membership shall consist of national, local, state and regional engineering and allied technical organizations and affiliations, classified as follows:

(1) National engineering and allied technical organizations.

(2) Local, state or regional engineering or allied technical organizations other than local associations, sections, branches or chapters of national organizations.

(3) Affiliations consisting of any one, or a combination, of the following constituents: (a) Local sections or associations of members of national organizations included under (1); (b) local engineering or allied technical societies or clubs, not of national scope; (c) local engineers and members of allied technical professions and their associates.

Sec. 2. Qualifications.—The qualifications for membership shall be as provided in the bylaws.

Sec. 3. Application for Membership.—Application for membership shall be made in the form and manner prescribed in the bylaws.

Sec. 4. Termination of Membership.—The membership of any constituent organization may be terminated by it or by the council in the manner provided in the bylaws.

Article IV. Management

AMERICAN ENGINEERING COUNCIL

Sec. 1.—The management of this organization shall be vested in a body to be known as the "American Engineering Council" and its executive board.

Sec. 2. Functions.—The American Engineering Council shall consist of representatives of member societies selected as hereinafter provided. This council shall co-ordinate the activities of state councils and of local affiliations whenever these activities are of national or general importance or may affect the general interests of engineers.

Sec. 3. Representation.—Each national, local, state or regional organization or affiliation shall be entitled to one representative on the council for a membership of from 100 to 1,000 inclusive, and one additional representative for every additional 1,000 members or major fraction thereof; provided that in the determination of the representation of local, state or regional organizations or affiliations no count shall be taken of any organization which is represented individually or through another local, state or regional organization or affiliation; and provided further than no organization shall have more than twenty representatives on the council.

Sec. 4. Selection of Representatives.—Representatives on the council shall be selected as stipulated in the bylaws.

Sec. 5. Meetings.—The council shall hold an annual meeting. Other meetings may be called by the executive board and shall be called by it upon the written request of twenty-five representatives on the council.

Sec. 6. Officers.—The elected officers of the council shall consist of a president, to hold office for two years and who shall be ineligible to re-election; four vice-presidents to hold office for two years, two to be elected every year, and a treasurer, to hold office for one year. These officers shall be elected by a letter ballot of the representatives on the council as provided in the bylaws. There shall be an executive officer who shall also be secretary appointed by and holding office during the pleasure of the executive board. He shall not be a member of the executive board but may be a representative on the council.

EXECUTIVE BOARD

Sec. 7. Functions.—There shall be an executive board of thirty members of the council constituted as hereinafter provided and charged with conducting the business of the organization under the direction of the council.

Sec. 8. Membership.—The executive board shall consist of thirty members, of whom six shall be the officers elected by the council and twenty-four shall be elected, a part by the national societies and the remainder by the local, state and regional organizations and affiliations according to districts, as provided in the bylaws; provided that the number of representatives of the national societies shall bear as nearly as may be the same ratio to the number of representatives of local, state or regional organizations or affiliations as the representation of the national societies bears to the representation of the local, state or regional organizations or affiliations.

Sec. 9. Electoral Districts.—For the purpose of facilitating the selection of the district members on the executive board, the council shall divide the country into districts as provided in the bylaws, based upon an equitable representation, having regard to both its membership and area.

Sec. 10. Officers.—The president and secretary of the American Engineering Council shall be respectively the chairman and the secretary of the executive board. There shall be two vice-chairmen elected by the board from its members.

Article V. Unexpired Terms

Vacancies in the offices of the president, the vice-presidents, the treasurer and in the executive board and among the representatives on the council shall be filled as soon as feasible by the agencies originally selecting the incumbents. Officers and delegates thus chosen shall serve for the unexpired terms.

Article VI. Funds

Sec. 1.—Funds for the use of the organization shall be contributed as follows:

(a) Each national society represented on the American Engineering Council shall contribute annually $1.50 per member.

(b) Each local, state or regional organization or affiliation represented on the council shall contribute annually $1 per member. No portion of such funds shall be applied to the use of local affiliations or state councils.

Sec. 2.—The American Engineering Council may receive and administer gifts, bequests or other contributions for carrying out the purposes of the organization.

Aticle VII. Local Affiliations

Sec. 1. Object.—The American Engineering Council shall encourage the formation of local affiliations, to consider matters of local public welfare with which the engineering and allied technical professions are concerned, as well as other matters of common interest to these professions, in order that there may be united action and that suggestions and advice may be offered to the council.

Sec. 2. Constitution.—Each local affiliation desiring membership in this organization shall submit its constitution and bylaws and all subsequent amendments thereto to the executive board of the council for approval of such portion thereof as may affect its eligibility or its relation to the work of the council.

Article VIII. State Councils

Sec. 1. Object.—State councils, consisting of representatives of local affiliations within the state or otherwise representative of the majority of engineers and members of allied technical professions in the state, if members of this organization, shall consider state matters of public welfare with which the engineering and allied technical professions are concerned, as well as other matters of common interest to these professions, in order that there may be united action in state affairs.

Sec. 2. Constitution.—Each state council desiring membership in this organization shall submit its constitution and bylaws and all subsequent modifications thereto to the executive board of the council for approval of such portion thereof as may affect its eligibility or its relation to the work of the council.

Article IX. Delimitation of Authority

Local organizations or affiliations, state organizations or councils and the American Engineering Council shall deal with local, state and national matters respectively, and they shall be autonomous with respect thereto. It shall, however, be the duty of the American Engineering Council to interest itself in the activities of local affiliations and state councils if such activities are of national scope or affect the general interest of the engineering and allied technical professions; provided that nothing herein stated shall be construed as preventing the discussion by any local affiliation or state council or by the American Engineering Council of any matters of interest to engineers and members of allied technical professions, or action by the said council on local or state matters where no local affiliation or state council exists.

Article X. Publicity

This organization shall stand for the principle of publicity and open meetings under such regulations as may be provided for in the bylaws.

Article XI. Amendments

Sec. 1.—An amendment to this constitution may be proposed by the executive board.

Sec. 2.—An amendment may be proposed in writing, by at least twenty-five representatives on the American Engineering Council; such amendment shall be considered first by the executive board, which may approve, disapprove or formulate a modified or alternative amendment, report of which action shall accompany the original proposal to this organization.

Sec. 3.—Any amendment proposed as provided in Sections 1 and 2 shall be considered at a meeting of the American Engineering Council and shall be submitted to its members at least ninety days in advance of such meeting. At this meeting, provided a majority of the representatives are present, the amendment may be rejected or ordered submitted to the members of the council for letter ballot within thirty days thereafter, with such modifications as may be adopted by a majority of those present. The amendment shall fail of adoption if one-third of the votes cast are in the negative.

110 engineering and allied technical organizations and societies. These represented an aggregated membership of more than 120,000, who were entitled to send 184 delegates to the organizing conference. The list included all societies, organizations or affiliations, not associations, sections, chapters or branches of national societies, whose chief object was the advancement of the knowledge and practice of engineering and the application of allied sciences and which were not organized for commercial purposes.

The conference, Mr. Humphrey said, was thoroughly representative. There were in attendance delegates representing over 60 per cent of the organizations invited. These delegates, over 70 per cent of those who could attend under the conditions of the call, represented organizations having an aggregate membership of over 100,000, or 83 per cent of the membership of all the organizations and societies invited. This splendid response was evidence that the organizations represented looked with favor on the fundamental principles involved.

"We are met," Mr. Humphrey continued, "not to discuss details but to use our best endeavors to reach a harmonious agreement as to fundamental principles. This occasion, to be properly utilized, must deal with the fundamental principles involved and leave the working out of the details of whatever plan that may be agreed upon to the governing board of the new organization. I would suggest that this problem be approached with an open mind and that the discussion be on a broad, unselfish plane, having one object, namely, the good of the engineering and allied technical professions."

WHAT ENGINEERING IS

Engineering, Mr. Humphrey said, is defined "as the art of organizing and directing men and of controlling the forces and materials of nature for the benefit of the human race." The growth and development of this country had been largely a matter of engineering. The European war, because of the brilliant work of the engineer, brought the universal recognition of his importance in its successful prosecution; it awakened the public to a keener realization of the service of the engineer and awakened in the engineer a desire for greater service to the public—a desire to do his part in the successful administration of the affairs of the nation. The engineer had, therefore, changed his viewpoint from the somewhat narrow one of following his profession exclusively to the broader one of unselfish devotion to the common cause.

"It is not to be expected," the chairman went on, "that a conference of this character, composed of delegates representing organizations and societies of widely different activities, could be brought together without the expression of a very considerable difference of opinion as to the best means of accomplishing the object sought. I believe that the keynote of this conference could be properly expressed by the word "service." We desire first to serve the country, and, second, to serve the societies and organizations of which we are the representatives. One cannot contemplate service, which means giving, not receiving, with any feeling that it is actuated by selfish motives, but rather is it the giving of our best.

"It is one of the outstanding characteristics of the engineer that he gets results. Let us, therefore, determine that this gathering, unparalleled in this country, shall not adjourn without having taken a forward step in the formulation of a plan which will culminate in some form of comprehensive organization that will represent the solidarity of these professions. If each one of us will keep this object firmly before him we shall attain the end desired."

Four Possible Courses of Action Outlined

Dr. Newell Favors, Among These, a Co-operative Arrangement Between the Technical Societies and the A. A. E.

Dr. F. H. Newell, professor of civil engineering at the University of Illinois and past-president of the American Association of Engineers, representing the viewpoint of the latter body, declared that in the undertaking there was an attempt to repeat the experiment tried by the thirteen original states of the Union when they endeavored to form a confederation. "Experience has shown the weakness of this form of organization," Dr. Newell said. "Many of the men who have been studying the question of the effectiveness of an all inclusive or super-engineering association have reached the conclusion that in this matter we must ultimately follow the experience of the United States and form a new body politic, one which, while recognizing the separate existence of each and every other association, yet has the power of self-determination and is not dependent for its life and functions upon the action of any other association or group."

The speaker asked if it was necessary to construct a plan for another organization when the A. A. E. was already functioning along the lines contemplated. He specified four possible courses of action: (1) the ignoring of the existence of the A. A. E. by the other national societies; (2) a new organization as recommended in the report of the joint conference committee, but with the understanding that in its operations an attempt should be made to become acquainted with the activities of the A. A. E. and to co-operate rather than compete; (3) enlarging the functions of the engineering council, making it representative of those societies which confine their activities mainly to technical matters, and letting it be generally regarded as the spokesman of these societies on such matters, in the same way that the A. A. E. is the spokesman on lines of social, economic or political questions; (4) a co-operative arrangement between the technical societies and the A. A. E. individually in building the latter up as a broad, all-inclusive society, leaving the technical societies free to devote all of their funds to the kind of work in which they have been so successful in the past.

Of these plans the latter, Dr. Newell declared, is the one which is most nearly ideal, and which in the opinion of many engineers will ultimately prevail, even though at present the representatives of the older societies are unconvinced. The other plans, if tried out, he said, will ultimately be modified as the A. A. E. continues to grow in size and effectiveness. Opposition will undoubtedly strengthen it; thus the friends of the A. A. E., while deploring such differences of opinion among engineers, are not seriously disturbed at the possibility of competition; for it is, after all, the most energizing of all motives.

Publicity for Engineers

James H. McGraw Emphasizes the Great Part of the General and Especially the Technical Press in the New Movement

DECLARING that engineers are glad to have publicity but don't like to talk about themselves, James H. McGraw, president of McGraw-Hill Company, New York, publishers of the eleven McGraw-Hill engineering publications, deprecated this state of mind. One of the most constructive things the proposed organization could do, he held, would be to visualize the opportunities for publicity for the engineer and perfect some method of obtaining this publicity. As an individual, except under very specialized conditions, the engineer may not advertise. Because he has held himself professionally aloof he has had too little credit for the kind of thinking he does and his place at the world's council table is not recognized as it should be.

The great contribution of the engineer to modern life, Mr. McGraw said, is not mere technical knowledge and specialized information, but an all-around consideration of the problem presented from the point of view of service. That is what the engineer has to advertise, but to do it he must become a better business man, he must shuffle off some of the apparent narrowness that goes with a specialized kind of thinking, and his group must give expression to the idea that he is the man who makes our present life possible. In other words, the engineer must be human as well as an engineer.

There are four or five great mediums for publicity for engineers—the newspapers, the general magazines and weeklies, the technical and industrial press, papers before associations and societies distributed to specialized lists, and the public platform. A committee which could do much constructive work might be organized as a result of the proposed federation to analyze and develop opportunities for publicity in all these fields.

When it comes to publicity in general magazines of wide circulation the best way to get publicity is to bring in the point of view of men who make their living by appealing to the public. What the general magazine man wants is not an engineer's story of the development so much as an interpretation of the public conditions of that engineering development written from the point of view of the particular magazine or weekly.

The public platform offers another opportunity for publicity which in general is by no means capitalized by the engineer for reasons already given. Yet in hundreds of towns every week the engineer's place in the economic life of the community and his natural place in the development of local enterprises can find an audience before chambers of commerce, merchants' associations and other similar business organizations.

RELATION OF TECHNICAL PRESS TO SOCIETIES

Alluding to the twofold purpose of the technical press, as a medium of publicity and as an interpreter of engineers to other groups and other industries, Mr. McGraw said that the technical press and the engineering societies are natural partners. The engineering press is a powerful and important factor without which this proposed organization would be badly crippled, if indeed it would be possible at all. A mutual recognition and support between the engineering societies and the engineering press is therefore necessary. The technical and ngineering press has been associated with the work of the societies from the very beginning. Several of the societies had their beginnings because of the enthusiastic support of the editors of the technical press, whose vision was added to that of other engineers to make the purpose of the societies evident to engineers at large.

The editorial policy of the technical journals today is the outgrowth of the splendid traditions of the past, and the editors today are equally responsive to the needs and to the purposes of the societies, with this exception, that both the journals and the societies have grown in complexity with the development of industry, and whereas in the early days of both the societies and the journals it was possible for a comparatively small group of men to know pretty much everything about the industry, today it takes large groups of men to keep in touch with the development of the industry, and there is a lack, not of desire to co-operate on either side, but of co-ordination of effort, which is at times responsible for the misunderstandings of purpose.

The world-wide sweep of the technical press in reporting openings and news of the industry is sometimes overlooked by the men who themselves are furnishing a great part of the news. In hundreds of offices technical journals are circulated not only to the engineers, but to the men who depend for their profit upon the work of the engineers, and on many a president's desk on Monday morning are laid the clippings from some engineering journal pointing to a new engineering department, or a new development in the industry or the art, or a new development in applied engineering in the industry on which his business depends. Scores of our leaders of industry have come to rely, moreover, on certain journals for certain classes of specialized information, and the news brought by the technical journal helps to make policies in business.

This great organ of education for the advancement of engineering is behind the engineering societies and their developments and should be put to even more definite purpose by complete understanding and co-operation with the engineering societies.

The technical press today, Mr. McGraw continued, is a part of the industry it serves. The editors are trained men with an intimate knowledge of engineering and engineering accomplishment and a point of view on the opportunities for engineering that is made possible because of their very calling. There is an apparent policy on the part of some of the society publications to look upon the publication work of the society as in the nature of a "scoop" to be held only for publication in the society journals. If engineering is to have publicity, certainly that publicity will never be gained if the greatest organ of the publicity, the technical press, is put in competition for news with the publications of the societies. There is certainly a place for the society publications. Societies need publications to transmit the business news of the society organizations and the papers and discussions which help to form the literature of the science or art of that society. But the speaker believed that it was an economic waste of white paper, to say nothing of brain power, so to misunderstand the function of the technical and engineering press as to duplicate that function and to assume that the organ of the society should parallel and take the place of independent technical journalism. There is no room for competition between the society journals and the technical press and there should be none. An independent technical press is recognized by the public as an interpreter of constructive thinking in an industry. The editors of technical publications are one of the greatest forces for publicity in the country.

Nation's Bigness Makes Organization Imperative

Philip N. Moore Says That Only by Such Means and with Accredited Spokesmen Can Any One Interest Reach the Public Ear

SPEAKING for the Engineering Council, of which he has been a member from its start, Philip N. Moore, past president of the American Institute of Mining Engineers, paid tribute to its noteworthy accomplishments while declaring that "if another body can be formed which shall have stronger support, a greater clientage, more widespread loyalty, the Engineering Council stands ready to give place to it." The point which should be stressed, he said, is that unless the meeting could gather to it a larger representation of the local and State engineering societies and kindred societies, and unless these societies shall become active as well as nominal in their membership, nothing will be gained by changing a name or attempting a substitution for an existing organization which has found its place. Further, if the societies which become represented do not as such take an active part in the work for which the proposed council is designed, and if, still more important, the members of those societies do not realize that membership brings obligations, and that the only remedy for coterie control is widespread activity, these efforts will have been in vain.

"Our nation has grown so large," Mr. Moore continued, "that with difficulty can any one man or set of men impress public sentiment with needs and ideals to a result of action. Originally, an impression desired could be activated through local aid. Fortunately for us, valued in terms of long time, local political force is lessened and the national motive has grown until it dominates. Only by organization expressed through accredited spokesmen can any one interest reach the public ear and wield political influence. This is not an unmixed good—quite the contrary—but it is a condition which limits the activities of all organizations, and apparently until mankind shall change its ways of thought, it is a condition which will endure and must be reckoned with."

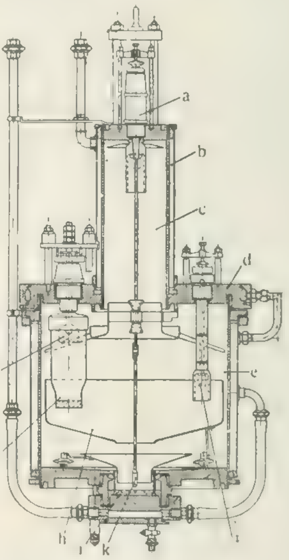
Addresses by Prominent Delegates and Others

INTERSPERSED throughout the session of the two days were addresses on general topics by prominent engineers and executives who emphasized the influence and functions of the engineer in public affairs. The following were among the speakers, in addition to those whose addresses have been abstracted on the preceding pages: Arthur P. Davis, president American Society of Civil Engineers and director United States Reclamation Service, Washington, D. C.; Leroy K. Sherman, president American Association of Engineers and president United States Housing Corporation, Washington, D. C.; Thomas H. MacDonald, chief Bureau of Roads and Rural Engineering, Washington, D. C.; William D. Uhler, chief engineer Pennsylvania State Highway Department, Harrisburg, Pa.; Homer L. Ferguson, past-president United States Chamber of Commerce and president Newport News Shipbuilding Company, Newport News, Va.; George Otis Smith, director United States Reclamation Service, Washington, D. C.; Samuel M. Vauclain, president Baldwin Locomotive Works, Philadelphia, Pa.; Robert S. Woodward, president Carnegie Institute, Washington, D. C.; and James R. Angell, chairman National Research Council, Washington, D. C.

Great credit is due to Calvert Townley, president of the A. I. E. E., who served as chairman of the conference, which he conducted under the Roberts rules of orders with marked ability and fairness.

Mercury Arc Rectifiers for Large Outputs

SOME of the problems in the manufacture of rectifiers for large outputs arise from the difficulty of constructing large metallic chambers sufficiently gas-tight to enable a vacuum of 0.02 mm. of mercury to be maintained. The insulated terminals for the conductors carrying the current should be perfectly gas-tight. Some means must also be provided for preventing short circuits between the anodes, for as the output to be converted increases the changes of short circuits between anodes also increase. It is said that it is possible to prevent short circuits by carefully choosing the position of the electrodes in the apparatus and by compelling the arc to follow a predetermined path with the aid of shields and suitable guides.



DIAGRAMMATIC REPRESENTATION OF A MERCURY-ARC RECTIFIER FOR LARGE OUTPUTS

a Ignition solenoid.
b Water-jacket.
c Condensing cylinder.
d Cover carrying anodes.
e Arc chamber.
f Anode.
g Anode cover.
h Arc collector.
i Cathode.
k Ignition anode.
l Excitation anode.

One of these rectifiers manufactured by the Brown, Boveri Company is described as consisting of a circular chamber having a cylindrical extension at the top wholly built of steel plates. The base and the cover of the chamber are made of thick steel plates. The mercury cathode is contained in a recess in the base, while the cover is perforated to receive the six principal anodes and the two auxiliary anodes for the excitation of the rectifier. The cylindrical extension acts as a condensing chamber for the mercury vapor which arises from the cathode. The cover of the condensing cylinder carries a solenoid for controlling the ignition anode and a screw ring for lifting purposes. To prevent the discharges which may occur between the anodes and the parts of the chamber adjacent to them the arc and the anodes are surrounded by protecting tubes of insulating material.

A recent design of high-capacity rectifier is shown in the illustration. Further particulars may be found in the London *Electrician*, Jan. 2, 1920.

Electric Drive for Station Auxiliaries

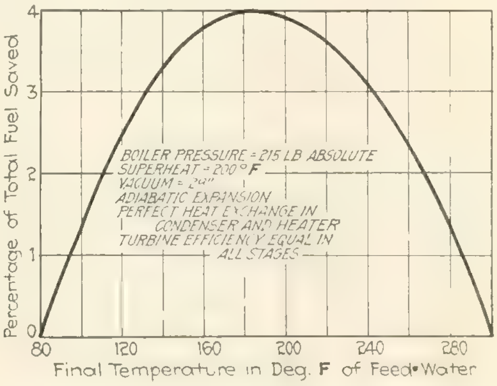
Motors, with Steam Diverted from Intermediate Stage of Main Turbines for Feed-Water Heating, More Economical than Steam Auxiliaries

By E. E. GEORGE
A. L. Drum & Company, Chicago

IT IS the general custom in power plants to use enough steam-driven auxiliary apparatus to furnish exhaust steam for preheating the feed water and after this is done to use electric drive for any excess of auxiliaries. This discussion will show that diverting steam from an intermediate stage of the main turbine to heat the feed water and driving all the auxiliaries by electric motor is a more economical method. With electrically driven auxiliaries there is also an additional saving possible through varying the amount of diverted steam to the most economical value. Exhaust steam is the only thing that is required, and it may be taken from an intermediate stage of the turbine as well as from auxiliaries. There is no reason why it should not be reduced to a low pressure by the most efficient process; that is, in the large turbine, which will get the most work out of the steam while its pressure is diminishing. For the same exhaust pressure the quality and the heat content are about the same with the diverted steam as with the exhaust steam of auxiliaries. Moreover, bleeding a small part of the steam at a certain stage does not appreciably lower the efficiency of the later stages of the turbine.

Briefly, the reasoning is as follows: Every pound of steam taken from the main turbine at atmospheric pressure has done about 75 per cent more work than a pound of exhaust steam from the auxiliaries. The saving with electrically driven auxiliaries, however, is not 75 per cent, but is reduced to 60 per cent by electrical losses. A kilowatt-hour increase in energy requires only one-third as much steam for its generation in the main turbine as in the steam auxiliary. Therefore the net saving in steam is 0.60 divided by 3, or 0.20, times the steam used by the auxiliary. How this saving is derived is told in more detail in the following paragraph.

Small turbines in the sizes used in driving power-plant auxiliaries take from 35 lb. to 65 lb. (15.8 kg. to 29.4 kg.) of steam per kilowatt-hour, depending upon their size. Reciprocating auxiliaries taking from 70 lb. to 250 lb. (31.7 kg. to 158.7 kg.) per kilowatt-hour are seldom used in modern plants of medium or large capacity. The auxiliaries in such plants aggregate from 1⅓ per cent to 4 per cent of the total plant capacity. The efficiency of the main units is from 11 lb. to 20 lb. (4.9 kg. to 9 kg.) of steam per generated kilowatt-hour. The efficiency of the steam diverted at atmospheric pressure is from 20 lb. to 35 lb. (9 kg. to 15.8 kg.) per kilowatt-hour. In other words, 20 lb. to 35 lb. of steam diverted at atmospheric pressure has already done 1 kw.-hr. of work. Then 1/20 (0.05) to 1/35 (0.0286) is the number of kilowatt-hours generated per pound of diverted steam. The over-all losses of the generator, lines and motors used in electric drive are 9 per cent to 17 per cent. If the generator is considered as driven only by the diverted steam as it passes through the main turbine, then the efficiency of the total diverted steam is reduced 20/35 × (9 to 17) per cent, which equals 5 per cent to 10 per cent. Then 0.0475 to 0.0257 kw.-hr. is the net output per pound of diverted steam. But the steam auxiliaries deliver only 1/35 to 1/65, which equals 0.0286 kw.-hr. to 0.0154 kw.-hr. per pound. Therefore, taking the differences (0.0475 — 0.0286) to (0.0257 — 0.0154), the result is 0.0189 kw.-hr. to 0.0103 kw.-hr. saved for each pound of exhaust steam used. But in the main turbine 11 lb. to 20 lb. is used for each kilowatt-hour. Therefore 11 × 0.0189 to 20 × 0.0103, which equals about 0.21 in each case, is the number of pounds of steam saved for each pound used in the auxiliaries. The auxiliaries require 1.33 per cent to 4 per cent of the total power, and, if all are turbine-driven, 4 per cent to 12 per cent of the total steam. Therefore the total fuel saving is about 1 per cent to 2.5 per cent.



THEORETICAL FUEL SAVING BY PREHEATING FEED WATER TO TEMPERATURE OF PARTLY SPENT STEAM, NEGLECTING SAVING POSSIBLE BY ELECTRIC DRIVE

The other advantage of the electric auxiliaries is that the most economical amount of steam can be used for heating feed water. With the steam auxiliaries the amount of exhaust steam is fixed. There may, however, be another amount which is more economical and which it is possible to obtain when using diverted steam. This value may be determined by the following method:

Notation:

H_b = the total heat above 32 deg. Fahr. (0 deg. C.) of the live steam (wet, dry or superheated) at boiler pressure.

H_e = the total heat above 32 deg. Fahr. of the partly spent (or exhaust) steam (usually wet) at the pressure when diverted.

H_f = the total heat above 32 deg. Fahr. of the feed water, after preheating.

H_v = the total heat above 32 deg. Fahr. of the steam (usually wet) entering the condenser, at the condensed vacuum.

H_c = the total heat above 32 deg. Fahr. of the condensate water, at the condenser temperature.

Equations:

$\frac{H_e - H_f}{H_f - H_c}$ pounds of feed water heated per pound of exhaust steam.

$\frac{H_e - H_f}{H_b - H_c} =$ equivalent pounds of live steam at boiler pressure generated by available heat per pound of exhaust steam.

$\frac{H_e - H_v}{H_b - H_v} =$ equivalent pounds of live steam at boiler pressure taken from available mechanical energy per pound of exhaust steam.

$\frac{H_e - H_f}{H_b - H_c}$ must be greater than $\frac{H_e - H_v}{H_b - H_v}$ if any fuel is to be saved.

$$\frac{H_f - H_c}{H_b - H_c} - \left(\frac{H_f - H_c}{H_e - H_f}\right)\left(\frac{H_e - H_v}{H_b - H_v}\right) = \text{percentage of fuel saved.}$$

Example: Steam at 215 lb. (17 kg. per sq.cm.) absolute, 200 deg. Fahr. (110 deg. C.) superheat, 29 in. (737 mm.) vacuum. Find the saving if feed water is heated 212 deg. Fahr. (100 deg. C.).

$$\frac{180 - 47}{1310 - 47} - \left(\frac{180 - 47}{1084 - 180}\right)\left(\frac{1084 - 890}{1310 - 890}\right) = 3.8 \text{ per cent.}$$

From the accompanying curve, which is plotted for the conditions of pressure, superheat, and vacuum listed above, it is seen that the fuel saving is maximum at 184 deg. Fahr. (84.4 deg. C.), where it is 4.0 per cent. The corresponding pressure is 8.2 lb. (0.57 kg. per sq.cm.) absolute. The final temperature of the feed water should always be as near as possible to the temperature corresponding to the steam pressure used, but with an open heater the pressure of the exhaust cannot be less than 14.7 lb. (1.03 kg. per sq.cm.) absolute, and the final temperature of the feed water cannot be over 212 deg. Fahr. 100 deg. C.). It should be noted that the percentage of the total fuel saved by preheating is independent of the source of the steam, but that the total fuel consumption, with or without preheating, is greater for steam-driven than for motor-driven auxiliaries because the total mechanical power is the same and the over-all efficiency is less.

The curve herewith, although plotted from the equation with only H_e and H_f variable (and dependent on each other), and with other conditions assumed, is representative of the variation of saving with feed-water temperature for all ordinary conditions. In finding the various values of total heat it should be noted that the steam is getting wetter as it expands to a lower pressure. The entropy is constant and a "Mollier diagram" or heat entropy chart, as furnished with most textbooks on thermodynamics, is the only quick way of finding the quality or total heat for any pressure. Condenser losses and other sources of error have been neglected, to simplify the reasoning, but the equation given is accurate enough for commercial purposes.

All the advantages of adjustable-speed, high starting torque, simplicity of maintenance, reasonable first cost, high maintained efficiency, durability, efficient speed, automatic control and easy application of safety devices are possessed by the direct-current motor generally to a greater extent than by the small turbine. In starting up the plant after a shut-down of the steam equipment it is advantageous to be able to run the feed pumps before steam is up. This is possible with motor-driven pumps using energy from another station or from a storage battery.

The idea of preheating feed water with partly spent steam from an intermediate stage of the main turbine is not new. Plants using the system have been described in American and British engineering periodicals, but it is not well known or widely used, perhaps because its mention has never been accompanied by a comparative over-all heat balance such as is described here.

A Drive for High-Intensity Industrial Lighting

Central Station Establishes Machine Shop in Heart of Retail District of Chicago to Prove Advantages of High-Intensity Industrial Lighting

By O. R. Hogue
Head Lighting Agent Commonwealth Edison Company, Chicago

It is not often that a central station sets out to make itself of any special and direct value to the electrical contractors and the builders. This claim may, however, be made by the Commonwealth Edison Company in connection with the demonstration of productive lighting intensities now being conducted in its downtown office building.

About 1,000 sq.ft. (93 sq.m.) of the company's retail-store space was set aside for this industrial lighting exhibit, consisting of two shops equipped with machine tools operated by regular mechanics. A typical system of illumination by drop cords and bare lamps was installed in one shop, while the other shop is equipped with type C lamps hung in modern industrial reflectors which give intensities of illumination of from 3 foot-candles to 114 foot-candles (32 lumens to 1,225 lumens per square meter).

In the intensively illuminated shop the lighting units are hung in groups of five reflectors in different positions and so wired and arranged that the effect of seven different combinations can be observed. Twenty-four foot-candles (258 lumens per square meter), which was considered to be the real productive intensity, can be obtained with any one of the group of reflectors. The effect of 6 foot-candles (64 lumens) is produced by reducing the number of units in one of the groups. Then 3 foot-candles (32 lumens) is obtained by raising the reflectors and leaving the lamps bare. This is accomplished by means of ropes and pulleys.

Other tests are provided to show the effect of glare, Mazda B and C-2 lamps are compared for color matching, the application of diffused and directional lighting is shown, and legibility tests are made by dropping letters past an open slot. At 1.5 foot-candles (15 lumens) the letters cannot be distinguished. The intensity of illumination is then gradually increased to 15 foot-candles (160 lumens), at which point the letters are perfectly plain.

It was impracticable to show more than a few representative types of reflectors in the shops proper but

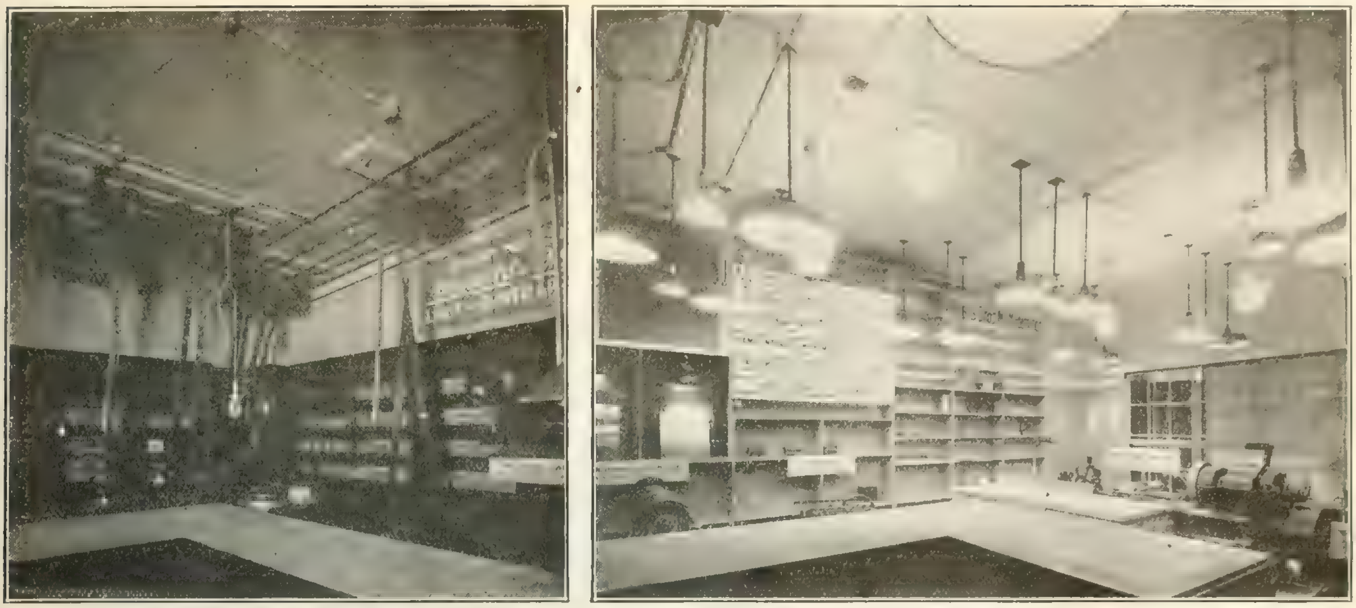


FIG. 1—ANTIQUATED VERSUS MODERN LIGHTING

These are photographs of the two machine shops installed in the downtown office building of the Commonwealth Edison Company, Chicago, to show the difference between inadequate and high-intensity lighting. In the shop to the right seven lighting combinations can be obtained and the printed signs on the back wall show which systems are in use at any one time. On the left side of this picture the color-matching test can be seen. The left-hand view shows the antiquated systems of many factories.

several additional types are shown along a wall in an adjoining room. On this wall back of each reflector is a chart showing the distribution curve and the technical information concerning each particular unit.

The company has divided its industrial customers into classes according to industry, and groups of customers are invited to visit this model machine shop every day. The demonstration induces manufacturers to ask what it would cost to have a modern lighting system installed in their factory, and the company has engineers whose time is devoted to preparing such reports and propositions for customers. Even before the machine shop was installed the company's salesmen were able to interest industrial concerns in the advantages of high-intensity lighting and to get permission for the company's engineers to submit recommendations and estimates of cost. However, it has been much easier to arouse interest in better lighting since it has been possible to give demonstrations under such favorable conditions.

Although the Commonwealth Edison Company makes complete specifications and estimates for all prospective customers, it is not primarily interested in making the actual installation. It would rather have local contractors take the job, permitting the company to check it so as to make sure that the specifications are followed out.

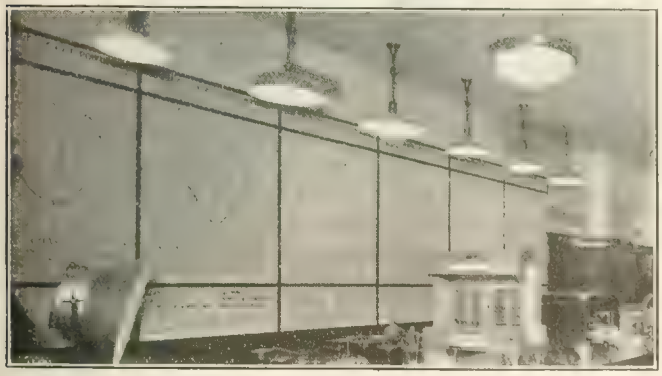


FIG. 2—DEMONSTRATING INDUSTRIAL LIGHTING UNITS

The entrance to the two machine shops shown in Fig. 1 may be noted in the right background of this photograph. Industrial lighting units which could not be hung in the store are shown on exhibition on the left-hand side of this photograph. The technical data are on the wall behind each unit.

The company's industrial lighting campaign has resulted in the installation of 8,515 factory units with an additional connected load of 1,700 kw. during the last four months. This was accomplished with six engineers working up industrial lighting propositions, but the business that can be obtained in a given time is limited only by the number of men that can be obtained to do the engineering and installation work.

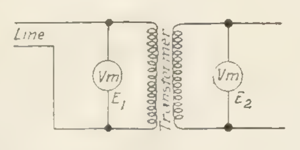
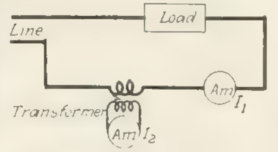
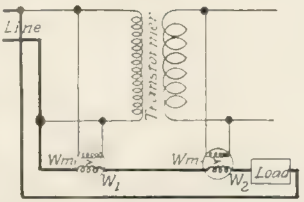
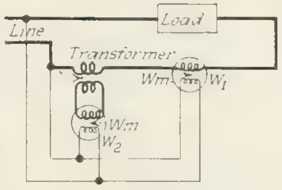
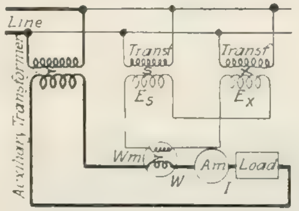
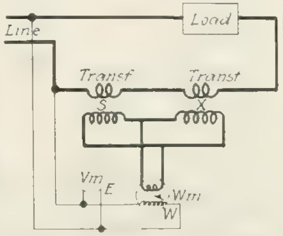
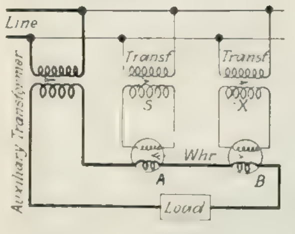
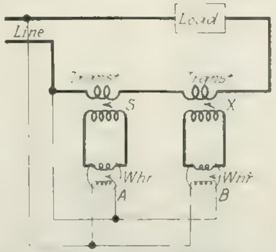
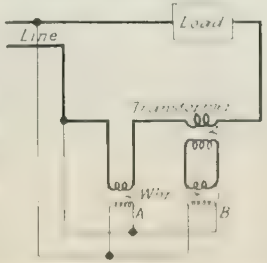
Hydro-Electric Possibilities in Transcaucasia

THE United States trade commissioner at Constantinople, Elliot G. Mears, predicts a great development in the use of water power for electricity in Transcaucasia. The mountainous character of the country and the proved mineral wealth are the two important factors that will make these undertakings commercially profitable.

The total yield of existing hydro-electric stations is only 6,725 hp., although surveys have indicated that over 350,000 hp. is possible. A report of leading engineers presents specific data on the region that covers, roughly, Russian Armenia and the de facto republics of Azerbaijan and Georgia.

The furnishing of cheap electric power in the Caucasus will influence the development of the productive forces of the country, notably in agriculture, mining and the exploitation of the forests. It will aid also in the lighting question and in promoting and improving various kinds of internal communication. An electrochemical industry is sure to follow, in the opinion of Mr. Mears, such as the extraction of nitrogen from the air, which would naturally lead to the production of important chemicals, dyeing, artificial manure, ammonia, potassium, aluminum, chlorine, carbide of calcium and other chemical substances.

CLASSIFICATION OF FIELD METHODS OF TESTING INSTRUMENT TRANSFORMERS

Type of Test	Quantities Measurable	VOLTAGE TRANSFORMER: Simplified Connections	VOLTAGE TRANSFORMER: Equations for Ratio Factor	VOLTAGE TRANSFORMER: Equations for Phase Angle	Comments	Comments: Estimated Accuracy Obtainable	CURRENT TRANSFORMER: Simplified Connections	CURRENT TRANSFORMER: Equations for Ratio Factor	CURRENT TRANSFORMER: Equations for Phase Angle	References
I Absolute (voltmeter) (ammeter)	Ratio Factor Only		$F=\frac{E_1}{E_2 R_m}$		Accurately Calibrated Instruments of widely different Ranges required Affected by Voltage Fluctuations	In the Field 1% In the Laboratory $\frac{1}{4}$ of 1%		$F=\frac{I_1}{I_2 R_m}$		
II Absolute (wattmeter)	Ratio Factor and Phase Angle		When θ = 0° $F=\frac{W_1}{W_2 R_m}$	When θ = 90° lagging $\cos(90°+\beta)=\frac{W}{E_2 I_2}$		In the Field 1% In the Laboratory $\frac{1}{4}$ of 1%		When θ = 0° $F=\frac{W_1}{W_2 R_m}$	When θ = 90° lagging $\cos(\theta-\alpha)=\frac{W_2}{E I_2}$	
III Comparative (differential)	Ratio Factor and Phase Angle	 Line Auxiliary Transformer Transf E_S Transf E_X Wm W Am I Load	When θ = 0° $F_x=F_s\left[1+\frac{W}{IE_s}\right]$	When θ = 90° lagging $\tan(\beta_x-\beta_s)=\frac{W}{IE_s}$	Independent of Voltage Fluctuations Standard Transformer of Known Characteristics and Instruments of only Reasonable Accuracy Required	In the Field $\frac{1}{4}$ of 1% In the Laboratory $\frac{1}{10}$ of 1%	 Line Load Transf S Transf X Vm E Wm W	When θ = 0° $F_x=F_s\left[1+\frac{W}{EI_s}\right]$	When θ = 90° lagging $\tan(\alpha_x-\alpha_s)=\frac{W}{EI_s}$	Brooks, Bull Bur Stds Vol 10 p 419, 1914 El Wld vol 62 p 898 Nov 1, 1913 Silsbee, El Wld 1917 Vol 70 p 667 Crothers, El Wld 1919 Vol 74 p 119
IV Comparative (Agnew)	Ratio Factor and Phase Angle	 Line Auxiliary Transformer Transf S Transf X Whr A B Load	When θ = 0° $F_x=F_s+\frac{F_s}{2}\left[\frac{a_s-a_x}{a_x}+\frac{b_s-b_x}{b_x}\right]$ or $F_x=F_s+\left[\frac{b_s-b_x}{2a_s}\right]$	When θ is lagging and ≠ 0° $\beta_x=\beta_s+\frac{3438}{\tan\theta}\left[\frac{a_s'-a_x'}{2a_s'}+\frac{b_s'-b_x'}{2b_s'}-\frac{F_x-F_s}{F_s}\right]$ or $\beta_x=\beta_s+\frac{3438}{\tan\theta}\left[\frac{b_s'-b_x'}{2a_s'}-\frac{b_s-b_x}{2a_s}\right]$ or When θ = 60° lagging $\beta_x=\beta_s+20\left[\frac{100(b_s'-b_x')}{2a_s'}-\frac{100(b_s-b_x)}{2a_s}\right]$	Independent of Voltage Fluctuations Standard Transformer of known Characteristics Required Uncalibrated Watthour-meters may be used	In the Field $\frac{1}{4}$ of 1% In the Laboratory $\frac{1}{10}$ of 1%	 Line Load Transf S Transf X Whr A Whr B	When θ = 0° $F_x=F_s+\frac{F_s}{2}\left[\frac{a_s-a_x}{a_x}+\frac{b_s-b_x}{b_x}\right]$ or $F_x=F_s+\left[\frac{b_s-b_x}{2a_s}\right]$	When θ is lagging and ≠ 0° $\alpha_x=\alpha_s-\frac{3438}{\tan\theta}\left[\frac{a_s'-a_x'}{2a_s}+\frac{b_s'-b_x'}{2b_s'}-\frac{F_x-F_s}{F_s}\right]$ or $\alpha_x=\alpha_s-\frac{3438}{\tan\theta}\left[\frac{b_s'-b_x'}{2a_s'}-\frac{b_s-b_x}{2a_s}\right]$ or When θ = 60° lagging $\alpha_x=\alpha_s-20\left[\frac{100(b_s'-b_x')}{2a_s'}-\frac{100(b_s-b_x)}{2a_s}\right]$	Agnew, Bull Bur Stds Vol 11, p 347, 1915 El Wld Vol 64, p 1004 1914 Crothers, El Wld 1919 Vol 73 p 516
V Absolute (Agnew)	Ratio Factor and Phase Angle	Not adapted to the testing of commercial types of voltage transformers, since such transformers cannot conveniently be changed to have a 1:1 ratio			Independent of Voltage Fluctuations No Standard Transformer Required Uncalibrated Watthour-meters may be used Can be used only for 'loop-thru' type cur Tr	In the Field $\frac{1}{4}$ of 1% In the Laboratory $\frac{1}{10}$ of 1%		When θ = 0° $F_x=1+\left[\frac{b_s-b_x}{2a_s}\right]$	When θ is lagging and ≠ 0° $\alpha_x=\frac{3438}{\tan\theta}\left[\frac{b_s'-b_x'}{2a_s'}-\frac{b_s-b_x}{2a_s}\right]$ or When θ = 60° lagging $\alpha_x=20\left[\frac{100(b_s'-b_x')}{2a_s'}-\frac{100(b_s-b_x)}{2a_s}\right]$	Knopp, El Wld Vol 67 p. 92 Crothers, El Wld Feb 7 1920

Testing of Instrument Transformers—IV

Analysis of Available Methods, Pointing Out Particularly Those Which Are Most Easily Applicable Under Ordinary Conditions Found by Central Stations in the Field and in Their Meter Shops and Laboratories

By F. A. KARTAK
Formerly Director Standards Laboratory, University of Wisconsin

DURING the past few years the standards laboratory of the University of Wisconsin has been requested a number of times by public utilities of the state to recommend methods for testing instrument transformers which, while giving a reasonably high degree of accuracy, would not require the use of precise and expensive laboratory apparatus nor the services of a specially trained expert.

In attempting to fix upon the best methods to be recommended for determining the constants of instrument transformers both in the field and in the meter shops or laboratories of central stations an analysis of the various available methods has been made. The analysis as carried out was not only based upon a theoretical consideration of the principles involved, but the various schemes or methods were tested experimentally under typical conditions both in the laboratory and in the field. Detailed discussions of some of these methods have already been presented in these columns.[1] The results of this analysis have shown some interesting conclusions which are here presented.

TABLE I—INSTRUMENT TRANSFORMER TERMINOLOGY

Quantity	Symbol	Defining of Equation	Remarks
Marked or nominal ratio	Rm		Nominal Ratio as Marked on Nameplate
Voltage ratio	Re	$Re = \frac{Ep}{Es}$ (for voltage transformer)	Actual ratio of primary voltage (or current) to secondary voltage (or current)
Current ratio	Ri	$Ri = \frac{Ip}{Is}$ (for current transformer)	
Ratio factor	Fe	$Fe = \frac{Re}{Rm}$ (for voltage transformer)	Voltage (or current) ratio expressed in terms of marked ratio
	Fi	$Fi = \frac{Ri}{Rm}$ (for current transformer)	
Phase angle	β	(For voltage transformers)	The small angle by which the reversed secondary voltage (or current) *leads** the primary voltage (or current)
	α	(For current transformers)	
Power ratio	Rw	$Rwe = \frac{EpIp \cos \theta}{EsIp \cos (\theta + \beta)}$	Ratio of true power of circuit to apparent power in secondary circuit of transformer
		$Rwi = \frac{IpEp \cos \theta}{IsEp \cos (\theta - \alpha)}$	
Meter power factor	$\cos (\theta + \beta)$	(For voltage transformer)	Operating power factor of meter connected to secondary circuit of transformer
	$\cos (\theta - \alpha)$	(For current transformer)	

* If the reversed secondary voltage (or current) *lags* the primary voltage (or current), the phase angle β (or α) is assumed negative and given a negative sign.

Before studying the various methods it was thought advisable to define the constants of transformers in such manner that the equations developed for the various methods might take the simplest or most convenient forms. A set of such definitions, defining equations and symbols, is presented in Table I. The use of "ratio factor" instead of "ratio" has been found to be particularly useful, since it not only readily permits the comparison of the characteristics of transformers of different ratios, but is quite useful where indicating instruments or watt-hour meters are connected in the secondary circuits of transformers, the percentage error in the meter indications or registrations due to error in transformer ratio being at once apparent.

In studying the situation only such methods were considered as could properly be classed as "field" methods; that is, methods which could be applied in the field, using engineering instruments (such as ammeters, voltmeters, wattmeters and watt-hour meters) rather than the more precise laboratory methods, requiring the use of reflecting dynamometers, special shunts, phase shifters and the like.

The methods available naturally divide themselves into two classes, which are termed "absolute" and "comparative" methods. "Absolute" methods are considered as those in which the constants (ratio factor and phase angle) of a transformer are determined directly from its operation under given conditions, while the "comparative" methods are those in which the constants of a given transformer are compared with the known constants of another transformer of the same nominal ratio.

USEFULNESS OF VARIOUS TESTING METHODS

In the chart on page 1368 has been grouped practically all of the desired information relating to the various types of tests, which are five in number. It will be seen that for every type of voltage transformer test there is a corresponding type of test for current transformers.

Type II test differs from type I test in that the use of indicating wattmeters in place of voltmeters or ammeters makes possible the determination of phase angle as well as ratio factor when a second circuit of displaced phase is used. As indicated in the table, neither of these methods is usually satisfactory because of the widely different ranges of accurately calibrated meters required and because any fluctuation of voltage of the supply circuit affects the accuracy of the readings.

The differential methods (type III) suggested by Brooks[2] for voltage transformers, Silsbee[3] and Crothers[4] for current transformers are particularly useful where a standard transformer—one of known characteristics—of the same nominal ratio as the transformer to be tested is available. The method is virtually independent of fluctuation of the supply voltage and requires only a low-range wattmeter of reasonable accuracy, since any error in the wattmeter indication enters only into the differential quantity being measured, that is, into the *difference* in voltages or currents of the two transformers being compared. The Brooks method with modifications, as described by Crothers[4], has been adopted by the standards laboratory of the University of Wisconsin for the testing of voltage transformers.

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[1] Crothers, ELECTRICAL WORLD, March 15, 1919; July 19, 1919, and Feb. 7, 1920.

[2] Brooks, ELECTRICAL WORLD, Vol. 62, p. 898, Nov. 1, 1913.

[3] Silsbee, ELECTRICAL WORLD, Vol. 70, p. 667, Oct. 6, 1917.

[4] Crothers, ELECTRICAL WORLD, Vol. 7, July 19, 1919.

The "comparative" Agnew test (type IV) is perhaps the most useful type which the small central-station meter shop will find available, particularly with the modifications worked out at the standards laboratory and presented by Mr. Crothers[5]. The method is independent of voltage fluctuations and requires only the use of two portable standard watt-hour meters or their equivalent. The watt-hour meters need not be accurately calibrated since they are interchanged during the test to eliminate any differences in their adjustments.

The "absolute" Agnew test[6] (type V), which is applicable only to the test of a current transformer of the "hole" or "loop through" type, combines all of the advantages of the "comparative" Agnew test (type IV) together with the fact that no standard transformer of known characteristics is required, the secondary current being compared with the primary current, as to both magnitude and phase position, after placing the proper number of primary turns to give the transformer a nominal one-to-one ratio. This method is obviously not applicable to commercial voltage transformers, since such transformers cannot be made to have a one-to-one nominal ratio. The Agnew method, both comparative and absolute, has been adopted by the standards laboratory of the University of Wisconsin for the testing of current transformers.

The estimated values of the accuracies obtainable in the various methods have been conservatively chosen after conducting tests by the different methods both in the laboratory and in the field, and it is believed that no difficulty will be encountered under ordinary conditions in obtaining results to the degrees of accuracy stated. By taking considerable care in observations it has been shown that the degrees of accuracy can be appreciably increased, particularly in tests carried out in laboratories or meter shops where it is possible to control conditions more closely than in the field. It is felt that under such conditions, in the case of type III, IV and V tests, the values of one-tenth of 1 per cent given may be changed to one-twentieth of 1 per cent and even to one-thirtieth of 1 per cent in the case of the absolute Agnew test where no standard transformer is required.

Alternating-Current Service Facilitates Mine Extensions

On reaching the point where the direct-current energy supplied for the operation of the St. David (Ill.) mine of the Big Creek Coal Company was inadequate for the requirements, it was found that the most economical solution of the problem was the closing down of the mine power plant and conversion to central-station energy. The inadequacy of the direct-current energy was both a question of a lack of capacity and of ability to meet demand conditions. These conditions had been changing because the mine was of the drift type and the scene of operations had begun to get farther and farther away from the power plant. This caused a material reduction in the voltage applied to the electric drilling machines. Production was hampered, and in addition the hauling capacity of the electric locomotive was lowered. The locomotives have a 2-mile (3.2-km.) haul, and their decreased speed became an important factor. Although the voltage could have been corrected by the installation of larger copper feeders, this would not have been entirely satisfactory, because the time was bound to come when the drilling operations were again so far from the power plant that production would be reduced.

For these reasons the mine power plant was shut down and equipment was installed to convert the alternating-current supplied from the 13,200-volt transmission line of the Canton (Ill.) Gas & Electric Company. Two motor-generator sets are used, one, rated at 100 kw., at the mouth of the mine, and the other, rated at 200 kw., 1½ miles (2.4 km.) northwest of the main entry, directly over and 70 ft. (21 m.) above the main tunnel. The first set, besides supplying energy to the 6-mile (9.6 km.) mine feeder system, furnishes direct-current energy for the lights at the mine mouth and various motors in this vicinity. The purpose of the second set is to supply energy to the portion of the mine out of the range of the first set and to effect a good ventilation system for the mine. This is accomplished by means of a fan driven by a 25-hp. motor. Fresh air is furnished directly to the miners at the terminal of the mine. The power feeders in the mine are connected to this set by means of 1,000,000-circ.mil cable in a 2½-in. (6.3-cm.) "sherardized" conduit in the air shaft. This substation can be reached by traveling in the locomotive to the air shaft and then by climbing stairs.

MOUTH OF MINE SHOWING THE ELECTRIC LOCOMOTIVES

The endless-chain tipple at the mouth of the mine is driven by a 50-hp., 220-volt induction motor receiving energy from a 2,300/220-volt transformer connected to the 2,300-volt bus at the main switchboard. This motor replaces an old steam engine and was installed without delay to mining operations by reversing the shaft of the pulley. Thus the motors could be mounted on a new concrete base while the steam engine was still performing its duty.

Motor-generator sets were installed instead of rotary converters on account of the varying load requirements. The flashover which is common in high-frequency converters where a great number of poles are used is thus averted.

The installation of central-station service has increased the output of the mines about 20 per cent. Considerable saving of copper for feeders was also effected, and 10,000 lb. (4,500 kg.) of copper was removed.

The total connected load on the Canton Gas & Electric Company's service is now 175-hp. induction-motor load, 675-hp. synchronous-motor load and 6-kw. lighting load.

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[5] Crothers, ELECTRICAL WORLD, Vol. 73, p. 516, March 15, 1919.

[6] Knopp, ELECTRICAL WORLD, Vol. 67, p. 92, Jan. 8, 1916, and Crothers, ELECTRICAL WORLD, Vol. 75, p. 319, Feb. 7, 1920.

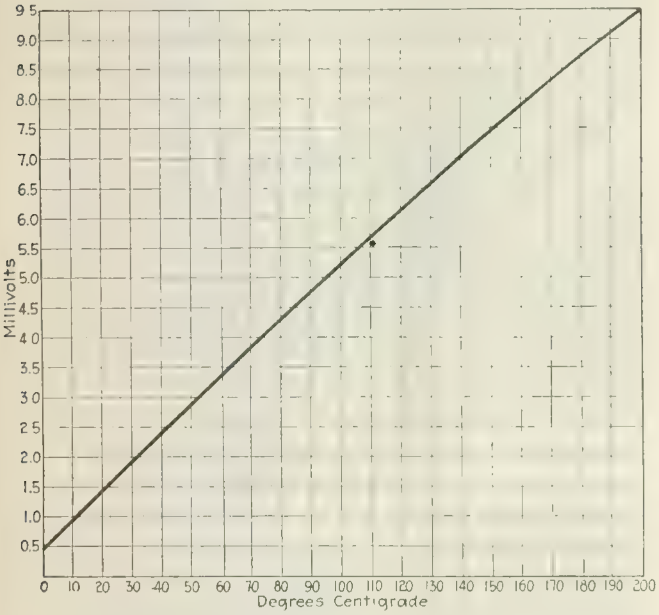
Readers' Views and Comments

Thermocouple Potentials

To the Editor of the ELECTRICAL WORLD:

SIR: On page 14 of the ELECTRICAL WORLD dated Jan. 3, 1920, an article appeared on the "Thermal Conductivity of Underground Ducts." In Fig. 2 of that article and in the discussion Mr. Wilder gives data which do not agree with the writer's data on copper-advance and copper-constantan couples. The paper is not entirely clear on the subject of cold-junction temperature, but inasmuch as the author refers to an ice-water bath, it is assumed that the cold junction was at a temperature somewhere near 0 deg. C.

Below Fig. 2 the author gives a value of 0.017 millivolt per degree change in temperature but does not state whether this refers to Fahrenheit or Centigrade degrees. From Fig. 2, this figure would appear to check with emf. values for Centigrade degrees. The writer's data show an emf. of about 0.04 millivolt per degree Centigrade at the hot junction, with the cold junction at 0 deg. This is more than twice the value given by the author, so that it is difficult to interpret his results even though Fahrenheit degrees are assumed instead of Centigrade degrees.



CHARACTERISTIC CURVE FOR COPPER-CONSTANTAN THERMOCOUPLE, COLD JUNCTION 0 DEG. C.

The accompanying curve gives figures for copper-constantan or copper-advance couples, but it is desired to point out that this curve cannot be duplicated by selecting advance or constantan wire at random. Constantan and advance are alloys, and the thermal characteristics are not the same in every piece of wire. Accordingly wire must be carefully selected in order to reproduce the characteristics which are shown in the inclosed curve.

The potentiometer method for measuring thermocouple potentials is not new, and in fact instruments based on this principle have been carried to a considerable degree of refinement. The Leeds & Northrup Company makes a compact portable instrument calibrated to read directly in temperature units and having an automatic cold-junction compensator so that when making measurements the temperature of the cold junction can be ignored. An automatic potentiometer is also made for recording the temperature of one or more thermocouples. This same form of instrument has been very successfully adapted to temperature control problems. Like the indicating instruments these recorders and controllers are automatically compensated for cold-junction temperatures.

I. MELVILLE STEIN,
Philadelphia, Pa. Leeds & Northrup Company.

Farm-Line Service Has Become a Social Necessity

To the Editor of the ELECTRICAL WORLD:

SIR: Some time ago a representative of the United States Chamber of Commerce, in an interesting address before a gathering of central-station men at a convention in Chicago, laid particular stress on the lack of social conscience among American business men and pointed out that unless business organizations in general visualize their position in the business world as a social factor in the life of the nation they will not fulfill their mission. It is the duty of the business men of the nation to know their position and duty as a useful link in the nation's organization and always to place the benefits of the people in general above their immediate business gains. It is this quality that is defined as social conscience, and the necessity of this social conscience among central-station men is glaringly displayed at present, when service is being denied to farmers simply because there is often no immediate gain for the central-station company in carrying electricity to the rural customer.

Any one who has followed the continuous movement from the farms to the cities during the last two years can easily see for himself that if this movement is not stopped, the time is fast approaching when we shall have bread lines in the cities, due not to lack of money but to lack of bread. The fact is that the farmer cannot get sufficient help to raise the crops he used to raise. One solution for this difficulty is to make it possible for electric power to do the work that the hired man refuses to do.

If it were necessary for the central-station companies to furnish power to the farmers at a loss, the situation would be difficult and would call for men of large vision and unselfish motives to lead the "back to the farm" movement via central-station service, but such is not the case. The farmer is willing to pay for the necessary expense in giving him service, and it is just a question of the central-station man breaking away from his hobby of building large stations supplying large industrial loads and turning a part of his organization over to this very important duty of providing service for the farmers.

It is an excellent opportunity to gain the good will of our most conservative voters, insure their confidence in existing business institutions and incidentally develop a hitherto untouched field for central-station securities. The farmer who is satisfied with central-station service will be glad to buy securities in the corporation in which he is personally interested.

ALFRED ALSAKER.
Chicago, Ill.

Station and Operating Practice

A Department Devoted to Problems of Installation,
Operation and Maintenance of Equipment for Economical Generation and
Distribution of Electrical Energy

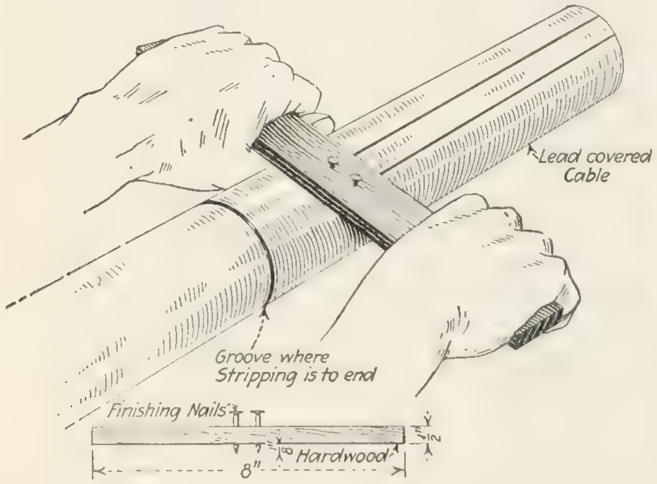
Cutting Extra Oil Ducts Stops Transformers Overheating

IN ORDER to eliminate heating of some 11,000 4,150-volt transformers of the Rochester (N. Y.) Gas & Electric Corporation additional oil ducts have been cut in the laminated cores and the iron cooling coils have been cleaned of scale and sediment. Seven of these 60-cycle transformers totaling 30,000 kva. have operated successfully at rated capacity for four years, but recently abnormally high temperatures have developed on account of insufficient oil-duct capacity and of obstructed water-cooling coils which are of iron instead of the preferable brass or copper tubing. To remedy the trouble it was found necessary to disconnect and dissassemble the transformers without interrupting service. After the laminated iron was removed additional slots were cut in the section between different phases to form extra oil ducts at the points where they were most needed. The iron cooling coils were then flushed with muriatic acid, which entirely removed the scale and sediment. Several transformers in which these changes have been completed are showing very satisfactory operation. GEORGE BAILEY.

Rochester, N. Y.

Tool for Stripping Lead Cable Sheath

FOR stripping the lead sheathing from cables the easily constructed tool illustrated here has proved very useful. The tool consists of a strip of hard wood, about 8 in. x 1½ in. x ½ in. (20 cm. x 3.5 cm. x 1.5 cm.), into which are driven two No. 6 finishing nails. The nails are spaced from ⅜ in. to ¾ in. (1 cm. to 2 cm.) apart, depending on the size of cable to be stripped, and the ends of the nails are allowed to project ⅛ in. (0.3 cm.)



TOOL CUTS TWO GROOVES IN SHEATH TO BE STRIPPED

To operate the tool it is drawn along the cable, scoring two deep grooves in the lead. A limiting groove is also cut around the cable at each end of the section to be stripped. After this strip is removed by peeling back with heavy pliers, the remainder of the sheath is taken off by forcing a blunt tool between the sheath and the cable. H. E. WEIGHTMAN.

Chicago, Ill.

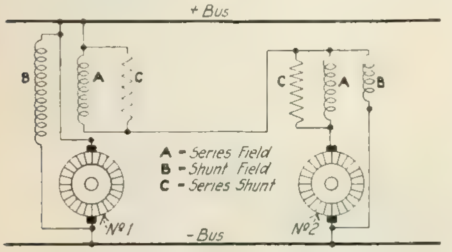
Indicator in Boiler Room Shows Load on Turbine

FOR keeping firemen constantly informed of the load on a bank of boilers, an illuminated indicator is mounted where it is easily seen in the Long Beach plant of the Southern California Edison Company. The indicator, as shown in the photograph, consists of a box-like frame having two glass sides on which are painted numbers from 1 to 20, corresponding to the number of valves on the turbine fed by the particular bank of boilers. Behind each of the numbers is an incandescent lamp which is lighted when the valve corresponding to that number is open. As the valves open in proportion to the load carried, if the steam pressure is constant, the firemen are able to keep close watch of the load and to regulate their fires accordingly. As this plant is an oil-burning plant, it is a simple matter to shut down or start up a boiler within a few seconds. An indicator is installed on each of the three banks of boilers in this plant, each bank feeding only one turbine.

LIGHTED NUMBERS INDICATE OPEN TURBINE VALVES

Parallel Operation of Unsimilar Direct-Current Generators

THE difficulty sometimes found in the parallel operation of direct-current generators can be overcome by connecting the two machines together as shown in the accompanying drawing. One of these machines may be overcompounded and the other undercompounded, and both may be driven by separate prime movers. The proper proportion of load is obtained by adjustment of the compound field shunts and the shunt-field rheostat. With proper adjustment the machines will divide the load as though tied together with an inflexible coupling. Treating this unit as a single unit, it in turn can be coupled to other units. In case of any difference in rating of the two machines No. 2 should be the smaller.



SEPARATELY DRIVEN GENERATORS CONNECTED FOR PARALLEL OPERATION

By referring to the drawing the action is seen to be as follows: As No. 1 generator is connected to the line as a simple shunt machine, when called on for current there will be an immediate drop in voltage due to armature reaction and I^2R loss. No. 2 generator then starts delivery of current which passes through the compound winding of generator No. 1 and thus raises its voltage.

In a specific case the No. 1 generator was a 250-kw., 500-volt machine, 25 per cent overcompounded, belted to a cross-compound Robb-Armstrong engine. The No. 2 generator was a 125-kw., 500-volt machine, 25 per cent undercompounded, connected to a second Robb-Armstrong engine of the same type. The series shunt on No. 2 generator was removed entirely and the series shunt on the No. 1 machine was adjusted to give the desired proportion of load in each machine. The result was a perfect parallel orperation. B. N. EMMET.

San Francisco, Cal.

Branding Poles to Check Depth of Setting

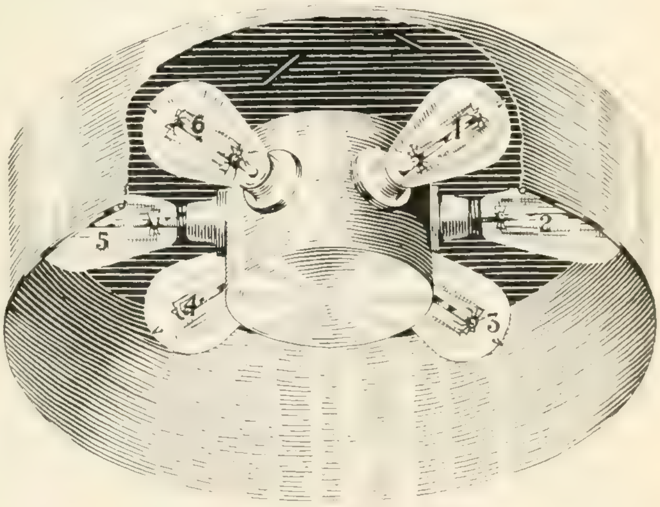
AFTER a pole is set in the ground it is usually impossible to tell the depth of setting. To check the depth to which poles have been set the San Joaquin Light & Power Corporation brands the poles at the time of shaping about 8 ft. or 10 ft. (3 m.) from the lower end. This is a very simple process and makes it possible to judge just how deep the pole is planted by the distance of the brand above the ground. The only way to avoid having to dig a hole of the proper depth is to saw off the pole, which involves as much labor as digging the hole deeper and can be easily detected. The stencil used is simply an ordinary branding stencil with cast-iron letters "SJL&P Corp." which are heated red-hot and burned into the pole.

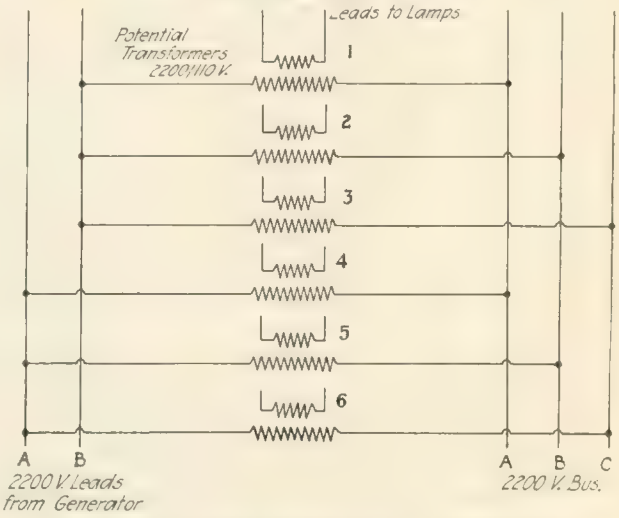
This method was adopted after a high wind some years ago had blown down several poles which according to all calculations should have withstood the wind pressure. It was found that the contractor who set up the line had not sunk the poles to the required depth but had saved himself the trouble of digging holes deeper than 3 ft. (1.8 m.). In order to obviate a repetition of this difficulty and make such a fraud impossible without too expensive inspection, the company now uses the scheme of stenciling the poles as described. L. J. MOORE,
Electrical Engineer.

San Joaquin Light & Power Corporation,
Fresno, Cal.

Rotating-Light Synchroscope Easily Seen at Distance

SIX incandescent lamps mounted in a circular trough, as shown in the accompanying illustration, form a synchroscope used in the Borel plant of the Southern California Edison Company. The lamps are mounted on a small cylinder and around the whole is the inclosing circular rim. In synchronizing, only one lamp burns brightly at a time, and this condition passes from one lamp to the next around the circle, giving the appearance of a rotating streak of light. This light throws a shadow on the inside of the rim which may be seen from almost any part of the room. To add to the brightness the interior is painted white.




Leads to Lamps
Potential Transformers 2200/110 V.
1
2
3
4
5
6
A
B
2200 V. Leads from Generator
A
B
C
2200 V. Bus.

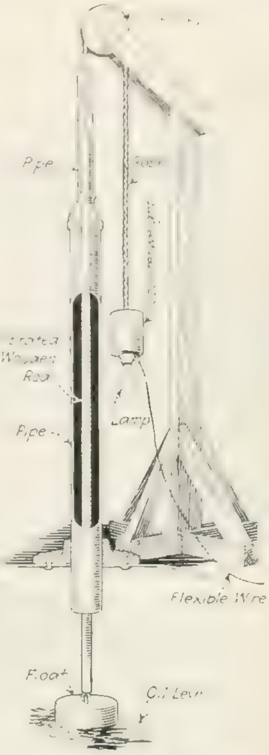
HOME-MADE SYNCHROSCOPE AND CONNECTIONS FOR LAMPS

The connections require six potential transformers wired, as the diagram shows, to two legs of the leads from the generator to be synchronized and to the three legs of the station bus. J. O. BANGSBURG.

Southern California Edison Company,
Los Angeles, Cal.

Gage to Measure Height of Oil in 30,000-Barrel Tanks

A QUICK and easy means to ascertain the height of fuel oil stored in the supply tank for large steam-electric power plants is a matter of considerable importance. The North Beach plant of the Sierra & San Francisco Power Company has a unique and helpful installation to ascertain the height of oil quickly. As shown in the illustration, the rod inside the pipe is calibrated in feet and inches and passes down into the tank, which is of 30,000-barrel capacity. This rod rests on a float supported by the oil. The weight of the rod is balanced by a counterweight, the position of which gives a rough idea of the height of oil in the tank. Attached to the counterweight is an electric lamp fed through a flexible cord so that the position of the counterweight may be known at night.



HEIGHT OF ROD SHOWS LEVEL OF OIL IN TANK

Test to Check Deterioration of Lubricating Oils

TO DETERMINE the condition of a lubricating oil the following simple test can be made in the power plant. This test will show if an oil is beginning to break down and is consequently becoming dangerous to use, or if a new oil has been acid-treated. The test is made with a tall 4 oz. (114 c.c.) sample bottle. The bottle is first sterilized by boiling in distilled water, then 1 oz. (28 c.c.) of distilled water is added to 1 oz. of the oil to be tested. The bottle containing the oil and water is heated in a water bath up to 180 deg. Fahr. (83 deg. Cent.), corked and shaken vigorously for five minutes. After standing three hours the condition of the liquid is noted. A good filtered oil, not broken down and free from acid, will completely separate from the water with no layer or line of emulsion between the oil and water and will retain its clearness and original color.

To aid in measuring the liquids in this test, the 4-oz. bottle may be graduated at the 1-oz. and the 2-oz. points by making a horizontal line with a file on the outside of the bottle. Several bottles may be marked in this way, so that comparative tests may be conducted on several oils at the same time and under the same conditions. In this way an oil in use may at times be compared with new oil to see if it is beginning to break down and become dangerous. This test can easily be applied to turbine oils in the plant where they are used. After a little experimenting an oil that is beginning to break down or contains acid can readily be distinguished.

This emulsification test is important for oils used in steam turbines, splash feed, crank-case steam engines and circulating oiling systems. In some cases oil must separate from water readily and retain this property during use. With motor oils a filtered oil can be detected from an acid-treated oil.

Color does not indicate the lubricating value of an oil. Highly filtered oils are paler than other oils of the same viscosity, but the color can also be lightened by acid treatment. Heavy oils have deeper colors than light oils. Red engine oils should be clear when held toward the light in a sample bottle. Cylinder oils are green in color instead of black if free from tar. All mineral oils show more or less "bloom" or fluorescence, unless it is removed. Oils should be free from turbidity, which indicates impurities.

Consumers Power Company, C. D. Basler,
Jackson, Mich. Chemical Engineer.

Hydraulic Valve Operated Quickly by Motor

AS IT is a slow, difficult process to operate a 36-in. (92-cm.) hydraulic gate valve by hand, the valves controlling the Francis waterwheels of two 5,000-kw. generators in a Michigan hydro-electric plant are equipped to be operated electrically by the Dean system. Each valve is equipped with a high-torque, totally inclosed, 125-volt, ball-bearing direct-current motor running at 1,600 r.p.m., which actuates the valve stem through a system of worm and planetary reduction gearing. Energy for operating these motors is taken from the exciter bus, and control stations are conveniently located in the power plant.

MOTOR OPERATES 36-IN. HYDRAULIC VALVE IN THREE AND ONE-HALF MINUTES

The control mechanism is so arranged that after the valve gate is fully opened or closed a mechanically operated clutch disconnects all high-speed parts, such as motor, gears, etc. Simultaneously the motor circuit is opened by a limit switch after which the motor usually makes about twenty revolutions, or one-half turn of the gear. These limit switches are set so that the motor will not overrun and jam the valve and burn out the motor. By means of this arrangement the motor starts without load and makes about twenty revolutions before the clutch starts the gears. The current then rises momentarily to 10 amp. at 110 volts, while unseating the valve, after which it drops to 5 amp., remaining fairly constant until the valve is fully opened or closed, the complete operation requiring about three and one-half minutes.

A hand wheel is provided so that the valves can be manually operated in case of failure of the motor or of the source of energy. An emergency storage battery was not considered necessary, as the equipment in the plant is in duplicate, and in any event sufficient power can be obtained through the bypass valve to drive the wheel and produce sufficient voltage on the exciter to operate the motor. R. K. Durland.

Cleveland Cliffs Iron Company,
Ishpeming, Mich.

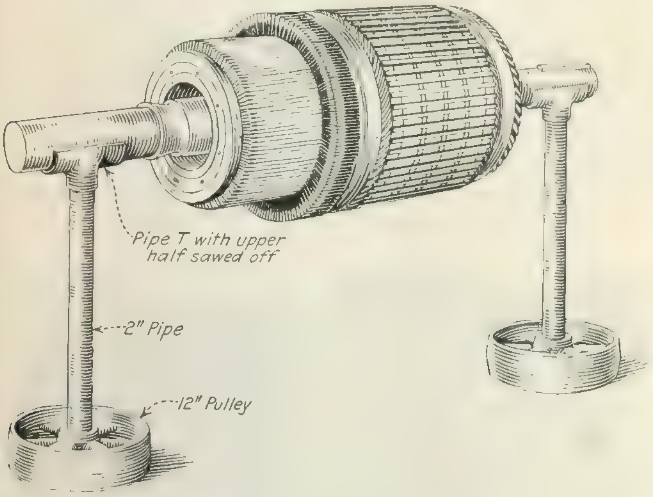
Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

Improvised Armature Support

FOR holding armatures which have been taken out of the frame to be worked on the support described here has proved very useful in an Eastern industrial plant. The stand is made from two 12-in. (30-cm.) pulleys which are set on the floor and into which are inserted 2-in. (5-cm.) pipes about 3½ ft. (1 m.) long. To the upper end of each pipe which must be threaded is screwed a T-joint, of which the upper half of the cross member has been sawed off. Such a stand will accommodate motors from small sizes up to those with shafts the size of the T. **W. A. Harris.**

New York, N. Y.


Pipe T with upper half sawed off
2" Pipe
12" Pulley

ARMATURE STAND MADE FROM PULLEYS AND PIPES

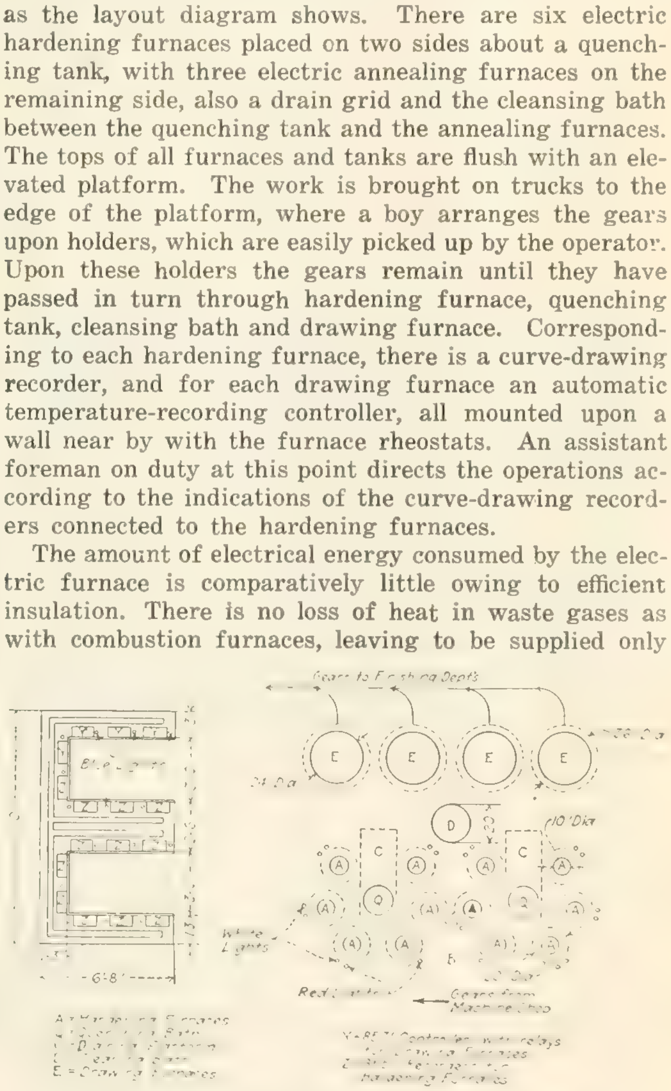
Electric Heat-Treating of Automobile Gears

BY SUBSTITUTING electric heat-treating furnaces for the gas furnaces formerly used production operations have been greatly simplified in a large plant producing automobile gears. Moreover, the quality of the product has been improved while the output has been increased.

Formerly in this plant automobile transmission gears were heated for hardening in lead pots located in the basement beneath the machine shop. After the gears had been machined, they were removed on trucks to an elevator, lowered to the heat-treating room, an uncomfortable place because of heat and fumes, and wheeled to the lead pots. The gears were placed in the lead pots in batches and when they had come up to temperature were lifted out one at a time and dropped into the oil quenching bath. The time of heating in the lead pots was thus not the same for all pieces, and the temperature also varied with the location in the pot, possibly resulting in non-uniform hardness and grain structure. The gears were also sometimes injured by dropping upon one another in the quenching tank. The drawing was done in gas furnaces, followed by an oil quench. Upon their return to the machine shop the gears were wire-brushed to remove adhering lead.

The electric furnace equipment replacing the lead pots and gas furnace is installed in the machine shop itself as the layout diagram shows. There are six electric hardening furnaces placed on two sides about a quenching tank, with three electric annealing furnaces on the remaining side, also a drain grid and the cleansing bath between the quenching tank and the annealing furnaces. The tops of all furnaces and tanks are flush with an elevated platform. The work is brought on trucks to the edge of the platform, where a boy arranges the gears upon holders, which are easily picked up by the operator. Upon these holders the gears remain until they have passed in turn through hardening furnace, quenching tank, cleansing bath and drawing furnace. Corresponding to each hardening furnace, there is a curve-drawing recorder, and for each drawing furnace an automatic temperature-recording controller, all mounted upon a wall near by with the furnace rheostats. An assistant foreman on duty at this point directs the operations according to the indications of the curve-drawing recorders connected to the hardening furnaces.

The amount of electrical energy consumed by the electric furnace is comparatively little owing to efficient insulation. There is no loss of heat in waste gases as with combustion furnaces, leaving to be supplied only the heat imparted to the work. The higher cost of electrical energy is more than repaid by the saving in necessary apparatus, such as pumps, blowers, burners, etc., and the labor costs, as the electric furnace is installed in the machine shop in the direct line of manufacture, thus saving the double handling necessary where the work must be taken from the machine shop to a hardening room and then back again.



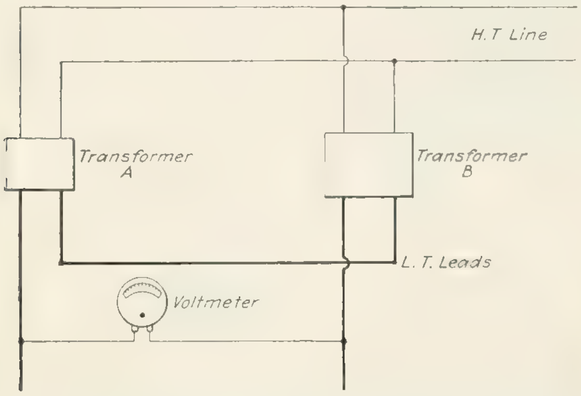
LAYOUT OF SHOP FOR HEAT-TREATING GEARS

The method of heat treatment used in this plant, which is controlled by the Leeds & Northrup Company, Philadelphia, makes use of the fact that at a certain critical point in the heating a chemical change in the metal allows heat to be applied without proportionately raising the temperature. In electrical processes this point can be accurately judged by the use of indicating meters. G. H. GIBSON.

New York, N. Y.

Conditions for Successful Parallel Operation of Transformers

TO OPERATE in parallel transformers must have (1) no-load terminal voltage the same; (2) the same voltage regulation on load, and (3) the same polarity. The no-load terminal voltage may be measured by a voltmeter, in connection with a potential transformer if necessary. As the voltage ratio on transformers is usually ten to one, twenty to one or some such simple ratio, the first condition is usually easy to fulfill. However, with large power transformers having voltage taps to change the voltage only a small percentage, care must be taken to have the terminals connected to the correct voltage tap. Regarding the second condition, which is that the transformers must also have the same voltage when they are loaded, the voltmeter test may be made as before, but the transformers must have a load on them. If the voltage drop on each transformer from no load to full load is the same, then the second condition of the successful paralleling is fulfilled. As the voltage regulation is determined when the transformer is built it cannot be readily changed. In cases of temporary emergency the voltage drop on one transformer may be increased by inserting a resistance or reactance in series with either the high-tension or the low-tension leads.



CHECKING POLARITY OF TRANSFORMERS TO BE PARALLELED

If voltmeter reads zero, transformer may be paralleled. If voltmeter reads twice transformer voltage, low-tension or high-tension leads of one transformer must be reversed before paralleling.

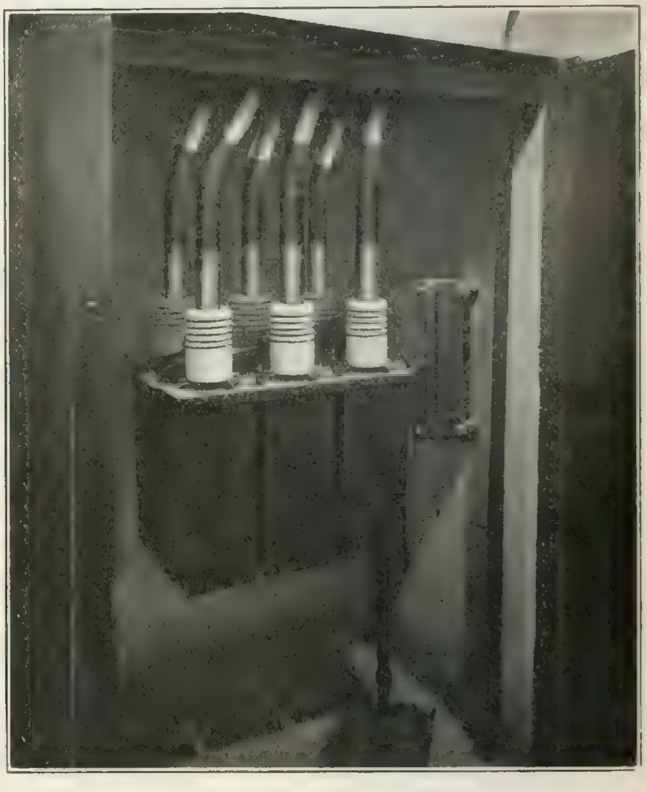
For the third condition the polarity can be checked by connecting the high-tension leads in parallel and connecting two corresponding low-tension leads together. With this connection the voltage across the two other corresponding leads should be zero. By connecting a voltmeter across these leads this voltage may be measured. A voltmeter of twice the voltage of the transformers should be used because if the polarity of one transformer is the reverse of that of the other, double voltage will be put upon the meter. In such a case the corresponding low-tension leads must be connected to opposite sides of the low-tension line.

When a transformer is to be used as a tie between two systems both of which have generators running on them, the transformer leads must be treated in exactly the same manner as the leads of an alternator which is being cut in to a like system. The phase rotation in the two systems must be observed. This may be checked by noting the direction of rotation of a polyphase induction motor first on one system and then on the other. Another method is by means of phasing lamps. If the transformer is the only tie between the two systems, it can be cut in only when the two systems are in synchronism. This requires a synchronoscope or lamp used in the same manner as when paralleling alternators. JAMES DIXON.

Cleveland, Ohio.

Oil Switch Mounted on Side of Shallow Cell

BY MOUNTING oil switches on the sides of the cells in a New England industrial plant they could be put in the very shallow cells shown in the accompanying illustration. It was necessary to limit the depth of these cells to 27 in. (68 cm.) on account of real estate conditions. Therefore it was impossible to mount the 6,900-volt mechanically operated switch by placing the supporting bracket at the rear of the cell, as the switch was 28 in. (71 cm.) long over all. By simply turning the axis of the switch 90 deg. and installing it upon the side wall of the cell a most convenient installation was obtained, with the further advantage of avoiding offsets or right-angled adjustment turns in the cables running to the disconnecting switches and busbars above. As the switch happened to be offset by several panels from its control point, a diagonal run of operating lever was provided in the floor as shown, after a convenient



METHOD USED IN MOUNTING OIL SWITCHES TO SAVE ROOM sectional slab 9 in. (33.5 cm.) wide was cut in the concrete flooring and in the linoleum covering at the rear of the switchboard.

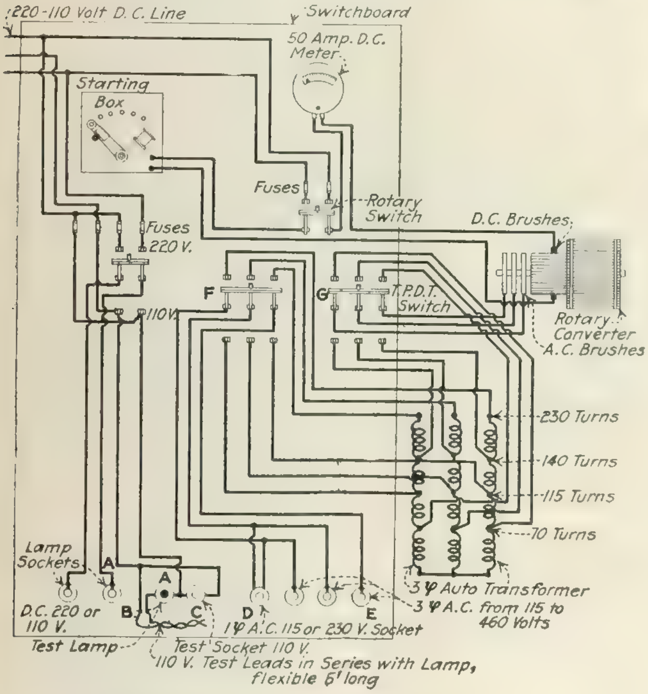
Switchboard Useful for Motor Repair Shop

A CONVENIENT switchboard for providing alternating and direct current for testing purposes described here was constructed in a Western repair shop for use with a home-made rotary converter described in the ELECTRICAL WORLD, April 3, 1920, p. 793. Although designed for use with this converter, the switchboard may be connected to an alternating-current line in place of the converter where such a line is available.

Starting at the left-hand side of the board as shown in the illustration, the first two lamp sockets at the bottom of the board are for 110 volts or 220 volts direct-current. Both terminals of these sockets are soldered together so that a single-wire cord may be connected to them by means of a plug. The voltage is changed from 110 volts to 220 volts by means of the double-pole, double-throw switch. At *B* is a two-wire flexible cord, about 5 ft. (1.5 m.) long, connected in series with the incandescent lamp across the 110-volt direct-current line. These leads are used for testing for grounds, open coils, etc. At *C* is a socket connected in the ordinary manner across the 110-volt direct-current line. At *D* is a socket connected in the same way across the alternating-current lines. At *E* are three sockets with terminals soldered together for three single-wire leads. On these sockets is three-phase alternating-current. These wires connect to the middle point of the double-throw, three-pole switch, *F*. Where 110/220 volt alternating-current is available, the outside terminals of this switch might be connected respectively to two lines of these voltages. However, in the present case the outside terminals are connected to taps of the auto-transformer, which is wound with 230 turns of No. 7 double cotton-covered wire on a three-legged core, each leg of which is 2¼ in. square and 12 in. high (5.5 cm. x 30 cm.). The rotary converter, which generates 70 volts, is connected to other taps of this auto-transformer through the switch *G*. By means of these two switches the voltage on the socket at *E* may be varied from 115 volts to 460 volts. The positions of these switches for the various voltages are given in the accompanying table.

CONNECTIONS OF ROTARY CONVERTER AND SWITCHBOARD

Switch F.	Switch G.	Voltage on Three-Phase Plugs
Up	Up	460
Up	Down	230
Down	Up	230
Down	Down	115

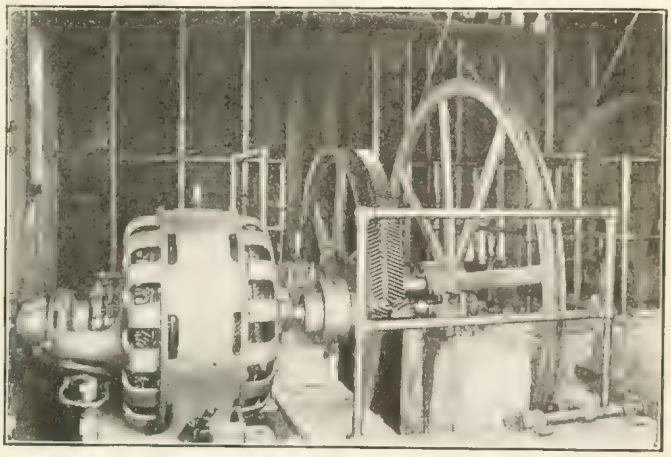


SWITCHBOARD CONVENIENT FOR TESTING IN A MOTOR REPAIR SHOP

Chicago, Ill. C. W. GODING.

Single-Sheave Haulage Gives Reliable Service

ABOUT three years ago one group of iron mines in Michigan changed the drive on its surface haulage from endless rope with double-tandem drums to the single-sheave haulage sets shown in the illustration. The change has proved very satisfactory in every way. This haulage is used to carry ore and other material in cars above ground.



SINGLE-SHEAVE HAULAGE INSTALLATION FOR HANDLING SURFACE MINE STOCK

Each set consists of a remotely controlled 50-hp., 2,200-volt, three-phase, 60-cycle, 600-r.p.m. (synchronous speed) slip-ring motor, geared to drive the rope on a 6-ft. or 8-ft. (1.8-m. or 2.4-m.) sheave at a speed of 1,000 ft. to 1,500 ft. per minute (5 m. to 7.5 m. per second). The motor is geared down about ten to one to permit the use of a large sheave and rope surface. The effective driving surface is further increased by crossing the rope as it leaves the sheave, and there is an automatic rope tightener at the end of each trestle. A ⅝-in. (16-mm.) rope is used, and each sheave is lined with rubber to minimize rope slippage. Some fifteen of these sets have been in use by one company for about three years without requiring a renewal of the rubber linings in the sheaves.

F. C. STANFORD,
Chief Electrical Engineer.
Cleveland Cliffs Iron Company,
Ishpeming, Mich.

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

Possibilities of Electric Range Business

IT SHOULD not be many years before electric range sales are comparable with the present output of washing machines, according to close students of the progress of electric cooking. Some of the reasons on which this belief is based follow:

First—An electric range in its operation is as far in advance of a fuel range as washing machines are ahead of hand-tub methods.

Second—The average washing machine is used only four or five times a month. Domestic cooking, on the other hand, is an insistent, compulsory routine three times a day, and the more often any appliance is used the greater advantage accrues to the user.

Third—The household wash can be handled outside of the home and in a reasonably satisfactory manner. However, it is not generally desirable or likely that family meals shall or can be cooked or obtained outside.

Fourth—The cost of an electric range is comparable to that of an electric washing machine.

Successful Local Financing of Small Companies

AMID all the credit difficulties which are besetting central stations large and small, profitable and unprofitable, the Greenville (Ohio) Electric Light Company has been able to get all the money it needed at a cost of virtually 7 per cent net. A block of $25,000 of 7 per cent cumulative preferred stock was sold at par last year at a cost of eighty 2-cent stamps plus the time necessary to dictate and write a form letter. For about the same expenditure of money this spring $125,000 of the same class of stock was disposed of, also at par. These two stock issues almost doubled the capitalization of the company, but nevertheless there was not sufficient stock to satisfy the wants of the buyers.

Many small companies have experienced more difficulties raising money than have the larger companies, because the amount required is often larger than the local banks can handle but too small an amount to interest the bankers at the large centers of finance. D. L. Gaskill, president of the Greenville Electric Light Company, believes that small independent companies must depend largely on the direct sale of securities to customers, local investors and employees. It is a testimonial to the standing of Mr. Gaskill's company in the community it serves that, although the stock sales were not advertised except in an announcement to stockholders and employees, the issues were both oversubscribed. Unfortunately, every company is not so favorably situated; but Mr. Gaskill said: "With intensive sales effort a company can usually sell its securities directly to investors cheaper than they can be sold through intermediary sources. Furthermore, companies can often raise money by direct sales when they could not sell securities to investment bankers at a satisfactory price. It is very desirable to make the interest rate such that the securities can be sold at par, and it is usually easier to do this by direct sales than through the medium of a banker or broker."

Charge for Fuse Replacement Coming Into Favor

FREE replacement of fuses is becoming less popular in New England central stations, according to statements at the recent question-box convention of the New England Section of the National Electric Light Association at Boston. The Narragansett Electric Lighting Company, Providence, R. I., sends a man out from 6 p.m. to 7 a.m., on telephone call, to replace fuses free of charge, but if a call is received during the day, the customer is asked to go to an electrical contractor-dealer. Considering the cost of fuses, time of troublemen, gasoline expense, etc., the yearly expense of fuse replacement by the Providence company is about $3,500. The Fitchburg (Mass.) Gas & Electric Light Company charges for fuse replacement, whether by day or night. The customers are encouraged to buy fuses and stock them in their homes, so that they may replace them themselves. At Hartford, Conn., no charge is made, but the company may make a change in this regard. The Edison Electric Illuminating Company of Brockton, Mass., charges for the fuses but not for transportation or time. The United Electric Light Company, Springfield, Mass., refers trouble calls to electrical contractors by day. At night a nominal charge of 75 cents is made, unless the cost of fuses, such as the main fuses in apartment blocks, exceeds this, in which case the cost of the fuse plus 75 cents labor is charged the customer. No difficulty has been had in explaining the reasons for such a charge to the customer, and no dissatisfaction has come to light.

Utility Offers Six Engineering Courses to College Men

SIX practical courses in applied electrical, mechanical and civil engineering are being offered to college students and graduates by the Milwaukee Electric Railway & Light Company and associated companies. The length of each course is eighteen months and the work is laid out in six divisions. The men receive from $85 to $95 a month to start, depending upon the amount of college work they have done. The salary is then raised every three months, so that during the last three months of the course all the men are getting $120 a month. The salary they are paid after finishing depends upon the ability of the individual and the opportunities for advancement available at that time.

The electrical engineering course is subdivided into meter testing, electric shop and customers' installations, station construction and maintenance, overhead lines, drafting and distribution engineering. The commercial engineering course covers meters and testing, shop and customers' installing, distribution lines, power plants, plant testing and commercial engineering. The combustion engineering course goes into the subject of power-plant combustion, plant testing (junior), plant testing (senior), plant records and plant design. In addition to these courses there are also courses in railroad equipment engineering, way and structures engineering and gas engineering.

Electric Vehicle Technical School Started in Chicago

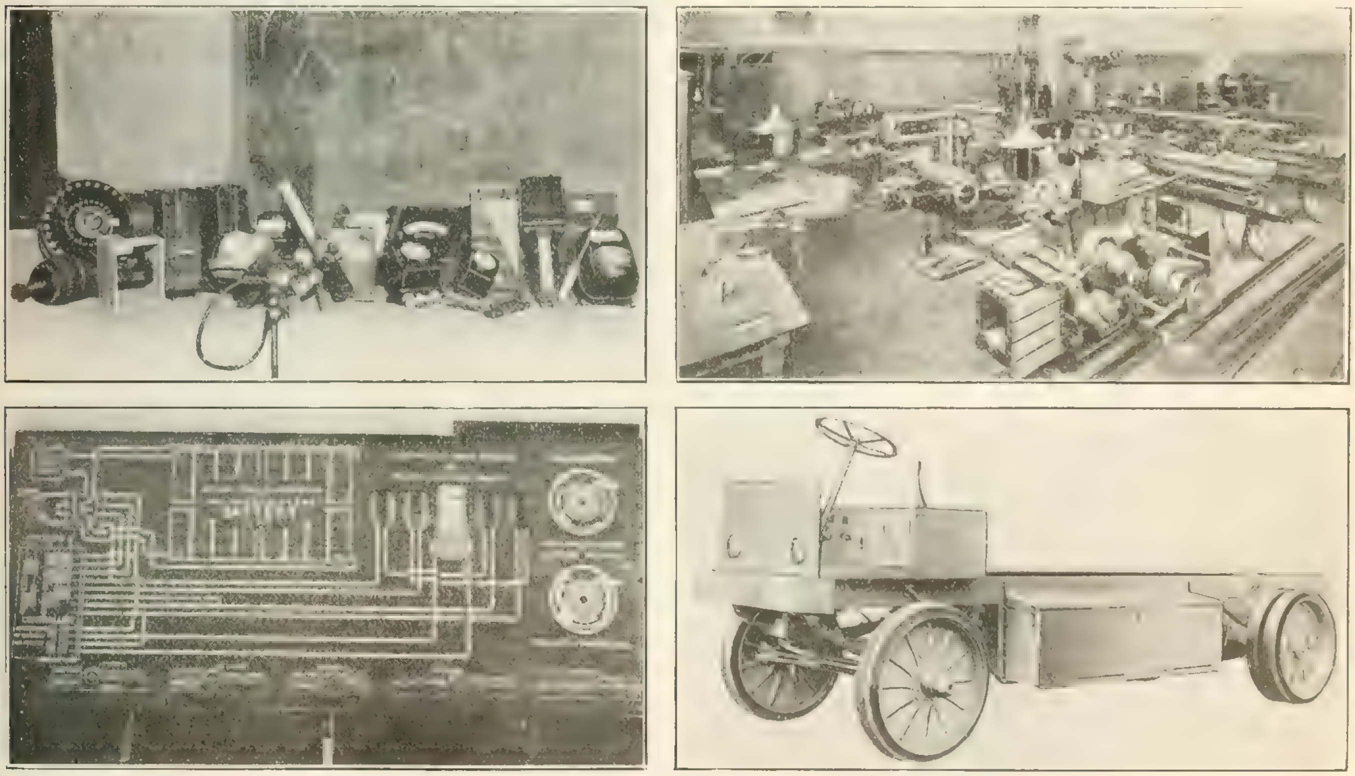
A COURSE of electrical instruction has been inaugurated by the Chicago Board of Education for the benefit of drivers, mechanics, garage employees, owners, salesmen and others interested in electric trucks and pleasure cars. In addition to the necessary machine shops, lecture rooms, testing laboratory and instruments, this school has been supplied with an illuminated wiring diagram. This is mounted on a board and equipped with lights which show the direction of the current through the electrical system of the vehicle at each notch of the controller. After visualizing what happens electrically when the controller is moved, the students are allowed to operate a truck where they are able to see the mechanical effects produced.

Instruction is given in the fundamental principles of electricity and magnetism, the use of electric measuring instruments, characteristics of electric motors and their control equipment, electric vehicle wiring, batteries, charging devices and machine-shop work. This comprehensive course was planned primarily for the benefit of electric vehicle men, but it is expected to disseminate a general knowledge of electrical subjects. The hours of instruction are from 1 p.m. to 5 p.m. on Mondays and Wednesdays, and the course extends over eight weeks. This is said to be the first school of its kind, and when the graduates get out into the electrical vehicle field they are expected to add to the prestige of electric vehicles and to pave the way for their more general use.

The Electric Arc Furnace and the Central Station*

APPLICATION of the arc melting furnace is by no means limited to the steel foundry, but by degrees will find its way into the gray-iron, malleable-iron and brass foundries, and for certain specific purposes into the larger steel rolling mills.

Power requirements of the arc furnace, varying instantaneously from zero demand to a short circuit, are more severe than any load the central station has been called upon to supply, and unless curbed in some manner may seriously retard the development of this field. This might be exemplified by a certain 3-ton, three-phase furnace installation in a steel foundry in Buffalo. The electric service is delivered at 11,000 volts to three 333-kva. transformers from a line used for no other purpose, and the automatic oil switch at the power company's substation end is set to open up at 320 amp., the equivalent of about 6,000 kva. It is a common occurrence for this switch to open up several times during every heat on the furnace. If there were ten, or even five, similarly operated furnace installations on this substation, which is not a future improbability in this



EQUIPMENT OF TECHNICAL ELECTRIC VEHICLE SCHOOL

These photographs show the electrical measuring instruments, the machine shop, the 10-ft. x 6-ft. illuminated connection diagram and the electric road truck used by the students of the electric vehicle school in Chicago.

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*Abstracted from a paper presented by Augustus C. Smith, sales engineer of the Buffalo General Electric Company, at the joint meeting of the American Electrochemical Society and the American Institute of Electrical Engineers.

particular section of Buffalo, the power company would not be able to meet their combined demands.

Against such a possibility the central station must immediately fortify itself. Unless it is to discourage this class of service there must be moderation in furnace operation. The severe manner in which electrical energy is used in the above furnace is not due to furnace design but is caused by the method of operation.

An identical furnace installation in another steel foundry never exceeds a momentary maximum demand of more than 2,000 kva. In another instance the combined momentary maximum demand of two 10-ton three-phase furnaces rarely exceeds 6,000-kva. The feeder switch controlling this circuit is set for 640 amp., or the equivalent of about 12,000 kva., and very rarely opens up. External reactors are used with these furnaces to keep down excessive demands during the melting-down period.

The first steel-melting arc furnace to be installed in Buffalo and operated from central-station power was made in March, 1914. It was a 2-ton, single-phase hand-control furnace. The electrical energy furnished was three-phase, 2,200 volts, 25-cycle, transformed to 220 volts through two 750-kva. Scott-connected transformers. Current-limiting reactance was permanently installed between the transformers and the furnace, which limited the current flow to three and one-half times normal. While about 800 kw. was the maximum power required at the furnace, 1,500 kva. capacity was required on the primary of the transformers. Following this initial installation, a second furnace, similar in every respect to the first and with a like amount of reactance, was installed, a third 750-kva. transformer was added, and the three transformers were connected closed-delta on the primary. It was expected to obtain a better balancing of load across the three primary phases by the operation of the two furnaces, but this did not work out, as the same power requirements in the two furnaces seldom occurred simultaneously. These furnaces are still in operation, but on account of the low power-factor and phase unbalancing they are limited to the use of power at night only.

Here are four distinct furnace installations, the first two indentical in equipment and free from any external reactance, the third provided with removable 15 per cent external reactance, and the fourth with 30 per cent permanent external reactance. The first of the two without reactance uses about six times normal current rating during the melting-down period, while the second rarely if ever exceeds twice normal current rating. It is quite apparent, then, that the method employed in furnace operation has considerable to do with the energy requirements of the furnace. In the third installation the reactance is so connected that it can be cut in on the primaries of the transformers at any time during the heat by means of an oil switch. It is not customary, however, to use this reactance until the heat has been on for about half an hour, or when the electrodes begin to form a hole in the charge. When this reactance is put in use the voltage is increased about 100 per cent by a change in transformer taps.

The external reactance, and possibly the higher voltage used during the melting-down period in this furnace installation, undoubtedly are of material help in keeping down electrical surges, but are not alone sufficient entirely to prevent excessive use of energy, and the reason that these furnaces seldom exceed thir normal current rating is due to the operator's knowledge of both furnace operation and the electrical equipment used and to his skilled manner of handling.

Another furnace is ideal in its simplicity and comparatively free from very severe electrical surges, but on account of its low power factor and phase unbalancing is not acceptable to the central station as a day load.

The greatest difficulties which the central station is going to have from this class of service will come from furnaces which are improperly operated owing largely to the incompetency of the operator and the disregard of the strain put upon the power company's system.

Unless something shall be done to improve these conditions the central stations will be compelled to impose penalties to prevent automatically the reckless use of energy, and they may even be obliged to reserve the right to discontinue service to any furnace where such recklessness continues.

Particular attention should be paid to instructing a new operator how to charge his furnace properly. It is also suggested that a wiring diagram be furnished with every furnace installation. This would be invaluable to the central-station engineer if called upon for assistance in time of electrical trouble. It is believed that furnace transformers should be provided with three or four additional voltage taps, each tap connected with a switch so that the voltage at the electrode can be changed any time during the heat.

It is also believed that a small amount of external reactance, possibly 10 to 15 per cent, should be furnished and connected across a short-circuiting switch so that it can be put in or out of circuit any time during the heat.

Something more than the present electrical data available on furnace operation should be obtained before prescribing a standard for these transformer taps, and the same might be said as to the amount of external reactance to be used.

As the central stations will be called upon to furnish the greater part of the electrical energy used in the operation of electric furnaces, they become a factor to be regarded, and the electric furnace manufacturer should give more consideration to the operating problems with which the central-station company is confronted.

With the co-operation of the electric furnace manufacturers along these lines and their assistance in regulating the operation of electric furnaces, it is believed that the central-station company will be able to meet the future demands from this class of service.

Merchandising Business of Providence Company 23 Per Cent Over Last Year

THE Narragansett Electric Lighting Company, Providence, R. I., has placed 1,000 new wiring contracts for house installations since Jan. 1 and is now taking new applications at the rate of fifteen a day. Sales of electrical merchandise in the company's various electric shops exceed those of last year to date by about 23 per cent. The company has planned to establish another electric shop for retail sales in Providence by June 1. Notwithstanding the shortage of electric motors, the company has succeeded in building up a stock which now is valued at about $40,000, and it is taking on new power business at a rapid rate.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Current Distribution in Laminated Armature Conductors.—F. PUNGA.—In order to cut eddy-current losses in heavy armature conductors, the copper is divided into several bars, which are insulated from each other and connected in parallel. The stranding, however, is not effective unless the strands are so transposed that all the different strands have the same effective reactance, thus causing the current to distribute itself evenly over all the strands. This equalizing of reactance may be made in two ways. Either the composite conductor is twisted inside the slot or else the strands are carried parallel in the slot but are systematically transposed in the coil ends outside the slot. The latter system is taken up for a more detailed discussion, special attention being given to the case of fractional pitch windings.—*Elektrotechnische Zeitschrift*, Jan. 22, 1920.

The Single-Field Cascade Machine.—L. J. HUNT.—The writer describes a single-field type of machine for cascade connection in which only one core is used and the two component fields merge into a single resultant. The two individual stator and rotor windings are replaced by single windings. The stator winding is so arranged that both the "main" and "slip frequency" currents can circulate in it independently. The theory and characteristic of this motor are discussed.—London *Electrician*, April 16, 1920.

Operation of Scott-Connected Transformers.—REQUISTAN and LOUTZKY.—A theoretical and experimental investigation of the operation of three-phase to two-phase transformers in Scott connection under different conditions of unbalanced loads on the two-phase side. A series of tests were made with various degrees of unbalance on the secondary, for determination of the current distribution on the three-phase side, and corresponding vector diagrams were constructed. A special form of the Kapp transformer diagram is derived with particular reference to unbalanced Scott transformers. It is shown that very bad unbalance of voltages and currents result from an unbalance in the two-phase loads, and only when two practically equal loads of the same power factor are connected on the secondary side will a reasonably good balance be obtained.—*L'Industrie Electrique*, Feb. 10, 1920.

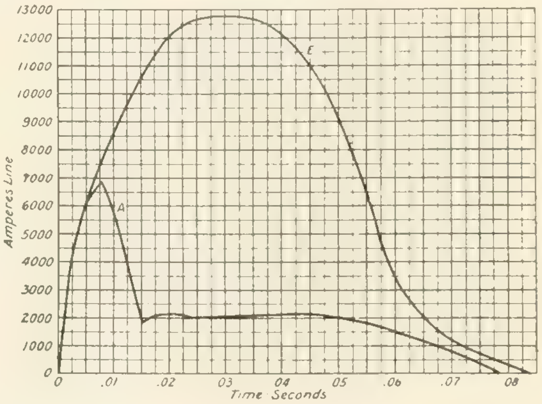
Lamps and Lighting

Illumination Curves Graphically Obtained from the Polar Intensity Curve.—R. B. BÖKER.—The author describes a method for graphical determination of the floor illumination curve directly from the polar intensity distribution curve as obtained in the photometer room. The method is based upon conditions of proportionality in similar triangles. The construction is carried out by means of right angles and compasses only and appears to be adapted for practical use because of its simplicity. A similar method may be used for constructing that intensity curve which will give a certain desired illumination curve.—*Elektrotechnische Zeitschrift*, Jan. 8, 1920.

Generation, Transmission and Distribution

Radio Versus Wired Telephony for Power Systems.—NUEBEL.—The radio-telephone as a means of intercommunication between power stations within a distribution system is sharply criticised from the point of view of economy, reliability and convenience, the wired telephone being said to fulfill better the requirements of a reliable intercommunicating service at a lower cost. *Elektrotechnische Zeitschrift*, Feb. 12, 1920.

New Type of High-Speed Circuit Breaker.—J. F. TRITLE.—The problem of correcting or protecting direct-current generators from flashover became very acute at the advent of the high-voltage direct-current railway electrification. The first high-speed breakers developed for this purpose operated at fifteen times higher speed than standard breakers. In this article a new type of high-speed breaker is described in which all mechanical latches and triggers have been eliminated and the breaker is tripped electromagnetically instead of electromechanically. The power necessary to operate this device has been greatly reduced and the magnetic blowout has been improved, it is said. In the diagram are shown the effects of short circuits on 2,000-kw., 3,000-volt motor-generator sets using (A) a high-speed breaker and (B) a standard breaker.—*General Electric Review*, April, 1920.



HIGH SPEED AND ORDINARY BREAKER ACTIONS

Electrical Characteristics of Transmission Circuits—IX.—WILLIAM NESBIT.—In this number is given the rigorous convergent series solution for the performance of long transmission lines.—*Electric Journal*, April, 1920.

Supplying Electric Steel Furnaces Directly from Central-Station Distributing Systems.—E. F. RUSS.—The question of rate-making in case of industries using large electric steel furnaces is touched upon, and the adaptability of the different furnace types for direct supply from a distribution system is discussed. It is pointed out that induction furnaces, owing to their excessively low power factor and the requirement of extremely low frequencies, practically always must be provided with separate motor-generator outfits, so that the furnace circuits can be electrically separated from the supply. Arc furnaces are less detrimental to the supply power factor, their disadvantage, however, being a certain tendency to give large and sudden variations in load current. It has been suggested that special furnace transformers with large magnetic leakage might be used for smoothing out the load peaks, and various types of choke coils have also come into use for the same purpose. These and various other devices are discussed from the point of view of their effectiveness in transforming the furnace load into a more attractive proposition for the central station.—*Elektrotechnische Zeitschrift*, Jan. 15, 1920.

Heating of Alternators and Induction Motors.—M. Baringolz.—The author derives a set of formulas permitting the calculation of the working temperature (1) of stator copper, (2) of rotor iron, (3) of rotor copper, in alternators and induction motors. The formulas are applied for the computation of the heating of certain existing machines, the results of actual tests substantiating the theory by giving very close agreements with the results of calculation.—*L'Industrie Electroque*, Nov. 25, Dec. 10 and 25, 1919.

Rules for Electrical Machinery.—These rules were adopted at the plenary meeting of the International Electrotechnical Commission held in London, October, 1919. The rules apply to rotating machines of which the terminal pressure does not exceed 5,000 volts, of which the rated output does not exceed 750 kva. or of which the stator cores do not exceed 50 cm. in length axially, and to all transformers which are not water-cooled.—*Publication 34, International Electrotechnical Commission*, March, 1920.

Installations, Systems and Appliances

Stroboscopic Slip Determination.—M. M. Bries.—It is pointed out that in several of the common methods of determining slip difficulty is encountered in the direct determination of slip values in the neighborhood of full load. A modification of the vibrating reed slipmeter has been devised by G. Jenson, by which it is possible to obtain accurate measurements of slips ranging from zero to 10 per cent or more. The device, as used in commercial tests, consists fundamentally of two parts, the electromagnetic vibrator and the slotted disk, arranged so as to be driven at various speeds through a set of gears from the shaft of the motor under test. —*Electric Journal*, April, 1920.

The Glass-Bulb Mercury-Arc Rectifier in Theory and Practice.—Fritz Kleeberg.—After some introductory remarks regarding the physical phenomena of the mercury-vapor arc, the author gives a very thoroughgoing mathematical discussion of the performance of a single-phase rectifier, derives expressions for secondary current and other important quantities, discusses the wave form under different load conditions and analyzes the effect of choking coils connected in the anode and the cathode leads. The theory of a polyphase rectifier, which leads to extremely complicated expressions, is treated more briefly, the resulting formulas, however, being given in full. In emphasizing, as a conclusion, the great usefulness and flexibility of the rectifier, when correctly designed and operated, the writer points out the astonishing increase in capacity to be derived from forced air-cooling of the tube. In a test on one particular type of glass-bulb rectifier designed for 350 volts and 40 amp. the maximum allowable current was raised from 40 amp. to 120 amp. owing to the use of forced air cooling. In another experiment the same bulb, also air cooled, proved capable of handling 8 amp. at 6,000 volts.—*Elektrotechnische Zeitschrift*, Feb. 19 and 26 and March 4, 1920.

Performance of Mechanical Stokers.—David Brownlie.—It is the purpose of the paper to deal with mechanical firing and to present exact figures obtained by the complete investigation of the working of eighty typical Lancashire boiler plants mechanically fired. The results of the author's analysis are shown in the table:

PERFORMANCE OF MECHANICAL STOKERS

	80 Plants Mechanically Fired		250 Plants (76 per Cent Hand-Firing and 24 per Cent Mechanical Firing)	
	No. of Plants	Per Cent	No. of Plants	Per Cent
Over 80 per cent	1	1.25	2	0.8
75 per cent to 80 per cent	2	2.50	9	3.6
70 per cent to 75 per cent	2	2.50	13	5.2
65 per cent to 70 per cent	17	21.25	30	12.0
60 per cent to 65 per cent	11	13.75	44	17.6
55 per cent to 60 per cent	16	20.00	62	24.8
50 per cent to 55 per cent	15	18.75	47	18.8
Less than 50 per cent	16	20.00	43	17.2
	80	100.00	250	100.0

There is little difference, he says, between the result of mechanical and hand firing with the present methods of running boiler plants.—London *Engineering*, March 26, 1920.

Telegraphy, Telephony and Signals

German Contributions to Theory and Practice of Vacuum-Tube Applications.—Owing to the peculiar conditions imposed by considerations of military secrecy upon the development of triode tube applications, the literature on this subject displays some very unusual features. The lack of interchange of ideas between the belligerent nations caused a duplication of effort which led to the evolution of necessary theory on two independent although very similar lines. It is interesting to compare the means and results of the two systems. The importance of the static characteristics was early recognized on both sides, and the characteristic surface was made the foundation for an analytical treatment of the tubes. The useful device of introducing the partial derivatives of plate current with respect to grid and plate voltages due to Latour seems to have been used by Barkhausen at an early date (published in *Jahrbuch für drahtlose Telegraphie und Telephonie*, May, 1919). Barkhausen also introduces—following a private suggestion of Schottky—the notion of the "equivalent circuit" which has long been a useful tool of analysis in this country. He also gives the theory of tubes with two and three grids. The problem of oscillations with large amplitude seems to have attracted more attention in Germany than on this side. One fundamental paper (*Jahrbuch*, May, 1919) is due to Meissner, holder of one of the earliest oscillator patents, who also gives some interesting historical notes. The "dynamic characteristics," introduced by Miller, were derived and employed for analyzing large amplitude oscillations by H. G. Möller (*Jahrbruch*, September, 1919). Rukop is the author of another paper on the theory of triode amplifiers and oscillators (*Jahrbuch*, July, 1919, errata August, 1919). All these investigators deal with power generation and lay much stress upon considerations of efficiency. The theory seems to be founded on empirical conceptions rather than mathematical developments, and the points are usually brought forth by means of schematic diagrams. The design of circuits for tube transmitters is taken up by Vos and Ziegler (*Jahrbuch*, November, 1919) of the Telefunken Company, and an article (*Jahrbuch*, September, 1919) by Ludwig Kühn deals with the development of a line of triode oscillators where the tube is said to operate in another mode than is usual. In the Kühn patents, which refer to circuits where a flywheel circuit is connected between filament and grid, it is claimed that such oscillators operate without "back-coupling," the minute amount of energy necessary for the self-excitation being transferred within the tubes from output to flywheel circuit. These and a great number of other patents in the field are reviewed by Eales (*Jahrbuch*, November, 1919; January and February, 1920). A paper by R. Jaeger (*Jahrbuch*, September, 1919) deals with the experimental testing of tubes by observing the static characteristics and contains a valuable collection of data and curves relating to German and other tubes. A graphical table is exhibited showing the emission characteristics of tungsten filaments in milliamperes per watt, temperature, life length, etc. Some practical experiences regarding evacuation, effect of different materials for constructing the tubes, etc., form the subject of a paper by E. Rückhart (*Jahrbuch*, November, 1919).

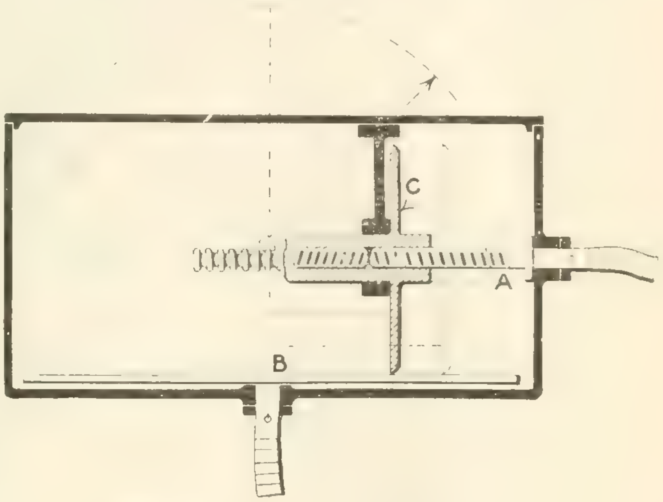
Duplex Amplifiers.—MARIUS LATOUR.—A description of various two-way telephone repeater circuits employing one or two triode tubes and balancing networks. —*Revue Générale d'Electricité*, March 13, 1920.

Naval Aircraft Radio.—T. JOHNSON, JR.—The application of radio to naval aircraft is discussed, together with the difficulties of development, standardization, installation and operation, especially under the stress of war conditions. The first operation of radio on naval aircraft and the development of the earlier types of sets are described. There is next taken up the development work carried on at the naval air station at Pensacola, Fla., and Hampton Roads, Va. A brief review of the standard types of naval aircraft is given, together with the characteristics of the radiating systems applied to them. After consideration is given to several preliminary matters in connection with transmitting apparatus, the standard transmitting equipments are described, performance data being given. Next the standard receiving equipment is taken up, and the principle, applications and performance of the naval aircraft radio compass described. In conclusion, consideration is given to the air-station telephone transmitter and its use in connection with remote-control conversation with aircraft. A recent demonstration of this application for the Secretary of the Navy is described, in which a rather remarkable record for this method of communication was established.—*Proceedings Institute of Radio Engineers*, April, 1920.

The Story of the Insulations.—C. E. SKINNER.—Some experiences with early forms of insulations are recited by the author, and then the characteristics of various insulating materials used at the present time are discussed in the light of developments from the early days up to the present time.—*Electric Journal*, April, 1920.

Units, Measurements and Instruments

A Direct-Reading Slip Meter.—F. E. MYARD.—A sectional view of the interior of the apparatus is shown in the figure. The motor whose slip is to be measured drives by means of a flexible coupling a friction disk *B*, while the shaft *A* is driven from a small synchronous motor. The end of the shaft *A* is threaded and the disk *C*, which is rotated by the friction disk *B*, fits loosely on its threaded part. When *B* is rotating at a slightly lower speed than *B*, the disk C will evidently tend to move along the disk *A* till its angular velocity of rotation becomes the same as that of the shaft *A*; *i.e.*, it tends to adjust itself on that diameter on the disk *B*, where the peripheral velocity equals the synchronous peripheral speed of the disk *C*. The axial displacement of the disk *C* thus is proportional to the slip and is observed by means of rack and pinion and a pointer moving over a scale, which may be graduated directly in slip.—*Revue Générale d'Electricité*, Jan. 19, 1920.



DEVICE FOR DIRECT MEASUREMENT OF SLIP

Miscellaneous

Vacuum and Heat Treatment of Insulating Materials. —J. E. SHRADER.—Considerable difficulty has been experienced in determining the resistance of insulating materials under different conditions of temperature, humidity, etc. The author undertakes to show the effect of moisture removal by both vacuum and heat treatment on the conductivity of some insulating materials. Fish paper, paraffined paper, fullerboard, bakelite and bakelite micarta were investigated. The results indicate the part that moisture plays in the electrical conductivity of insulating materials. This moisture can readily be removed by vacuum and heat treatment, during which treatment its progress can be followed by electrical measurements. The author states that conductivity in this class of materials depends largely upon the amount of moisture present, by which means only can conduction take place, and that the insulating properties of a dielectric depend largely upon its tendency to absorb moisture. It was noticed that most of the materials tested became very good insulators after the treatment given. This property is not altogether permanent when the materials are again exposed in a humid atmosphere.—*Electric Journal*, April, 1920.

Heavy buying is continuing in the electric supply field, although it is believed to be less than would take place were more stocks available. Jobbers are going a little easier on long-term buying.

Freight is moving in better condition than it was a week ago, but all the shipments of the past three and four months are not yet cleaned up. At the same time, new stuff is coming through better; but the situation is far from normal and manufacturers are still hard up against the raw-material problem, while their storage space is congested with finished goods.

Steel and porcelain products are extremely short in jobbers' hands. Here and there pipe, armored conductor, boxes, etc., have come in, but they are immediately required on back orders. Lamp stocks are broken, and shortages are beginning to be felt in rubber-covered wire because of the traffic conditions.

The high-tension insulator market is active and shipments are getting longer. Orders for aluminum conductor are being refused because factory capacity is oversold, and a limit to supply of raw materials is in view. Demand, both foreign and domestic, is good.

While notice is received that the assets of the Bluebird Manufacturing Company are double the liabilities, it is learned that a receiver has been appointed for the electric machinery company. The Langmuir gas-filled lamp patents have been upheld in the United States Courts.

Heavy buying has been reported in the electric toy market. The public is demanding more educational and useful toys, and more attention is being paid to workmanship and material.

Although railroad conditions are improving somewhat in New England, one of the largest jobbing houses had a quarter of a million dollars' worth of material en route from factory to Boston stock the first of the week.

Perpetual right to the water resources of the Skagit River has been granted to the city of Seattle, Wash., by the United States Department of Agriculture as a source of power for the city's lighting system.

The project for a federal Department of Public Works has been disapproved of in the referendum on the subject taken by the Chamber of Commerce of the United States at the instance of the Engineering Council.

Owing to the failure of the President to sign the water-power bill and the hasty adjournment of Congress, the measure has failed to become law up to the time of going to press, but there is a rumor that the President may still sign it and his signature be held constitutional.

According to figures on energy production just issued by the Geological Survey for the first quarter of 1920, the average daily production from 2,800 power plants was 124,600,000 kw.-hr. in January, 119,800,000 kw.-hr. in February and 121,800,000 kw.-hr. in March.

News in Brief

Summary of Market Conditions and of Recent and Approaching Happenings of Importance to the Industry

Cleveland, Ohio, has been selected as the place for the annual convention of the Illuminating Engineering Society, which will probably be held in the last week of September.

A bill providing for the development of water power and the construction of reservoirs for better conservation, under the oversight of the state, is before the Massachusetts State Senate.

The president of the National Fire Protection Association ascribed carelessness on the part of consumers as the chief cause of fires due to electricity.

A platform expressing the views of the United States Chamber of Commerce on labor relations has been submitted to a referendum of the organizations composing the national chamber.

Suggested planks covering questions with a direct bearing on business prosperity were submitted to the platform committee of the national Republican convention by a committee of the National Association of Manufacturers.

Construction of the first unit of a plant for the fixation of atmospheric nitrogen has been commenced by the Atmospheric Nitrogen Company at Solvay, N. Y.

By a decision of the Supreme Court of Missouri the right of the Cupples Station Light, Heat & Power Company to furnish electrical energy in St. Louis has been sustained.

Prof. H. A. Bumstead of Yale has been elected president of the National Research Council for the year beginning July 1.

A request to the Public Utilities Commission of Idaho for a 60 per cent increase in rates for irrigation pumping brought the Idaho Power Company only a 10 per cent increase on existing business and 20 to 25 per cent on new contracts. This decision, however, is to hold for 1920 only, pending further hearings.

Rapidly growing load has led the Havana (Cuba) Electric Railway, Light & Power Company to plan to double its present plant capacity of 37,500 kw. in the near future.

Conservation of hydraulic resources under state supervision in Massachusetts failed to pass the 1920 Legislature, which was prorogued on Saturday.

Synchronous condensers aggregating 30,000 kva. have now been installed or authorized for early use on the New England Power Company's system. These are installed at substations in 7,500-kva. units.

An appropriation of $125,000 for a study of power production by the Geological Survey was carried in the sundry civil bill passed before Congress adjourned.

California power companies have agreed not to obligate themselves to supply any power demand of 15 hp. or more without first submitting the matter to Power Administrator Butler for determination of its necessity.

Plans are being prepared for the establishment at Seaton Lake, in British Columbia, of a hydro-electric plant rated at 175,000 hp., to cost $12,000,000.

Electric locomotives of the type used by the Chicago, Milwaukee & St. Paul Railway will be used on the London & Northwestern, according to Sir Vincent Raven, chief mechanical engineer of the British railway systems, who with his assistants has just completed a tour over the electrified American road accompanied by the president and vice-president of that system.

Daylight saving from the second Sunday in June to the last Sunday in October has been decreed by the Chicago City Council.

A general increase in rates of nearly 20 per cent is sought by the Detroit Edison Company.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

National Manufacturers Urge Their Platform on Republican Convention

A COMMITTEE of five representatives of the National Association of Manufacturers went before the resolutions committee of the national Republican convention at Chicago this week and urged the incorporation into the platform of that party of the "platform for American industry" which was adopted by the National Association of Manufacturers at its annual convention in New York City. The manufacturers' association represents 5,400 industrial establishments employing more than 6,000,000 persons and producing about 75 per cent of the manufactured output of the United States. The members of the committee were A. B. Humphrey of the Westinghouse Air Brake Company, chairman; E. B. Leigh of the Chicago Railway Equipment Company; James A. Emery, general counsel of the National Association of Manufacturers; J. Philip Bird, general manager, and Stephen C. Mason, president of the association.

The nine planks advocated by the association may be summarized as follows: (1) Opposition to government ownership or operation of industry; (2) employers' and employees' associations to be alike subject to public authority; (3) protection of every citizen in the pursuit of lawful business or occupation; (4) repeal of the excess-profits tax and substitution of a tax on gross final sales; (5) development of a constructive plan of national transportation, interrelating railroads, waterways and hard-surfaced roads; (6) control of immigration at the source and supervision of its distribution; (7) building up of an American merchant marine privately owned and operated; (8) encouragement of foreign trade and a liberal policy toward the nation's allies in the late war; (9) generous provision for injured soldiers and for the dependents of those slain, but opposition to a general cash bonus.

Chamber of Commerce to Hold Referendum on Labor Relations

THE United States Chamber of Commerce has submitted for a referendum vote to the 1,300 and more organizations composing its membership a number of propositions outlining the suggested attitude of the chamber on labor relations. These propositions favor freedom of contract, the open shop, state control alike of employers' and employees' organizations and, generally, a conservative policy. On labor as related to public utilities the report of the chamber says:

"In public service activities the public interest and well-being must be the paramount and controlling consideration. The power of regulation and protection exercised by the state over the corporation should properly extend to the employees in so far as may be necessary to insure the adequate, continuous and unimpaired operation of public utility service."

In accordance with this declaration of principle, two recommendations made by the Merchants' Association of New York and other business associations and reported on favorably by the chamber's committee on public utilities, of which Lewis E. Pierson is chairman, are among the propositions on which the referendum will be had. These two suggested planks are as follows:

"Strikes by employees of all public service corporations performing public service essential to the lives, health, well-being and comfort of the people should be explicitly prohibited by law."

"Suitable tribunals should be created by the law to adjudicate differences between employees of public service corporations and their employers, and the decisions of such tribunals should be final and binding upon both parties."

Pocket Veto of Water-Power Bill "Invalid"

ON GOING to press the ELECTRICAL WORLD learns of a fine legal situation surrounding the so-called pocket veto which gives reason for belief that the water-power bill will be signed by President Wilson and become a law before this issue reaches its readers. Attorney-General Palmer, according to a statement issued Thursday morning by J. P. Tumulty, secretary to the President, had just rendered an informal opinion, to be confirmed later by a formal opinion, saying that the pocket veto is "invalid" and that the President has ten days, not counting Sunday, in which to sign legislation. This gave the President until midnight of June 11 to sign the water-power bill.

It has been customary to regard legislation in the hands of the President at the close of a Congressional session and not acted upon by the Chief Executive as of no effect. Precedent certainly, as pointed out in the editorial on pages 1351 and 1352, has given every warrant to this construction of the clause in the Constitution governing the matter.

Distinction between the end of a Congressional session and the end of a Congress, which occurs on March 4 at noon each second year, became a fine point in the issue. Precedent for executive approval was found in the case of an act signed by President Lincoln under similar circumstances, which act has been confirmed by Supreme Court decision holding it to be proper and effective as completion of the law.

Opportunity therefore seems to be afforded for President Wilson to act on the measure at any time within the ten-day period following the presentation of the bill to him, that is, on or before June 11.

Explanations that do not explain are the order in Washington with respect to the water-power bill, which the correspondents of the daily press and others versed in political and legislative affairs at first agreed became of no effect by the failure of the President to sign it before adjournment of Congress on Saturday of last week. The nearest to an official statement in the matter was made informally by Private Secretary Tumulty, who announced that Secretary John Barton Payne of the Interior Department was vigorously opposed to the measure and then later stated that the President had received this and other bills too late to permit consideration and favorable action in view of a serious difference of opinion which had developed.

The water-power bill went to the President for signature the middle of last week. On Thursday it was referred to the Secretaries of War, the Interior and Agriculture, who by the terms of the bill would have been members of the proposed Federal Power Commission. All three Secretaries reported to the President on or before Saturday, June 5. It is definitely known that the Secretaries of Agriculture and War reported favorably, recommending that the bill be signed. However, Mr. Tumulty's statement, above referred to, clearly implies that the Secretary of the Interior's advice was against the bill. This fact is also borne out by the general belief that Secretary Payne is personally opposed to the measure. The nominal ground upon which he is supposed to have recommended a veto is that such an act would tend to destroy the national parks. Considerable credence may be given to the story on the ground that Judge Payne has been since 1911 president of the Board of South Park Commissioners of Chicago, and this activity is known to have aroused great personal interest and attention from the President.

SEVERAL OPPOSING INFLUENCES

There is no question that several influences are still opposed to the bill. As late as the time of the conference report to the Senate, barely a week before passage, Senators Lenroot, King and Norris all took occasion to point out their objections. Two grounds for opposition were cited: First, that the proposal made the development of water power a dominating influence, even giving the right to the federal commission to interfere with navigation on important navigable streams; second, that the terms for continuing a license after the initial period were such as to give practically a perpetual lease to the original licensee.

It is probably the opposition thus voiced which leads to the common rumor in Washington, which, however, cannot be confirmed, that either Senator Lenroot or Senator King had some influence in causing the "pocket veto." In any event great surprise is expressed at every turn that the President should have declined to sign a bill of such great importance solely on the ground that possibly some measure of damage might be done to the national parks.

Two power projects had been suggested as the possible cause of Secretary Payne's objection. It had been proposed that a dam be placed near the Idaho state line, just outside of the boundaries of Yellowstone Park, in such a way that the storage of water would have been within the park territory. Another dam on the Yellowstone River, within the boundaries of the park, had also been proposed. It is quite possible that these two projects among others may have been the cause of the Secretary's opposition. However, he had refused to make any statement in the matter to the press up to the time that this was written.

The bill provides that licenses may be granted for dams, reservoirs and other projects in or upon any part of the public lands and reservations of the United States. These reservations are defined specifically to include national monuments, national parks, national forests, etc. It is evident, therefore, that one who desired to object on this ground would find some measure of plausibility for so doing in the terms of the proposed act.

In view of the fact that objection came from the Interior Department, it was questioned whether the United States Geological Survey might not also have opposed the legislation, but Dr. George Otis Smith, director of the Geological Survey, said: "It was as much a surprise to me as to any one else that the bill was not signed."

FAILURE TO SIGN BILL CALLED ATTENTION TO AT REPUBLICAN CONVENTION

At the time that the water-power bill was left without signature at the close of the Congressional session, it was probably not realized that this legislation would become a matter of extremely great political significance in the Republican-Democratic conventions as to the achievements of the session just closed. However, the matter was deemed of such great importance by the Republicans that Senator Lodge, in his keynote speech at the Republican convention, made reference to it. The platform committee of the convention has also been urged to incorporate a plank in the platform on the matter by the American Forestry Association, which appealed to this committee in the following language:

"Water-power development is so essential in newsprint production, which affects all the newspapers of the country, and is so imperative in every economic sense, that the action of President Wilson in failing to sign the water-power bill, passed by Congress, blocks constructive legislation for increased production which the nation demands.

"The President has killed the water-power bill by his pocket veto, and his action, which stifles economic development, will cost the country dearly and it will in numerous ways aid in maintaining the high cost of living and retard increased production, so vital at this time to all our people."

Official Washington has also busied itself in the matter and not a stone was left unturned in the effort to locate some means whereby the completion of the legislation could be accomplished. It was even rumored that the Secretary of the Interior was to withdraw his objection to the bill, so that there might be no ground for the charge that the administration is hostile to it. In any event it was clear that the friends of the measure refused to lose hope in the situation, both with respect to the political aspects and the actual accomplishment of the end sought.

Late developments this week indicate additional support for the rumor that Secretary Payne opposed the legislation on the score of its possibilities in the despoliation of our parks. It is recalled that the Secretary has vigorously criticised the Director of the Reclamation Service for the latter's proposal that the Yellowstone development be made as above referred to. In this matter, the Secretary is quoted as being unalterably opposed to the projected legislation, but political exigency is often a potent influence in such cases. In this matter he is regarded as having out-Pinchot-ed the original.

Missouri Flexible-Rate System Recommended

LEGISLATORS of Missouri were temporarily displaced by other servants of the people when the Missouri Association of Public Utilities held its fourteenth annual convention in the State Capitol at Jefferson City last week. The association members and guests were welcomed by Lieut.-Gov. Wallace Crossley, who said that the state was about to experience great industrial development and that the utilities should be equipped to supply the additional service that will be required of them.

In an interesting paper on "Merchandising of Electrical Appliances," C. E. Michel, sales manager of the Union Electric Light & Power Company, St. Louis, enumerated some of the factors which should be considered in the formulation of a set of electrical merchandising fundamentals.

Public utilities should render the best possible service under the conditions, not only because it is the duty of the company to do so, but because it is very difficult for a commission to give relief from inadequate rates when the service is not what it should be, William G. Busby, chairman of the Public Service Commission of Missouri, said in an address on the advantages of state as compared to municipal regulation.

"Large numbers of rates have been changed," said Mr. Busby, "from a fixed to a flexible basis in Missouri, and this is as it should be. Rate schedules should meet changing conditions and costs of operation, and for this reason flexible schedules are more scientific and better for both public and utility than are schedules with fixed rates."

"Utilities have been yellow," said M. H. Aylesworth, executive manager of the National Electric Light Association, in the course of an address on "Public Relations." "Central-station men have allowed agitators to denounce their companies without replying and without giving the public the correct information about the central-station business. Utility men should get out and fight those who malign them, as dishonest attacks will be prevalent until they are exposed by an honest defence. More emphasis should be placed on the service rendered, and the name of the company's bills should be changed from light bills to service bills."

That the weakness of most utility financing is because securities have been mainly sold outside of the community served was an opinion expressed by C. E. Randall of the Bank of Commerce, Springfield, Mo.

In a paper on the manufacture of raw-water ice, George E. Wells, consulting engineer of St. Louis, told the operators of small central stations how they could build up their revenue by either operating an ice plant or selling power to an ice-manufacturing company. The records of past water-power development in Missouri and the possibilities of future development were outlined in a paper presented by P. J. Sargeant of the Empire District Electric Company, Joplin, Mo.

At the closing session the association decided to affiliate with the Southwestern Division of the National Electric Light Association and with the Commercial Gas Association. The officers and committees elected to serve for the year 1920-1921 were as follows: President, L. P. Andrews, Sedalia; first vice-president, Herman Spoehrer, St. Louis; second vice-president, Col. P. J. Kealy, Kansas City; third vice-president, E. R. Locke, Mexico; secretary-treasurer, Frank D. Beardslee, St. Louis.

Further Changes in Grounding and Station Rules of Code

FURTHER proposed changes in the rules on station equipment and on grounding service wiring have been issued by the Bureau of Standards. Comments on these proposals are requested before June 20, as it is desired to close the new edition of the code on July 1.

In the matter of guards for station equipment, the new rules require that exposed current-carrying parts of more than 7,500 volts must be protected by inclosures or barriers. For current-carrying parts between 750 volts and 7,500 volts, if inclosures or barriers are not practicable, insulating floors, platforms or mats shall be provided, and in addition permanent insulating guards shall prevent persons from touching the current-carrying parts and other live or grounded parts at the same time. For current-carrying parts between 300 volts and 750 volts, not isolated by elevation and not guarded by inclosures or barriers, insulating floors, platforms or mats shall be provided.

Low-voltage protection is now required for any motor so arranged that unexpected starting of the motor is a hazard, except those with an emergency use and where opening the circuit may cause a greater hazard. Motors with their auxiliary equipment which are liable to sparking or arcing or high temperature must be solidly inclosed if installed in a room containing explosives, inflammable gas or flyings.

Instead of one ground detector for each circuit leaving a station, the rule now provides that one or more means of ground detection must be installed in any station where circuits are not permanently grounded and that this ground detector may be applied to any such circuit extending outside the station. Equipment which does not require fuses or automatic circuit breakers (Rule 165) now includes electrically driven generators and rotary converters adequately protected from excessive load by fuses or circuit breakers in the motor leads or primary supply leads, ground conductors, field circuits, alternating-current generators protected by reactance. Arresters are now required on circuits over 7,500 volts, but not in locations where thunderstorms are infrequent at all seasons.

The rules on grounding require that, except in ice houses, packing plants, etc., where a great deal of moisture is present, no separate ground conductor shall be required for non-current-carrying part of equipment if grounded through the conduit, cable sheath or metal-raceway system of the building by means of standard lock-nuts and bushing or by a separate bond. The ground connections for non-current-carrying parts may be made to water piping at a point near the part to be protected, provided that there are no insulating joints in the pipe to prevent a good ground. It is not now necessary to shunt water meters when ground connections are made on the house side of the meter as it was according to the old rules. The ground conductor for a three-wire direct-current system shall have current capacity not less than the neutral conductor to which it is attached except when the neutral conductor is larger than No. 0000 copper wire, which is the largest size required for a ground conductor.

I. E. S. to Meet in Cleveland at End of September

The fourteenth annual convention of the Illuminating Engineering Society will be held in Cleveland, Ohio. Sept. 27, 28, 29 and 30 have been chosen tentatively as the dates, subject to change by the local convention committee.

It was stated at headquarters of the society this week that the State of Maryland had adopted last week the I. E. S. automobile headlight specifications and that the State of New York is revising its rules to conform to the most recent I. E. S. specifications.

Havana Utility to Double Plant Capacity

To take care of its rapidly growing load and still have some surplus capacity available, the Havana (Cuba) Electric Railway, Light & Power Company will double its present plant capacity. The present plant has three 12,500-kw. turbines with room for a fourth. Two Westinghouse 25,000-kw. units have been ordered, one to be installed in the available space and the other to replace one of the 12,500-kw. units.

The first unit will be installed and will be in operation in 1921, and the second one will be on the line in 1922. The units are to be designed to operate at 185 lb. pressure (13 kg. per sq.cm.), 150 deg. (83 deg. C.) superheat and 28 in. (700 mm.) vacuum.

Mr. Gompers' Belated Reply on Public's Rights

After nine days' delay Samuel Gompers issued early this week a reply to the question asked him by Gov. Henry J. Allen of Kansas at their joint debate in New York City and left unanswered at that time. The question, which was printed in last week's Electrical World, is reproduced below, together with Mr. Gompers' reply in full, which was prefaced with a reiteration of his claim that the query was "improper":

Q. When a dispute between capital and labor brings on a strike affecting the production or distribution of the necessaries of life, thus threatening the public peace and impairing the public health, has the public any rights in such a controversy, or is it a private war between capital and labor? If you answer the question in the affirmative, how would you protect the rights of the public? And, in addition, define for us, if you will, who had the divine right to forbid the switchmen to strike in their 'outlaw' strike. Who controls this divine right to quit work?

A. The strike is the only effective weapon by which the workers may compel consideration of just demands. It is a weapon the use of which entails serious consequence, but the question of life, which is the question at issue, is a serious question. It is much more serious to strikers than it is to Gov. Allen or members of employers' associations. The freedom of workmen in enjoyment of the right to strike means the freedom of men to make life better, safer, happier—the right of men to elevate the whole tone of society and to force abolition of abuse, injustice and oppression. There is no denial that strikes of magnitude temporarily affect the general public. Few strikes affecting production or distribution actually threaten the public peace and fewer become a menace to the public health. Strikes in which there has been a threatening of the public peace usually have been strikes in which employers, or public officials influenced by employers, have created the breach of peace by the use of thugs, armed guards and detectives. The necessity for order and obedience to laws governing conduct is impressed upon every striking organization by its leaders. The conscience of employers and of officers of the law has frequently not been so clear. Labor has no desire to cause inconvenience to the public, of which it is a part. The public has no rights which are superior to the toiler's right to live and to his right to defend himself against oppression. So far as labor is concerned, the right to strike must be and will be maintained, not only as a measure of self-defence and self-advancement, but as a measure necessary to public progress. The first step toward conservation of the rights of the public lies in a real and intelligent understanding of industrial problems by all of the people, and in the possession of that understanding the people will see that public and general welfare cannot be conserved by denying fundamental liberties to the useful members of society. The right to strike, with all its disadvantages, is an agency of progress, a buttress of manhood, of health and vigor, a promoter of public thought and education—an instrument for good, democratic in concept and essential to freedom. Its greatest justification is found in its results.

American Engineers to Help Solve Italian Inductive Interference Problems

To confer with representatives of the Italian Government and Italian engineers in connection with railway inductive interference problems in telephone and telegraph work, Charles F. Scott, professor of electrical engineering at Yale University, and L. P. Ferris, of the engineering organization of the American Telephone & Telegraph Company, sailed for Europe on Saturday, May 29. The Italian Government is planning the installation of a modern telephone network which will connect Milan, Genoa, Touraine and Rome. At the same time, owing to the fact that Italy must import all of its coal at a cost of $30 to $40 per ton extensive hydro-electric development is contemplated looking to the ultimate electrification of its railway systems.

As both Professor Scott and Mr. Ferris have been widely engaged in the study of inductive interference in the United States, they were selected to go to Italy as representatives of the Western Electric Company.

Professor Scott is well known in this field, having made early studies in Indiana and later on the New York, New Haven & Hartford Railroad and Pennsylvania Railroad systems. Mr. Ferris has been active in the California inductive interference work in this line for the past five years.

Dr. Rosa Suggests Government Research on Utility Problems

Active co-operation by the government with public utilities in the study of the engineering involved in rendering good service to the public was urged by Dr. E. B. Rosa, chief physicist, Bureau of Standards, in an address, entitled "The Economic Importance of the Scientific Work of the Government," made on May 20 before the Washington Academy of Sciences.

"If the government would help the companies," Dr. Rosa said, "to help themselves, it would be better than an increase in rates. The government could render a service of immense usefulness and importance by studying the problems of public utilities and helping the companies to secure more efficient operation and a better public understanding of their difficulties and needs.

"If the utility's credit is impaired or it fails altogether, the community, as well as the company, suffers. It is essential, therefore, that the public should take a keen and intelligent interest in public problems, and especially in the situation which has resulted from the rising cost of labor and commodities, for which the utilities are not responsible."

Electrical Manufacturers' Council Opens Permanent Office

THE Electrical Manufacturers' Council has opened an office in the Fifth Avenue Guaranty Building, 522 Fifth Avenue, New York. This office will serve as a headquarters for the council and its work. The council co-ordinates the work of constituent organizations of the electrical manufacturing industry, and its activities have been increased with the development of those organizations and the growth of the industry. The constituent organizations which have representatives on the council are the Associated Manufacturers of Electrical Supplies, the Electrical Manufacturers' Club and the Electric Power Club. Frederic Nicholas, as already announced in the ELECTRICAL WORLD, is executive secretary.

Interconnection of Industrial Power Plants Discussed

IN THE absence of D. M. Petty, Bethlehem Steel Company, who was to present a paper on "Interconnection of Industrial Power Plants" at the June 8 meeting of the Pittsburgh Section, A. I. E. E., a discussion of this subject was given by several engineers of the Pittsburgh district. This discussion was led by E. C. Stone, Duquesne Light Company, who spoke of the disadvantages of industrial-plant interconnection by illustrating the value of central-station interconnection. In the case of the central station, Mr. Stone said that the interconnection was really a byproduct of two well-developed nearby systems tied together by short transmission lines. Even if long lines were necessary, the load which the line itself could supply directly would justify the expense.

There were some advantages of connecting industrial plants, Mr. Stone thought, these being:

1. Reducing the ratio which the capacity of the largest motor bears to the power plant capacity feeding it.
2. More efficient use of the generating equipment through diversity of load and consequent higher load factor.
3. Pooling of emergency resources.

The advantages of interconnection, however, are not to be obtained by merely building a few transmission lines between the various power plants. On the contrary, they require an adequate engineering department and a consideration of the following points:

1. Construction of proper tower lines having sufficient capacity to provide the necessary synchronous power between plants and to handle the biggest loads that are to be interchanged.
2. Installation of switches and circuit breakers to take care of concentrated generating capacity.
3. Provision for voltage regulation.
4. Adjustment of governors on prime movers to provide proper division of load.
5. Installation of protective devices to isolate breakdown.
6. Organization of line force for maintaining lines.
7. Working out of a contract or operating agreement so that operating economics will be realized by all concerned.

J. T. Thomas, West Penn Power Company, pointed out the advantages of interconnecting several plants in different localities with special reference to the coal situation last fall.

F. C. Hanker and H. W. Smith, Westinghouse Electric & Manufacturing Company, discussed interconnection with relation to protective devices to insure continuity of operation.

John Kelly, secretary Association of Iron and Steel Electrical Engineers, pointed out the economical considerations of interconnecting industrial plants with respect to the waste heat.

R. J. Wensley and G. E. Stoltz of the Westinghouse company told how industrial plants could be interconnected. The Bethlehem Steel Company, it was learned, intended to connect its Sparrows Point (Md.) and South Bethlehem (Pa.) plants through the systems of the Pennsylvania Water & Power Company, the Consolidated Gas, Electric Light & Power Company of Baltimore and possibly the Lancaster (Pa.) company. As this interconnection involves all 25-cycle service and stations of such magnitude (ultimate rating of Sparrows Point plant will be 200,000 kw.), it was thought that this project would work.

At the annual election of officers for the Pittsburgh Section B. C. Hennison, Carnegie Institute of Technology, and H. W. Smith were chosen president and secretary respectively. New members of the executive committee are W. H. Schaefer, J. V. Peters, O. Needham and A. L. Broomwall.

Work Started on Initial Unit of Large Nitrogen Plant

CONSTRUCTION of the first unit of a plant for the fixation of atmospheric nitrogen has been commenced near Syracuse, N. Y., by the Atmospheric Nitrogen Company, a five-million-dollar corporation formed late last year. Power for the operation of the first unit, requiring about 500 kw., will be purchased from Niagara, Lockport & Ontario Power Company.

A 60-acre site has been acquired at Solvay, outside of Syracuse, and if present plans are carried out an extensive new power-consuming industry will be built up. At the office of the General Chemical Company, which, together with the Solvay Process Company, is interested in the new plant, it was stated to a representative of the ELECTRICAL WORLD that if the present arrangement for power proves satisfactory on the first unit, the electrical load probably will be increased to fifty times the initial installation.

Public Works Referendum Fails to Carry

ESTABLISHMENT of a federal Department of Public Works will not be advocated by the Chamber of Commerce of the United States. Results of the referendum on this subject, which was taken at the instance of the Engineering Council, were announced at the beginning of the week. The returns disclosed an especially strong sentiment against the creation of an entirely new and independent department, the vote being about four to one against it. The votes on the three propositions submitted were:

"Shall a Department of Public Works be established by the national government?" In favor, 826; against, 549; necessary to carry, 917.

"Shall a Department of Public Works be established by a suitable modification of the existing Department of the Interior, excluding therefrom the non-related bureaus and offices by change of name from the Department of the Interior to the Department of Public Works?" In favor, 675; against, 679.

"Shall a Department of Public Works be established by creation of an entirely new department?" In favor, 282; against, 992.

British Columbia Electrical Men Meet

MORE than 200 electrical men from all branches of the industry in the Canadian Far West met at Vancouver, B. C., on May 31 and June 1 for the annual convention of the Vancouver Association of Electrical Contractors and Dealers. President E. Brettell made a welcoming address, and merchandising topics were discussed by H. B. Kirkland, vice-president American Wiremold Company; M. K. Pike, general sales manager Northern Electric Company, Montreal; O. H. Caldwell, editor *Electrical Merchandising*, New York, and W. L. Goodwin, General Electric Company, Schenectady, N. Y.

At a luncheon meeting William McNeill, assistant general manager Western Power Company, Vancouver, spoke on the reconstruction problems of the world. E. E. Walker, sales engineer British Columbia Electric Railway Company, Vancouver, opened the second day's session with a discussion of co-operation in the industry, and J. Lightbody, publicity manager of the same company, read a paper on "Co-operative Advertising."

Geological Survey Gets $125,000 for Study of Power Production

THE sundry civil bill, which passed both houses and was signed by President Wilson last week, provides $125,000 for the Geological Survey "for a survey of power production and distribution in the United States, including a study of methods for further utilization of water power and the special investigation of the possible economy of fuel, labor and materials resulting from the use in the Boston-Washington industrial region of a comprehensive system for the generation and distribution of electricity to transportation lines and industries and the preparation of reports thereof." The Secretary of the Interior is also authorized to receive contributions to supplement this appropriation and to be expended under its provisions. The Geological Survey announces no plans as yet, but will present a program in the near future. It is probable that outside engineers will be engaged to direct all major parts of the investigation.

Mobridge Hydro-Electric Development by South Dakota Recommended

THAT the hydro-electric development on the Missouri River four miles above Mobridge, S. D., at an estimated cost of $9,103,000 for plant and hydraulic works and $7,044,000 for primary and secondary transmission lines and substations, is feasible for the State of South Dakota but not as a private project is the conclusion of the report by Daniel W. Mead and Charles V. Seastone, consulting engineers to the Hydro-Electric Commission of the State of South Dakota. Eight units of 6,000 hp. each under a head of 30 ft. (9 m.), with 110,000 kw. transmission lines reaching Aberdeen, Redfield, Huron, Mitchell, Tripp, Yankton, Sioux Falls, Madison, Brookings, Watertown and Webster, with a step-down substation at each of these points and secondary transmission lines at 33 kv. reaching the smaller communities in the State east of the Missouri River, are proposed for the initial development. A 1,400-ft. (427-m.) dam, a power house 384 ft. (117 m.) long, a lock with 60 ft. (18.3 m.) clear width and 350 ft. (106 m.) long, and 1,200 ft. (365 m.) of earth dam with concrete core wall compose the hydraulic works. Under present development conditions only that portion of the State east of the Missouri River can be considered, and it is estimated that if the plant can be completed by 1925 and a market developed simultaneously with the plant 53,156,830 kw.-hr. can be generated for that year at a cost (including interest, depreciation and operating charges) of 2.65 cents per kilowatt-hour. By the year 1930 if a market for 85,593,500 kw.-hr. (the approximate maximum capacity of the site) can be developed, the cost would fall to 1.65 cents. Should the market not develop to these figures, the cost of generation would increase, the cost of a minimum 30,000,000 kw.-hr. output for the first year being estimated at 4.70 cents per kilowatt-hour.

If the market will warrant, an increased expenditure of $2,300,000 will permit development of the site for a 40-ft. (12.2-m.) head with a maximum capacity of 117,000,000 kw. per year, at an estimated cost of generation of 1.35 cents per kilowatt-hour. Eight possible power sites on the Missouri River, at Medicine Butte, Little Bend, Bad Hair, Mulehead, Chamberlain, Reynolds Creek, Mobridge and Big Bend, were investigated. The Mobridge site was selected for the first development because the site admits of the most economical development up to a capacity well within the estimated requirements of the State for many years.

New England N. E. L. A. Section President on Co-operation with Contractors

"FAITH in the other fellow is the true basis of co-operation," declared President C. R. Hayes of the New England Section of the National Electric Light Association at a meeting on May 20 of the Massachusetts State Association of Electrical Contractor-Dealers at Boston.

"Both contractor and central station can be making money without injuring the other," said Mr. Hayes. "Some of you may feel that the electric light company is standing between you and success. Nothing could be further from the truth. How many electrical contractors would there be today if it were not for the optimism and energy of the central stations? You men who are successful have got to admit that you 'arrived' through your willingness to co-operate with the electric light company. You men who have been successful realize, I know, that a very fertile field has been prepared by the electric light companies.

"Good legitimate competition is not going to hurt any one. Competition in any line of business is bound to make that business prosperous. You contractors can make more money with the central station as a competitor in certain lines than you would otherwise.

"Both interests must play square. The central station, if it is planning a campaign, must let every one in on it. Have no price cutting, no haggling and no underhanded competition. Any policy of merchandising that antagonizes the local trade and causes it to talk against the utility is unprofitable. The strength of the retail electrical trade as a molder of public opinion is growing."

Other speakers who advocated co-operation were M. A. Oberlander, sales manager supply department, Western Electric Company, Inc., New York; W. F. Abely, assistant manager Western Electric Company, Inc., Boston; J. P. Coghlin, Worcester, Mass.; J. E. Wilson, secretary Massachusetts State Association, and C. S. Davis, Westinghouse Lamp Company, Boston.

War Caused a Temporary Growth in Casualties of Public Utilities

THAT "military scorn for personal danger" evinced by returned soldiers in public utility employ was the cause for a temporary growth in its loss ratio is the view of the Utilities Mutual Insurance Company as expressed in its sixth annual report, just issued. Premiums for 1919 were $493,000, an increase over 1918 of $164,000; engineering surveys completed numbered 369 as compared with 206, and compensation cases handled totaled 1,900 as compared with 1,750. Since the organization of the company it has earned $1,485,000 in premiums and paid $345,000 in dividends, the latter amount including a dividend of $99,000, or 20 per cent, on the business of 1919.

In addition to the original purpose of the company—to write workmen's compensation insurance—the Utilities Mutual now writes public liability and automobile insurance for its member companies (exclusive of railways). It has also extended the sphere of its operation, originally confined to New York, to include Pennsylvania, New Jersey and New England, and from public utilities exclusively to include kindred industries of financial soundness.

Taunton Municipal Plant May Purchase Energy

BY SPENDING $400,000 the municipal electric lighting plant at Taunton, Mass., can be enlarged sufficiently to handle the anticipated increase in load during the next five years, according to a recent report to Mayor Coughlin by Jackson & Moreland, consulting engineers, Boston. The report points out, however, that the cost of purchasing energy from one or more central stations within electrical range of Taunton would be about the same as the expense of local generation under favorable conditions and with good management. No recommendation as to future policy was made, the engineers believing that issue to rest exclusively with the city. The future of the plant has therefore become a live question at Taunton.

The plant generated 8,614,767 kw.-hr. in 1919, the peak being 3,220 kw. The present rating is 3,800 kw., with a temporary capacity of 5,000 kw. on overload. The fuel consumption last year was 4.8 lb. of coal per kilowatt-hour. Recently fuel oil has been used successfully. The estimated load in 1925 is 5,000 kw., and the Jackson & Moreland report states that an additional 5,000-kw. unit will be needed if the plant is to handle the business expected. The Narragansett Electric Lighting Company, Providence, R. I., the Brockton Edison company and the Eastern Massachusetts Street Railway are or shortly will be each in a position to sell energy to Taunton. The cost to the city would be about 2.25 cents to 2.5 cents per kilowatt-hour, although the railway company has made a supplementary offer of 2.08 cents per kilowatt-hour.

M. I. T. Co-operative Plan a Proved Success

FOR the past year an interesting experiment in co-operative engineering education has been conducted by the Massachusetts Institute of Technology and the General Electric Company in which several departures from the usual plan were introduced. The class was limited to thirty students, who were chosen entirely upon the records which they had made in the equivalent of the first two years' work of the electrical engineering course at the institute. Included in this group were graduates from Yale, Harvard, Dartmouth, Princeton and the Naval Academy, besides men who had completed their first and second years solely at the institute.

The result of this year's work has been gratifying to the originators of the plan. As evidence of its approval of the work, the General Electric Company has increased the number of men who can be enrolled in this year's class to sixty. The new class will enter July 6.

Seattle Obtains Skagit River Site

IN THE issuance of a final permit by the United States Department of Agriculture perpetual right to the immense water resources of the Skagit River has been granted to the city of Seattle, Wash., as a source of power for the city's lighting system. The permit authorizes the city to proceed with the construction of a generating power plant, which, it is estimated, will cost $7,000,000. The Gorge Creek project, which is specifically authorized in the permit, when completed, will consist of a masonry dam across the Skagit River, a 2-mile (3.2-km.) through the mountain and a 50,000-hp. plant. A part of the preliminary work on the project is already under way.

The government has agreed that the permit be enjoyed by the city without charge to the extent that the power generated by the plant is "sold to the public without profit or used by the permittee for municipal purposes."

New Telephone for Naval Service

For months past the Navy Department has been conducting tests on a new type of hydroplane, which can be used by naval vessels for communicating with passing airplanes. The photograph shows Capt. Arthur L. Brissel of the destroyer Breckinridge and Dr. H. C. Hayes of Swarthmore College, who aided in the perfection of the instrument, listening in on the hydrophone installed on the Breckinridge.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Canadian Engineers Incorporating.—Six of the Canadian provinces—Quebec, New Brunswick, Nova Scotia, Manitoba, Alberta and British Columbia—have passed laws dealing with the incorporation, registration and licensing of engineers, and in Saskatchewan and Ontario preliminary steps to the same end have been taken.

N. E. L. A. Convention Souvenir.—"Hydro-Electric Development," a handsomely printed and illustrated account of the company's development, "beginning with the harnessing of Snoqualmie Falls twenty years ago and leading up to the electrification of a great transcontinental road," has been issued by the Puget Sound Power & Light Company, Seattle, Wash., as a souvenir of the Pasadena convention.

Stone & Webster Incorporated.—The firm of Stone & Webster has been incorporated under Massachusetts laws and will henceforth be known as Stone & Webster, Inc. The partnership has consisted of Charles A. Stone, Edwin S. Webster, Russell Robb, Henry G. Bradlee, Frederick P. Royce, George O. Muhlfeld, Henry B. Sawyer, Frederick S. Pratt, Harry H. Hunt and Howard L. Rogers. Stone & Webster, Inc., will continue the business with the same personnel.

Prompt Restoration of Service.—A group of towns centering about Aledo, Ill., and served by the Illinois Northern Utilities Company were left without service when the interurban railroad from which the energy had been purchased decided to cease supplying it. Aledo was about 21 miles from the nearest lines of the Illinois Northern Utilities Company, but this company immediately set about extending its lines to serve the community. Wire was strung from wagons hub deep in mud while improvised rafts carried the reels of wire over swamps and swollen creeks. Notwithstanding these conditions the line was completed in forty-two days, which was considered satisfactory even by the company's patrons patiently or impatiently waiting for service.

Great Western Power Company Asks Rate Increase. — Presenting figures based on the estimated load for this year to show that an increase in rates is necessary to enable the company to meet current expenses, the Great Western Power Company has applied to the California Railroad Commission for a new set of rates that will enable it to earn a fair return on the money invested. The company expects an output of 112,737,560 kw.-hr. of steam-generated electrical energy in 1920 as against a steam production of 41,757,450 kw.-hr. last year, its hydro-electric production of 373,753,580 kw.-hr. in 1919 dropping probably to 281,309,580 kw.-hr. in 1920 owing to low water.

Memorial Tablet to Edison Men.—Thomas A. Edison unveiled a bronze memorial tablet at the Edison plant, West Orange, N. J., on May 28, in honor of men from the Edison industries in the United States who lost their lives in the world war. The ceremony was witnessed by about 5,000 employees. The tablet is placed on the south wall of the laboratory at the works. The inscription reads "World War: This tablet erected and dedicated, in memoriam, to the employees of Edison industries who gave their lives in the cause of humanity. Erected by Edison Industries Post, No. 210, American Legion, through popular subscription of employees of the Edison industries, May, 1920." About 800 Edison men served in the war, of whom about 100 lost their lives.

Electric Drive in an English Rolling Mill. — What the London *Electrician* asserts is the largest rolling mill in the world, that of Dorman & Long, near Redcar, England, is now driven electrically, turning out plates about 9 ft. x 100 ft. in size and $\frac{3}{8}$ in. thick at the rate of 60 tons an hour for two hours and 30 tons an hour for the remainder of the shift. Two power stations in the plant, with a total rating of 6,750 kw., work in parallel to generate 2,750-volt, three-phase, 40-cycle energy, and this supply is supplemented with electricity from the Cleveland & Durham Electric Power Company. Transformers at each station step down the current to 440 volts. There is also a plant for lighting the works, and energy for lighting and other purposes will be transmitted to groups of houses that the company is erecting for its workpeople.

A Mountain State System. — The shops of the Union Pacific Railroad at Cheyenne, Wyo., the second largest on the Union Pacific's system, receive all their electrical energy from the Western Light & Power Company, the steady growth of which is reported by George E. Hayler in the *Doherty News*. The local railway also buys energy from the central station. Besides this plant in the Wyoming capital, the company has an extensive transmission plant in northern Colorado, with its main generating station at Lafayette. A 44,000-volt line forms a loop, serving Fort Collins, Greeley and other towns and returning to Lafayette, the distance covered being 119 miles. There are also about 10 miles of 13,000-volt line between Lafayette and Boulder, 22 miles of 6,600-volt line to several other towns and 17 miles of 2,200-volt branch lines. Power is supplied to the street railways at both Boulder and Fort Collins and for the Denver & Boulder Electric Railway. Irrigation at the northern end of the system and coal mining at the southern end provide steady loads.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Telephone Pioneers of America.—The seventh general meeting of the Telephone Pioneers of America will be held at Montreal, Canada, on Sept. 10 and 11.

N. E. L. A., North Central Geographic Division.—This body will meet in annual convention at Minneapolis, Minn., on next Wednesday and Thursday, June 16 and 17.

National Electric Credit Association.—This association will hold its annual meeting at the Hotel Commodore, New York City, on Thursday and Friday, June 17 and 18.

Conference Club.—The meeting of the Conference Club under its new form of membership which was to have been held at White Sulphur Springs, W. Va., June 17-19, has been postponed until a date in the fall to be announced later.

A. I. and S. E. E., Pittsburgh Section.—A paper on "Current Limit Reactance," by R. H. Keil, power engineer Jones & Laughlin Steel Company, Pittsburgh, will be read before this section at its meeting tonight.

American Physical Society.—The Pacific Coast Section of this society is to meet at the University of Washington, Seattle, on June 17 to 19, simultaneously with a meeting of the Pacific Division of the American Association for the Advancement of Science.

A. I. E. E., St. Louis Section.—On Monday evening, June 7, the Associated Engineering Societies of St. Louis held an important meeting under the auspices of the above section, B. H. Peck, general manager of the Southern Illinois Light & Power Company, giving the main address, on "Broader Applications of Engineering Methods."

Canadian Electrical Association.—On next Wednesday, Thursday and Friday, June 16 to 18, this association will hold its annual convention at the Ritz-Carlton Hotel, Montreal. Paul N. Lincoln will present a paper on the maximum-demand meter, and Executive Manager Aylesworth of the N. E. L. A. will address the convention. The constitution of the association is to be revised.

I. E. S., New York Section.—The June 17 meeting of the New York Section of the Illuminating Engineering Society will be held at Seventh Avenue and Forty-ninth Street at 8.15 p.m. It will be ladies' night and the meeting will be preceded by a dinner. The speaker of the evening will be E. L. Bragdon, technical editor of the *Motion Picture News*. Demonstrations by representatives of motion picture firms will be given.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Disallowance of Stock Issued to Promoters for Organization Expenses and of Other Hypothetical Claims.—Stock of a power company issued to promoters under the head of compensation for preliminary and organization expenses where it did not appear that the services were of value and where the promoters were acting in a fiduciary capacity, a claim for hypothetical "compensation to conceivers" and hypothetical costs for developing the business were all properly disallowed by the Public Utilities Commission of the District of Columbia in arriving at a valuation for rate-making purposes, according to the finding of the District Supreme Court.

Colorado Commission Without Jurisdiction in Home Rule Cities.—According to a decision by the Supreme Court of Colorado annulling an order of the Public Utilities Commission of that state which raised the rates of a gas company against the opposition of the city of Pueblo, it has been finally determined that the commission is without jurisdiction to fix rates in home-rule cities and it cannot acquire any such jurisdiction because such cities proceed illegally in the discharge of that duty or fail to act at all. The only relief for the company in case the city fixes an unreasonable or confiscatory rate is through application to the courts. (187 P. 1026.)

Electric Railway Deficiency Cannot Be Considered in Fixing Power Rates.—The fact that an electric railway company has contractual relations with an electric power company and has guaranteed its obligations does not entitle it to be made a party to proceedings for the valuation of the power company's property, according to the decision of the Supreme Court of the District of Columbia sustaining the Public Utilities Commission of the District against the Potomac Electric Power Company; nor is an electric railway company entitled by reason of its ownership of the stock of an electric power company to have electric rates fixed with reference to deficiencies in the earnings of the power company.

Electric Company Not Responsible for Injury to Trespasser.—In a suit against the Twin State Gas & Electric Company and the city of Berlin, N. H., to recover damages for injuries to a boy playing on top of a compressor owned by the city and operated by electrical energy furnished by the company, the Supreme Court of New Hampshire found for the defendants, holding that the boy as a trespasser could not recover damages and, moreover, that an electric company is not responsible for injury from "inside wires" not owned by it where it is not shown that the company had knowledge of their being defective. In the case at issue the compressor was allowed to stand in a vacant lot, the wires connecting it with the company's lines were uninsulated, and the current had not been turned off although the work of drilling for which the apparatus had last been used had been completed twelve days before. (109 A. 839.)

Capitalization of Free Franchises, etc., Disallowed in Fixing Rates.—In Potomac Electric Power Company vs. Public Utilities Commission of the District of Columbia (see ELECTRICAL WORLD, March 6, page 564), the District Supreme Court held that the amount paid in stock of a power company for water rights transferred to it by an electric railway company was properly disallowed as part of the original cost of the power company's property where it appeared that both companies were controlled by the same boards of directors and there was no evidence that the water rights, of which the natural value was problematical, had been or ever would be used for the purposes of the power company. Similarly a sum added to the cost of an electric plant at the time of its absorption by another company with the same board of directors, and real estate acquired by a street railway and transferred to an electric power company, but never used except for the benefit of the railway, were properly disallowed, as were easements in the public streets in the nature of franchises which cost the company nothing.

Water-Power Rights as Affected by Lapse of Time.—In passing judgment in a suit brought by the Northern New York Power Corporation against the State of New York to establish water-power rights based on riparian ownership of very long standing, the Court of Claims of New York declared that where the state in constructing the original Oswego Canal in 1826 tore down the riparian owners' wing dam, constructed a new dam and appropriated the water for canal purposes, reserving to owners such portion of the water as was available through the openings which it left in the pier, the rights of the owners and of the state became fixed by lapse of time, notwithstanding absence of grant or appraisement, the only right of owners' successors being to water through such openings and to maintenance of such openings by the state. The court further found that since the construction of the new Barge Canal dam at Minetto the company has not only derived from its water-power rights all the electric horsepower (about 500 hp.) to which, under the decision just stated, it had claim, but in addition has had the use of 11,500 electric horsepower that according to law belongs to the state. (181 N. Y. S. 588.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Illinois Commission Permits Increase in Length of Span.—On application of the Central Illinois Public Service Company, the Public Utilities Commission of Illinois has permitted the company to place its poles 350 ft. apart, the extreme distance formerly permitted having been 175 ft. This permission has reference to a new transmission line using three No. 0 B. & S. gage steel-core stranded aluminum conductors and 40-ft., 8-in.-top cedar poles set 7 ft. in the ground—a standard of construction that the commission is persuaded will give to the transmission line a factor of safety of approximately three and two-tenths.

Discrimination by Electric Service Company Against Contractors.—While the Maryland Public Service Commission asserts that it exercises no jurisdiction over electric companies when engaged in the work of wiring houses, it has directed the Eastern Shore Gas & Electric Company to discontinue the practice of immediately furnishing service, by virtue of an agreement with the underwriters, to new installations for which it has done the wiring, while refusing service to other applicants before the issue of the underwriters' certificate. This practice is held to be a discrimination, but the company may negotiate an agreement with other wiring contractors in order to adjust the trouble.

Jurisdiction of Commission—Competition—Importation of Energy.—The Grosvenordale Company, an industrial concern in North Grosvenordale, Conn., having asked the approval of the Connecticut Public Utilities Commission of the method of construction employed in a 66,000-volt transmission line running from petitioner's plant three miles to the Massachusetts boundary for the purpose of carrying energy from the New England Power Company of Massachusetts, the commission assumed jurisdiction to pass also upon the petitioner's right to construct and use such a system. This it denied on the ground that a manufacturing company without special charter rights authorizing it to do so has no power to construct an electrical transmission system across public highways and across the existing rights-of-way of other public service companies. The commission also declared that it is the legislative policy of Connecticut to prohibit within the state the purchase, sale and distribution for power purposes of electricity generated outside of the state. (See ELECTRICAL WORLD for March 6, 1920, page 568.)

Prof. Henry A. Bumstead, director of the Sloane Physical Laboratory, Yale University, has been elected chairman of the National Research Council for the year beginning July 1. Professor Bumstead has been associated with the Yale faculty since 1893 and for three years before that was professor of Johns Hopkins University. He is a graduate of Yale and Johns Hopkins universities.

R. Sanford Riley, who was elected president of the Stoker Manufacturers' Association recently, is president of the Sanford Riley Stoker Company of Worcester, Mass. Mr. Riley is a graduate of the Worcester Polytechnic Institute, class of 1896. For some time after graduation Mr. Riley followed marine engineering, and in 1906 he became manager of the American Ship Windlass Company of Providence, R. I. While he was employed by this company he specialized on the Taylor stoker, then manufactured by it. In 1911 Mr. Riley sold out his interest in the American Ship Windlass Company, and later he organized the Sanford Riley Stoker Company, Ltd., to develop and market the Riley self-dumping underfeed stoker. He is also president of the Murphy Iron Works of Detroit.

R. SANFORD RILEY

C. A. Nash, manager of the new-business department of the People's Light Company, Davenport, Iowa, for the last two years, has been placed in charge of company policies in the new-business departments of the twelve gas and electric light companies operated by the United Light & Railways Company, Grand Rapids, Mich., which also operates the People's Light Company. Mr. Nash's headquarters will remain in Davenport, with the People's Light Company.

H. P. Blodgett, who for the past year has been superintendent of the Penobscot Bay Electric Company, Belfast, Me., has been transferred to Rockland as superintendent of that district under the new merger with the Central Maine Power Company, which acquired the Knox Power Company.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Edward J. Cheney, who has recently opened an office at 61 Broadway, New York City, for a general engineering and consulting practice, giving particular attention to public utility problems, including rates, appraisals, public relations, design, construction, operation and management, was for several years connected with the Public Service Commission, Second District, New York, and resigned the position of chief of its division of light, heat and power in order to take up consulting work. While with the commission he was in charge of all general and technical questions concerning gas, electric and steam heat corporations and the service rendered by them. In addition to routine testing and inspection of meters, lines, plants and service and handling all complaints and general correspondence, this work involved the making and checking of inventories and appraisals and investigations and reports in connection with service, construction, purchase, capitalization and rate questions

W. A. Hillebrand has recently entered the San Francisco office of the Ohio Brass Company as engineer for the company on sales matters. Mr. Hillebrand has been connected with engineering activities on the Pacific Coast for a number of years, having been engaged in instructional work at Leland Stanford Junior University and later having become head of the department of electrical engineering at the Oregon Agricultural College. More recently he was electrical engineer for the Federal Telegraph Company, where he did very important work on the design and testing of apparatus for high-voltage, high-frequency work. Mr. Hillebrand has made important contributions to the *Transactions* of the American Institute of Electrical Engineers and to various technical journals.

John G. Callan, who has been appointed professor of industrial management, Harvard Graduate School of Business Administration, is well known in the New England electrical field, having been at one time in the steam-turbine engineering department of the General Electric Company at Lynn, Mass., and later mechanical engineer with Arthur D. Little, Inc. He is a graduate of the Massachusetts Institute of Technology, 1896, and during the past four years has been chairman of the department of mechanical engineering, University of Wisconsin, also lecturing at Harvard on factory management.

H. R. Woodrow, who in 1917 was made assistant chief electrical engineer of the New York Edison Company, has resigned to take up similar work under Peter Junkersfeld with Stone & Webster. Mr. Woodrow was born in 1887 at Rock Rapids, Iowa, where he obtained his early schooling. Following his graduation from the University of Illinois in 1909, he took up a two-year post-graduate course in electrical engineering under Dr. E. J. Berg. Mr. Woodrow became associated with the New York Edison Company in 1911 as an assistant to Philip Torchio and was identified with various investigations and developments at that time. After his appointment as assistant chief electrical engineer he was closely in touch with the design and operation of the various generating stations and substations of the company. Lately he has been very active in the affairs of the protective devices committee of the American Institute of Electrical Engineers and has devoted considerable time and original study to the investigation of oil-switch failures. Mr. Woodrow was identified in a consulting capacity in the design of the Trenton Falls and Washington Street stations of the Utica Gas & Electric Company, the new developments of the Municipal Gas Company, the Miller's Ford station at Dayton, the Williamsburg station of the Brooklyn Rapid Transit Company and the government plant at Nitro, W. Va.

H. R. WOODROW

R. A. Mitchell has been made treasurer of the Alabama Power Company, Birmingham, Ala., succeeding H. S. Swan, resigned. Mr. Mitchell is also vice-president of the company, which operates 1,051 miles of high-tension transmission lines served by two hydroelectric plants and two steam plants with a total rating of 140,000 kva.

R. M. McCletchie has been elected comptroller of the Alabama Power Company, Birmingham, Ala. Mr. McCletchie will have supervision of all accounting and finances of the company. The office of comptroller has recently been created by this company.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler
and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities
and Business Methods

Limited Supply Features Aluminum Conductor Market

DEMAND for aluminum conductors for high-tension transmission has been increasing at a good rate in the last few years. The market for this metal in non-electrical trades, however, is so large and is increasing at such a high rate that difficulty is being experienced in satisfying it. In the face of this, supply is reported as becoming rather limited.

Shipments for lengths to cover small distances, say 50 miles, are being quoted at from four to six months, while for several hundred miles the time is running up to ten months and a year. Congestion is experienced in the mills, more so in the fabricating than in the drawing processes, however. Present capacity is more than booked up, and on account of the limited stocks for electrical work orders are being refused.

While domestic demand is good, the foreign market is especially so. Large orders have recently been received for this conductor for European, Japanese and Australian properties, while inquiries, particularly from Italy, France and Scandinavian countries, have been heavy. This market has been opening up rather rapidly in view of existing installations in the States. If the material is available, a good future business is anticipated in the light of the prospect held out, when the water-power bill shall come up again next winter. While no retrenchment has been seen in the purchasing of this material by industrial power companies, reports indicate a recent holding back on the part of certain electric railway properties.

Ingot aluminum prices are strong, the market for 98-99 per cent material holding at 33 cents a pound.

Time Studies of Production to Be Continued at Lynn

AT THE Lynn (Mass.) Works of the General Electric Company there is no intention of abandoning time study as a means of determining piece rates. Recently about 100 employees in one of the winding departments went on strike as a protest against time studies, without submitting their problem to the usual routine of the plan of representation in effect at this plant. Representatives of the men stated to Richard H. Rice, manager of the Lynn works, that their only objection was to the time study and that no other complaints existed. No complaint existed as to the fairness of the time-study checker. Mr. Rice pointed out to the men that time studies are necessary in setting new prices, determining the cost of apparatus, revising existing prices and improving methods. No revision of prices for piece work involved in this matter will be effected before July 1.

The management pointed out that if prices as set at any time are not considered fair, recourse may be had to the shop committee, which may call for a retiming at which the employees' representatives may be present. In this way, it was said, no possible injustice can result from any time study being made now or at any time. Time studies are necessary in the plant to protect the interest of employees and management alike, it was stated. Recently the general joint committee on adjustment unanimously voted that it did not consider it its function to lay down any procedure as to the methods employed in making time studies, as this has always been the function of the management, and noted the course available in case of disagreement.

Certain employees feared that beginning July 1 it was the company's intention to start the practice of wholesale price cutting in the shops, with a view to reducing piece-work costs. When this was called to the attention of the management, Mr. Rice issued a vigorous denial, stating that he could not state too emphatically that during the entire period of his managership of the works it had not been and that it is not now the policy to reduce piece-work prices merely because large earnings are made, and that the management has no complaint against those who are making large earnings by reason of large output. Whenever a time study is made a representative of the employees' shop section involved has the privilege of being present and of assisting if requested by the employee concerned.

Tie-Up Holds Wood Pole Stocks at the Mills

THE chief problem regarding wood poles, pins and cross-arms seems to be the difficulty of obtaining shipments from the mills. One of the largest dealers in this line says he has received no cedar poles for three months. Pins are impossible to obtain, he says, and there are no stocks in the hands of dealers. Select fir cross-arms can be shipped in two weeks, but deliveries are subject to the railroads and average for all these materials from six to nine weeks. The situation is expected to clear up soon, as large surplus stocks have piled up at the mills and a plentiful supply will be available in about a month, it is thought. Chestnut poles can be obtained in two or three weeks, but the demand and supply of these is largely a local matter.

The demand for poles, pins and cross-arms is fairly strong, heavier than in the corresponding period a year ago, but not so vigorous as earlier this year, since the railroads have curtailed expenditures for the summer months.

Prices have held steady in the past few weeks. Standard locust electric light pins are quoted at $34.70 per 1,000 in lots up to 5,000. Prices for the 30-ft., 7-in. top red cedar poles are quoted as $21.95 f.o.b. New York City, $20.40 at Chicago and $22.10 at New Orleans. Forty-foot lengths, 7-in. tops, are quoted at $22.95 f.o.b. New York City, $21.40 for delivery at Chicago and $23.10 in New Orleans.

Deliveries Slow on Electric Furnace Supplies

OWING to transportation congestion and underproduction, extended deliveries prevail at present on a majority of the mechanical and electrical items used in electric furnace construction. In some cases this applies also to raw materials used in the melting and manufacture of steel, although to a considerable extent furnace manufacturers and users who follow the material market closely are rewarded by better shipments than can be obtained on the hit-or-miss plan. In furnace material proper one of the most serious difficulties is that experienced in securing electrode deliveries. Sixty to ninety days is about the best that any electrode maker will quote. Refractories are quoted at from six to eight weeks' delivery. Slagging materials, such as fluorspar, bauxite and lime, are obtainable, but prices are rather stiff.

Electric furnace scrap is cheap compared with other types of melting scrap, such as heavy open-hearth and air-furnace melting stock, but the increasing number of electric furnaces being installed has augmented the demand so much that there is a probability that at some future time prices on this material may tend to rise. A prominent furnace maker states, however, that the price of electric furnace scrap should never closely approach the price of heavy melting stock, as in that event melting stock would be purchased.

Present prices on refractories are very unstable. Considerable research has been done of late on furnace linings, especially in brass melting equipments, and the outlook is excellent for improved life. A leading maker of electric brass furnaces pointed out to a representative of the ELECTRICAL WORLD that electrodes are abnormally high and that it appears as if there would be no relief from present prices until some competitor enters the artificial graphite field equipped with sufficient capital to do business on a large-production basis. The same situation, though less pronounced, is believed to exist in the carbon electrode market.

By and large, it is believed that prices have about reached the top in many furnace supplies. The development of the industry is progressing rapidly, especially in the multiplication of installations. One brass furnace maker recently had orders on his books for ten furnaces and stated that in less than two years his installations had grown so fast that they now exceed in daily melting tonnage the output of all competitors combined. From the delivery standpoint, the situation is declared difficult rather than alarming.

National Electric Credit Association to Convene June 17

JUNE 17 and 18 have been set apart for the twenty-first annual meeting of the National Electrical Credit Association at the Hotel Commodore, in New York City. Besides the regular business to be attended to, topics for discussion and addresses that have been provided indicate the general interest in things fundamental to the credit side of the electrical business.

J. H. Pardee, president of the J. G. White Management Corporation; W. E. Rice of the Western Electric Company; W. Y. Conrad, vice-president of the Irving National Bank; George J. Murphy of Boston and W. H. Morton of New York, managing director of the National Association of Electrical Contractors, are among those who will address the convention. Besides, an open forum will discuss trends of the times and means of expanding the service of the association. The entertainment committee has plans for occupying the time outside of sessions.

Market for Electric Toys Well Above That of Last Year

IN DISCUSSING the market for electric toys, manufacturers of these specialties report favorably on the demand which has arisen this spring and summer. Dealers and distributers are ordering well above their volume of last year; 50 per cent is the more general increase this season, although the range is given from a low of 25 to a high value of 100 per cent in one case. From all appearances the present-day toy is being purchased more and more with an eye toward education and utility, and a high quality of material and workmanship is demanded.

Little difficulty has been experienced in obtaining this business, manufacturers say, and it has been given out somewhat earlier in the season because of material shortages and transportation delays. Raw-material shortages are holding back production in many cases and making it impossible for some manufacturers to keep up to capacity, even though they have plenty of orders on hand. Shipping schedules are already behind, although customers are willing to take their goods earlier than they ordinarily would because of this delay in transit. Manufacturers do not agree on the outlook for raw materials this summer and fall. Some have purchased in anticipation of a shortage and are well fixed. Others are rather expecting that they will be unable to obtain raw material on time in qualities sufficient to take care of all the business that can be secured, even though freight conditions should improve. On the other hand, there is some optimism in regard to summer and fall delivery to enable schedules to be filled.

Capacities, as a rule, are sufficient to care for the demand, but at the same time one producer advises that he will have to complete an addition in order to fill his orders.

The question of price is rather easily disposed of, in that only in one case has it been reported that it will be necessary to leave it to that which shall rule at time of delivery. Definite quotations have been given in the other cases for fall delivery. No advance is anticipated, although no decline is expected this season. One manufacturer with limited stock has set a price on goods made from that stock, but advises price at time of delivery when he shall have to go into the market to replenish his stock.

Supply of Line Hardware in an Unsatisfactory Condition

STRIKES at the steel mills are still largely responsible for the present shortage of line hardware. The freight tie-up has further handicapped steel works by curtailing their normal supplies of raw material. One dealer states that no shipments are coming in at present, and promises for future delivery range anywhere from six weeks to four months. Another company is still waiting for the fulfillment of orders given last November and December.

Existence in the field of line hardware is at present a hand-to-mouth affair, as stocks on hand are insufficient to meet current needs. This class of metal goods is particularly scarce because manufacturers are paid for such material as bolts, braces, washers, etc., on a pound basis, and there is less profit in proportion to the work concerned.

In spite of the fact that demand continues to be strong, the market has held steady since a price increase of 10 per cent about March 1. Quotations at present average approximately 6½ to 7 cents a pound.

Bluebird Assets Shown to Be More Than Double Liabilities

AS AN aftermath to the notice of receivership concerning the Bluebird Manufacturing Company, given in these columns last week, a committee representing more than 50 per cent of the liabilities of the company has met and reported an earnest purpose on the part of the creditors to assist in the rehabilitation of the business.

Certified public accountants have completed an audit showing the assets of the company to be $2,319,191, and liabilities exclusive of capital stock to be $1,017,686. This audit also shows profits for the first three months of 1920 amounting to $197,886, before an estimated deduction of $74,000 for taxes is made.

Big Consolidation in Washing Machine Industry

THE most recent consolidation in the electric washing machine industry has just been announced under the name of the Gillespie Eden Corporation, effective June 1. With the former Brokaw-Eden Company, which was the sales organization and which also manufactured washing machines at Alton, Ill., there have been joined the Gillespie Manufacturing Company, which makes washing machines and wringers at Lowell, Mass.; the Gillespie Motor Company, which manufactures motors at Paterson, N. J., and the Gillespie Foundry Company, which produces castings for both motors and washing machines at Paterson, N. J. This makes the Gillespie Eden Corporation a self-contained manufacturing organization, with over $4,000,000 of net assets, without additional outside assistance.

W. H. Marshall, formerly president of the American Locomotive Company, is chairman of the board of directors; T. H. Gillespie is president; E. L. Bergland, H. G. Seaber, P. J. Holdsworth and George De Laval are vice-presidents; F. J. Nash is secretary; H. S. Hart is treasurer; J. E. Halligan is comptroller, and P. V. D. Brokaw, formerly president of the Brokaw-Eden Company, is consulting director.

Among the directors are T. A. Gillespie of the T. A. Gillespie Company; Paul D. Cravath, attorney of Cravath & Henderson; Edgar Palmer, president of New Jersey Zinc Company, and Joseph B. Terbell, president of the American Brake Shoe & Foundry Company. General sales offices have been established at 23 West Forty-third Street, New York City, with branch offices at St. Louis, Denver, San Francisco and Toronto, Canada. Executive offices are at 50 Church Street, New York City.

Langmuir Lamp Patent Sustained

IN A DECISION just handed down by Judge Hough, the United States Circuit Court of Appeals for the second circuit has sustained the Langmuir gas-filled lamp patent in the case of the General Electric Company against the Nitro-Tungsten Lamp Company. This opinion upholds that rendered by Judge Mayer on Oct. 27, 1919, the findings of which were published in these columns, page 913, issue of Oct. 25 to Nov. 8, 1919.

Receiver for Electric Machinery Company

The federal court has appointed the Minneapolis Trust Company as receiver for the Electric Machinery Company, Minneapolis, Minn., as the result of a petition on the part of a large creditor and a stockholder of the latter company. The receiver has authority from the court to continue the business.

Metal Market Situation

LITTLE change is noted in the copper market. Large producers are holding June copper at 19 cents, while early third quarter may be found at that price and August and September at 19.25 cents. Demand is practically nil. Even inquiries to the big producers are light. Smaller producers are making some sales around 18.50, and the outside market is selling at around 18.25 at refinery. In addition, Japanese interests are reported as reselling copper just under 18 cents, the lower figures being for ingots and ingot bars. The producers' market shows continued strength, and the feeling is that large consumers cannot hold off many more weeks. London has declined £5 to £90.

Scarcity of lead in the spot market has not been removed. While the ruling producer's price is 8.50 cents, the outside market is holding for as high as 8.90 and 9.25 cents. July figures are quoted a half cent under spot. Better supplies are reported as available from South American and Mexican fields.

NEW YORK METAL MARKET PRICES

	June 2	June 9
Copper	£ s d	£ s d
London, standard spot	95 2 6	90 0 0
	Cents per Pound	Cents per Pound
Prime Lake	18.75	18.75
Electrolytic	19.00	19.00
Casting	17.75	17.75
Wire base	22.50–23.00	22.50–23.00
Lead, trust price	8.50	8.50
Antimony	8.75	8.50–8.75
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Zinc, spot	8.00	8.00
Tin	51.50	48.75
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.75 to 16.00	15.75 to 16.00
Brass, heavy	9.00 to 10.00	9.00 to 10.00
Brass, light	8.00 to 8.50	7.50 to 8.00
Lead, heavy	7.00 to 7.25	7.25 to 7.37
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

ORDERS continue to come in to jobbers in almost unabated volume. The edge of buying is taken off, however, because of inability to satisfy demands. The trade is living in hopes of deliveries "next week." Shipments are moving in and out among manufacturers and jobbers in better condition, but in many cases orders seem to be getting further and further behind.

Some pipe and armored conductor lots have been delivered, but these stocks last only long enough to fill "hurry" necessary orders and to apply on unfilled back orders. In some cases fans have not been received and jobbers affected have had to go into the market for them. Wire is less plentiful this week in jobbers' stocks. Lamp receipts have not replenished the heavy drains made on shelves just before the April price advance.

Building is progressing in good shape, at least in so far as supplies of building materials will allow. Collections are not so bad as conditions might seem to indicate, but then jobbers have exercised great care in the last few months. Prices have been holding with little change.

NEW YORK

Incoming deliveries have been better this week, and there is still much material being received which has been on the way for up to three and four months. At the same time fresh goods are coming through, but not in good volume. Jobbers are entering orders for various kinds of supplies which they expect to be able to fill from incoming deliveries in a week or so.

Stocks are virtually bare of most steel and porcelain goods. Carload receipts here and there of pipe, flexible armored conductor, pipe fittings, etc., give jobbers a little material to work on. Back orders are taken out, and these materials are apportioned among the balances still showing on these orders. Lamp stocks are pretty badly broken in the high-wattage B's and in the low-wattage C's, but present demand is being fairly well supplied. Cable and wall boxes are very short, and in some spots schedule material is beginning to run down. Key switches are reported in poorest supply of all the switches.

Building continues in good volume, although shortage of cement is curtailing much work. Prices show little change this week.

Wire.—Rubber-covered wire mill prices are holding steady and jobbers are asking from $12 to $13 for No. 14 in 1,000-ft. lots. Local stocks are not ample in all cases because shipments are not in especially good condition. Demand is good.

Flexible Armored Conductor.—Several good shipments have come in and jobbers are able to make fair-sized allotments on standing orders. To regular customers the holding price is rather general at $120 per 1,000 ft. for two-wire, No. 14, while orders of convenience are bringing up to $150 for either single-strip or double-strip whichever is available.

Outlet Boxes.—Few wall boxes or cable boxes, 3-in. sizes, are to be had. Inquiries bring the answer from jobbers that they hope to have a hundred next week.

Conduit.—Here and there a small amount of pipe has come in, but in general stocks are dead. Jobbers who have some are billing ½-in. black to the trade at about $96.

Heaters.—Delayed shipments are giving some jobbers pretty awkward stocks for this time of year. Recent cool weather, however, is moving this in a small way, but there will be quite a few to carry over the summer.

Schedule Material.—Strikes in brass mills are holding out poor prospects for continued shipments in shells, Edison screw parts, shade holders and snap-switch covers. Porcelain parts are pretty low.

Lamps.—Heavy buying just before the April price advance depleted stocks badly, and incoming deliveries since then have not been sufficient to refill the shelves. Stocks are spotty under a good demand.

Fans.—Jobbers receiving early shipments are in good shape, but transportation delays have kept some shelves bare. In this case jobbers have had to purchase from each other. The few warm days last week started a light movement, but cool weather again has brought a reaction.

Heating Appliances.—Demand is heavy and is being supplied to the extent of the short stocks at hand.

Fuses.—Prices of "Union" plug fuses have been advanced. Plug fuses have just advanced through a five-point drop in discount.

CHICAGO

Amelioration of conditions in regard to rail shipments is coming about very slowly. A certain amount of freight is constantly moving, and naturally varying quantities of electrical supplies are delivered. Strenuous efforts are required to supply even approximately the demands of the trade from day to day, and the accumulation of stocks is impossible. Light construction operations are the only thing that has prevented a serious shortage in schedule material. Jobbers are receiving inquiries and orders in a steady stream, and the opinion is expressed that any falling off which may have occurred is chargeable to the rail troubles and general financial stringency rather than to any other factor.

Local building stagnation is reflected in the total of building permits for May, which were $5,660,000, against $8,925,000 in 1913 and a ten-year average of $7,570,000 for the corresponding month. For the past week permits totaled $749,300.

Wire.—All stocks are badly broken. It is possible to obtain immediate delivery on bare copper, dependent on the rail service, and certain fortunate jobbers have been able to maintain limited supplies of weatherproof and rubber-covered and are filling small-quantity orders out of stock. Magnet wire is unobtainable except in small quantities, and then only in certain sizes.

Rigid Conduit.—One-inch, ¾-in. and ½-in. are not to be had for immediate deliveries, and orders are being placed with delivery date open. Factories are reported as having a considerable supply on hand, but they are unable to get cars for shipment. Lack of building construction has prevented a serious condition in this class of material.

Non-Metallic Flexible Conduit.—Stock shelves are bare and delivery is quoted as ranging from eight to fifteen weeks. Factories are having difficulty in maintaining heavy production, and the outlook for an easier supply is not encouraging.

Knobs, Tubes and Cleats.—Local supply is practically exhausted, with only small lots and odd sizes remaining in jobbers' hands. Deliveries are very uncertain, promises ranging from three months up.

Bell-Ringing Transformers.—Demand is quiet, all present needs being easily met. Current price is $1.40 each.

Annunciators, etc.—The call for annunciators is light, with almost no demand for large sizes. Push-buttons, door openers, buzzers and similar goods are all to be found in jobbers' stocks, with demand lower than ordinarily.

Lamps.—Conditions are markedly improved over those of three or four weeks ago. Coal shortages which caused the shutdown of some plants have been straightened out and goods are coming into Chicago nicely. Large interests report that a few weeks of similar trend will see the re-establishment of reserve stocks on a normal basis.

Klein Tools.—List, which was withdrawn on this line some weeks ago, has been re-established at a considerable advance. The 5-in. diamond special plier is now $3.50 and the 8-in. $5. These prices are for current deliveries only, all orders being accepted for billing at price ruling at time of shipment. Delivery promises are long.

Household Appliances.—Retail sales are reported as falling off to a certain extent. On small items this is attributed to a feeling of uncertainty as to future prices on the part of the buying public, and on large items to the difficulty of financing extended payments.

BOSTON

Orders continue to flow in faster than material does. Collections are holding up well, but deliveries show little improvement. Prices are firm, rubber-covered wire and fiber conduit trending higher. Stocks are considerably upset by irregular deliveries, and rigid conduit and knobs are short, to say nothing of small motors. Labor unrest continues in the Naugatuck Valley and at Lynn, Mass., in the electrical manufacturing field. Building contracts to date far exceed those of the corresponding period of last year. Some improvement is noted in railroad shipments in this district. Industrial plants and public utilities, however, are becoming very anxious about the large supplies of coal being shipped abroad at the expense of New England necessities.

On June 3 fire destroyed a portion of the Joseph E Greene Company property in Boston, causing damage to the extent of about $400,000.

Lamps.—The long-deferred falling off in demand has begun to be in evidence, but no excess supplies of lamps are in hand. There is vigorous trade in 25-watt and 40-watt lamps and healthy activity in sign lighting. Stocks sufficient for current needs are being held by the larger manufacturers, but jobbers' stocks are rather low.

Fiber Conduit.—Orders are maintained on a basis which taxes distributers to the utmost, in view of railroad conditions. The removal of embargoes within the past fortnight has helped shipments materially. Prices trend upward, one large house withdrawing quotations last week in anticipation of an early advance.

Fuses.—The shortage of fiber tubing is cutting down production, and one manufacturer of 250-volt fuses virtually has had to suspend output for lack of this material. Stocks in general are not up to normal.

Flexible Armored Conductor.—Stocks are uneven, some bins being empty and others having fair supplies. Prices rule stiff at $110 per 1,000 ft. in 5,000-ft. lots. Occasional carload shipments brighten the jobber's lot.

Non-Metallic Flexible Conduit.—Irregular stocks are the order of the day. Little price change is evident, but some jobbers are taking orders on the price-at-delivery basis. Nominal quotations are $37.50 per 1,000 ft. for ¼-in. loom and $35 for $\frac{7}{32}$-in. in 1,000-ft. lots.

Wire.—Rubber-covered wire is firmer at $11.75 per 1,000 ft. in 5,000-ft. lots. Supplies are excellent in volume. Weatherproof is harder to get and is quoted on 29 cents base. Bare is on 25 cents base, and so far little difficulty has been noted in getting shipments.

Porcelain.—"Nail-it" knobs bring $34 per 1,000 in barrel lots, with tubes fairly plentiful and cleats scarce.

Fans.—Retail buying began on a moderate scale last week, but soon stopped. Jobbers advise dealers to stock up at once, in expectation of a shortage after the first torrid spell. Stocks are not large.

Transformers.—Distribution-type transformers are hard to get in quantity, although one jobber reports an excellent line-up to and including 15 kva. Shipments soon fade away in face of the present active demand.

Control Equipment.—Distributers are keeping well within motor deliveries, except on occasional pick-ups. Prices are about 10 per cent higher than in the winter, and deliveries run around two to three months. Fair local stocks of hand-operated starting apparatus up to 10 hp., and of single-phase starters up to 5 hp., are reported.

Friction Tape.—Local needs have been well met as a result of embargoes on outside shipments. Black tape in ¾-in. size brings 63 cents per pound in 500-lb. lots. Fair supplies are on hand here.

ATLANTA

Improved weather conditions throughout the farming section should lessen the feeling of pessimism that has been reflected in the section for the last few weeks, although jobbers still report orders from rural districts below the prior month's average and collections are still somewhat slow.

The strike of the railway clerks of the Central of Georgia Railroad has spread to practically all other roads in the Southeast, and embargoes on shipments of freight have resulted. A number of jobbers report considerable stocks in transit and express the opinion that deliveries will continue to improve. New Orleans reports a strike of all union carpenters, numbering approximately 3,000, a walk-out which will materially slacken office building and industrial building construction in that city.

Jobbing firms report a disposition on the part of the trade to withhold orders for additional material, this being caused partly by the fact that long shipments were anticipated, thus causing orders to be placed earlier in the spring, and partly by the tightening up of the money market. No cancellations of moment are reported.

Conduit.—Fair shipments of conduit were received by jobbers last week and immediately split up and forwarded to contractors on back orders, tending to relieve the acute situation that existed. Shortage is still noted in sizes of ½-in. to 2-in., and sufficient back orders are on hand to absorb all shipments received for some time to come. There are no stocks in the territory, and present promises of shipment approximate four months.

Stamped Steel Boxes.—An increase in price of approximately 10 per cent is reported on this item, effective last week. Stocks at present are in fair shape in spite of the brisk demand, but unless goods in transit are quickly received difficulty will be experienced in meeting all orders. Shipments are quoted at from three to four weeks.

Lock-Nuts and Bushings.—Acute scarcity of these items is reported by all jobbers. There are practically no stocks in the territory, and manufacturers hold out no promise of relief.

Covers and Fittings.—A 10 per cent price advance is announced. Local stocks are reported in fair shape, with the demand holding up well.

Flexible Armored Conductor.—Incoming shipments are being diverted to back orders, so no stocks can be accumulated in the face of the brisk demand. Such shipments as are going out are handled strictly on an allotment basis and deliveries continue to be very poor. Price has advanced approximately 7½ per cent and present quotations are as follows: 250 ft. to 1,000 ft., two wire, No. 14, $131.40 per 1,000 ft.

Single-Phase Motors.—While motors in small numbers are being received from time to time, they are entirely insufficient to meet the present demand; in fact, back orders are absorbing all motors received. Shipments continue to grow in length, the latest quotation being from forty to fifty weeks.

Armored Lamp Cord.—This article has become active. Stocks have shrunk materially and bid fair to become exhausted in the face of very slow shipments. This is particularly true of the reinforced type. Prices are quoted as follows: Lots of 250 ft. to 1,000 ft., $4.94 per 100 ft.

Desk Fans.—The embargo in the East holding up shipments of fans for this section has caused a temporary shortage to develop. A number of jobbers report stocks exhausted, though shipments have been in transit for an unusual length of time.

Washing Machines.—No shortage of this specialty has yet developed, though jobbers are expecting difficulty in obtaining machines in sufficient quantity to meet the growing demand.

Mangles.—One of the largest jobbers reports his stock exhausted, owing principally, however, to difficulty in transportation. This specialty seems to be following in the footsteps of the washing machine and daily grows in popularity.

SEATTLE—PORTLAND

There is no particular change to report over the past two weeks. Stock shortages along practically every line exist, and chances of rebuilding them are as remote as ever. Sales volumes are showing further decreases, and this applies to retailers as well as jobbers. Electrical jobbers state they have not been hurt by the building trades strike of June 1. There is considerable construction work progressing despite the walkout.

Portland jobbers report business still slow with no indications of early changes for the better. There is no heavy dropping off, but a general downward tendency. Contractors and dealers make similar reports on the situation. This naturally is reflected in a shortage of money and a demand by the contractors and dealers for an extension of time in making their payments, resulting in poorer collections by the jobbers. Jobbers report that they are tightening up on credits and would hesitate a long while before opening a new account. In fact, they undertake to discourage any new business starting at the present time.

In the retail section reports state that there is some slowing up of sales in washing machines and sweepers. Ranges remain about the same as usual. The greatest activity, retailers say, is in the line of small appliances of various sorts. A recent increase in prices of electric irons has apparently had no effect in reducing the number of sales. The volume of merchandising sales is not what it has been for the last two or three months and is appreciably lower than would naturally be expected for this season. However, conditions are still materially better from the standpoint of the retailer than a year ago, but the tendency for the past few weeks has been downward.

Washing Machines.—Sales are very satisfactory and the demand is far in excess of available stocks. Tentative plans for sales campaigns this summer have been dropped owing to inadequate stocks and poor shipments.

Ironing Machines.—Very little effort is being expended to increase sales volumes because of limited or practically exhausted stocks. Demand for domestic flat-work ironers is far in excess of available stocks.

Meters.—The demand of the past two weeks has showed considerable dropping off; still it is in excess of actual supply on hand.

Insulating Tape.—Demand is steady and stocks are very spotty. A 15 per cent increase was noted recently.

SAN FRANCISCO

The last of the striking shipyard workers have returned to work, ending the eight months' strike. A large number of the men had returned to work some months ago, but the additional skilled workers were needed and will incidentally help retail business. Building permits issued during May, 1920, in the three principal California cities are of the following value: Los Angeles, $3,160,000; San Francisco, $3,037,000; Oakland, $958,000. Collections are more difficult, running nearer to two months, and credit is being extended very sparingly.

Ranges.—Range business is spasmodic, being scattered among a number of dealers without any organized campaign. A great increase in the number of government inquiries is noticeable. There are also many heavy-duty inquiries for large ranges and bake ovens, although exceedingly slow factory deliveries are spoiling many prospects.

Household Devices.—This is the quiet season and dealers, as they glance at their bare shelves, are rather glad of it. With proper deliveries the small holiday business should break all records by a wide margin.

Fixtures.—A great increase in the number of sales of industrial reflectors is noticeable, due to the creation of modern illuminating standards. Some good government sales are reported. Improved residence lighting is also receiving attention, and a great deal of missionary work has been done by Eastern experts. Local stocks are good.

Lamp Cord.—Despite the number of fixtures being sold, sales are poor and large stocks have piled up on the coast.

New Apparatus & Appliances

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Electric Blasting Machines

The Davis No. 1 blaster is a new electric blasting machine manufactured by the Atlas Powder Company, Philadelphia, Pa. This machine generates its own current through the turning of its handle one turn, which is sufficient, says the manufacturer, to fire five charges. Net weight is 3¼ pounds, the outer case is heavily nickeled seamless brass tube with aluminum top and bottom plates.

ONE TURN OF HANDLE FIRES FIVE CHARGES

Demand Meter Register

The type M-7 demand meter register is a new form of demand device manufactured by the General Electric Company and arranged for attaching directly to a standard General Electric type I-14 or D-6 watt-hour meter to convert either of them into a combined watt-hour and demand meter by simply removing the old register and substituting the new one. This device takes a form not much larger than that of a standard register and is attached to the meter in the same manner. The watt-hour meter dial remains about the same as that of the standard register. Over the upper arc of this dial is attached a small demand dial which the demand pointer traverses.

SMALL INDUCTION MOTOR DRIVES DEMAND MECHANISM

The device is of the definite-time-interval type and gives the same class of record, says the manufacturer, as that obtained from the present type M-4 demand meter. It will be furnished in 110-volt and 220-volt ratings. Standard time intervals are fifteen, thirty and sixty minutes. When shipped complete from the factory and mounted in a I-14 or D-6 watt-hour meter the combination is known as a type IM-14 or DM-6 watt-hour demand meter.

Tension Device for Coil Winding

For high-speed winding the Belden Manufacturing Company, Twenty-third Street and Western Avenue, Chicago, is putting out a tension device fundamentally suited for small sizes of wire ranging from No. 23 to No. 40 B. & S. gage. The machine will take a spool not exceeding 6 in. in diameter, 3⅝ in. over all in width, with a ⅝-in. hole. The manufacturer says that variations in tension during starting, winding and stopping are compensated for by means of a cross-head and sheave mounted between two vertical guide rods. The machine is designed to prevent the wire from tangling and breaking and to insure compactly wound coils.

Battery Handle

A heavily lead-coated handle for storage batteries has been put out by the Mueller Electric Company, 423 High Avenue, Cleveland, Ohio. It is of steel with reinforced sides and made so that acid should drain around the screw heads.

Battery Gage

A voltmeter which indicates the condition of a storage battery is being distributed by Mehan-McBroom Company, 1301 Michigan Boulevard, Chicago. It is said to require about 0.01 amp. to operate.

Totally Inclosing Unit for Commercial Lighting

The Ivanhoe "Trojan" is a new inclosing commercial lighting unit for gas-filled lamps rated at from 75 watts to 500 watts produced by the Ivanhoe-Regent Works of the General Electric Company, Cleveland, Ohio. It is a one-piece unit made in 12, 14 and 16-in. diameters, of light-density "Genco" glass. Freedom from glare is effected, the manufacturer says, by the position of the lens, the high diffusing quality of the glass and the dimensions and contour of the unit. Having no exposed inside surfaces, it is designed to be dirt-proof. Ventilation is cared for through the large radiating surface.

NO EXPOSED INNER SURFACES TO CATCH DIRT

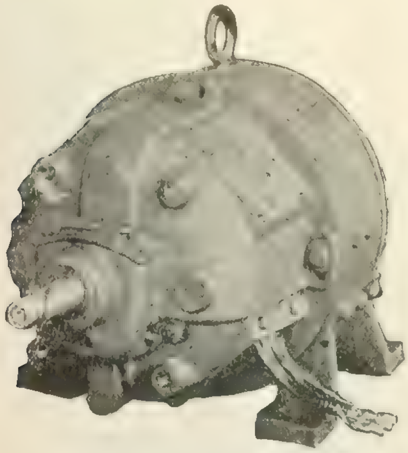
Auto-Transformers for Phase-Changing Service

A number of different sizes of one-to-one ratio auto-transformers, which furnish a means of deriving three phase from two phase, four wire service, and vice versa, have recently been listed as standard by the General Electric Company. These auto-transformers, type MTQ, are air-cooled, suitable for indoor or outdoor operation, and compact. They are for service on frequencies between 50 cycles and 140 cycles, 220-220 volts. The sizes selected as standard are of the following kva. output: 1, 3, 5, 7, 10, 15, 20 and 25. They cannot be used, says the manufacturer, for three-wire, two-phase service or to operate motors with interconnected phase.

FOR ADAPTING POLY-PHASE MOTORS TO EXISTING CIRCUITS

Direct-Current Motors for Crane and Hoist Service

For severe intermittent varying speed service where heavy starting torque is required, as for cranes and hoists, the Westinghouse Electric & Manufacturing Company has recently brought out the type "HK" direct-current, series-wound motors. They are of compact construction, giving small over-all dimensions, light weight and great mechanical strength, the manufacturer says. Those above 3-hp. rating are equipped with commutating poles. Oil-ring lubrication is used, while a blower is placed in the rotor for ventilation. Electrically operated shoe-type brakes may be supplied. Rating is on the one-quarter-hour basis.



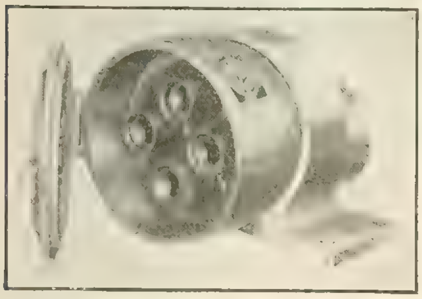
FOR VARYING SPEED AND HEAVY STARTING SERVICE

Electric Alarm Clock

An alarm clock operated by dry battery in its base has been developed by the Darche Manufacturing Company, 643 West Washington Boulevard, Chicago, Ill.

Four-Pole Receptacle

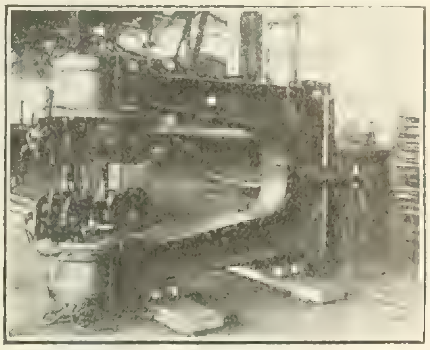
The Delta-Star Electric Company, Chicago, has developed a four-pole receptacle for two-phase service and for a three-phase motor service, where it is found necessary or desirable to ground the motor frame. It is a development of the company's three-pole type. It is used in series with switches and not for opening or closing circuits under load.



FOR USE WHERE MOTOR FRAME IS TO BE GROUNDED

Rotatable-Head Two-Spot Welder

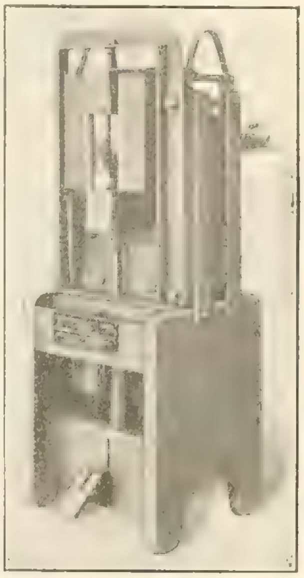
A two-spot, rotatable-head, air-operated spot welder has been developed by the Federal Machine & Welder Company, Warren, Ohio. The machine is built with a cast-iron frame with a 60-in. depth of throat for capacity from two 24-gage to two 8-gage steel stock. In the upper and lower rotating heads is built a 40-kva. welding transformer with primaries in parallel and secondaries in series to permit of two spots being made at a time. The four welding points may be adjusted with distance of 3 in. to 8 in. between centers and are drawn apart 5 in. The head may be rotated through 90 deg. Hand-operated air control is applied to each point and so arranged that during the heating period 80 lb. air pressure can be regulated to apply from 300 lb. to 700 lb. pressure; welding pressure is 1,200 lb. between points. The regulating transformer supplies power to the welding transformers in eight equal voltage steps.



SPOT WELDS UP TO TWO 8-GAGE STEEL

Rivet Heater

The American Car & Foundry Company, New York City, has developed its line of Berwick rivet heaters so that the same machine may be used on 25 cycles or 60 cycles and 220 volts or 440 volts. It can be arranged also for 550-volt service. The heater is built in gangs to heat from one rivet to 5 rivets at a time, and is portable for use in the field.



FLEXIBLE IN FREQUENCY AND VOLTAGE

Instrument Cases

The Hickok Electrical Instrument Company, Cleveland, Ohio, is putting out its direct-current instruments in plain polished black bakelite cases.

Notes on Recent Appliances

Autovent Fan

The Batterman-Truitt Company, Chicago, has brought out a 36-in. autovent propeller-type ventilating fan equipped with a single-phase series compensated-type variable-speed motor.

Dust-Proof Lighting Fixtures

A dust-proof lighting fixture for ornamental purposes is being manufactured by the Philip Panama Electric Light Company, 1627 Melrose Street, Chicago.

Gage-Type Pressure Regulator

A new gage-type pressure regulator is being manufactured by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

Battery Clip

The Diamond Electric Specialties Corporation, Newark, N. J., is marketing its tubular flashlights with a swivel clip for attaching purposes.

Heater Connector Plug

The Magnus Electric Company, Inc., New York City, is marketing a plug, the "Plugall," which is said to fit all heating appliances.

Industrial Flood-Lighting Unit

The Alexander Milburn Company, Baltimore, Md., has brought out an industrial flood-lighting unit.

Dishwasher

The Electric Maid Company, Davenport, Iowa, has developed an electric dishwasher.

Electric Tool Heater

A 175-watt electric heater for heating tools has been brought out by the S. U. E. Company, Boston, Mass.

Vacuum Cleaner

A vacuum cleaner designed for heavy duty is a development of the Bissell Motor Company, Toledo, Ohio.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE CHESAPEAKE IRON WORKS, Baltimore, Md., have appointed C. H. Michel as sales manager handling cranes, structural steel and general machine work. Fairbanks, Morse & Company, New York City, have been appointed sales agents for the Chesapeake crane for the territory covered by New York State, New England and Pennsylvania east of Johnstown, including Philadelphia. The Chesapeake Iron Works are building an extension to their shop, 58 ft. x 210 ft.

ROBEL & BRYANT, INC., Chicago, Ill., announce the removal of their offices from 58 East Washington Street to the Transportation Building, 608 South Dearborn Street, Chicago, effective May 1, where the firm has much larger quarters to meet the requirements of its rapidly increasing business.

THE DOYLE-DACOSTA MANUFACTURING COMPANY, Easton, Pa., is building an addition to its factory, providing approximately 5,000 sq.ft., which will enable the company to double its present capacity for the manufacture of coil windings. The company has recently begun the manufacture of armature and field coils for small electrical units.

THE PAGE STEEL & WIRE COMPANY, Grand Central Terminal Building, New York, announces the removal of its central district sales office from 29 South La Salle Street to 208 South La Salle Street, Chicago.

THE ROLLER-SMITH COMPANY, 233 Broadway, New York City, announces that it has made arrangements with the W. Montelius Price Company, 524 First Avenue, Seattle, Wash., to handle the company's line of electrical instruments, meters and circuit breakers in the States of Washington, Idaho and part of Oregon.

GEORGE C. EGGERS has resigned as district manager for the E. T. Chapin Company and is now at the head of the Eggers Pole & Supply Company, 327 South La Salle Street, Chicago. The manufacturing headquarters are at 510 Empire State Building, Spokane, Wash.

THE PYROLECTRIC INSTRUMENT COMPANY, 638 East State Street, Trenton, N. J., will continue in the pyrometer and instrument business in other quarters at the above address under the active management of H. L. Saums and W. C. Harter.

THE ERIE ELECTRICAL EQUIPMENT COMPANY, Johnstown, Pa., manufacturer of insulator pins, pipe fittings, pole-line hardware, brackets, etc., is planning to build a malleable-iron foundry, equipped with electric furnaces, to cost about $50,000. The company also contemplates increasing its capital stock from $25,000 to $100,000.

THE VICTOR ELECTRIC CORPORATION, Chicago, has a teacher regularly employed for instruction in X-ray work and gives courses in various parts of United States at different times during the year.

THE MASTER ELECTRIC COMPANY, 460 Bacon Street, Dayton, Ohio, is occupying the factory formerly used by the Burnett-Larsh Company, manufacturer of the Duro pump. The product of the Master company is fractional horse-power motors with ratings of from $\frac{1}{10}$ hp. to $\frac{1}{4}$ hp., using 110 volts and 220 volts direct current; also 32-volt motors in several sizes for farm-lighting plants, and alternating-current motors of the repulsion and induction type of various frequencies. The president is E. P. Larsh; S. A. Brown is vice-president and treasurer, and A. C. Jackson is secretary.

THE SOUTHERN ELECTRICAL EQUIPMENT COMPANY, Charlotte, N. C., expects soon to be in a position to fill orders for substation equipment, high-tension and switchboard apparatus, which it is planning to distribute through jobbers.

THE HART & HEGEMAN MANUFACTURING COMPANY, Hartford, Conn., has broken ground for the proposed new three-story addition to its plant for increased capacity.

THE INDEPENDENT ELECTRIC MACHINERY COMPANY, 1917-21 Central Street, Kansas City, Mo., has made arrangements for a two-story-and-basement office building near its present plant, in which the executive and sales offices, as well as the display room, will be contained. The present buildings will be converted into a shop and warehouse. The company is acting as distributor of the "Alamo" farm light plants.

THE SELECTED ELECTRIC APPLIANCE COMPANY, 251 Weybosset Street, Providence, R. I., has increased its capital from $60,000 to $125,000 for expansion purposes.

D. T. LAYLIN has been appointed sales manager of the Adams-Bagnall Electric Company, Cleveland, Ohio. Mr. Laylin became associated with the electrical business in 1905, when he entered the service of the Western Electric Company. After being in charge of the electrical sales and shop departments of the Strong-Carlisle-Hammond Company of Cleveland for five years, he became electrical engineer of the Standard Parts Company of Cleveland.

D. T. LAYLIN

THE WESTINGHOUSE LAMP COMPANY will hold a conference of managers and distributers at its main plant at Bloomfield, N. J., on June 23, 24 and 25. The subjects for discussion cover a wide range in an endeavor to encourage closer co-operation between the company and its distributers.

D. B. RUSHMORE, of the Schenectady works of the General Electric Company, has been elected vice-president of the American Welding Society.

THE GENERAL ELECTRIC COMPANY, Pittsfield, Mass., is to further a plan of company aid in the formation of a home-building department under R. G. North.

THE LUMINOUS UNIT COMPANY 2615 Washington Ave., St. Louis, Mo., has just completed a factory building which will double its space and permit of 50 per cent increase in production. A new Pittsburgh office has been opened in charge of M. B. Diedeichsen. The company now has 200 jobbers and 400 agents. It announces that Joe Chassaing is sales manager of both the Luminous Unit Company and the St. Louis Brass Manufacturing Company.

THE BLACK SWAN COMPANY, 1100 Marshall Street, Northeast, Minneapolis, Minn., has appointed L. B. Duntley, formerly general manager of the Bluebird Appliance Company, St. Louis, as sales manager. Mr. Duntley was one of the original members of the Bluebird company.

WESTINGHOUSE CHANGES. — The Westinghouse Electric & Manufacturing Company announces that H. M. Wible has been appointed manager of the rectifier section of its supply department at Newark, N. J. Mr. Wible has been with the company since 1906 and for the past eleven years has been engaged along supply lines. A new section of its supply department has been formed at Newark, N. J., to be known as the fan-motor section, commercial. W. J. Jockers, formerly of the New York office of the company, has been appointed manager of the new section. Mr. Jockers came but recently to the Westinghouse Company, but has been engaged in the electrical jobbing business for the last fourteen years, first with the Western Electric Company, then as vice-president and secretary of the Northwestern Electric Equipment Company, and later with the Royal Eastern Electrical Supply Company.

THE BESSEMER GAS ENGINE COMPANY, Grove City, Pa., announces that it has opened a new sales office in Fort Worth, Tex., and has also built a large warehouse in that city. B. L. Potter is in charge of the Fort Worth office. Another sales office has been opened at Shreveport, La., in charge of A. K. De France. The company has purchased a two-story building in Tulsa, Okla., which will be occupied as a warehouse and office. A new factory building, 240 ft. x 145 ft., will be erected at Grove City, the steel for which has already been purchased.

THE WHITE LILY MANUFACTURING COMPANY, Davenport, Iowa, has added about 12,000 sq.ft. of factory space to its plant during the past year and is now building extensions which will give an additional 50,000 sq.ft. The company has instituted a profit-sharing plan among its employees.

THE BUTTERFLY MOTOR CORPORATION, 243 West Seventeenth Street, New York, has filed notice of dissolution.

THE GREENFIELD TAP & DIE CORPORATION, Greenfield, Mass., has acquired 100 per cent of the common stock of the Lincoln Twist Drill Company of Taunton, Mass. The Taunton plant will be enlarged, as necessity requires, to meet the demands for its products. Edward Blake, Jr., formerly sales manager of the Wells Brothers Company, is vice-president and general manager of the Lincoln Twist Drill Company.

THE ELECTRIC CONTROLLER & MANUFACTURING COMPANY, 2700 East Seventy-ninth Street, Cleveland, Ohio, has opened a branch office at 49 Federal Street, Boston, Mass. The new office will be in charge of M. D. Goodman.

B. E. SUNNY, president of the Chicago Telephone Company, has been elected to fill the vacancy left in the board of directors of the Hurley Machine Company, Chicago, by the retirement of Edward N. Hurley, Jr. The other members of the board were re-elected. The company has more than 125,000 shares of common stock outstanding, and, contingent on the exercise of an option on 25,000 shares by the General Electric Company on or before Oct. 1, 1920, will have more than 150,000 shares outstanding by that date. With this option exercised less than one-third of the common stock will be held by the General Electric Company. The sales for the first four months of 1920 total $3,481,381, amounting to 61 per cent of the entire business in 1919, and show an increase of 158 per cent over the sales for the first four months of 1919.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has moved its Chicago offices from the People's Gas Building to the company's own building at 323 North Michigan Avenue, where it will have much larger quarters, which enable the company to carry a larger amount of stock of standard apparatus and parts. H. L. Dawson is manager of the Chicago office.

THE OHIO BRASS FOUNDRY COMPANY, Mansfield, Ohio, contemplates the construction of a malleable-brass foundry, providing additional floor space of 80,000 sq.ft.

THE GEORGE WEIDMAN ELECTRIC COMPANY, 191 Flatbush Avenue, Brooklyn, N. Y., has filed a notice of an increase in capital stock from $15,000 to $100,000.

THE SENECA WIRE & MANUFACTURING COMPANY, Fostoria, Ohio, is planning to build a plant extension, 167 ft. x 208 ft., to cost with equipment about $100,000.

THE ROME MANUFACTURING COMPANY, Railroad Street, Rome, N. Y., has filed notice of an increase in its capital stock from $850,000 to $3,000,000 for general business expansion.

THE LEHIGH VALLEY SUPPLY COMPANY, Allentown, Pa., is now established in its new quarters at Third and Oak Streets. The company will handle electric light and power plants for suburban residences and farm service as well as lighting fixtures, etc.

THE PREMIER MOTOR PRODUCTS COMPANY, Chicago, Ill., recently organized, will act as exclusive agent for the sale of the automotive products of the Premier Electric Company, Chicago. H. A. Cook, formerly advertising and general manager of the Premier Electric Company, is president of the new company, and Walter D. Graham is vice-president and treasurer.

THE EDISON LAMP WORKS of the General Electric Company at Fort Wayne, Ind., will begin work at once on the construction of a new plant on Winter Street, to cost about $500,000. Most of the building is to be two stories high, but part will be three stories. Glass bulbs are to be manufactured from the raw material. The building which was to have been erected on Holman Street will be delayed for the present.

THE EDISON ELECTRIC APPLIANCE COMPANY, Ontario, Cal., is contemplating extensions to its plant, to cost about $100,000.

Supply Jobbers' Notes

THE ELECTRICAL EQUIPMENT COMPANY, Walla Walla, Wash., is planning to increase its capital stock from $25,000 to $75,000 for the purpose of general business expansion.

THE ALPHA ELECTRIC COMPANY, 151 West Thirtieth Street, New York City, has taken the agency for the metropolitan district for the General Railway Signal Company's washing machine, covering the territory from Trenton, N. J., to Kingston, N. Y.

THE ELECTRIC APPLIANCE COMPANY, 408 Canal Street, New Orleans, La., has acquired the property adjoining its plant, thereby increasing its floor space. The company recently celebrated its eighteenth anniversary at New Orleans, and the Chicago store is about to observe its twenty-seventh anniversary.

SWORDS BROTHERS COMPANY, Rockford, Ill., met its electrical dealers on its premises on April 23. Eighty-seven electrical dealers attended the meeting, as well as several guests in the industry who were invited to come and address the dealers. The gathering was arranged for and was under the general direction of C. A. Felker, sales manager of the company.

Foreign Trade Notes

THE CANADIAN GENERAL ELECTRIC COMPANY, 212 King Street, West, Toronto, Ontario, Can., has awarded contract for an extension to its plant at Peterboro, Ontario, to cost, including equipment, $500,000.

ELECTRICAL EQUIPMENT FOR INDUSTRIAL PLANTS IN CHINA.—The United States Commercial attaché at Peking, China, states there will be a great demand for electrical machinery and equipment for industrial plants in China during the next few decades.

A BOHEMIAN GLOW-LAMP FACTORY.—It is reported from Prague that a glow-lamp factory on a large scale is to be established in that city by a group to which the A. E. G. and the Osrom works belong and in which American capital is said to be interested. The factory is to serve the purpose of meeting the needs of Bohemia, the adjacent states and the export trade.

DEMAND FOR ELECTRICAL MACHINERY IN RUMANIA.—There is a great demand for electric generators, motors, transformers, copper wire and cables, insulated and bare, in Rumania. Under the proposed method to finance purchases in America, the United States seller is to deliver the machines needed for the development of the Rumanian industry on credit. As security for payment the seller or the party financing the sale is to retain the right of ownership of the machines until the full purchase price, as well as the interest thereon, shall be paid.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A jewelry merchant in Canada (No. 32,933) desires to purchase electric lamps, etc.

A buyer for electrical apparatus firms in Switzerland (No. 32,936) wishes to purchase brass and copper bars, rolled section brass and electrical apparatus for high voltage.

An import firm in Ceylon (No. 32,927) desires to purchase electric lamps, etc.

An electrical products dealer in Spain (No. 32,959) wishes to secure agencies for the sale of electrical materials.

Detailed specifications of motors and pumps for waterworks desired by the city of Warsaw, Poland, have been received by the Bureau of Foreign and Domestic Commerce (Reference file No. 9045).

An agency is desired by a commercial agent in the Netherlands (No. 32,889) for the sale of electrical supplies and appliances.

A merchant in Switzerland (No. 32,897) desires to secure an agency for the sale in that country and Belgium of small electric motors, electric apparatus and implements and electric household machinery.

Trade Publications

OUTDOOR SUBSTATIONS FOR INDUSTRIAL SERVICE.—The Delta-Star Electric Company, 2433 Fulton Street, Chicago, is distributing a special publication, No. 93, illustrating its unit-type outdoor high-tension substations for industrial service.

RUBBER-INSULATED WIRE. — Bulletin No. 500-1, entitled "Standard Rubber-Insulated Wire," issued by the Standard Underground Cable Company, Pittsburgh, Pa., gives illustrations, specifications, prices, etc., of its rubber-insulated wire.

LINEAR CONDENSERS.—The International Radio Telegraph Company, 326 Broadway, New York City, is distributing bulletin No. 5, describing its series RXC-100 International linear variable condensers.

SEWING-MACHINE MOTORS. — The Chandeysson Electric Company, St. Louis, Mo., has issued a four-page pamphlet describing and illustrating the Chandeysson direct-to-shaft-connected sewing-machine motors.

ELECTRIC HOISTS.—The Shepard Electric Crane & Hoist Company, Montour Falls, N. Y., has prepared an illustrated booklet covering its electric hoists.

BALANCING APPARATUS—The Vibration Specialty Company, Philadelphia, has issued an illustrated booklet describing its "Akimoff" balancing apparatus and special machinery for the study and elimination of vibrations.

GRAPHIC RECORD SUPPLIES.—The Educational Exhibition Company, 26 Custom House Street, Providence, R. I., has issued catalog F, covering its graphic record supplies.

OIL FIRING.—Alldays & Onions, Ltd., Great Western Works, Birmingham, Eng., has issued catalog No. 464, describing its oil burners and giving diagrams and particulars of a number of conversions to liquid fuel.

AUTOMOTIVE AND DENTAL ELECTRICAL APPLIANCES.—The Anderson Electric Equipment Company, 154 Whiting Street, Chicago, is circulating catalog No. 3, covering its automotive accessories, electric lighting devices, dental and laboratory devices, etc.

HEADLIGHTS.—Engineering report No. 303 is a discussion of "Golden Glow" glass reflectors and their relation to the locomotive headlight question—a recent report sent out by the Electric Service Supplies Company, Philadelphia.

WIRE.—John A. Roebling's Sons Company has issued a 176-page price list and treatise on "Wire Rope and Wire."

LIGHTING FIXTURES — "Perfeclite" is the title of catalog No. 4 issued by the Perfeclite Manufacturing Company, Seattle, Wash., describing and illustrating its lighting fixtures.

New Incorporations

THE ADVANCE ELECTRIC COMPANY, Terre Haute, Ind., has been incorporated by T. W. Cook, J. M. Schoonover and W. C. Stewart. The company is capitalized at $50,000 and proposes to deal in electrical merchandise.

THE NEWLAND (N. C.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $25,000 by E. C. Guy and others.

THE PROSPECT STORAGE BATTERY & IGNITION COMPANY, Brooklyn, N. Y., has been incorporated with a capital stock of $25,000 by J. and J. Polek and A. Manly, 2421 Putnam Avenue, Brooklyn, N. Y.

THE PHILLIPS ELECTRIC COMPANY, Rochester, N. Y., has been incorporated with a capital stock of $100,000 by J. J. Phillips of Rochester. The company proposes to manufacture electric and gas fittings.

THE PHELPS SALES CORPORATION, Buffalo, N. Y., has been incorporated with a capital stock of $40,000 to manufacture lighting machinery. The incorporators are S. L. Reilly, E. J. Kuisel and S. M. Finch of Buffalo.

THE AMERICAN DISTRESS SIGNAL COMPANY, New York, N. Y., has been incorporated by F. T. Hendl, E. J. Garity and M. Scholder, 16 West 107th Street, New York City. The company is capitalized at $200,000 and proposes to manufacture fire and burglar alarm systems.

THE EDISON LIGHTBRIER CORPORATION, New York, N. Y., has been incorporated with a capital stock of $30,000 to manufacture gas and electric fixtures by W. H., S. and L. J. Shlesinger, 280 Broadway, New York City.

THE WHALEN ELECTRICAL APPLIANCE COMPANY, 802 South Grand Avenue, Los Angeles, Cal., has been organized by John M. Whalen, 1130 South Hope Street, and others. The company proposes to manufacture electrical specialties.

THE VONDER KUHLEN ELECTRIC COMPANY, Los Angeles, Cal., has been incorporated with a capital stock of $20,000 to manufacture electrical specialties. The incorporators are H. L. Vonder Kuhlen, 917 Georgia Street, and W. J. Barman.

THE ROTARY FAN SWING COMPANY, Evansville, Ind., has been incorporated with a capital stock of 200,000 by Isaac W. Crabtree, Charles N. Garrett and Travis B. Williams.

THE HIGH TENSION TRANSFORMER & EQUIPMENT COMPANY, Hoboken, N. J., has been incorporated with a capital stock of $60,000 by M. B. Cohen, S. J. Sondheim and H. A. Cone of New York.

THE LINWORTH (N. C.) MUTUAL LIGHT & POWER COMPANY has been incorporated with a capital stock of $4,000 by L. M. McGuren, J. C. Mitchell and others.

THE PHILBRIN CORPORATION, Merion, Pa., has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $1,500,000 to manufacture electric starting systems. The incorporators are: H. Boardman Hopper, Merion; Rowland S. Phillips, Kennett Square, and Firman S. Houson, Wayne, Pa.

THE GENERAL BATTERY MANUFACTURING COMPANY, Los Angeles, Cal., has been chartered with a capital stock of $150,000 to manufacture electric batteries. The incorporators are B. S. Young, Everett E. Eldridge and Arthur E. Boland.

THE VULCAN ELECTRIC COMPANY, Los Angeles, Cal., has been incorporated with a capital stock of $200,000 to manufacture electrical specialties by W. W. Sweeney, I. W. Gleason and H. A. Masac.

THE ATLAS ELECTRIC COMPANY, 101 Washington Street, Providence, R. I., has been organized to manufacture electrical specialties. Sylvester F. Argent, 192 Cedar Street, is interested in the company.

THE BRASS LIGHT FIXTURE COMPANY, New York, N. Y., has been chartered with a capital stock of $10,000 by P. and I. Pine and E. Diamond, 294 Stanton Street, New York City.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

RUTLAND, VT.—Contract has been awarded to the Northern Engineering Company, 27 School Street, Boston, Mass., by the Rutland Railway, Light & Power Company, for the construction of its new hydro-electric power plant, to cost about $500,000, including equipment.

RUTLAND, VT.—Arrangements are being made by the Vermont Hydro-Electric Corporation for the installation of a third unit at the new hydro-electric plant at Mill Village, now nearing completion.

FALL RIVER, MASS.—The construction of a one-story transformer station is contemplated by the Connecticut Mills at its plant on Bay Street.

FITCHBURG, MASS.—The Fitchburg Gas & Electric Company is having plans prepared for the construction of a one-story power plant. Charles H. Tenney Company, 201 Devonshire Street, Boston, is engineer.

NORTHBRIDGE CENTER, MASS.—The Worcester Suburban Electric Light Company of Whitinsville has been granted a franchise to extend the electric light and street-lighting system from Northbridge Center to the Grafton town line. O. E. Walcott is superintendent of the company.

ARNOLD MILLS, R. I.—At a recent meeting it was voted to petition the Blackstone Valley Gas & Electric Company to establish an electric distribution system in Arnold Mills and vicinity.

COSCOB, CONN.—Plans have been completed for improvements to the local power house of the New York, New Haven & Hartford Railroad, to increase its output about 30 per cent and thereby furnishing sufficient electricity to operate the eastern end of the railroad system.

WATERBURY, CONN.—The Connecticut Light & Power Company plans to erect an addition to its power house, to cost about $10,000.

Middle Atlantic States

CENTRAL ISLIP, N. Y.—Bids will soon be received by E. S. Elwood, secretary of the State Hospital Commission, Albany, for the installation of new underground service connections at the Central Islip State Hospital. Plans also include the installation of two turbine-driven pumps, feed-water heater, etc.

HUDSON, N. Y.—The question of establishing a municipal electric light and power plant is under consideration.

IONA ISLAND, N. Y.—Improvements to the power plant at the local naval magazine are contemplated by the Bureau of Yards and Docks, Navy Department, Washington, D. C. The cost is estimated at about $27,000.

LANCASTER, N. Y.—According to Ernes Feyler, president of the Lancaster & Depew Electric Power & Conduit Company, it is probable that within a few months Broadway Road from Lancaster to Alden will be electrically lighted. The proposition is subject to the decision of the taxpayers and town boards of Lancaster and Alden.

NEW YORK, N. Y.—Contract has been awarded by V. Viviaudou, Inc., Times Building, to J. M. Brody, care of the National Ice & Coal Company, 103 Park Avenue, for the construction of a group of factory buildings, to cost about $1,000,000. Summerfeld & Steckler, 32 Union Square, are engineers.

POTSDAM, N. Y.—Application has been made by the St. Lawrence Transmission Company to the Public Service Commission for permission to construct and operate an electric system at Fowler, St. Lawrence County.

ROCKY POINT, L. I., N. Y.—The Radio Company of America, Woolworth Building, New York, has awarded contract to the J. G. White Engineering Company, 43 Exchange Place, for the construction of a wireless station consisting of several buildings, including a power house, to cost about $10,000,000.

WHITEHALL, N. Y.—Application has been filed by the Consolidated Light & Power Company with the State Public Service Commission for permission to proceed with the construction of an electric light plant and the erection of a local tranmission system.

YONKERS, N. Y.—The Yonkers Electric Light & Power Company has awarded contract to the Joseph Canepe Contracting Corporation, Inc., 604 South Broadway, Yonkers, for the erection of a transformer station, to cost about $200,000.

CLINTON, N. J.—The Jersey Electric Company of High Bridge has been granted permission to erect an electric transmission line from Clinton to Annandale.

IRVINGTON, N. J.—F. C. Mesa is having plans prepared for the erection of a power plant in connection with the new addition to his ammunition factory on Chancellor Avenue.

LAKEHURST, N. J.—Bids will be received at the office of the chief of the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 21 (Specification 4128), for the erection of a power house and the installation of equipment at the local navy yard, to cost about $400,000. Further information may be obtained on application to the above address.

MORRISTOWN, N. J.—The Board of Public Utility Commissioners has granted the United Electric Company of Boonton and Morristown authority to dispose of its property to the Morris & Somerset Electric Company of Morristown for $350,000. The new owner has been granted permission to issue $200,000 in stock and $350,000 in notes, to purchase and make extensive improvements to the property.

HARRISBURG, PA.—Application has been made to the Public Service Commission for the merger of eight electric and gas companies under the name of the Pennsylvania Light & Power Company. The proposed new company contemplates the expenditure of about $5,000,000 for new electric generating machinery and new transmission lines.

HARRISBURG, PA.—The Public Service Commission is considering the following applications for bond and stock issues for proposed extensions to electric light plants and systems: Pennsylvania Lighting Company, bonds, $558,000; Lykens Valley Light & Power Company, Philadelphia, bonds, $73,000; Pennsylvania Utilities Company, Easton, bonds, $137,000; Penn Central Power & Transmission Company, Altoona, bonds, $150,000; Penn Central Light & Power Company, Altoona, bonds, $251,000; Scranton Electric Company, Scranton, bonds, $190,000; Metropolitan Edison Company, bonds, $50,000; Wilkes-Barre Connecting Railroad, Wilkes-Barre, stock, $82,000, and bonds, $16,000; Reading Transit & Light Company, Reading, bonds, $50,000.

PHILADELPHIA, PA.—Bids will be received by James T. Cortelyou, director, Room 215, City Hall, Philadelphia, Pa., until June 18, for the following: For furnishing two boiler-feed pumps; 13,000 ft., 50-pair, and 11,000 ft. 15-pair, all No. 14 gage paper and lead cable; forty dynamotors; improvements and extensions to the fire alarm central office equipment; 100 patrol signal boxes; one dynamotor frame; one storage battery and equipment; 3,500 ft. twenty-conductor, 6,000 ft. fifteen-conductor, 4,000 ft. four-conductor, all No. 14 gage rubber and lead cable; for the installation of 2,000 ft. of four-way terra-cotta conduit, etc. Specifications and proposal blanks may be obtained at Room 616, City Hall.

PHILADELPHIA, PA.—The General Electric Company of Schenectady, N. Y., contemplates the construction of an electrical plant in Philadelphia, to cost about $10,000,000. A. Vogel, at the Schenectady works, is assistant superintendent of grounds and buildings.

PHILADELPHIA, PA.—The City Council has approved an issue of $4,000,000 in bonds, the proceeds to be used for equipment for the Frankford elevated railway line. W. S. Twining, director of the Department of City Transit, is in charge.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company, 5 Light Street, will soon award contract for the erection of a telephone exchange, to cost about $250,000. McKenzie, Vorhees & Gmeline, 1123 Broadway, New York, N. Y., are architects.

LAUREL, MD.—The Maryland Motor Corporation, 631 Munsey Building, Baltimore, contemplates the erection of a new hydro-electric plant on the Patuent River, to cost about $120,000. T. B. Webster, 631 Munsey Building, is engineer.

OAKLAND, MD.—The Town Council has petitioned the State Legislature for authority to appropriate $50,000, the proceeds to be used for lighting purposes.

QUEENSTOWN, MD.—A bill has been introduced into the State Legislature authorizing the Commissioners of Queen Anne's County to construct and operate an electric light and power plant in Queenstown.

SNOW HILL, MD.—The Council has appealed to the State Legislature for authority to purchase and operate the local electric light plant, owned by the Snow Hill Electric Light & Power Company.

THURMONT, MD.—A bill has been introduced into the State Legislature authorizing the Commissioners of Frederick County to make arrangements to provide funds for improvements to the municipal electric light and power plant in Thurmont.

CHARLESTON, W. VA.—Electrification of its plant and the installation of a 250-kw. generator unit is planned by the Brush Creek Coal Company.

FAIRMONT, W. VA.—The Monongahela Valley Traction Company has been granted a permit for the erection of a 22,000-volt electric transmission line in Monongahela County.

BEDFORD, VA.—Plans are being prepared by W. C. Whitner & Company, engineers, Virginia Railway & Power Building, Richmond, for the construction of a new municipal hydro-electrc plant and dam, to cost about $100,000.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until June 18, South Charleston, W. Va., Schedule 6356, electric hoists; Schedule 6357, electric furnace control panels. Until June 22, Washington, D. C., Schedule 6289, electric cable. Until June 25, Boston, Mass., Schedule 6349, electric hoists. Mare Island, Cal., Schedule 6299, electric insulators. Applications for proposals should designate the schedule desired by number.

WASHINGTON, D. C.—Bids will be received at the office of the Chief of Engineers, United States Army, Washington, D. C., advertisement 41, for furnishing electric power cable. For further information apply to above address.

WASHINGTON, D. C.—Contracts have been awarded by the Potomac Electric Company, 231 Fourteenth Street, to P. F. Gormley Company, Union Trust Building, and to S. R. Harris, 710 Fourteenth Street, for the construction of two substations.

North Central States

DETROIT, MICH.—Bids have been rereceived by Smith, Hinchman & Grylls, Washington Arcade, for the erection of a factory addition, 79 ft. x 532 ft. Lighting equipment for central-station supply, provisions for motors, etc., will be required.

MARCELLUS, MICH.—The question of issuing $23,000 in bonds for the installation of two new generating units in the municipal electric light plant to provide for twenty-four hour service will soon be submitted to the voters.

TRAVERSE CITY, MICH.—The construction of a steam-operated electric light plant, to cost about $75,000, is contemplated.

CANTON, OHIO.—Bids will be received by Mr. Lane of the Board of Education until June 19 for the erection of a high school, to cost about $1,000,000. Thayer & Johnson, 5716 Euclid Avenue, Cleveland, are architects.

CLEVELAND, OHIO.—The erection of a market house, garage, ice place, etc., on East 105th Street and Euclid Avenue, to cost about $1,500,000, is contemplated. Electric wiring, motors and electric elevators will be installed. G. H. Greenberg, attorney, Society for Savings Building, is in charge.

COLUMBUS, OHIO.—The City Council has been urged to authorize a survey of the municipal electric light plant for the purpose of determining the defects of the plant and its system of operation.

DAYTON, OHIO.—The erection of a central station and the installation of a new signal system for the fire department, to cost about $180,000, is contemplated. George Baker is city engineer.

LIMA, OHIO.—Work has been started by the Ohio Railway Company on the erection of an electric transmission line between Lima and Toledo, to carry electric energy from the plant of the Doherty organization. Other improvements, to be started at once, have been planned by the company. The total cost is estimated at about $185,000.

MIDDLETOWN, OHIO.—A project is being promoted by the Chamber of Commerce for extension to the ornamental street-lighting system in Middletown.

FULTON, KY.—Plans are under consideration for the extension of electric light service to all farmers along the route between Fulton and Hickman, and possibly to the town of Cayce, which is a midway point. The cost of the improvements is estimated at about $90,000.

INDIANAPOLIS, IND.—An appropriation of $650,000 has been made for the installation of a new power plant at the Arsenal Technical High School.

MARION, IND.—The installation of a "white way" street-lighting system in the principal streets of the village is being planned by the Village Council.

CHICAGO, ILL.—The University of Chicago contemplates the construction of a power plant on Ellis Avenue, to cost about $1,000,000. Holabird & Roche, 104 South Michigan Avenue, are architects.

MARION, ILL.—The installation of an ornamental street-lighting system, to cost about $54,000, has been approved by the City Commission.

EAGLE RIVER, WIS.—Bonds to the amount of $17,000 have been voted for improvements to the electric light and water plant.

HARTFORD, WIS.—The Hartford-Rubicon Electric Company, recently organized, has purchased the poles and lines of the Hartford Electric Company on Pleasant Hill, and plans extensions and improvements to cost about $6,000.

NEW LONDON, WIS.—The City Council has voted to enter into contract with the Huron Valley Light & Power Company of Shelby, for a period of five years, to supply electricity to New London. It is probable that a transmission line will be erected midway between Plymouth and Shelby, coming through Shiloh, Greenwich and up to New London.

RUTLAND, WIS.—The Interurban Lighting Company has been recently incorporated with a capital of $10,000 for the purpose of furnishing electric light and power to the town of Rutland.

ARGYLE, MINN.—Bids will be received by E. A. Brekke, village recorder, until June 14 for improvements to the electric distribution system.

BENSON, MINN.—Bids will be received by W. E. Skinner, engineer, 542 Lumber Exchange Building, Minneapolis, until June 15, for improvements to the municipal electric light plant, including the installation of boilers, stokers, etc.

BRECKENRIDGE, MINN.—At a special election to be held June 15 a proposal to issue $15,000 in bonds for the erection of a new municipal electric light plant will be submitted to the voters.

MAQUOKETA, IOWA.—Authority has been granted to the Iowa Electric Company by the Board of Supervisors of Jackson County to use the public highway for extensions to the company's transmission lines north from Maquoketa to Andrew.

DE SMET, S. D.—A bond issue for the establishment of a telephone system in De Smet is contemplated.

ROCKHAM, S. D.—The erection of an electric power plant is contemplated by the city officials.

LINCOLN, NEB.—Bonds to the amount of $300,000 have been voted for improvements to the electric light system. T. H. Berg is city clerk.

WAKEFIELD, NEB.—The installation of a new 100-hp. engine and a generator in the municipal electric light plant is contemplated.

Southern States

WINSTON-SALEM, N. C.—Contracts will soon be awarded by the Memorial Hospital for the construction of several hospital buildings, including power house, to cost about $800,000. C. B. Keen, 1218 Chestnut Street, Philadelphia, Pa., is architect.

COLUMBIA, S. C.—Plans are being prepared for improvements and extensions to the electric street-lighting system, to cost about $20,000. W. H. Harth is city electrician.

PARIS ISLAND, S. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 21, for improvements to the power plant at the local navy yard, to include the provision and installation of one 300-kva. turbo-alternator; one 25-kw. exciter; alterations to building and the removal and relocation of present equipment to provide for the new arrangement of machinery. A deposit of $20 is required for drawings and Specification 4211, which may be obtained on application to the above address or the Post Commander, Marine Barracks, Paris Island, S. C.

DAVISBORO, GA.—An issue of $15,000 in bonds is under consideration for the erection of a municipal electric light and power plant.

EASTMAN, GA.—C. F. Wagner of the J. B. McCrary Company, of Atlanta, has been appointed by the city authorities to make an estimate of the cost to install a municipal electric light plant at Eastman.

LOUISVILLE, GA.—The municipal electric light plant and water pumping station, recently destroyed by fire, causing a loss of $20,000, will be rebuilt.

MORRISTOWN, TENN.—Extensions to the electric light system, to cost about $30,000, are planned. F. W. Donaldson is Mayor.

JACKSON, ALA.—The Bolen Brothers contemplate the establishment of a local electric light plant.

MUSCLE SHOALS, ALA.—Bids will be received at the office of the constructing quartermaster, U. S. Nitrate Plant 2, Muscle Shoals, until June 21, for the erection of a 4-mile transmission line between plants 1 and 2. Plans and specifications may be obtained on application to the above office.

CONWAY, ARK.—Improvements to the electric light and water systems, to cost about $12,000, are under consideration.

MONROE, LA.—The Petticord Motor Supply Company contemplates the construction of a plant and the installation of electrically driven equipment for the manufacture of automobile accessories. T. H. Petticord is president and general manager.

MARNE, OKLA.—Bonds have been voted for the construction of a municipal electric light plant, to cost about $20,000.

FORT WORTH, TEX.—The Southwestern Telegraph & Telephone Company contemplates an expenditure of $500,000 for additions and extensions to its telephone system.

LA PORTE, TEX.—The erection of a power house and water tower at St. Mary's College, is contemplated.

Pacific and Mountain States

NEWPORT, WASH.—Application has been made by the Calispell Light & Power Company for permission to divert 20-sec.ft. of water from the north fork of Calispell Creek for power purposes.

HOOD RIVER, ORE.—The City Council contemplates the installation of an electric street-lighting system.

ROSEBURG, ORE.—At a recent election bonds to the amount of $500,000 were voted for the erection of an electric light and power plant, to be located at Whistlers Bend, 12 miles east of Roseburg.

SALEM, ORE.—A project has been started by business men of Union and Grant counties for the purpose of securing $100,000 toward the construction of a private power plant to be leased to the Eastern Oregon Power Company of Baker. The proposed generating plant would cost $200,000, half of which would be furnished by the Eastern Oregon Power Company.

SALEM, ORE.—The Oregon Electric Company is planning improvements to its plant, to cost about $10,000.

COVELO, CAL.—Application has been made to the State Water Commission by S. E. Getlis for the diversion of 189 sec.-ft. from the north fork of the Eel River for power purposes. The amount of water to be stored aggregates 137,388 acre-ft. Plans provide for a development of 23,589 hp. and also the erection of a dam 665 ft. x 138 ft., a ditch and pipe line 4½ miles long. The cost of the project is estimated at about $1,500,000.

LOS ANGELES, CAL.—The City Council contemplates the installation of an ornamental street-lighting system on various business streets of the city.

PASADENA, CAL.—The city officials have arranged to purchase the local electric light and power plant now owned by the Southern California Edison Company, at a cost of $515,000.

SANATAQUIN, UTAH.—The installation of an incandescent street-lighting system to consist of about eight 1,000-cp. units is under consideration by the City Council.

TUCSON, ARIZ.—At a recent election bonds for the installation of an ornamental street-lighting system were defeated.

DEL NORTE, COL.—AT an election to be held soon, the proposal to issue $8,500 in bonds for improvements to the municipal electric light plant will be submitted to the voters.

Canada

VANCOUVER, B. C.—Plans are to be prepared this year for the construction of a hydro-electric plant at Heton Lake, to generate 175,000 hp. The cost of the project is estimated at about $12,000,000.

BRANDON, MAN.—A proposal to develop power for Brandon at Currie's Landing, 8 miles east of the city, will be submitted to the provincial government by the Board of Trade.

WINNIPEG, MAN.—According to the officials of the Manitoba Electric Power Transmission Commission, expenditures amounting to about $600,000 will be made this year on development work, including the construction of a power plant at Virden, to cost about $75,000. J. M. Leamy is commissioner.

BROCKVILLE, ONT.—The Hydro-Electric Power Commission contemplate extensions to the power line along the river road east of Brockville.

KITCHENER, ONT.—Bids are being received by the Kitchener Light Commission for the erection of a new hydro-electric distribution station, rated at 4,500 kw.

MILVERTON, ONT.—In connection with the establishment of a waterworks system in the village, a pumphouse will be erected and two electrically driven pumps, rated at 500 gal. per minute, will be installed. The total cost of the system is estimated at about $100,000. E. A. James Company, 36 Toronto Street, Toronto, are engineers.

PRESTON, ONT.—J. Mickler, architect for the Grand Valley Railway, is placing contracts for materials, etc., in connection with two new power stations.

TORONTO, ONT.—Over $17,000,000 is to be spent on the Provincial power schemes this year, according to supplementary estimates submitted to the Legislature. The greater portion of this, $10,500,000 is for the big development at Chippawa and Queenston; and $2,500,000 will be required for the Port Arthur and Thunder Bay development. Estimates on the other developments are as follows: Niagara system, $1,250,000; Severn system, $50,000; Eugenia and Saugeen system, $475,000; Muskoka system, $40,000; Wasdell system, $90,000; St. Lawrence system, $500,000; Rideau system, $250,000; Central Ontario system, $750,000; Nipissing system, $175,000. Expenditures on account of Province, $177,000. Miscellaneous, $500,000.

WOODSTOCK, ONT.—The Water & Light Commission plans the erection of a substation on Ingersoll Avenue. Mr. Archibald is superintendent.

MONTREAL, QUE.—Plans for the new electrically driven low-level pumping station provide for the initial installation of five 30,000,000-gal. pumps and space for three additional pumping units. Two of these pumps have been ordered and will be in operation this season. A. E. Doucet is director of public works.

REGINA, SASK.—An expenditure of $54,310 has been voted by the City Council, for materials for the proposed extensions to the municipal electric light and power plant.

REGINA, SASK.—Bids have been received by the Minister of Public Works, for the construction of a power house at the Parliament Buildings in Regina.

UNITY, SASK.—Contract has been awarded to G. Janowsky for the construction of a new power house at Unity.

Miscellaneous

PETERSBURG, ALASKA.—Bonds have been authorized for the construction of an electric light and water plant. The development of a water-power system is also contemplated.

WAILULU, T. H.—A new electric company is being organized for the purpose of establishing an electric distribution system in this place.

Record of Electrical Patents

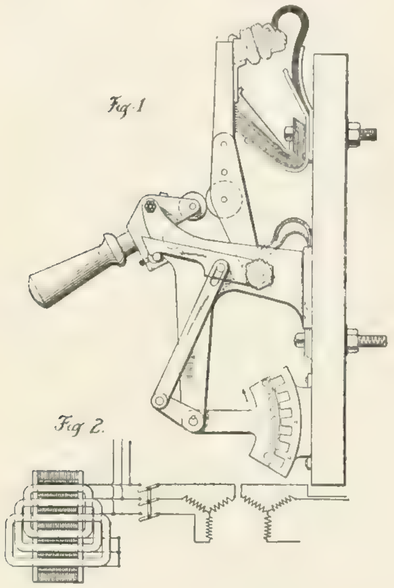
Notes on United States Patent

(Issued May 11, 1920)

1,339,391. Protection of Electric Distribution System; Philip V. Hunter, Purley, England. App. filed May 6, 1918. Protection of distribution systems in which current transformers connected by pilot wires are employed. The relays, etc., are unaffected by the capacity current.

1,339,456. Circuit Controller; Clark T. Henderson, Milwaukee, Wis. App. filed June 5, 1915. Circuit-breaker which will not telegraph.

1,339,903. Regenerating System; Friedrich W. Meyer, Pittsburgh, Pa. App. filed March 24, 1915. Electric railway systems for return to source of surplus energy developed.



1,339,981. Circuit Breaker

1,339,914. Starting Means for Electric Apparatus; Thomas A. Barrett, Englewood, N. J. App. filed March 17, 1917. Method of starting mercury-vapor lamp.

1,339,923. Protective Means for Distributing Systems; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed May 6, 1915. Means for minimizing inductive disturbances on adjacent circuit.

1,339,928. Control for Single-Phase Alternating-Current Motors; Rudolf E. Hellmund, Swissvale, Pa. App. filed June 15, 1917. Systems of control for commutator alternating-current motors.

1,339,929. System of Control; Rudolf E. Hellmund, Swissvale, Pa. App. filed April 18, 1917. Electrical and mechanical braking systems.

1,339,930. Motor Controller; Clark T. Henderson, Milwaukee, Wis. App. filed June 29, 1914. For constant speed under varying load.

1,339,936. Electrical Regulator; Allen A. Tirrill, Pittsburgh, Pa. App. filed Sept. 13, 1916. Vibratory-contact voltage regulator.

1,339,915. System of Control; John A. Clarke, Jr., Wilkinsburg, Pa. App. filed April 4, 1916. Control and dynamic braking for electric vehicles.

1,339,966. Method of Producing a Rib on an Electrically Weled Joint; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed Nov. 25, 1919. Producing strengthening rib simultaneously with welding.

1,339,967. Method of Electrically Welding Metal Bodies; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed Nov. 25, 1919. Welding by first pressing surfaces together to eliminate irregularities.

1,339,968. Method of Electrical Welding; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed Dec. 16, 1919. Welding bushing within flanged plates to form hollow casing.

1,339,969. Method of Electrical Welding; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed Dec. 24, 1919. Electrically welding longitudinal edges of a tube.

1,339,970. Method of Producing Longitudinal Ribs on the Exteriors of Tubes; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed Dec. 24, 1919. Forms longitudinal ribs on tube by electrically heating portions under pressure.

1,339,971. Method of Electrical Welding; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed Jan. 3, 1920. Prevents transverse vibration of edges of hollow object during welding.

1,339,972. Method of Electrical Welding; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed Feb. 4, 1920. Seating bodies to be welded in recesses in electrodes.

1,339,981. Circuit Breaker; Frank W. Roller, East Orange, N. J. App. filed March 19, 1917. Protection against phase reversal and no voltage.

1,339,985. Lamp Construction; Lindsley Schepmoes, Hasbrouck Heights, N. J. App. filed March 16, 1915. Lamp construction for railway carriages.

1,339,987. Steering-Post Bearing; Grant E. Smith, Poughkeepsie, N. Y. App. filed Aug. 25, 1916. Combined bearing and slip ring for steering-wheel posts.

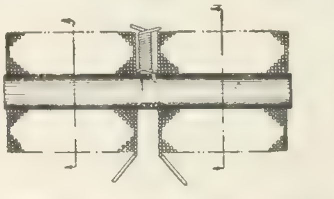
1,339,988. Insulating Collector or Distributer Spool; Louis Steinberger, Brooklyn, N. Y. App. filed March 20, 1917. High-tension collector for automobiles.

1,339,996. Regulating System; Fred H. Winter, Schenectady, N. Y. App. filed Aug. 13, 1919. To maintain constant voltage or current.

1,339,998. Shaped Filament; Daniel K. Wright, Paterson, N. J. App. filed April 15, 1914. Metal lamp filaments shaped before mounting.

1,340,004. Dynamo-Electric Machine; Sven R. Bergman, Nahant, Mass. App. filed June 20, 1918. Dynamo-electric machines for arc welding.

1,340,005. Dynamo-Electric Machine; Sven R. Bergman, Nahant, Mass. App. filed Aug. 3, 1916. Voltage varies directly with speed.



1,340,027. Electro-Conducting Coil

1,340,027. Electro-Conducting Coil; Chas. W. Dunham, Edgewood Borough, Pa. App. filed March 6, 1917. Coil with terminals on outer surface and adjacent to middle thereof.

1,340,054. Incandescent Lamp; John Judge, New York, N. Y. App. filed June 26, 1919. Reflecting surface inside lamp.

1,340,056. Multiple-Arc Welding; Otis A. Kenyon, New York, N. Y. App. filed Nov. 19, 1918. Several electrodes operate simultaneously on same weld.

1,340,101. Method of and Means for Controlling Electrical Energy; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed June 15, 1914. Control of radio energy.

(Issued May 18, 1920)

1,340,155. Process of Controlling the Thickness of Walls in an Electric Furnace; Charles H. Chapman, Niagara Falls, N. Y. App. filed Feb. 20, 1917. Forming furnace lining and controlling thickness.

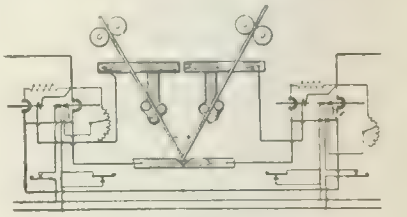
1,340,193. Electrical Oscillator; Frederick K. Vreeland, Montclair, N. J. App. filed May 15, 1919. Improved purity of wave form secured.

1,340,197. System for Recording Electrical Phenomena; Loren S. Wells, New York, N. Y. App. filed June 21, 1919. Records locations liable to electrolysis.

1,340,203. Electric Furnace; Thaddeus F. Baily and Frank T. Cope, Alliance, Ohio. App. filed Aug. 12, 1918. Plurality of resistance elements one above the other equally distribute heat.

1,340,222. Galvanic Cell; Christiaan A. R. Graamans, Rotterdam, Netherlands. App. filed July 25, 1917. Simplified electrode with depolarizer for wet and dry cells.

1,340,240. Hoist Control; Alexander J. Nicht, Jr., Milwaukee, Wis. App. filed Jan. 30, 1914. Control of hoist motors.



1,340,056. Multiple-Arc Welding

1,340,241. Liquid Rheostat; Alexander J. Nicht, Jr., Milwaukee, Wis. App. filed Jan. 30, 1914. Liquid rheostat for hoist control.

1,340,249. Automatic Controlling Apparatus for Mixed Driving Systems; Henri Pieper, Liege, Belgium. App. filed Nov. 29, 1916. Controls power of mixed vehicle-propulsion system.

1,340,260. Registering Circuits for Coin Boxes; George K. Thompson, Maplewood, N. J. App. filed Oct. 17, 1918. Coin-registering circuits for telephone.

1,340,269. Storage Battery; Percy D. Ivey, Guelph, Canada. App. filed Feb. 14, 1919. Transparent container allows density indicator to be seen.

1,340,261. Lighting Fixture; James T. Thompson, Washington, D. C. App. filed Feb. 18, 1919. Bowl support and shade holder for semi-indirect lighting.

1,340,268. Electric Conductor Take-Up; Arthur W. Hill, Belmond, Iowa. App. filed June 19, 1919. Rewinding reel for extension light.

1,340,343. Direction Indicator; Robert B. Pollock, Los Angeles, Cal. App. filed Dec. 30, 1918. Direction indicator for automobile.

1,340,412. Method of Electrically Welding; Albert Schmidt, Flint, Mich. App. filed July 26, 1918. Welds electrodes to spark plug casings.

1,340,435. Cost-Keeping Machine; James W. Bryce, Binghamton, N. Y. App. filed Jan. 22, 1919. For calculating pay of men working at different rates.

1,340,471. Vibratory-Diaphragm Controller; Marshall I. Williamson, Baltimore, Md. App. filed May 13, 1919. Regulates sound volume of telephone receiver.

1,340,499. Picture-Projection Lamp; Walter G. Preddey, San Francisco, Cal. App. filed Feb. 11, 1919. For dissolving effects.

1,340,502. Apparatus and Method for Rectifying High-Tension Alternating Current; Walter A. Schmidt, Los Angeles, Cal. App. filed Sept. 15, 1915. For precipitation of suspended matter from gases.

1,340,537. Automobile Signal; William Edward F. Gibson and Ida M. [illegible], Port Coquitlam, B. C., Canada. App. filed May 17, 1919. Automobile direction signal.

1,340,540. Battery Hand Lamp; Thomas J. Madigan, Brooklyn, N. Y. App. filed Aug. 27, 1919. Unaffected by dripping water.

1,340,575. Electro-ionic Valve; Erwin R. Stoekle, New York, N. Y. App. filed Sept. 4, 1917. Improved method of supporting parts.

1,340,588. Electrical Apparatus; Julius B. Wantz, Chicago, Ill. App. filed April 29, 1915. Current control for X-ray tube.

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician
Published by McGraw-Hill Company, Inc.

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Volume 75 New York, Saturday, June 19, 1920 *Number* 25

Buying Other Persons' Coal for Them

IN PETITIONING the City Commission for an increase in rates, the Sandusky (Ohio) Gas & Electric Company points to the many industries that have discontinued their own steam plants because of the high price of coal and are now purchasing power from the central station, which has to pay the same high price for fuel while continuing to sell electricity at before-the-war rates. These firms, the company says, "have taken advantage of our predicament to such an extent that anything like good service is impossible." An enforced contribution to the coal piles of independent plants would not be so vastly different in principle.

Investing for Service

THE temptation to continue in a rut so long as affairs run smoothly needs to be guarded against by users of industrial power and illumination no less than by individuals in personal matters. It is easier to let a motor installation function with routine cleaning and lubrication than to check its fitness for service under possible changes in conditions. To assume that so long as no complaints arise a lighting equipment need not be photometered or otherwise tested is to follow the path of least resistance. While periodical tests are coming more and more into vogue in large manufacturing plants, countless factories of more than average size have still to be awakened to the fact that their maximum efficiency is in the hands of men who should be encouraged to cultivate engineering methods of analysis in addition to "trouble shooting." Few worse errors in management can be made than to oppose reasonable investments in betterment work because of inertia and narrow vision.

A Notable Centennial

JUST a year ago, in a special supplement accompanying our issue of June 21 and bearing the title "A Glance at Early Electrical Literature," the ELECTRICAL WORLD suggested that July 21, 1920, the centenary of the publication of Hans Christian Oersted's epoch-making Latin treatise, "Experiments on the Effect of a Current of Electricity on the Magnetic Needle," would be a fitting date for commemoration by the electrotechnical profession. We print this week a letter from Dr. Francis B. Crocker in which he makes a similar suggestion. Very properly Dr. Crocker couples with the name of Oersted, as did the ELECTRICAL WORLD, the name of André Marie Ampère, the great Frenchman to whom was due the immediate development of the discovery made, perhaps somewhat fortuitously, by the Danish scientist. The relative degree of credit which is the due of each man and of the other early electrotechnicians who followed the paths thus opened up must be left to the historians of the art to apportion, but the centennial should not pass unobserved. It is our hope that the A. I. E. E. will call together American scientists in order that they may contribute for permanent record reflections from their experience and study which bear upon the influence of the early work of Oersted and Ampère in the United States and the great development of technical literature from its small beginnings.

Publicity for the Engineer

AS WE have already said, the Federated American Engineering Societies are to be congratulated on their recognition of the principle of publicity. There is very high authority against hiding one's light under a bushel. Modesty may compel an individual to do this, and his diffidence may be accounted a virtue. But diffidence in an organization is akin to cowardice and works to defeat the ends of the body that harbors it. When the engineering world shall speak out habitually and authoritatively, through the professional and the lay press alike, to recount its achievements, to outline its projects and to tender its advice on all matters where it has knowledge and a collective concern, it will both perform an imperative duty and help individual engineers to gain the greater degree of recognition, the higher scale of remuneration and the broader sphere of influence that should be theirs. The Federated American Engineering Societies have taken a forward step in this direction and established a precedent on which all engineering societies can effectively lean.

Central Stations Can Aid in Fire Prevention

CARELESS handling of electric flatirons, a prolific cause of local electrical fires, and the carelessness of maintenance men who are allowed to do wiring in large blocks and buildings because they have maintenance licenses are conditions recently deplored by Chief John F. Healy and Electrical Superintendent David Reed of the Denver (Col.) fire department. The necessity of keeping live wires free from contact with gutters, fire escapes and other carriers and the dangers brought about by the addition of loads without providing additional carrying capacity in the building wiring were also emphasized. Chief Healy declared that the men of the electrical industry in particular can help to remove these hazards. Although not one fire in ten in Denver charged against electrical causes is actually due to such a cause, the statements of these officials merit the careful attention of electrical central-station men. Fires do not occur, they are caused, and all too many are caused by the forms of carelessness to which attention has just been called in Denver. Every fire due to preventable electric causes, and particularly those within the homes, where the use of electrical appliances is so rapidly increasing, may be justly regarded as a black mark against central-station service in every case where indifference is displayed in regard to the degree of safety that this service can justly claim. Electrical wiring can be done in such a way and appliances are so manufactured that fire hazards from electrical causes should be almost nil. Carelessness and ignorance make them much larger than they should be, and the educational campaign necessary to eliminate such carelessness and ignorance is a very important part of the central station's service to its customers. Every central station might profitably include in its commercial policy a definite campaign of education on the elimination of electrical fire hazards and a positive campaign of education on the proper use of electrical appliances. That the public at large has an exaggerated idea of these hazards is evidenced by the tendency to attribute all fires of unknown causes to electricity. A persistent campaign of education is the most effective remedy.

Recent Practice in French Hydro Plants

THE activity of our French friends in hydro-electric work has been of late years very marked, and even under the terrible stress of war it has gone on in a way that is most encouraging from the standpoint of general electrification. Two very recent developments furnish power to the electrified section of the Midi railway across the Pyrenees between France and Spain and are considered in this issue by M. Pahin. More than 500 miles (800 km.) of railway is involved in this big undertaking, and the needs of war and the shortage of coal combine to make hydro-electric development imperative. Two large plants at Soulom and Eget respectively were pushed into utilization. The former is peculiarly interesting because it derives its water supply from two neighboring rivers under two different heads. From one of the streams, the Cauterets, water is taken in a deep gorge and passed through settling chambers and screens until it enters a cement-coated underground canal for a distance of about 2 miles (3.2 km.), where it finally widens into a subterranean reservoir flowing into an open reservoir which leads to a compression chamber and the penstocks. The storage capacity in these reservoirs is good for about four and half hours' flow of the entire stream, and the penstocks from it feed three independent groups, each consisting of a 3,500-hp. Pelton-type two-nozzle wheel driving a 2,400-kw., 6,000-volt, 500-r.p.m., single-phase alternator. An interesting point about this plant is that the penstocks do not have any permanent expansion joints or any similar contrivances. They are welded in 60-ft. (18-m.) sections assembled with flanged and bolted joints on a total length of more than 1,700 ft. (518 m.). The penstocks are so firmly anchored that expansion is restrained just as in the case of a continuous electrically welded rail. Each penstock is equipped with a flow meter, and the net head utilized is 820 ft. (249 m.)

The second stream which supplies the system is the Gavarnie, of somewhat larger flow but much lower head. The water is taken into a forebay formed by a dam, passes racks and settling chambers, then into the head canal, which is 4 miles (6.4 km.) long, terminating in a compression chamber. The penstocks, arranged something like those on the Cauterets, are about 1,000 ft. (300 m.) long. Each drives a unit similar to those already described, the six units from the two sources being brought into the same machine room. The water from the Gavarnie fall is utilized in Francis radial type turbines at a net head of 372 ft. (113 m.). In case of shutdown of one of the Cauterets units extra water can be diverted by a cross penstock to the compression chamber of the Gavarnie fall. The transmission is at 60,000 volts. The plant is unique on account of the duplex source of power on two different streams.

The second development, at Eget, derives its power from the Neste, which feeds various storage reservoirs for steadying the flow on the headwaters of neighboring streams. A special storage lake is provided for the plant. The net head in this case is 2,330 ft. (710 m.), and the equipment is of typical high-head form. The seven main units are driven by 5,000-hp. wheels, and there are two auxiliary units for exciters. The general conditions of the installations here are much the same as in the previous plant. In this installation it was found desirable to provide slip joints for the penstocks during the period of construction, when the expansion is greater than if the pipes are full. Later, and at an average temperature, the anchorages were made solid. Three other plants form the complete equipment of the electrification and are to be rapidly brought into service.

Modernizing Two-Phase Distribution

IT IS curious to look back and realize how the growth of electrical service, especially through the employment of motors, has modified all the earlier notions as to systems of distribution. In the beginning of power transmission by alternating current the service rendered was chiefly for lighting, the motor loads being small and rather incidental. In the few cases where heavy motor service was required recourse was generally had to operation at 25 cycles. Looking back over the development of five-and-twenty years, the early general distrust of polyphase motors seems a curious phenomenon, particularly since they were so swiftly and successfully developed—without any material difficulty in fact, whatever trouble may have been expected. The result of the predominance of the lighting load was the frequent use of the otherwise undesirable two-phase distribution, the introduction of the now defunct monocyclic system, and earnest and useful efforts at the production of single-phase motors in spite of the inherent difficulties. Today there still linger a very few two-phase systems, for the most part dating back a quarter of a century; but one after another these relics of earlier practice when motors were few are being changed over to the standard forms of three-phase distribution.

In this issue G. H. Hagar gives an interesting account of a change from two-phase to three-phase accomplished in the system of the Vallejo Electric Light & Power Company. Oddly enough, for a good many years this company has bought three-phase power from the Pacific Gas & Electric Company and transformed it by the Scott system to two-phase. The whole system, substation and all, was gradually outgrown, and it was decided to change from the old distribution to a three-phase, four-wire system of 4,000 volts between the phase wires. The great economy of this arrangement in copper is familiar, and in this case it was especially desirable on account of the increased loads. The general problem of shifting from two-phase to three-phase was, of course, a very simple one, the old arrangement being in the form of four-wire circuits. Some useful modifications, however, were made to simplify the motor service. To make the change of customer's transformers the easier the neutral was set up with white insulators, so as to escape all danger of connecting the old transformers across the phase wires. The transformer bank at the substation was replaced by a new one with one spare unit connected delta-delta. For temporary service a booster transformer in quadrature from the midway point of one delta leg enabled both two-phase and three-phase to be conveniently obtained for the time being. In the final arrangement it became necessary to make provision in some way for the use of the considerable number of motors already installed. To this end two radically different methods were adopted. In some cases the installation was made by grouping one standard transformer with two having a nine-to-one ratio, a certain number of these latter units being already on hand and thus utilized in the new arrangement. In the remaining motor installations the motors themselves were reconnected for three-phase, using three standard transformers. On the day finally set for the change-over the secondaries on the substation transformers were changed from delta to star and the booster was disconnected, while the three-phase transformer banks on the system were changed from delta to star and the extemporized two-phase banks likewise cut in. The whole change-over was accomplished in seven hours and with results of an extremely satisfactory character.

Welding Substituted for Rivets in Erection of Structural Steel

THE field of electrical welding has been steadily expanding during the last few years, and the process has already shown great usefulness from the structural standpoint, as, for example, in shipbuilding work, to which it was freely applied during the war. A new and rather notable application is reported by H. P. Payne—the application of electric welding to the ordinary structural steel work in buildings. The plan was tried out in framing a small building and the results proved so promising as to give great encouragement for a wide expansion of the field of electric welding. The structure concerned was a roofed-in shed about 40 ft. x 60 ft. (12 m. x 18 m.), and the net result was to show a very considerable saving over the ordinary riveting process. No holes are required in the steel members; consequently the cross-section may be correspondingly reduced and still retain the same factors of safety. No holes have to be laid out, so the fabrication of the structure resolves itself into cutting the beams and girders into the proper length, putting them into position, tacking them in place, and then finishing the welding in the ordinary way. The operations of setting and alignment are of course the same as with the usual method of construction.

Since there were no data on the strength of welded structural steel members, two trusses were set up and loaded to about double the requirement of the building code, and careful records were kept of the deflection at the start and after forty-eight hours at maximum load. The only permanent set observed was $\frac{1}{16}$ in. (1.6 mm.). From the results obtained it appears that there is an admirable opportunity here for extending the usefulness of electric welding. There seems to be no difficulty whatever in doing the work or inspecting it afterward, and the advantages over ordinary riveting with its necessary expenditure of labor are of a very marked description.

Reactive Power and Unbalanced Circuits

THE term "reactive power," in relation to the power factor of three-phase circuits, is discussed in this number of the ELECTRICAL WORLD by Prof. W. V. Lyon. The material presented is condensed, and a number of propositions are contained in the article all of which merit consideration. In the first place, it is pointed out that in a simple single-phase circuit it is possible for the resistance to vary cyclically, as, for instance, in an alternating-current arc. In such a case the volt-amperes may differ from the active power, even although there is no reactance and no reactive power. Again, if the circuit contains variable reactance—*i.e.*, hysteretic-cored coils—there will be reactive power; but the sum of squares of the active and reactive powers do not in general agree with the square of the volt-amperes. It will be generally admitted that the expressed conclusion is correct; that is, that the use of reactive power in alternating-current calculations will produce nothing but approximate results, except when the current and voltage are sinusoidal and the circuit constants do not vary cyclically. Nevertheless, there are many who consider that in practice the approximate results obtained by the use and measurement of reactive power are satisfactory. The average single-phase circuit deviates considerably from the sinusoidal in wave form, and yet for many practical purposes it is useful to regard it as though the wave form were sinusoidal.

The article suggests that an advantageous definition of an alternating-current power factor would be the ratio of the total actual active power in a circuit or system to the greatest active power that could under the most favorable conditions be obtained from the voltages and currents of the system. When this definition is extended from a simple single-phase circuit to an unbalanced three-phase system, an ingenious geometrical construction is offered for determining the maximum active power that a given set of unbalanced three-phase voltages and currents could produce.

It is further pointed out that the troubles experienced by operating engineers of three-phase systems are often more largely due to unbalanced loads than to a low power factor. A customer who applies a large single-phase load to one side of a three-phase system may give as much trouble to the central station as a customer who applies a large underloaded induction motor of low power factor to all three phases. Indeed, a plea is made for the owner of an induction motor that does not seem to have been offered before. Usually the induction-motor owner has no friends. It is shown that if a bad unbalance is effected by a large local single-phase load, so that the three-phase supply system becomes distorted thereby, an induction motor, operating on the unbalanced system, suffers in its efficiency and output. It is unable to deliver as much power or to give as good an efficiency as it could if the system were balanced. Moreover, the effect of connecting the induction motor to the system is to diminish the unbalance to some extent, or to restore the balance in part. Consequently, although the induction motor may tend to lower the power factor of the system, and so make the system worse than before, yet, by its reaction adversely to the unbalanced components, it may improve the balance and do the system some good, thus proving less an enemy to good order in a three-phase system than has hitherto been thought.

Joseph B. McCall

An organizer and executive widely recognized in central-station development work as a conservative thinker and originator of policies that build good will

FOR twenty-five years Joseph B. McCall has directed the electric public utility affairs of the city of Philadelphia. The huge generating stations which serve that city as well as the needs of the electrified sections of the Pennsylvania Railroad stand as ample testimony to his ability as an executive and his broad vision of the electrical future of the Quaker City. Mr. McCall entered the public utility field in 1886, at the age of sixteen as an employee of the Penn Globe Gas Light Company and, gaining rapid promotion, was in a few years chosen its secretary. In recognition of his able work as one of the organizers of the Penn Heat, Light & Power Company, in 1895, he was elected secretary and treasurer. When that company was absorbed by the Penn Manufacturing Light & Power Company, in 1898, Mr McCall was chosen as its president, and later, when the Philadelphia Electric Company took over the Penn company, he was continued as president of the consolidated organization. That position he holds today. Although Mr. McCall is among the younger of the chief executives of the great metropolitan public utilities of this country, he is generally regarded as among the veterans in central-station development work and has initiated much new work in station design and service included in the problems associated with the installation of large steam turbines, the handling of large industrial loads and the fluctuating demands of electrified steam railroads.

A self-made man, Mr. McCall exhibits none of that indifference to the welfare of his subordinates that is sometimes attributed to men who have themselves climbed from the foot of the ladder. The physical and mental well-being of the Philadelphia Electric Company's employees has always been among his chief concerns, and their beneficial association has, with the company's backing, taken a leading position among similar associations of public utility employees.

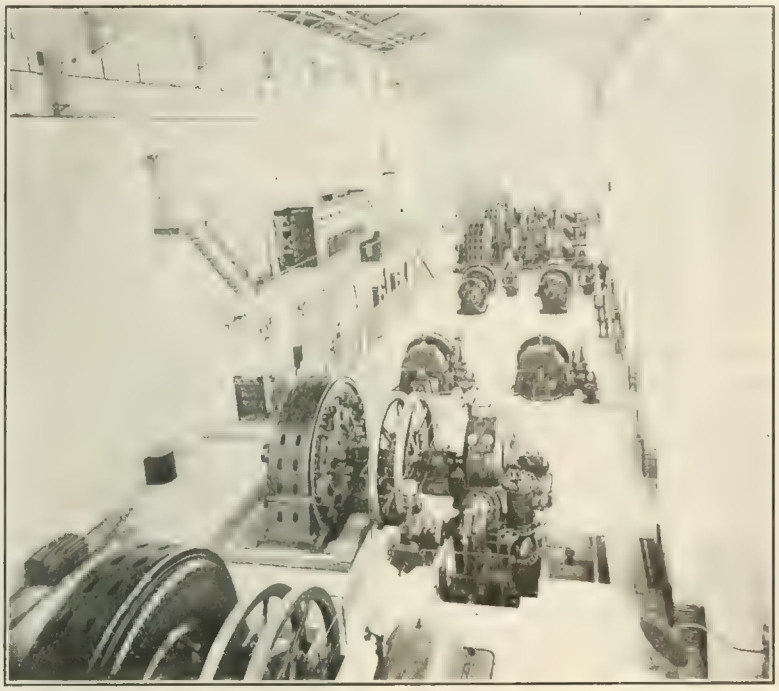
From 1904 to 1907 Mr. McCall served as president of the Association of Edison Illuminating Companies. In 1912 he was elected vice president of the National Electric Light Association, and in 1913 its president. He is a member of the Franklin Institute and of the American Institute of Electrical Engineers as well as of several local clubs. Mr. McCall was born in New York City, May 12, 1870, but has lived since early childhood in the city of Philadelphia.

Hydro-Electric Plants of French System

Five Power Stations Will Be Ultimately Developed Soulom Station, Supplying 15,000 Kw., and Eget Station, Supplying 26,000 Kw., Were Rushed to Completion for War Purposes—Heads Vary from 380 Ft. to 2,410 Ft.

By LUCIEN A. H. PAHIN
Pontoise, France

POWER requirements of the electrified section of the Midi Railway across the Pyrenees Mountains between France and Spain are taken care of by two main power stations at Soulom and Eget. Both are water-power developments. The Soulom plant is situated in the narrow valley of the Pau at the junction of the Gavarnie and the Cauterets valley and the Eget plant in the upper valley of the Neste d'Aure. While the electrification work was hampered by the war, the construction of the Soulom and Eget plants was rushed so that they might be used in helping to take care of the industrial load. The growing seriousness of the coal shortage had also made these developments imperative. The railway work involves some 530 miles (853 km.) of route and is in magnitude one of the most important in Europe.



MACHINE ROOM OF SOULOM PLANT

This plant consists of two independent water-power developments. In the background may be seen the three Francis turbines operated from the Gavarnie fall under a head of 380 ft. The group of Pelton turbines in the foreground are operated under a head of 840 ft. from the Cauterets fall.

The Cauterets River has an output varying from 71 sec.-ft. (2,000 li.-sec.) at low water up to 495 sec.-ft. (14,000 li.-sec.) at times of high water, with a mean flow of 140 sec.-ft. (4,000 li.-sec.). As it is necessary at all times to leave a flow of 10 sec.-ft. (300 li.-sec.) in the river, it is possible to count on the diversion of a usable flow of 53 sec.-ft. (1,500 li.-sec.).

Water is taken from the river at an elevation of 2,400 ft. (732 m.) in a gorge having very steep sides and passes into the settling chambers, which are specially constructed on account of the fact that water is discharged into them from another power plant (Calypso). After passing through screens the water enters a canal which is entirely underground, lined with a smooth coat of cement in order to facilitate the movement of the water, and roofed wherever the nature of the rocks is such as to render caving probable.

The canal, which is 5 ft. (1.5 m.) wide, has a slope of 1 in. 1,000. It has an output capacity of 78 sec.-ft. (2,200 li.) with a depth of water of about 3 ft. (1 m.) and of 109 sec.-ft. (3,100 li.) with a depth of 5 ft. (1.5 m.).

After following a distance of 2 miles (3 km.) the width increases abruptly to 5 ft. (4.5 m.), while the top remains horizontal and the bottom slopes downward at the rate of 1 in. 1,000 in successive steps; thus forming a subterranean reservoir about 2,300 ft. (700 m.) long. This is followed by an open reservoir 980 ft. (300 m.) long, 40 ft. (12 m.) wide and 5 ft. (4.5 m.) in mean depth. This reservoir itself is followed by a large compression chamber, whence the penstocks leave. The combined storage capacity is about 783,000 cu.ft. (22,000cu.-m.), which, under the head of 820 ft. (250 m.) here utilized, represents a capacity of 19,500 hp.-hr. This reservoir, built at the head of the penstocks and permitting the storage of the entire flow for nearly four and one-half hours, serves both as a daily reservoir and a flywheel to absorb momentary fluctuation.

To assure the maximum continuity of service as well as to facilitate the operation of the plant, the equipment is divided into three independent groups, each comprising one penstock, one 3,500-hp. turbine, one 2,400-kw. alternator and one transformer.

The penstocks are boiler-plate with an interior diameter of 32 in. (81 cm.) and are designed to resist 20 per cent more than the static head. The pipe was tested at the factory 50 per cent above normal pressure. The penstocks are welded in sections of 60 ft. (18 m.) mean length, these sections themselves being assembled with flanged and bolted joints, making a total length of about 1,740 ft. (530 m.). The level of the air in the compression chamber varies from 2,400 ft. (726 m.) to 2,380 ft. (721.5 m.) according to the quantity of water in the reservoir. The floor of the station is at the 1,550 ft. (473 m.) level. However, the Pelton turbines being able to operate with hydro-pneumatization the level of water in the discharge chamber of the turbines, which is at the 1,540-ft. (469-m.) level, may be used to calculate the gross head. This is 840 ft. (256 m.). The net head after deducting the friction loss in the conduits is 820 ft. (250 m.).

The penstocks do not contain any expansion joints or other analogous arrangement to provide for expansion. The two adjustable joints, which are parted, were provided simply to facilitate the installation of the pipe and were later made fast at the proper temperature to render these fixed joints. The displacement, which corresponds to a lengthening or a shortening of the pipe or, if movement is prevented, a molecular or tension stress in the plates, directed along the penstock, is absorbed by the large massive anchorages, between which the conduit maintains an invariable length. To reduce the damage in case of rupture of a penstock, the upper end of each is made in siphon form. Then if, through rupture or any other cause, the discharge of a penstock exceeds the predetermined maximum, the water column breaks and the siphon ceases to operate. Each penstock is equipped with a Venturi flow meter. The water is discharged into the river through a tailrace 1,950 ft. (600 m.) long. The Gavarnie or Pau has an output varying from 166 sec.-ft. (4,700 li.-sec.) at low water to 1,050 sec.-ft. (30,000 li.-sec.) at high water, with a mean of 354 sec.-ft. (10,000 li.-sec.). The utilizable flow is 155 sec.-ft. (4,400 li.-sec.).

HIGH-TENSION SWITCH ROOM OF SOULOM PLANT, SHOWING 60,000-VOLT OIL SWITCHES

The water is taken at the 1,940-ft. (592-m.) level, where a forebay is formed by a dam. The water passes across two series of racks into two successive settling chambers, from which it enters the head canal, which has a slope of 1 in 100. This canal is 4 miles (6.3 km.) long and terminates in a compression chamber.

The "head" canal is similar to that of the Eget development. It is 6 ft. 6 in. (2 m.) wide and is able to discharge 177 sec.-ft. (5,000 li.-sec.) with a water depth of 5 ft. (1.5 m.) and 212 sec.-ft. (6,000 li.-sec.) with a depth of 6 ft. 3 in. (1.9 m.).

There is no reservoir for daily load fluctuation. Such provision is limited to a chamber of 70,800 cu.ft. (2,000 cu.m.) capacity, which forms a flywheel to absorb momentary fluctuations. This capacity is constituted by a tunnel of large section from which branch at right angles other dead-ended tunnels of similar section.

Each of the three penstocks terminates in a 3,500-hp. turbine connected directly to a 2,400-kw. alternator. Only low units are normally in service. In case of shutdown of one of the Cauterets units during low-water periods water can be taken from the Cauterets headworks to the compression chamber of Gavarnie by the aid of a special penstock.

The mean level in the compression chamber is at the 1,920-ft. (584 m.) level and the 1,540-ft. (468 m.) level. There is thus a gross head of 380 ft. (116 m.) which produces, after deducting the friction loss, a net head of 372 ft. (113 m.). The penstocks have an interior diameter of 4 ft. (1.2 m.), a length of 1,080 ft. (330 m.) and are built like those at Cauterets.

The station consists of the machine-room turbo-alternators, exciters, distribution switchboards, the transformer room, the switch room and two towers, from which the lines for high-tension current leave. Each fall supplies three turbines of 3,500 hp. and two turbines of 350 hp. Each penstock is provided with a gate valve where it enters the main turbine and also supplies a branch pipe, equipped with a hand-operated gate valve, which leads to a manifold serving to feed the two secondary turbines with one of the three conduits.

Turbines operated by the Gavarnie fall are of the Francis radial type. The water enters through a hand-controlled valve, and the proper distribution of the water to the runner is assured by the speed governor. In case of sudden closing of the gates by the governor a relief valve opens, allowing water to escape. In closing it acts slowly enough to prevent excessive pressures. Each turbine is directly connected to a 2,400-kw., 6,000-volt, 16⅔-cycle, 500-r.p.m. single-phase alternator of the revolving-field type built by the French Thomson-Houston Company. The coupling itself forms a flywheel. The main turbine and the alternator bearings are cooled by circulation of water.

Turbines operated from the Cauterets fall are of the Pelton type, with two nozzles. The water enters a gate valve automatically operated by the high-pressure water. The water is directed at the runner by two nozzles connected by an oil-pressure speed regulator. The alternator is driven through an elastic cord coupling, formed by two flywheels, one on each shaft, so arranged that their spokes interlock. The necessary water for cooling the various bearings and the transformers, also for supplying the hydraulic lightning arresters, is taken from two pressure reducers, each connected to one of the two supply pipes of the exciter turbines.

SUBSTATION AT THE LOURDES RAILWAY STATION FED FROM SOULOM

Continuous current furnished by the exciters is conducted by aluminum bars to the distribution switchboard on a platform which overlooks the machine room. This switchboard is of the bench type and was furnished by the French Thomson-Houston Company. It receives 125-volt direct current for the remote control of the exciter switches, the field rheostats, the alternators, the 60,000-volt switches, etc. The functioning of the apparatus is indicated by pilot lamps of various colors. Six-thousand-volt single-phase energy is conducted by six aluminum-bar circuits to the 6,000/60,000-volt step-up transformers, which are oil-immersed and water-cooled. Oil is piped to an underground reservoir and returned through a filter by a motor pump. The 60,000-volt energy goes from the transformers to the 60,000-volt busbars over a system of copper tubes and through a high-tension remote controlled oil switch.

Three independent groups of apparatus, corresponding to each of two waterfalls, compose a half-station. The three groups may be connected in parallel through their corresponding 60,000-volt busbars. The speed governors of the turbines are controlled electrically from the same switch-board. The two half-stations can be paralleled in a similar manner by means of a switch joining the two 60,000-volt bus systems. The arrangement of the 6,000-volt busbars is such as to permit the operation of any one of the alternators with any one of the transformers.

26,000-KW. EGET DEVELOPMENT

The power plant at Eget, established in the upper valley of the Neste d'Aure, has profited in part by an advantageous situation. To prevent the rivers which rise in the Lannemezan plateau from drying up during the greater part of the year, provision has been made for them near their source by a canal from the Neste. A system of reservoirs receives the excess water from the heavy rains or the melting of the snows and holds it for use during the periods of small flow. This system assures to the Neste itself a minimum flow of 108 sec.-ft. (3060 li. per second) at the inlet to the canal. These various reservoirs being established to feed the rivers and not a power station, and one of them being situated in a distant valley, it was necessary to make a new lake, Lake Oulc (6,500,000 cu.m.) to provide against the low water in the others.

EACH TURBINE HAS ITS OWN SIPHON PENSTOCK

In general, the conditions of installation are the same as at Soulom. It is interesting to note that an improved method was adapted for installing the penstocks. Temperature variations in steel pipe are much greater when it is empty than when it is full of water; therefore, while the construction work is in progress the masonry anchorages must take up considerable daily fluctuations in the length of the pipe, and since the masonry requires time to set, the pipe is apt to slip, thus destroying the bond between the pipe and the masonry, or at least producing cracks in the masonry.

In order to avoid these troubles the masonry anchorages into which the pipes are embedded, as at Soulom, and intermediate anchorages are equipped with a joint that permits motion. This joint is made by embedding a pipe in the masonry through which the penstock passes. With this arrangement the penstock is free to expand and contract in length without exerting any force on the anchorage and without risk of dislocation. When the penstock is finished and sufficient time has elapsed the joint between the penstock and the pipe can be made solid, the work being done at a time when average temperature conditions exist.

The gross head is 2,410 ft. (736.5 m.), while the net head is 2,330 ft. (710 m.). The equipment of the station comprises seven electric units, each one consisting of a 5,000-hp. hydraulic turbine, a 6,000-volt single-phase alternator, a step-up transformer from 6,000 volts to 60,000 volts and two auxiliary electric units each comprising a 450-hp. turbine, one generator of 55 kw. and 125 volts and one of 175 kw. and 125 volts.

It is probable that the operation in conjunction of the Eget and Soulom plants will permit much more favorable handling of the peak loads than when they are handled independently.

Three other power plants are provided. The Cassagne plant, of 5,000 hp., on the Rivière dela Têt, supplies the line of the narrow-gage railroad from Villafranche de Conflent to Bourg-Madame. The Porte power plant, destined to supply the section from Foix to Ax-les-Thermes and the trans-Pyrenean line of Ax-les-Thermes to Ripoll, Spain, will use water from Lake Lanoux, in the Pyrenees. The third plant, fed by waters of the Sousoueou, will be built upstream from the stream station of Eaux-Chaudes. The 60,000-volt energy furnished by the power plants is transformed to 12,000 volts in the substation for distribution to the trains.

Electrification of Austrian State Railways

ACCORDING to a report from Consul-General Albert Halstead, of the American mission in Vienna, a plan has been formulated for the electrification of the state railways of Austria. At the present cost of construction it is calculated that 3,700,000,000 crowns would be necessary for this purpose. This, at the present rate of exchange, would be approximately $16,650,000. The electrification of the railways would assure transportation for Austria and thus help to make life normal, and at the same time reduce the amount of coal required for normal conditions.

Austria must try to diminish her consumption of fuel in general and for this purpose must use its streams and rivers for the production of electric power. For many years the imperial Austrian Government had been carefully studying the exploitation of water-power sites for producing electricity on a large scale. These investigations show that 2,000,000 hp. may be obtained from its rivers. This would reduce the annual consumption of coal by from 6,000,000 tons to 8,000,000 tons, or from 30 to 50 per cent.

The preliminary work has resulted in a suggestion to electrify within the next seven years 651 km. (404 miles), or 15 per cent of the total system of the Austrian state railways.

The lines to be electrified are those furthest from the coal mines; they are, at the same time, those having the greatest coal consumption per unit of capacity because of their steep grades, and they are situated nearest to the greatest sources of water power. On an average some 24,000 hp. per year is required to operate these lines, so that the use of water power would mean a saving of some 400,000 tons of coal.

After the completion of the first seven years' period of construction there would still remain 1,077 km. (667 miles), or 24 per cent of the system of the state railways to be electrified, the remainder, 2,750 km. (1,705 miles), equal to 61 per cent of the lines, not being suitable for operation by electricity.

Changing System from Two to Three Phase

By Adding Booster Transformer Both Two-Phase and Three-Phase Energy Are Obtained from Four-Wire System During Reconstruction Permanent Provision Is Made for Two-Phase Motors Already in Service

By **GEORGE H. HAGAR**
Vallejo Electric Light & Power Company, Vallejo, Cal.

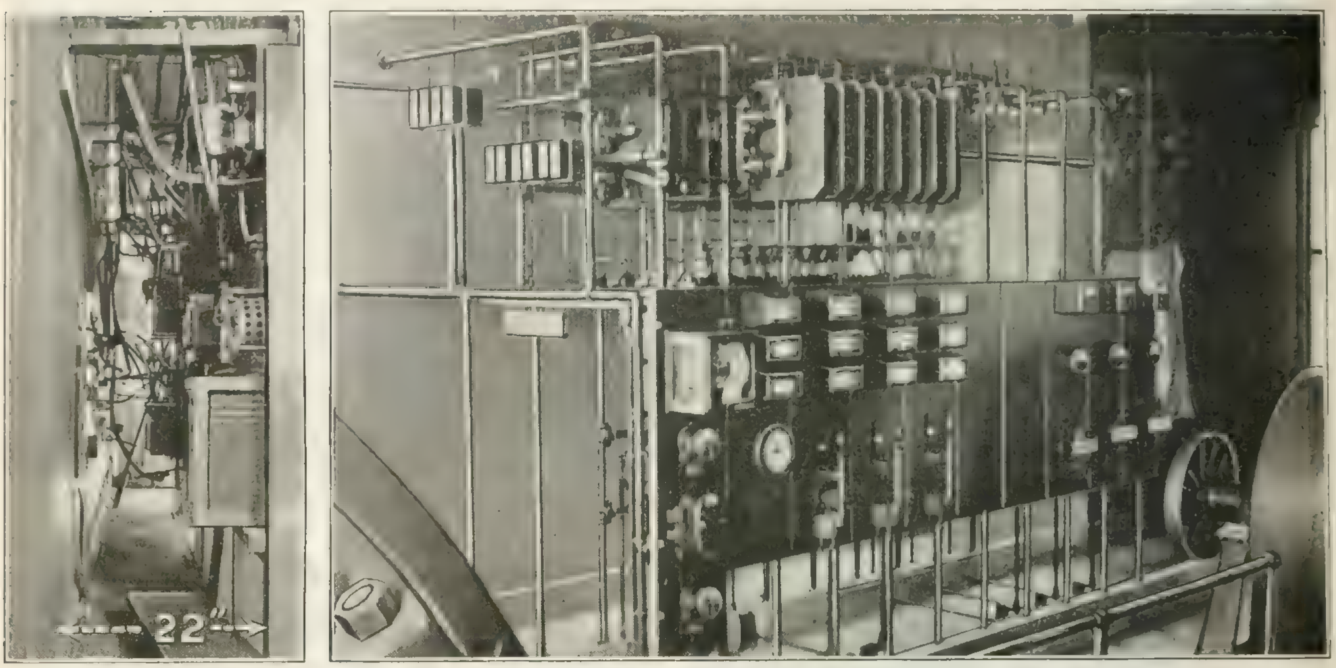


FIG. 1—OLD SWITCHBOARD REPLACED BY ONE OF MODERN DESIGN
End view of old switchboard and front view of new one. Note the small clearances behind old board and the 2,400-volt rubber-covered wire lying against the redwood wall.

THE two-phase distribution system of the Vallejo Electric Light & Power Company had been outgrown and it became necessary both to improve the voltage regulation of the distribution system and to provide modern substation equipment in place of an antiquated one. It was therefore decided to change from a two-phase, 2,400-volt distribution system to a three-phase, star-connected, four-wire system at 4,000 volts. By thus raising the voltage much of the old distribution copper was rendered sufficient for the increased load. Transformers also were rearranged for a minimum of new replacement transformers, and two-phase motors were reconnected for three-phase operation. During the transition period an interesting arrangement of transformers at the substation made it possible to supply either two-phase or three-phase loads over a four-wire system. The change was made with little inconvenience to the customers.

The Vallejo Electric Light & Power Company supplies light and power for the city of Vallejo and its immediate environs. It is a distributing company in that it distributes but does no generating whatever, buying power from the Pacific Gas & Electric Company. This supply was formerly over one 11-kv. three-phase line from the North Tower substation of the Pacific Gas & Electric Company, 6½ miles (10 km.) distant. This line also supplied the Mare Island Navy Yard and numerous shut-downs were caused by trouble at Mare Island.

At the local substation this voltage was stepped down to 2,400 volts, two-phase, four-wire, by means of a Scott-connected transformer bank of 750 kva. capacity. From this bank the power went to the switchboard of the Vallejo Electric Light & Power Company. A large part of this switchboard had been doing duty since 1895. It controlled two two-phase, four-wire, 2,400-volt feeders and three series street-lighting circuits. The entire switching and metering apparatus was mounted on the back of the board. The buses were of rubber-covered wire mounted on porcelain knobs or in loom lying on wooden braces. The instrument wiring was in loom. All this was squeezed between the panel and the wall, a space of just 22 in. (56 cm.). The clearance between wires of opposite polarity in some places was as great as 3 in. (7.6 cm.) (Fig. 1).

This system became greatly outgrown, and it was necessary to increase the capacity and to improve the voltage regulation. After a thorough investigation, a 4,000-volt, three-phase, four-wire, grounded-neutral system was decided upon.

TEMPORARY PROVISION FOR BOTH TWO-PHASE AND THREE-PHASE SUPPLY

The Pacific Gas & Electric Company built a new line of No. 2/0 copper from North Tower and installed the necessary switches, separating Mare Island and Vallejo and giving both double-throw service in case of necessity. The transformer bank was replaced with one of 1,500 kva., with one extra transformer as a spare and a flexible switching arrangement whereby the spare can be put in place of any one of the others. This bank was connected delta-delta. Two-phase was obtained with the addition of a booster transformer connected to boost from the center of and at 90 deg. from one delta leg. This made it possible to obtain both two-phase and three-phase, as is shown in Fig. 2, together with the primary connections of the various transformers along the line.

The old board was split in three sections and moved out of the way. The building was extended to give adequate space and a new switchboard was built. In designing this switchboard a great effort was made to attain simplicity and ease in operating. As is seen from the diagram (Fig. 3), the switching arrangement is decidedly simple.

The total energy purchased is measured on the first panel from the left (Fig. 1). The second shows the voltage maintained on the three phases with a curve-drawing instrument which can be plugged in on any phase. The third, fourth and fifth control the three feeders, with ammeters in each leg and hand-operated oil circuit breakers. The sixth and seventh are spare panels. The eighth, ninth and tenth control the street-lighting circuits. Each has a watt-hour meter, an ammeter and a hand-operated oil circuit breaker. In each case the geographical position of the panel with respect to the others corresponds to the geographical position of the territory served by that feeder. Thus, of the three feeder panels the north one controls the north feeder, which supplies the northern portion of the town. The three phases are called *A*, *B* and *C*. The meters are connected to *A*, *B* and *C* phases from top to bottom. The buses are *A*, *B* and *C* phases from front to back. This makes the board extremely simple (Fig. 3).

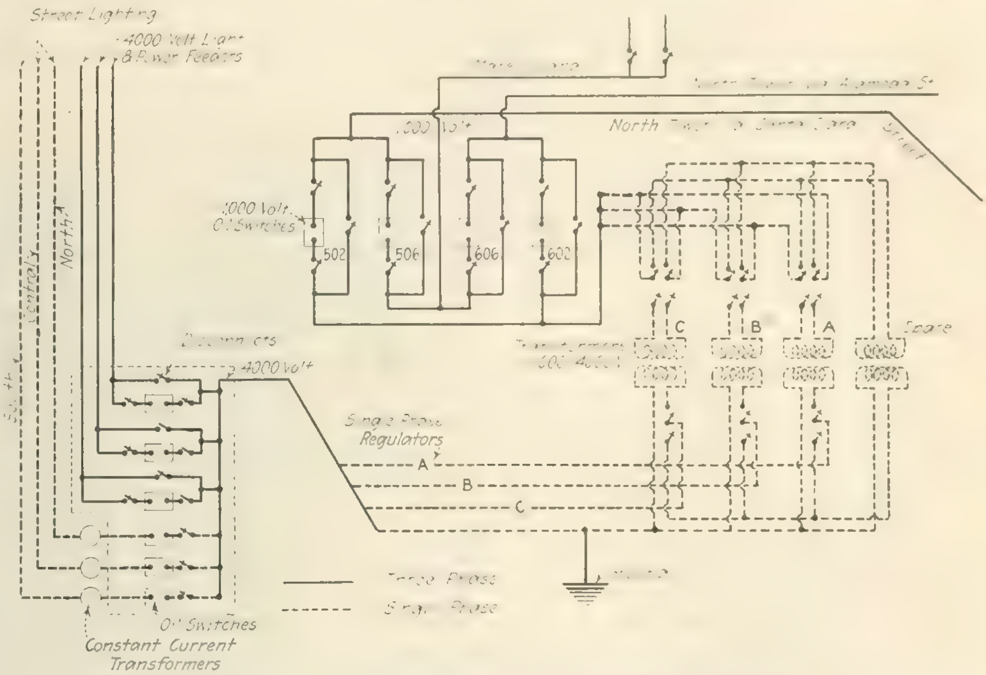


FIG. 3—SWITCHING DIAGRAM FOR SUBSTATION AT VALLEJO

The diagram of the new switchboard is shown inside the heavy dotted rectangle.

FEEDER CAPACITY INCREASED 100 PER CENT

A new primary feeder was built and the old ones were rerouted, dividing the territory into three sections. As no maps or records had ever been kept, it was necessary to trace out the phase wires on the line. These were marked on all important junction poles. The neutral wire is carried on white insulators to avoid any chance of connecting transformers across 4,000 volts. Pole-type oil switches are now being installed for isolation of trouble and to give duplicate service to the business section. The capacity has been increased so that a 100 per cent increase in load can be carried without any changes other than transformers and necessary extensions. The secondaries were rebuilt, abandoning the old two-wire, 115-volt non-grounded system for a three-wire, 115/230-volt grounded system. Power secondaries have been run separately from the lighting, improving the regulation. Except for a few scattered instances, which are being corrected as quickly as possible, the construction now conforms with the state law and good practice.

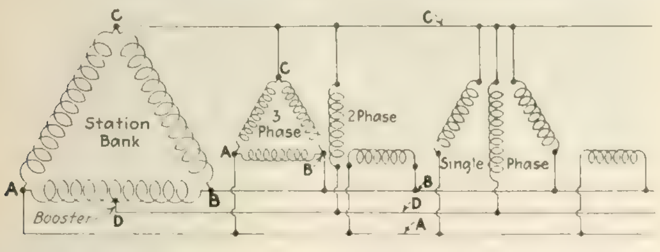


FIG. 2 — VECTOR DIAGRAM OF TRANSFORMER PRIMARY CONNECTIONS DURING PERIOD OF RECONSTRUCTION

HOW TWO-PHASE MOTORS WERE DISPOSED

After deciding to change to three-phase, no additional two-phase motors were allowed to be connected. Three-phase power was obtained from Scott-connected transformer banks until the transformer bank at the station was changed, after which it was possible to obtain three-phase from delta-connected banks (Fig. 3). The utilization of the two-phase motors then on the system presented quite a problem. Five methods were investigated, as follows:

1. To leave the motors two-phase and to use (see Fig. 4):

(a) One standard 2,300-volt transformer and one special 4,000-volt transformer.

(b) One standard 2,300-volt transformer and two 2,300-volt transformers, with a ratio of nine to one.

(c) One standard 2,300-volt transformer and two 2,300-volt transformers with 10 per cent taps.

(d) Two special 4,000-volt transformers, one with 50 per cent tap and one with 86.6 per cent tap, Scott-connected.

2. To reconnect the motors for three-phase and to use three standard 2,300-volt transformers, connected star-delta.

A combination of the second and fourth methods was decided upon as the most economical and best. Nine-to-one ratio transformers to the number of those on hand were used in the second method. In the remaining installations the motors were reconnected for three-phase.

The transformers were regrouped in banks and a schedule of changes was made. After load tests it was found possible to change a number of the commercial lighting transformers, substituting large units for several small ones, thereby effecting a saving, as the small units were then available for use in power banks.

SECTION FROM SCHEDULE OF TRANSFORMER CHANGES

Present Transformers					Future Banks of Transformers									
No. of Transformers	Kva.	Ratio	Load	Location	No. of Transformers	Kva.	Ratio	Connected	Move from	No. of Transformers	Kva.	Ratio	Move to
					1	7½	10	Star	North wharf............				
1	5	10	2	Indian between Sonoma and Marin	1	7½	10	Star	Indian-Sutter and Sonoma.	1	5	10	Hudson -Marin and Sonoma.
1	4	10	P										
1	1	10	1P		1	10	10	Star	Hudson -Bran. and St Clara ..	1	4	10	Jeffery -Marin and Sacto
1	3	10	1P							2	1	10	Stock
1	1	10	1P		1	20	10	B	In place	1	3	10	Indian -St Clara and Sacto.
1	20	10	L		1	25	10	B	Indian -St Clara and Sacto				
1	25	10	2P	Indian between Marin and Sacto						1	15	10	Six min. ferry.
1	15	10	2P		1	25	10	Star	In place	1	7½	10	Fourth and Chestnut
1	7½	10	3P		1	25	10	Star	Purchase	1	7½	9	Grant and Solano.
1	7½	9	3P		1	25	10	Star	Bay and McLane...	1	1	10	Stock.
1	1	10	1P		1	50	10	L	Purchase.........	1	25	10	Hudson—Sacto and Marin
1	25	10	L										
4	15	10	2P	Alameda and Kentucky.	2	15	10	T	In place				
1	25	10	3P		2	20	9	T	Maine and Branciforte..	1	25	10	Bay and McLane
1	15	9	3P		1	15	10	Star	Hudson and Marin......				
					2	15	10	Star	In place	1	15	9	Stock.

the day of the cut-over. Since then this load has had to be balanced between the three phases.

On the day of the cut-over the secondaries of the station bank were changed from delta to star and the booster was disconnected. The old switchboard was discarded and the new one cut in. Each three-phase transformer bank was changed from delta to star on the primary side, phase rotation being taken into account in order to have the motors running the right direction. Each two-phase bank was connected as in the second method above mentioned. All these changes were made in seven hours.

Each transformer bank was treated separately in cutting over. While the outside crew changed the transformers the inside crew reconnected the motors. As far as possible this was done at times which caused the consumers the least amount of inconvenience; that is, laundries and bakeries after 3 p.m., printing shops between 5 p.m. and 8 a.m., creameries on Sunday after 10 a.m.; machine shops on Sunday, motion-picture shows after 11 p.m. In all, fifty-five motors were reconnected, the sizes varying from 1 hp. to 25 hp.

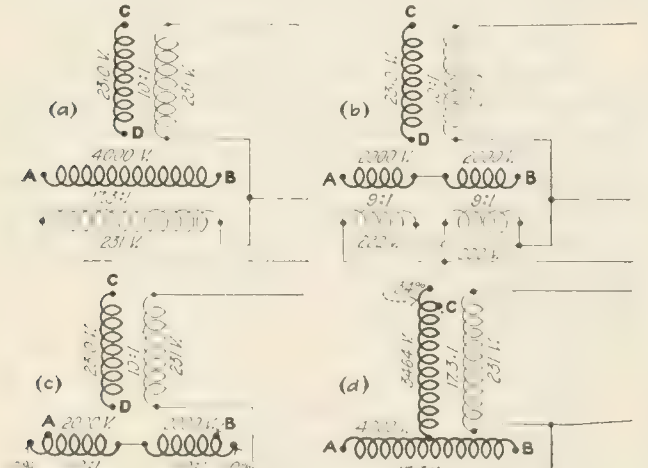


FIG. 4—POSSIBLE METHODS OF SUPPLYING TWO-PHASE MOTORS FROM THREE-PHASE LINES

Where it was possible, owing to pin positions of the wires, the *C* leg (Fig. 2) was made the neutral. In this case the single-phase load was balanced between *A* and *C*, *D* and *C* and *B* and *C* phases. Where this was not possible the single-phase load was put on *A* and *B* phases, in order not to be concerned with that load on the day of the cut-over.

The result has been entirely satisfactory. The reconnected motors have given no trouble whatever. Where the voltage regulation was formerly 14 per cent, it is now 4 per cent and the losses have been decreased proportionately. The capacity of the system is adequate for some years to come and can be added to indefinitely without disturbing operation.

Plans for National Research Institute for Canada

A COMMITTEE appointed by the Canadian Parliament to explore the question of scientific industrial research has advised that a National Research Institute be established in the vicinity of Ottawa and that $500,000 be appropriated for the site and building, $100,000 for the scientific equipment of the institute and $50,000 for salaries and maintenance during the first year.

One of the functions of the institute would be the standardization of measures throughout the country, of scientific and technical apparatus that is used in the public service or in the industries of the country, and of the quality of the materials required in the construction of public works. A second function would be to direct and supervise researches into technical processes and methods so as to assist in the development of the natural resources in Canada in the expansion of existing industries and the furthering of new industries and in utilizing materials which hitherto have been wasted.

The committee reported an investigation of the work of the United States Bureau of Standards and the National Research Council at Washington, also of the Mellon Institute at Pittsburgh.

Reactive Power and Unbalanced Circuits

The Term Reactive Power Requires Definition, Since Measurements Do Not Result in the Same Units Under Different Conditions in Three-Phase Circuits — Some Observations on the Effects of Unbalanced Voltages and Currents

By **WALDO V. LYON**
Assistant Professor of Electrical Engineering Massachusetts Institute of Technology

IT IS the purpose of this paper to discuss rather briefly active and reactive power, power factor and the degree of unbalance in three-phase systems, and, if possible, to arrive at conclusions in regard to the most suitable conceptions of these quantities, giving due consideration to their practical application as well as to their physical significance. In order that these conceptions may have the widest applicability no assumptions should be made which in any way limit the generality of the discussion other than those which are always made in connection with commercial low-frequency circuits. It is of prime importance, for example, that the wave forms of the voltages and currents should not be restricted to the sinusoidal, and further that the resistance and inductance in the circuit should not be assumed to be constant. That we may avoid the abstractness which such a general discussion often involves, frequent recourse is made to concrete illustrations. The point taken is that one established exception disproves the rule.

The paper naturally divides itself into two distinct parts as given in the following paragraphs:

PART I

Active and Reactive Power, Power Factor

The active power at any point in an electric circuit is the average rate at which energy passes the point. This is a definite physical concept. No assumption need be made in regard to the number of conductors which compose the circuit or to the way in which the voltages and currents vary. The instantaneous power is the sum of the products obtained by multiplying the corresponding instantaneous values of the voltages and currents. With a polyphase circuit one conductor may be considered as the return for all of the others. The frequency of the power is twice that of the voltage and current. Except in the case of a polyphase circuit on which the load is balanced the instantaneous power is variable. Not only is the power variable but it is usually reversed within the period of a cycle; that is to say, the energy flows from the generator to the receiving device during the major portion of the cycle but reverses and flows from the receiving device to the generator during the rest of the cycle (Fig. 1). In general this is all that can positively be said. The reactions within the receiving device cannot be determined if only the voltage and current supplied to it are known. In fact, different physical conditions of the receiving circuit may cause exactly the same instantaneous energy flow, the effects of which on the generator are indistinguishable.

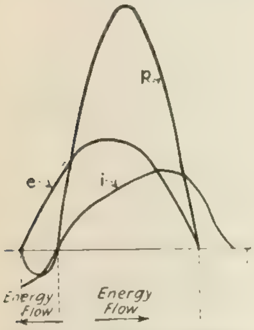


FIG. 1—USUAL POWER CYCLE OF DOUBLE FREQUENCY

The surest method of correctly analyzing the power to a receiving device is to determine the factors which cause the loss in electric pressure and the manner in which they vary. Some components of the pressure vary in such a way that electrical energy is continually absorbed by the device and transformed into another form. The active power is due principally to these components. Other components vary so that electrical energy is transformed into a convertible form and stored during one-half of the power cycle and then returned to the circuit, wholly or partly, during the next half cycle. The reactive power is due principally to these components. Before defining reactive power it is well to analyze the power conditions in a few simple types of circuits. Although these circuits are purely theoretical ones—in order that the analysis may be reduced to its simplest form—they may be substantially duplicated in practice.

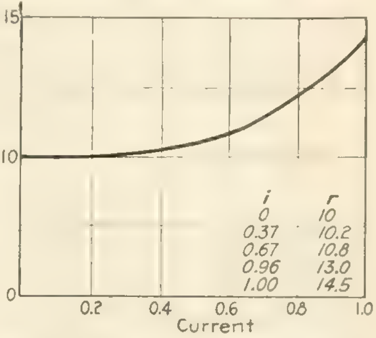


FIG. 2 — RESISTANCE VARIATION INTRODUCES THIRD HARMONIC OF CURRENT

Case I.—Non-inductive circuit, the resistance of which varies cyclically with the current, as does that of a fine metal-filament lamp. The variation of resistance with current is plotted in Fig. 2. For this assumed relation between resistance and current the latter will contain a 10 per cent third harmonic if the applied voltage is sinusoidal. The equations for voltage and current follow:

$$e = \sqrt{2}\, E_1 \sin \omega t$$

$$i = \sqrt{2}\, I_1 \sin \omega t + \sqrt{2}(I_1, 10) \sin 3\omega t$$

Energy flows into this circuit in a continuous stream. It is not stored in one half cycle to be returned in the next. Since the third harmonic in the current contributes nothing to the average power, the active power is:

$$P_a = E_1 I_1.$$

The volt-amperes, however, are:

$$VI = 1.053 E_1 I_1.$$

A reactive wattmeter[1] connected in the circuit would indicate nothing:

$$W_r = 0.$$

Case II.—A sinusoidal electromotive force impressed on a circuit having constant resistance and constant inductance. This is the simplest and most usual assumption. If the applied voltage is sinusoidal, the current will also be sinusoidal and of the form:

---

[1] A reactive wattmeter is one whose potential circuit is so constructed that the current through it leads or lags the applied voltage by substantially 90 deg., whereas in the regular wattmeter the two are in phase

$$i = \sqrt{2}I \sin \omega t.$$

The equation for the component electric pressures is:

$$e = ri + L(di/dt)$$

$$= r\sqrt{2}I \sin \omega t + L\omega\sqrt{2}I \cos \omega t.$$

The power equation is:

$$p = ei = rI^2(1 - \cos 2\omega t) + \omega LI^2 \sin 2\omega t.$$

The average power to joule heating is rI^2 and to the magnetic field is zero. The active power is thus:

$$P_a = rI^2.$$

The *maximum* power to the magnetic field is ωLI^2. This is frequently called the reactive power. The *average* rate at which energy is supplied to or delivered from the magnetic field is $(2/\pi)\omega LI^2$. A reactive wattmeter connected in the circuit indicates the maximum power to the magnetic field:

$$W_r = \omega LI^2.$$

The volt-amperes are:

$$VI = I\sqrt{(rI)^2 + (\omega LI)^2},$$

$$\text{or } (VI)^2 = (rI^2)^2 + (\omega LI^2)^2.$$

Thus in this case the square of the volt-amperes is the sum of the squares of the average rate at which energy is supplied as joule heating and the maximum rate at which energy is stored in the magnetic field. Also:

$$(VI)^2 = P_a^2 + W_r^2.$$

Class III.—A non-sinusoidal electromotive force impressed on a circuit having constant resistance and constant inductance. In this case the current will contain the same harmonics that the voltage does. The higher harmonics in the current, however, will be relatively smaller and lag more, so that the wave forms of the current and voltage may be considerably different. Assume that the voltage is such that the current is:

$$i = \sqrt{2}I_1 \sin \omega t + \sqrt{2}I_3 \sin 3\omega t.$$

The joule heating is:

$$i^2r = r\,[I_1^2(1 - \cos 2\omega t) + I_3^2(1 - \cos 6\omega t) + 2I_1 I_3(\cos 2\omega t - \cos 4\omega t)].$$

The average heating is: $r(I_1^2 + I_3^2)$.

The power to the magnetic field is:

$$iL\,(di/dt) = \omega L\,[(I_1^2 - 2I_1I_3) \sin 2\omega t + 4I_1I_3 \sin 4\omega t + 3I_1^2 \sin 6\omega t].$$

Since the average power to the magnetic field is zero the active power is:

$$P_a = r(I_1^2 + I_3^2).$$

If the third harmonic in the voltage is shifted in phase 180 deg., the third harmonic in the current will shift the same amount and the current will have a peaked instead of a flat wave form. The effective values of both current and voltage are unchanged. The power to the magnetic field is now:

$$iL\,(di/dt) = \omega L\,[(I_1^2 + 2I_1I_3) \sin 2\omega t - 4\,I_1I_3 \sin 4\omega t + 3I_3^2 \sin 6\omega t].$$

The active power is unchanged.

This shows that by changing the form of the applied voltage without changing the magnitudes of the harmonic components the conditions of energy storage in the magnetic field are altered. Neither the maximum value of the stored energy nor the maximum rate of storage nor the average rate of storage over one-half of a power cycle remains constant. As long as the harmonic components of the voltage are of constant magnitude the indication of a reactive wattmeter is independent of wave form:

$$W_r = \omega L\,(I_1^2 + 3I_3^2).$$

The square root of the sum of the square of the active and reactive wattmeter readings is no longer equal to the product of the applied voltage and current.

Class IV.—A sinusoidal voltage impressed on a circuit having variable resistance and variable inductance; such as a variable resistance in series with a reactor whose magnetic circuit is subject to hysteresis. The plots of resistance and current and of flux and current are shown in Fig. 3. For these particular relations the current is also sinusoidal and of the form:

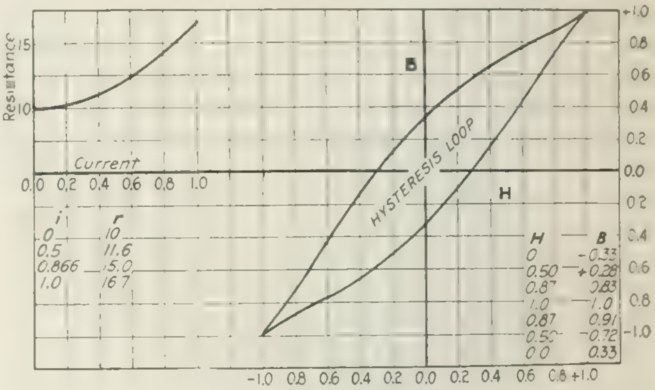


FIG. 3—CIRCUIT CHARACTERISTICS CAUSING CYCLIC VARIATIONS IN RESISTANCE AND INDUCTANCE

$$i = \sqrt{2}I \sin \omega t,$$

and the resistance and inductance, $N(d\phi/di)$, vary with the current as follows:

$$r = R - k \cos 2\omega t,$$

$$L = \frac{X}{\omega} + \frac{k}{\omega} \sin 2\omega t.$$

R, X and k are constants.

The joule heating is:

$$i^2r = I^2\left[\left(R + \frac{k}{2}\right) - (R + k) \cos 2\omega t + \frac{k}{2} \cos 4\omega t\right].$$

The average joule heating is: $I^2\left(R + \frac{k}{2}\right)$.

The power to the magnetic field is:

$$iL\frac{di}{dt} = \frac{kI^2}{2} + XI^2 \sin 2\omega t - \frac{kI^2}{2} \cos 4\omega t.$$

In this case the energy stored in the magnetic field during one-half of a power cycle is only in part returned during the next half cycle. The net loss in energy per cycle is proportional to the area of the hysteresis loop. The active power is:

$$P_a = I^2\left(R + \frac{k}{2}\right) + I^2\frac{k}{2}$$

$$= I^2(R + k).$$

A reactive wattmeter connected in the circuit will indicate XI^2. This however, has no definite relation to the maximum stored energy, the maximum rate of storage or to the average rate of storage during a half cycle. Nevertheless the square of the volt-amperes is now equal to the sum of the squares of the active and reactive wattmeter readings. Viewed from the external circuit this receiving device cannot be distinguished from one which has a constant resistance of $(R + k)$ and a constant inductance of $\left(\frac{X}{\omega}\right)$. The similarity will at once cease if the applied voltage is not sinusoidal.

DIFFICULTY OF DEFINING REACTIVE POWER

A consideration of these illustrative cases is sufficient to show that whereas active power has a definite physical significance, a practical value and can always be measured, reactive power is a much more difficult quantity to define or to measure. If the conception is founded on physical theory, the definition will involve the maximum stored energy, the maximum rate of storage, the average rate of storage during one-half of a power cycle or some similar quantity. This definition makes the measurement of reactive power difficult, if not impossible, except when the voltage and current are sinusoidal and the circuit constants do not vary cyclically. The reactive wattmeter is an instrument of doubtful value except in the case just cited.

The sum of the squares of the active power and either the reactive power or the reactive wattmeter reading is not in general equal to the square of the volt-amperes. This relation between the active and reactive powers and the volt-amperes is of considerable use in power calculations and might be taken as the definition of the reactive power. If this were done reactive power would be without physical significance except when the voltage and current are sinusoidal and the circuit constants do not vary cyclically. Neither would it always be possible to measure it with a reactive wattmeter. Since it would often lack physical reality, the designation "apparent reactive power" is to be preferred. Regardless of the definition that is adopted the use of reactive power in alternating-current calculations will produce nothing but approximate results except when the current and voltage are sinusoidal and the circuit constants do not vary cyclically.

PHYSICAL CONCEPTIONS OF POWER FACTOR

When an alternating voltage of any wave form whatsoever is applied to a circuit which is adjusted so that the current through it has a fixed ampere value, the power is greatest when the voltage and current have the same wave form and are in phase. This maximum power equals the product of the voltage and current.

In general, the ratio of the power that a given voltage and current do produce to the greatest they can produce is called the power factor of the circuit. This definition is generally accepted in substance if not in form. It is independent of wave form, circuit conditions or the number of phases, and, in the case of polyphase circuits, of whether the load is balanced or unbalanced. In single-phase and balanced polyphase circuits, if the voltage and current are both sinusoidal, the power factor is the cosine of their phase displacement. In three-phase circuits the maximum power is readily obtained from the general expression for the sum of the readings of the two wattmeters which are properly connected to measure the power. It is:

$$P_{max} = \sqrt{V_{13}^2 I_1^2 - 2V_{13}I_1V_{23}I_2 \cos(\alpha + \beta) + V_{23}^2 I_2^2}.$$

The voltages and currents are the readings of instruments connected in the circuit as indicated by the subscripts. The angles α and β are those between these voltages and currents when they form the sides of the triangles of line voltages and currents. The maximum power is conveniently obtained graphically as shown in Fig. 4. For the given values of line voltages and line currents it is the greatest that can be developed.

Thus far the discussion has been with the sole purpose of presenting the physical facts so that logical definitions may be given the quantities reactive power and power factor. In the practical measurement of these quantities on commercial circuits it may be best to make certain assumptions or approximations in order to arrive at a result that is at once accurate enough and at the same time not too difficult to obtain. The most common assumption made in alternating-current circuits is that the voltages and currents are sinusoidal. In a great many cases this is sufficiently accurate. When this assumption is made any receiving device may be replaced, in so far as the circuit external to itself is concerned, by one in which the resistance and inductance or capacitance do not vary cyclically. Under these conditions an active wattmeter indicates, as to be sure it always does, the average power and a reactive wattmeter indicates the maximum rate at which energy is stored. The maximum power that this voltage and current will give in any circuit—that is, the volt-amperes—is the square root of the sum of the squares of the active and reactive wattmeter readings. Thus if a right triangle is constructed whose sides are respectively proportional to the active and reactive wattmeter readings the ratio of the former side to the hypothenuse is the power factor. While the foregoing assumptions are perfectly allowable in much commercial practice it would be extremely unwise to have them form the basis for fundamental definitions.

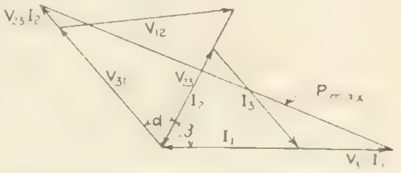


FIG. 4—MAXIMUM POWER IN A THREE-PHASE CIRCUIT

$I_1 = 56.2$ $V_{12} = 2235$ $P_{max} = 185.0$ kw

$I_2 = 45.3$ $V_{23} = 1990$ $\sqrt{3}\,V_{av.}\,I_{av.} = 186.9$ kva

$I_3 = 53.7$ $V_{31} = 2000$

PART II

Degree of Unbalance

The line voltages or currents of a three-phase system may be equal or unequal.[2] In the latter case they are said to be unbalanced. The most promising method of analyzing unbalanced circuits is that in which they are replaced by two balanced circuits of opposite phase order. If the voltages and currents are not sinusoidal, the analysis is rendered correspondingly more laborious and the practical measurement of the several components would be extremely difficult. The analysis shows that the copper loss for the unbalanced condition is equal to the sum of the copper losses for the two component balanced conditions, and that the reverse-phase-order current taken by a symmetrical three-phase motor is proportional to the reverse-phase-order-voltage. With a synchronous machine the constant of the proportionality may vary somewhat with the excitation and power factor. The reverse-phase-order current will also cause additional core and damper losses in a synchronous machine. If all polyphase devices connected to the circuit are symmetrical, the sole cause of any unbalance in the line currents and voltages is the single-phase power that the circuit supplies, disregarding any unbalance in the line reactance and capacitance. If the line currents are unbalanced, the capacities of all of the generating, transforming and transmitting devices are reduced and an additional burden is thrust upon the producer. If the line voltages are unbalanced by these unbalanced currents, all symmetrical polyphase motors will take additional reverse-phase-order currents, the effect of which is twofold. The capacities of the motors are reduced and their losses are increased. The action of these reverse-phase-order currents, however, tends to restore the balance in the line voltages, although the correcting currents taken by the polyphase motors are always smaller than the disturbing currents taken by the single-phase loads. The smaller the impedance of the polyphase motors to the reverse-phase-order current, the larger will be this current, the greater will be the attendant losses in them and consequent reduction in their capacity, and the less will a given arrangement of single-phase loads unbalance the line voltage and reduce the capacity of the generating and transmitting equipment.

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[2] C. L. Fortescue, *Transactions A. I. E. E.*, Vol. XXXVII, page 1027.

It has been suggested[3] that the reverse-phase-order voltages and currents be defined as the unbalance in voltage and current and that the degree of unbalance be taken as the ratio of the reverse-phase-order to direct-phase-order components. On the assumption of sinusoidal voltages and currents this definition makes the calculation and measurement of the degree of unbalance in three-phase circuits relatively simple.[4]

BALANCING EFFECT OF THREE-PHASE MOTORS

The reverse-phase-order currents taken by three-phase motors are always nearly, and may be exactly, in opposition to the reverse-phase-order currents taken by single-phase loads. In this respect these currents are similar to leading and lagging reactive currents. Three-phase motors in general will partially correct an unbalanced current condition in much the same way that overexcited synchronous motors will correct a low power factor due to lagging currents. In the latter case over-correction may be obtained, but never in the former. The power that single-phase loads have to unbalance a three-phase system is to a considerable extent under the control of the central-station engineer. If the loads are properly grouped, the resultant unbalancing may be small. On the other hand, a three-phase induction motor inherently operates at a power factor less than unity. Both unbalancing current and low power factor increase the losses in the circuit and the necessary size of generating and transmitting equipment. If the one is due to single-phase loads and the other to induction motors, both should be penalized, although not to the same extent, since the former may be largely controlled by skillfully distributing the single-phase loads between the different phases, while the latter is an inherent characteristic of the load.

When, however, the low power factor is due to a leading reactive current, such as taken by an overexcited synchronous motor, a reduction in, rather than an addition to, the power rate is often made. If this is just, it is also fair to compensate the consumer for the unbalancing current taken by his three-phase motors. If, however, the central station is looked upon as a source of three-phase power, a single-phase load should be charged an additional rate, depending upon the unbalancing current that it takes. It is just as important to distinguish between the unbalancing currents taken by single-phase loads and three-phase motors as between lagging and leading reactive currents. A three-phase motor operating on an unbalanced circuit partially corrects the fault and thus benefits the central station at the expense of its own efficiency and capacity.

Fuchsine Method for Testing Porosity of Electrical Porcelain

BY W. D. A. PEASLEE

AS POROUS electrical porcelain is very undesirable in electrical work, especially where the voltage exceeds 22,000, a simple method of testing porosity is of great importance. A solution of fuchsine dye in wood alcohol has been found a cheap and efficient means of making such a test. The equipment necessary for making the test consists of a tank and a pressure pump which forces the dye into the pores of the porcelain. The penetration is extremely active and has been observed under the microscope in cleavage cracks of minute quartz crystals in the porcelain. This color contrast does not photograph well, so micrographs cannot be made, though it may be observed quite distinctly.

In making use of the test in the control of quantity production, test or control pieces should be obtained of approximately the same volume and surface area as the pieces whose condition they are to indicate. It is therefore usually most convenient simply to use part of the ware for this purpose. From a manufacturing standpoint, this means, of course, a reduction in output. The proportion of the product thus sacrificed depends to a certain extent upon the arrangement of the ware in the kiln, the kind of kiln employed and the skill with which the kiln is operated. It should not, however, exceed 2 per cent of the total output.

In tunnel-kiln practice one test piece per car is sufficient, and the percentage destroyed in testing depends somewhat on the size of the pieces fired. In intermittent kiln practice the test pieces should be so selected as to represent as many pieces of ware as possible, yet they must be sufficiently numerous to be thoroughly representative of the entire charge. It should be assured that all pieces represented by a given test piece will be within the permissible firing range and held within that range the required length of time, so that an acceptable test piece will indicate with reasonable certainty that the pieces it represents are likewise acceptable.

It is important that the test pieces be unglazed, in order that the penetrative action may be more rapid and reliable. Slightly defective pieces, such as those with clipped edges, may be used for test.

When the ware comes out of the kiln the test pieces are broken up into fragments of approximately 27 cu.in. (0.4 cu.cm.) in volume and placed in a vat containing the solution. A pressure of 200 lb. per square inch is then applied. After two hours the pressure is released and the specimens are examined. The slightest measurable porosity will show a penetration of several tenths of an inch. Bad porosity will show a penetration clear through a sample 2 in. (5 cm.) thick. If a test piece shows any penetration however, the ware which it represents should be rejected.

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[3] J. Slepian, ELECTRICAL WORLD, Feb. 7, 1920; *Transactions A.I.E.E.*, Vol. XXXVII, page 1120.

[4] W. V. Lyon, ELECTRICAL WORLD, June 5, 1920.

Welding Structural Steel Work

Saving Shown by Welding Steel Work as Compared with Riveting—Tests on Roof Trusses Far Exceed Values Required by New York Building Code

By H. B. PAYNE
Chief Engineer Electrical Welding Company of America

SUCH excellent results have been obtained through the use of electric welding for building up the structural framework for a small building erected by the Electric Welding Company of America, as compared with the same work done by riveting, that the field for this work appears to offer unlimited possibilities. In making up the 40-ft. (12-m.) span roof trusses the contract price for the riveting was $85 per truss, and from the result of the welding work it was found that this work could be done on a commercial basis at $50 per truss, allowing the same reasonable profit as for the riveting job.

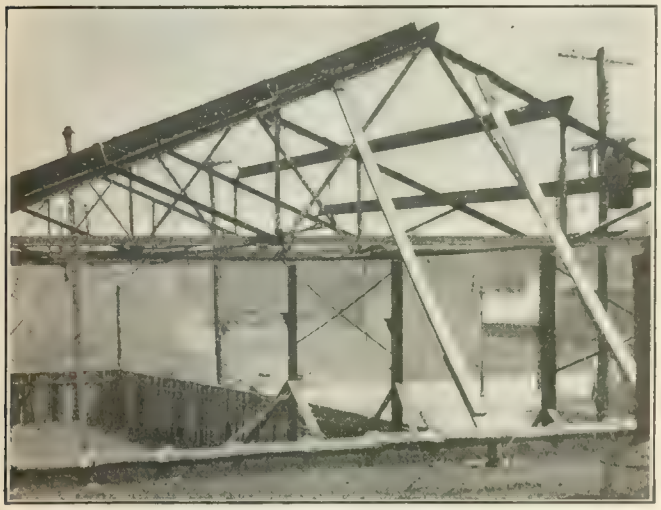


FIG. 1. FRAMEWORK DURING THE COURSE OF ERECTION

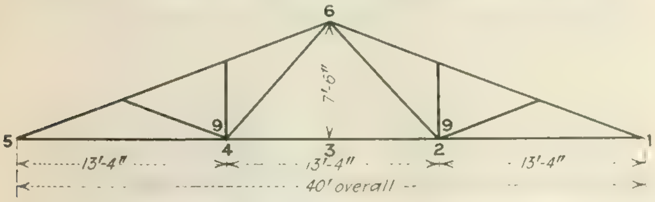


FIG. 2. ROOF TRUSS DESIGN SHOWING POINTS WHERE LOAD DEFLECTIONS WERE TAKEN UNDER TEST

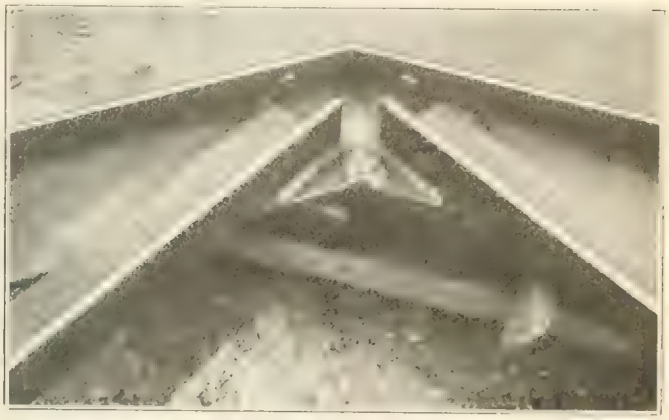


FIG. 3. METHOD OF WELDING PEAK OF ROOF TRUSS

A "V" shaped piece of metal was cut out of the center of the top member and the two ends bent down to form the upper angle of the roof. The ends were then welded together and the angle braces welded on as shown.

While the building is not a large one, being an open shed 40 ft. x 60 ft. (12 m. x 18 m.), as shown in Fig. 1, there is no reason to assume that this method could not be applied to all classes of building construction. From a welding viewpoint the plan is perfectly feasible, and from an erection standpoint there are many points of superiority over riveting. As no gusset plate angles are needed, there is a slight saving in material from that standpoint. Owing to the fact that holes are unnecessary in the steel members, it is possible to reduce the size of the member and still retain the cross-section area of a riveted job. From a fabrication view point there is an important gain in labor-saving time. As there is no laying out of holes to be done, the fabrication becomes merely a question of cutting beams and girders to the proper length, placing them to a scratch mark, "tacking" them in and finishing the welding at leisure. The usual rivet gang consists of three men, a riveter, a holder on and a heater. The same work can be done by one man, a welder, who has nothing but a single cable to pull around after him. It is assumed that the same arrangement for setting and aligning members as now prevails in standard building construction would suit this new method.

BUILDING THE ROOF TRUSSES

As shown in Fig. 2, the roof truss is of the "fan" design with a 40-ft. (12-m.) span over all and a height of 7 ft. 6 in. (2.28 m.). The "T" top member was made by cutting a V-shaped wedge out of the center of the top length, after which it was bent to the proper angle and the edges were welded together as shown in Fig. 3.

Angle braces were laid down in proper position and welded into place. The entire truss was then lifted into place and welded to the columns. Columns were welded to a foundation plate as shown in Fig. 4.

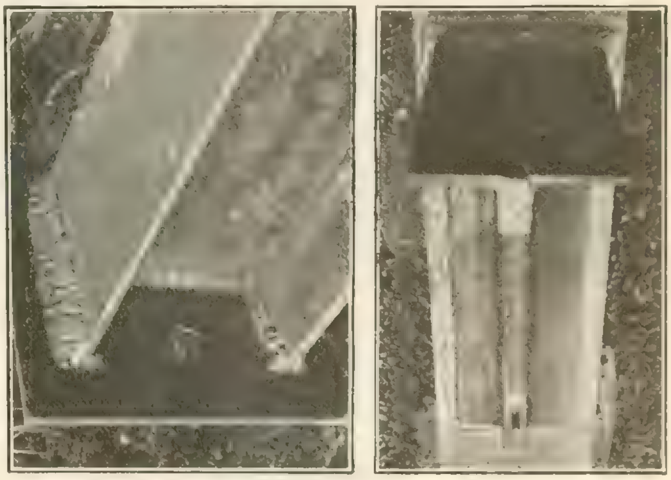


FIG. 4. "H" COLUMNS WERE WELDED ON TO A BUTT PLATE AND CRANE RAIL BRACKETS WERE WELDED ON THE COLUMNS

As no data were available showing the strength of welded structural members, the Bureau of Buildings, city of New York, requested a test before allowing the necessary building permit. The angle of the truss is greater than 20 deg., and accordingly the prescribed live load by the Building Code is 30 lb. per square foot (1.4 kg. per sq.m.) of horizontal plane, and as the trusses are intended to be set at 20-ft. (6-m.) centers the roof area to be supported is 800 sq.ft. (73.6 sq.m.). In testing these live loads the allowable live load was doubled to approach very nearly the elastic limit of the material which called for a load of 6 lb. to the square foot (2.8 kg. per sq.m.), or 48,000 lb. (21,800 kg.) on each truss of the plan. As shown in Fig. 5, the load was applied on two trusses set up on "H" section columns laid on the ground in a horizontal position. The roof purlins are 3-in. x 10-in. (7.5-cm. x 25-cm.) spruce and were doubled to carry the loads, the planking under the loads being of the same material. The two loads are concentrated over an area of about 5 ft. (1.5 m.) in width at each truss. The test load consisted of 96,000 lb. (43,600 kg.) of roofing gravel in bags. Readings were taken at different increments of the loading for deflection in the truss or members at points numbered in Fig. 2. After forty-eight hours under the maximum-load condition the load was entirely removed and readings were taken to determine the amount of permanent deflection. At point No. 3 there was $\frac{9}{16}$-in. (1.4-cm.) actual deflection under load and a permanent deflection of $\frac{1}{16}$ in (1.6 mm.) after the load had been removed. At no other point was there a permanent deflection. From the results of this test the Bureau of Buildings gave the necessary permit for construction.

A test was also made on the column brackets which will support the crane rails. These brackets were designed to carry a load of 5 tons and were tested up to 19 tons without showing any signs of failure.

POSSIBILITIES OF FUTURE STRUCTURAL WORK BY THIS METHOD

Building up structural work by this method offers a field of unlimited possibilities. No doubt the natural conservatism of builders will have to be overcome before such work becomes general. One point which might be raised is the question of the determination as to whether a welded joint is a real weld or simply deposited metal. There is, however, no more reason why an inspector familiar with welding work cannot determine the quality of the workmanship as well in this case as in that of the riveted joint. An experienced man can determine whether the metal is "burned in" or deposited without a good bond as easily as it is possible for present inspectors to determine whether rivets are drawn up tightly. From the standpoint of the large contractor and builder the field offers an interesting development. With the use of portable two-welder sets similar to that shown in Fig. 6 it would be possible to transport the equipment as readily as riveting equipment is carried from job to job.

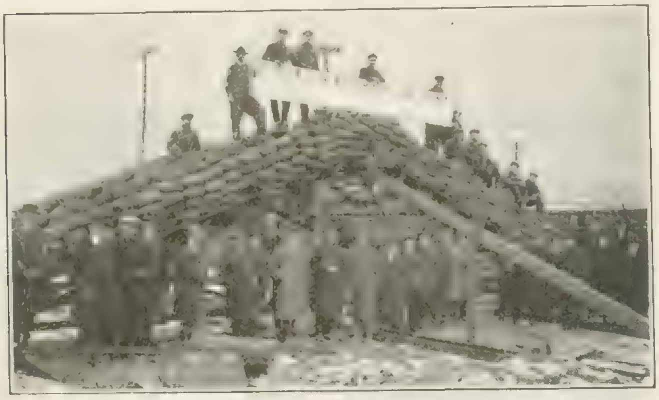


FIG. 5. TRUSSES WERE LOADED TO TWICE THE REQUIREMENTS OF THE BUILDING CODE AND SHOWED PRACTICALLY NO PERMANENT DEFLECTION.

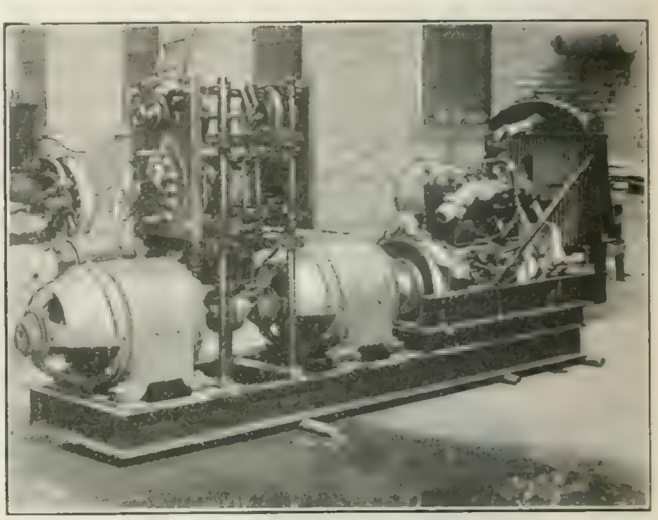


FIG. 6. GAS ENGINE SET FOR TWO WELDERS

Each machine supplies a welding current of 75 to 200 amps with 60 volt small load and 20 volt full load. The engine is rated at 27½ hp. at 1,150 r.p.m.

As the welder is probably a more skilled class of laborer than the riveter, the smaller contractor would not be likely to maintain a welding organization for such a purpose. In this case the field of use of the commercial welder would come into play, and the welding of members would be taken care of as a contract in itself, in much the same manner as the electrical work or plumbing is now taken care of.

Armature Repair Costs Average $44.67 at Lehigh Plant of Bethlehem Company

CAREFUL cost data on the repairs of 554 armatures in seven months' time at the Lehigh plant of the Bethlehem Steel Company have shown an average cost of $44.67, or a total of $24,752. This cost, however, does not include that of changing armatures. Out of a total of 1,262 armatures repaired, it was found that about 50 per cent came into the shop for new winding, while the other 50 per cent required only minor repairs. The average time required for rewinding was 21.8 hours, and the average for all the repairs was 14.8 hours per armature.

It was found that the relation between the cost of material and the cost of labor was about three to one. Of a total cost of $24,752, $18,603 was for material. It is evident, therefore, that in reducing maintenance costs a great deal of attention must be paid to buying material.

These points were brought out by H. W. Tice, efficiency engineer in the electrical department of the Lehigh plant of the Bethlehem Steel Company, in a discussion of a paper on repair-shop practice by A. J. Standing, presented before the Philadelphia Section of the Association of Iron and Steel Electrical Engineers.

Predetermining Foot-Candle Illumination

Chart for Rapid and Accurate Calculation of Illumination Intensities—The Distribution Curve of Lighting Unit Is the Only Supplementary Information Which Is Required

By I. W. GROSS,
District Engineer General Devices & Fittings Company, New York City

IN THESE times industrial concerns are working for better light to increase factory production, and commissions are recommending and in some cases insisting on given standards of intensity for almost every use to which a lamp is put, yet there is no sufficiently simple and quick method of predetermining luminous intensities on the working plane, *i. e.*, foot-candles. The writer therefore offers a chart which greatly simplifies the work of predetermining foot-candle illumination and requires only the distribution curve of the lighting unit. The probable error in the use of this chart, over a wide range of conditions, is less than 5 per cent. The chart is therefore sufficiently accurate for most practical purposes.

There are, it is true, simple and fairly accurate methods of determining intensities on a given system where the installation is already in place, such, for example, as the Sharp-Millar photometer and the foot-candle meter, with which the illumination can be read direct by a comparatively inexperienced person.

Although the rule of allowing a certain number of watts per square foot to obtain a satisfactory illumination has been used extensively in the past, the perfection of the lighting art stamps this method as of only general adaptability and wholly inadequate to insure even approximately a given illumination on a fixed plane.

SOME APPROXIMATE METHODS ARE INADEQUATE

One quite important case has come to the writer's attention where, after extensive tests had been made, a so-called illumination expert was called in, only to absorb the tests already made, make further tests and then recommend a certain value of watts per square foot on the horizontal plane. In this case the plane of vital interest was distinctly inclined to the horizontal plane; so it is clear the main point at issue was wholly missed.

Undoubtedly, the somewhat common and more ingenious rule of a given value of lumens per square foot more nearly approaches the problem from the right direction. But here again the light flux must be perpendicular to the reference plane, so that this rule cannot be universally applied, and good judgment must be exercised to get anything like accurate results.

In many cases, of course, it is unnecessary to go to refinements to predetermine the illumination desired, as for example, in halls, passageways and storehouses; but there are many other cases where a fairly accurate predetermination of intensity is highly desirable. Where such is the case, the old reliable $\cos^3\theta/H^2$ is necessary.

Referring to Fig. 1, this rule expressed as a formula becomes:

$$F = \frac{\cos^3\theta \times I}{H^2}\ (\textit{foot-candles}).$$

The value of I, or candlepower, is readily determinable from the distribution curve of the lighting unit, whether bare or shaded, under consideration. H is, of course, given for any given problem, and θ the angle, must be determined for each individual point where F is to be computed. The determination of θ is not difficult; neither is the calculation of $\cos^3\theta$ or $\cos^3\theta/H^2$, but these calculations are tedious, take considerable time, and if tables are not used are liable to considerable error. Even where predetermined tables are used, the procedure is difficult, tiresome and subject to some error where interpolation is necessary for mounting heights falling between table values, also for interpolation for horizontal distances and proper angles.

CHART FOR PREDETERMINATION OF ILLUMINATION INTENSITIES

In order to obviate the necessity of making the above interpolations and initially constructing the table, the writer has devised the accompanying chart. Here it is possible to predetermine with a reasonable degree of accuracy the vertical illumination on a horizontal plane at any distance below the center of light from 2 ft. up to 100 ft. (0.6 m. to 30 m.) and along the horizontal plane up to a distance of 300 ft. (90 m.) on each side of the unit, thus giving a 600-ft. (180-m.) spread on the horizontal plane. In addition to the chart, only the candlepower distribution curve of the lighting unit is necessary for calculations.

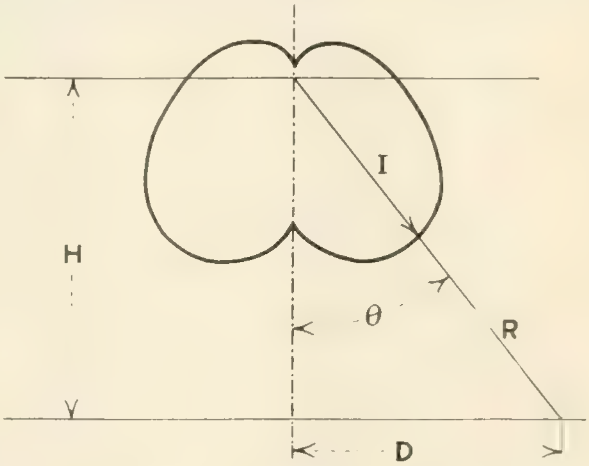
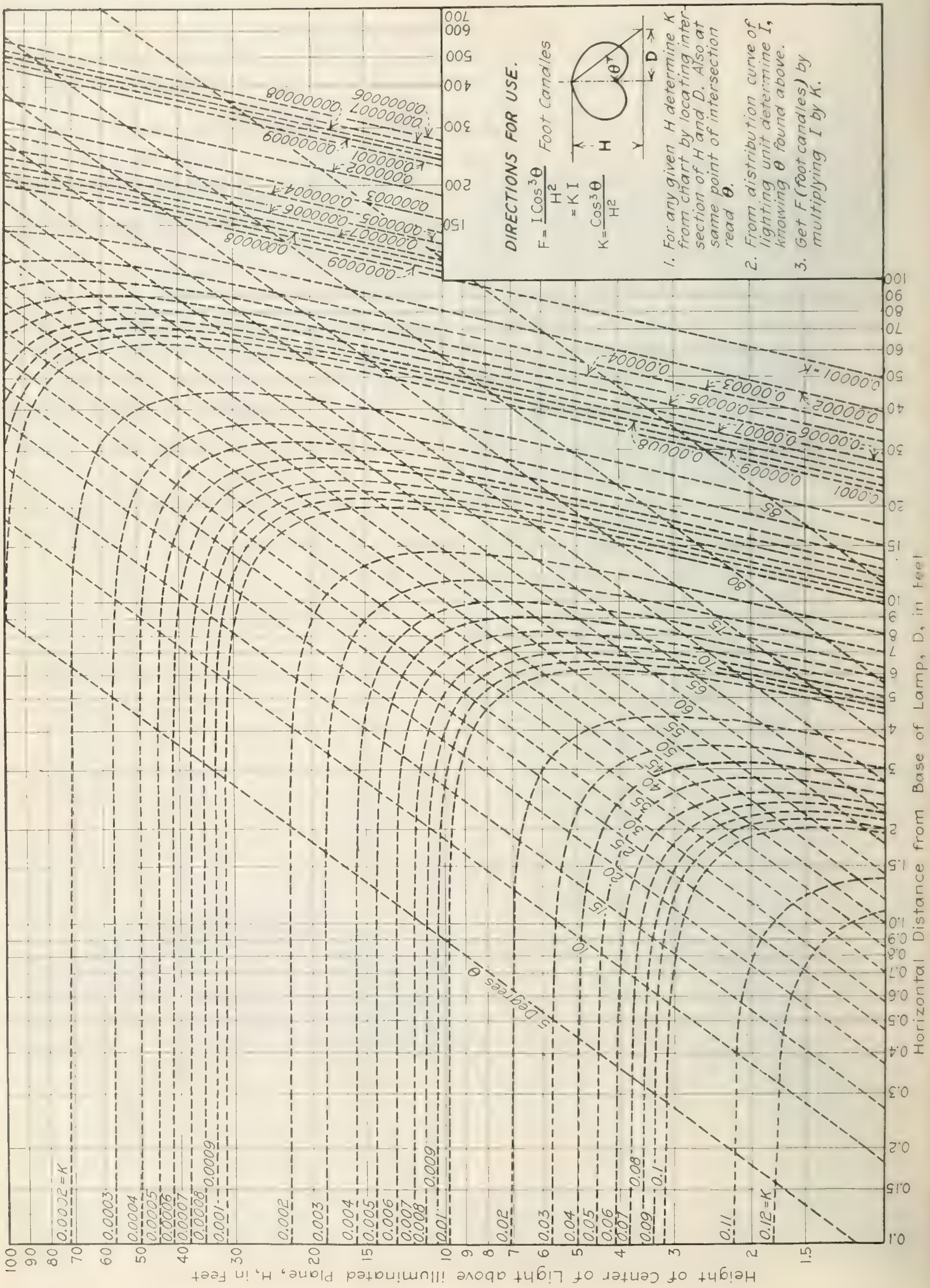


FIG. 1. CANDLEPOWER DISTRIBUTION OF LIGHTING UNIT

H = height of center of light above illumination plane-feet
D = horizontal distance from foot of lamp-feet.
I = candlepower of unit at angle θ-candlepower.
θ = any angle
F = perpendicular illumination on plane-foot candles.
$F = I/R^2 \cos\theta$. $H/R = \cos\theta$. $R^2 = H^2/\cos^2\theta$. $F = I(\cos^3\theta)/H^2$.

The chart has been constructed from the formula printed above and is a direct solution of this formula, represented in chart form. In order to obtain readable and usable values of H, D and K, both abscissas and ordinates have been drawn to a logarithmic scale. This permits of using the chart for very small values of H and keeps the K curves well spaced. The values of K ($= \cos^3\theta/H^2$) are drawn for $K = 0.12$ up to $K = 0.000006$, which will cover almost any conceivable range of mounting heights, horizontal distances and candlepowers met with in practice.



DIRECTIONS FOR USE.

$F = \frac{I \cos^3\theta}{H^2}$ Foot Candles

$= K\,I$

$K = \frac{\cos^3\theta}{H^2}$

1. For any given H determine K from chart by locating intersection of H and D. Also at same point of intersection read θ.
2. From distribution curve of lighting unit determine I, knowing θ found above.
3. Get F (foot candles) by multiplying I by K.

The use of the logarithmic scale has caused the values of $\theta = 0$ and $\theta = 90$ deg. to vanish; but this is unimportant, since the K curves are asymptotic for $D = 0.1$ ft., and hence the asymptote is the value of K for $D = 0$ and likewise for $\theta = 0$ deg. In much the same way the curve for $\theta = 90$ deg. is not necessary, since for this value K is zero, and further, for most commercial units I is very small when $\theta = 90$ deg.

Brief directions for use of the chart are given on the chart itself. To elucidate, however, proceed as follows: Place a transparent straight edge or triangle horizontally on the chart at H equal to the mounting height of the center of light above the illuminated plane. This straight edge cuts all values of K, and the intersection of each vertical line with the line of the straight edge locates a point, for the value of D selected, which determines both K and θ. I, for the value of θ found, can then be taken from the candlepower distribution curve of the lighting unit, and this value of I multiplied by the K found at the above point determines F, the perpendicular foot-candles on the illuminated plane.

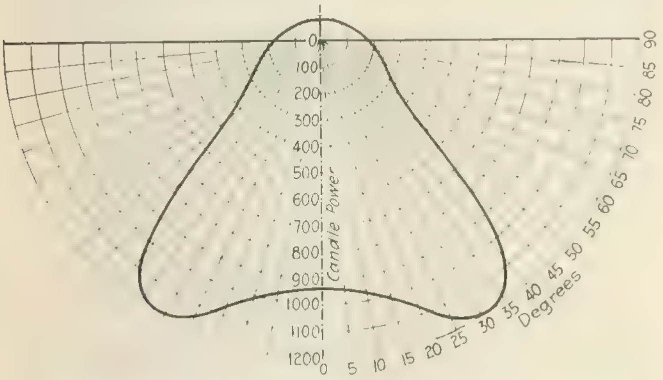


FIG. 2—DISTRIBUTION CURVE OF UNIT USED IN EXAMPLE

To compare the results obtained from this curve with those obtained from the standard formula, the following example has been picked at random. Assume the candlepower distribution curve in Fig. 2.

Let H = 30 ft.
I = candlepower at θ (Fig. 2).
θ = degrees from chart.
θ' = degrees from formula.
K = $\cos^3\theta/H^2$ from chart.
K' = $\cos^3\theta/H^2$ from formula.
p = per cent value of K/K'.
D = horizontal distance from foot of lamp-feet.

D	K	K'	θ	θ'	I	KI	p
0	0.0012	0.00111	0	0.0	930	1.116	107.8
10	0.00096	0.000947	18	18.5	1,050	1.007	101.5
20	0.00066	0.000640	33	33.6	1,190	0.785	103.2
50	0.00040	0.000393	45	45.0	760	0.304	101.9
40	0.00025	0.000240	53	53.1	440	0.110	104.1
30	0.00016	0.000152	58	59.0	320	0.0512	105.2
60	0.000105	0.0000985	63	63.5	280	0.0294	106.1
70	0.000072	0.0000694	67	66.8	260	0.0187	103.8
80	0.000050	0.0000468	69	69.4	250	0.0125	106.6

Average, 104.5. maximum, 107.8 minimum, 101.5

From the table it appears that the maximum error in the use of the chart as compared with the formula is 7.8 per cent and the average error is 4.5 per cent. The error in determining the angle θ is absolutely negligible, considering that it is used only in locating I on the candlepower distribution curve. It is believed that the error in the use of the accompanying chart will not exceed 10 per cent; and this should be absolutely realized in the final results, when the points of foot-candle values are plotted on co-ordinate paper and a smooth curve passed through or between all points.

Only a short use of the chart will show the great saving of time obtained over either the formula or tables, if available. Even a 10 per cent error over the formula or tables is negligible when it is considered that two lamps of the same rating differ in candlepower to some extent, and, further, that the candlepower of the unit changes slightly with the age of the lamp throughout its useful life, and greatly with the collection of dust on both the bulb and the shade. Furthermore, the reflected light will in many cases change the illumination on the reference plane by more than 10 per cent and this reflected light is virtually impossible to determine with any degree of accuracy or certainty.

It is hoped that this chart will supply a much-desired want of long standing in producing a means of arriving easily, quickly and with reasonable accuracy at foot-candle values from the distribution curves of lighting units.

Undeveloped Water-Power Rights Not Protected by Federal Constitution

THE United States Supreme Court has just handed down a decision in Cuyahoga River Power Company *vs.* Northern Ohio Traction & Light Company and Northern Ohio Power Company, a case appealed from the District Court of the United States for the Northern District of Ohio. By its decision the Supreme Court upholds the lower court, declaring that no element of contract violation as between the plaintiff company and the State of Ohio is involved and that therefore the federal courts have no jurisdiction and any dispute over clashing claims of eminent domain must be settled in the state courts.

The Cuyahoga River Power Company based its action on its articles of incorporation, filed May 29, 1908, and its subsequent proceedings for the condemnation of the property required to carry out its plans for a hydro-electric plant. These proceedings were long delayed, and while they were pending a parcel of the land involved was conveyed first to the Northern Ohio Power Company and then by it to the Northern Ohio Traction & Light Company, which prior to Feb. 24, 1914, erected a power house upon it and installed appliances for generating hydro-electric energy. This, the plaintiff claimed, was an infringement of its own contract with the state. In summarizing this contention the District Court said:

> The contention of the plaintiff is that by virtue of its charter, it has appropriated the potentialities of the river and its tributaries within the boundaries by it designated in its resolution of improvement, and that it is entitled, because of its incorporation under the general laws of the state, to exclude any use of the water power of these streams of the nature of the use which it anticipates enjoying in the future while it proceeds, however dilatorily, to make its improvements in detail and to complete its ambitious scheme. In brief, its proposition is that its charter is equivalent to a contract with the State of Ohio giving it the exclusive right to the employment of the benefits which nature has conferred upon the public through the forces of these streams to the end that, until it finds itself able completely to occupy all the territory which it has privately designated to be necessary for its use, the public shall not have the advantage of any portion not immediately occupied by it through the employment of the resources thereof by another public utility company.

This view of constitutional rights is now declared by the highest court of the nation to be "obviously without merit."

Readers' Views and Comments

Centenary of Discovery of Electromagnetism

To the Editor of the ELECTRICAL WORLD:

SIR: It is an interesting and important fact that this year is the centenary of the discovery of the phenomenon of electromagnetism by H. C. Oersted, the famous Danish scientist, on July 20, 1820. During the same year, in fact very soon afterward, André Marie Ampère worked out not only the theory of electromagnetism but also the theory of electrodynamics. These facts are stated briefly and authoritatively in the last edition of the Encyclopædia Britannica.

In an article on "Electromagnetism," Vol IX, page 226, it is stated that "in the *Annals of Philosophy* for November, 1821, is a long article entitled 'Electromagnetism' by Oersted in which he gives a detailed account of his discovery. He had his thoughts turned to it as far back as 1813 but not until July 20, 1820, had he actually made his discovery."

In an article on André Marie Ampère, Vol. I, page 878, the statement is made that "on Sept. 11, 1820, he [Ampère] heard of Oersted's discovery that a magnetic needle is acted on by a voltaic current. On the eighteenth of the same month he presented a paper to the Academy of Sciences of Paris containing quite a complete exposition of that and kindred phenomena." This paper and a series of papers by him on the same subject were published in *Annales de Chimie et de Physique*, 1820-1828.

The fundamental importance of these branches of science, with their wonderful practical development during the century since they were discovered and formulated, makes it appropriate to recognize and celebrate the hundredth anniversary of these great events.

The fact that Ampère was able in one week to work out and put in the form of a paper for presentation to the French Academy of Sciences the fundamental principles and theory of electromagnetism is one of the most brilliant achievements in the history of science. The difficulty of the subject, the shortness of the time and the remarkable completeness even of his first paper make his work a truly amazing feat of the human mind. Not only did he formulate the theory of electromagnetism—that is, the action of a wire carrying a current upon a magnet—but he also discovered experimentally and worked out theoretically and thoroughly the phenomenon of electrodynamics—that is, the action of one wire carrying a current upon another. He also proved and gave the laws of the action of one coil or helix carrying a current upon another, proving that each acted like a magnet having a north and a south pole and these poles attracted or repelled one another just as the poles of a magnet do.

Certainly electrical science and engineering should not let this centennial pass without duly recognizing and recording the far-reaching significance of the work of Oersted and Ampère. FRANCIS B. CROCKER.

New York City.

Depreciation and Interest Charges on Fuses

To the Editor of the ELECTRICAL WORLD:

SIR: Referring to an article, "Cost of Fuses for Service Entrances," which you published in your April 17 issue, page 897, I notice that the research engineer who prepared the figures comparing renewable-fuse maintenance with standard one-time fuses has included an item of 5 per cent depreciation. This is properly chargeable to renewable fuses as it is intended that the same case be used over and over. It is not properly chargeable to standard one-time fuses, however, because in the same calculation it is figured that each fuse is replaced once every four years (25 per cent replacements per year), so that the question of depreciation would not enter in. Incidentally prices have advanced since the article was written, on renewable fuses about 30 per cent and on standard one-time fuses about 15 per cent; also interest rates have increased from 6 per cent to about 7½ per cent. Substituting these new values in the equation, it is interesting to note that renewable fuses would not effect a saving over standard one-time fuses unless approximately 50 per cent of the fuses were replaced in a year. LOUIS DESLOGE.

St. Louis, Mo.

Ownership of Lines Serving Railroads

To the Editor of the ELECTRICAL WORLD:

SIR: In the May 15 issue of the ELECTRICAL WORLD an editorial appeared on "Ownership of Trunk Lines Along Electrified Railways." It seems to me that this field is a large one and we should get started in the right direction. The logical division of the whole electrical industry is into three main divisions: (1) the generation of power; (2) the transmission of power; (3) the utilization of power. It is going to be almost impossible to combine all three under one ownership head, owing to the fact that the first and third divisions are confined to definite locations, while the transmission of power is flexible and can extend from one community to another. We have a large number of steam and water generating stations scattered throughout the country which are running at a low efficiency because they have low load factors and are remote from coal and water supplies. If these were connected together by a transmission system great economies could be effected.

The most economical method is to generate in large steam generating stations, develop the water powers wherever they are available and tie them all into a transmission system. There might be a large number of plants generating and feeding into this transmission system, which would in turn transmit the power to the various communities and either wholesale this power to them and to the railways or retail it in these various communities as the occasion demanded. In this way the system would be entirely flexible and the load dispatching would be handled entirely by the transmission company within its territory to the best advantage. The plant which could make and deliver power at the lowest price to the transmission company would get most of the business. There would be numerous transmission companies, which in turn would interconnect and buy and sell power from and to each other. This all means that right now we should establish standard voltages for trunk lines and secondary lines, so that the equipment will be uniform. N. A. KEMMISH,

Public Service Company, General Manager.

York, Neb.

Station and Operating Practice

A Department Devoted to Problems of Installation,
Operation and Maintenance of Equipment for Economical Generation and
Distribution of Electrical Energy

Posting Firemen's Records Makes Better Firing

By POSTING the efficiency records of each man's run in a conspicuous place in the boiler room of a Missouri central station a spirit of rivalry has been created between firemen on different shifts. A blackboard used for the purpose is laid out for three shifts per day for a month. In the space set aside for each shift is given the fireman's name, the total amount of coal burned and the total kilowatt-hours generated, the pounds of coal per kilowatt-hour, and, as this plant acts as a reserve to water-power service, the coal used for banking, the banked boiler hours and the coal per banked hour are also given.

Owing to the different conditions prevailing on each shift one shift cannot very well be compared with another. However, the firemen change shifts every week and the figures are kept on the board to let each fireman compare his results with those of the other men when they were on the same shift. Very gratifying results have been obtained, and the slight trouble and expense involved have been fully justified.

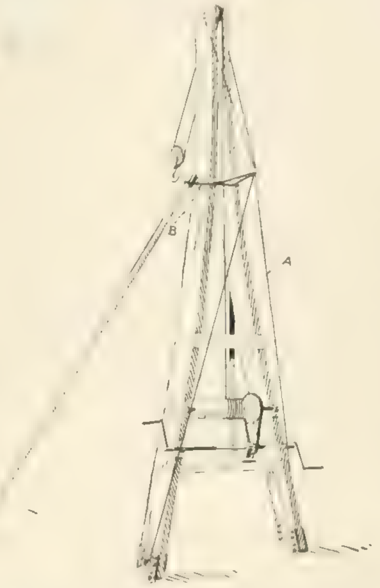
FRED M. RICHARDS,
Chief Engineer of Power Plants.
Empire District Electric Company,
Joplin, Mo.

Home-Made Light Derrick Raises Eighteen Poles in Half Day

A LIGHT pole-raising derrick transported on a trailer behind a touring car has proved economical of labor and time for the Molalla Electric Company, Canby, Ore. With this rig it has been found possible to raise as many as eighteen 35-ft. (11-m.) poles in a half day with a crew consisting of three men. The derrick has also been found very convenient for taking down or moving poles along highways, one afternoon's work having accomplished the taking down of eight large 35-ft. poles and one 50-ft. (16-m.) pole. In moving poles from one point to another near by, the derrick is able to make a great saving in time as it can move a pole a distance of at least 10 ft. (3 m.) without having to change the location of the automobile which braces the derrick.

AUTOMOBILE TOWS DERRICK AND SUPPORTS IT WHEN OPERATING

The principal details of construction are two 2-in. x 6-in. arms 18 ft. long (5 cm. x 15 cm. x 6 m.), forming the frame of the machine. This is braced with No. 4 iron wire, which is tightened by eye-bolts as illustrated in the sketch. From the upper end of the derrick is suspended a single-sheave block over which passes a $\frac{3}{8}$-in. (1-cm.) flexible steel cable used as a hoisting line. This cable is wound on a 6-in. (15-cm.) drum mounted near the lower end of the derrick, which is turned by hand through a four-to-one reduction obtained by heavy motor-cycle sprockets and chain. Handles may be attached to both ends of the shaft, but it has been found that one man is usually able to raise poles up to 35 ft. (11 m.) in length with ease. When operating, the lower end of the derrick is fastened to the front axle of the automobile by clamps. The rear wheels of the automobile are blocked to prevent movement, giving a very secure anchorage for the derrick. The derrick is braced by two poles similar to pike poles which are inserted in sockets at points some 12 ft. (4 m.) from the lower end.



DETAILS OF LIGHT DERRICK WITH WHICH THREE MEN RAISE EIGHTEEN POLES PER HALF DAY

The derrick is transported on a light two-wheeled truck which forms a trailer for the machine. The whole outfit is very light and inexpensive and may be readily handled by men less experienced than those needed for setting poles by "piking" up by hand.

Canby, Ore. E. G. ROBINSON.

Electric Current in Water Acts as Screen to Prevent Passing of Fish

TO PREVENT fish from being carried into irrigation ditches a Western man has devised an electrical screen, the scheme being to pass an electrical current through the water at the intake of the canal. It has been in use at the Utah state hatchery for some months and is now being installed for experimental purposes in Yakima County, Washington.

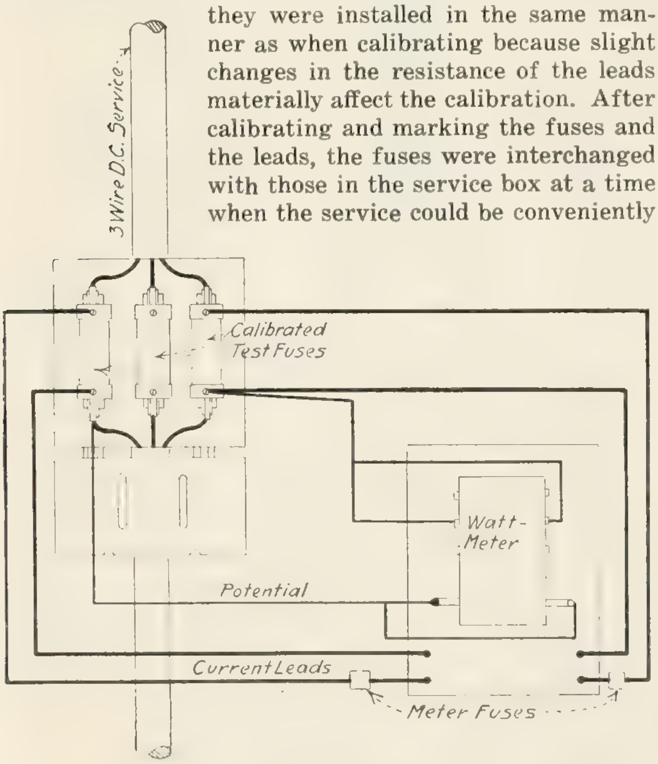
Difficulty has always been experienced in drawing irrigation water from rivers where fish abound, as the fish are inclined to follow the current into the side streams and onto the irrigated land. It was estimated that fully 40 per cent of the fish stock of some of these streams was annually destroyed in this manner. Screens or gratings were experimented with, but they collected floating material and soon became clogged or destroyed. By means of the electrical screen 90 per cent of the fish are prevented from entering the ditches.

Seattle, Wash. John H. Longfellow.

Calibrated Service Fuses Employed as Meter Shunts for Test

By the use of service fuses as direct-current meter shunts load measurements may be taken without the addition of extra leads in the power circuit, thus eliminating the danger of installing jumpers and shunts in a live circuit. This is especially advantageous where the installation is confined and all wires run in conduit, when the connecting of jumpers and the installation of shunts often becomes a very difficult procedure.

Fuses of the same type and capacity as used by the service to be tested were calibrated with the measuring instruments at the laboratory. The leads from the fuses to the instruments were marked, and on the test they were installed in the same manner as when calibrating because slight changes in the resistance of the leads materially affect the calibration. After calibrating and marking the fuses and the leads, the fuses were interchanged with those in the service box at a time when the service could be conveniently interrupted. The instruments were then connected when it was desired to make the test.



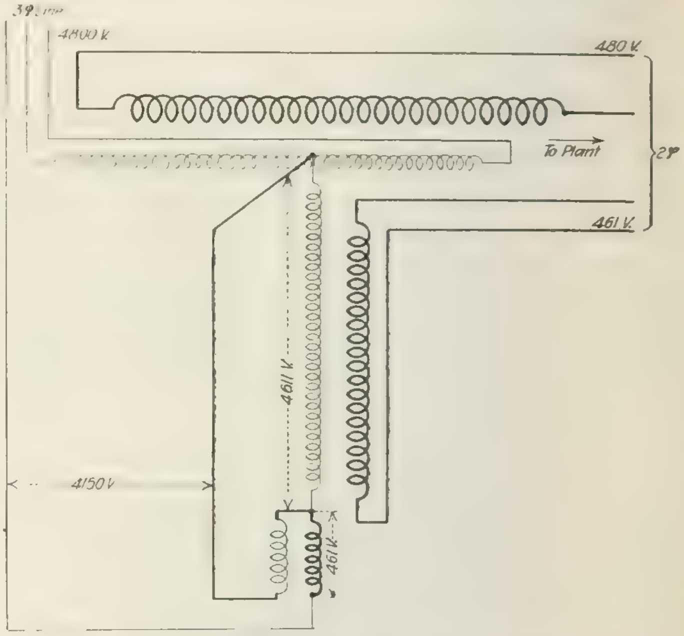
CALIBRATED FUSES REPLACE SHUNTS USED WITH PORTABLE WATTMETER

It is necessary to install two 5-amp. or 10-amp. fuses in the current leads of the measuring instrument to guard against damage in case a main fuse blows and throws an abnormal potential across the current elements of the instrument. Small fuses introduce a large resistance in the leads of the instrument, reducing the deflection of the pointer, so that these fuses should be as large as safety will permit. Willard S. Wilder.

Milwaukee, Wis.

Feeding Two-Phase Plant with Single-Phase Transformers

To furnish service to a two-phase load from a three-phase system, six 100-kva., single-phase transformers and one 50-kva. transformer were used in an emergency by the Consumers' Power Company, Jackson, Mich. Although Scott transformers had been ordered, before their arrival this emergency operation was necessitated by failure of a 600 kw. steam unit in the plant of the Advance-Rumely Company. These 100-kva. transformers were connected in two banks of three each with both high and low sides in parallel. To secure two-phase energy at 480 volts a Scott connection was made by connecting a lead from one bank to the middle points of the primaries of the other bank.



SINGLE-PHASE TRANSFORMER ARRANGED TO SUPPLY TWO-PHASE MOTORS

Small transformer used to boost voltage on one phase

In the accompanying diagram only one transformer is drawn to represent each bank of three. This gives a "T" connection, but when the 4,800-volt, three-phase line was connected to the three extremes of the arrangement the resulting secondary voltage was lower in the phase which corresponded to the first bank of transformers.

To correct this, a 50-kva. transformer was inserted in series with the primary side of this bank and connected so as to boost the voltage approximately 10 per cent. The low-voltage side of the transformer (connected for 480 volts) was placed between the bank of transformers and the 4,800-volt line. Then the 4,800-volt winding of the 50-kva. transformer was connected across the primary side of the bank, but connected with leads reversed, so that the voltage induced would boost the voltage impressed on the high side of the bank. This resulted in a voltage of 4,611 on the bank, which was raised from the voltage of 4,150 by the 461 volts of the boosting transformer. On the secondary side the voltage on the phase was 461 volts, which was sufficiently near the rated voltage of the motors. This temporary arrangement operated very satisfactorily and remained in service until the transformers which had been ordered were received.

In making the "T" connection in the transformers a hole was drilled in the back of each transformer case near the top and a bushing was set in, through which the third wire was brought out of the case. After the transformers were disconnected the hole was tapped and a pipe plug was screwed in to stop the opening.

Consumers' Power Company, H. H. STEPHENS,
Battle Creek, Mich. District Superintendent.

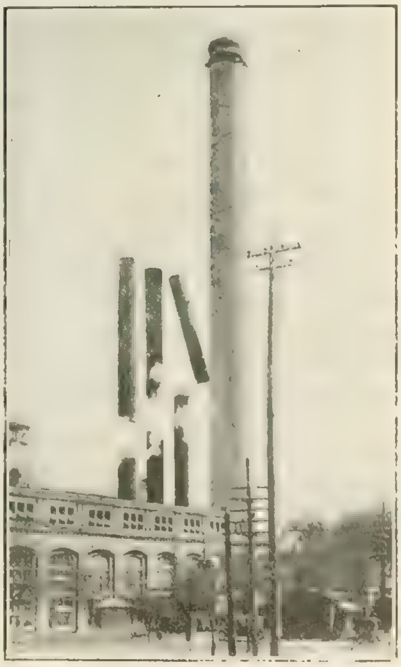
Cost of 2,500-Kw. Extension of New England Central Station

ABOUT a year ago a New England steam-driven central station completed an extension of 2,500 kw. capacity at its plant, and the final itemized cost of the work, which was done on the cost-plus basis by an outside engineering organization, was as given in the following table:

Engineering cost	$ 9,534.16
Services of construction engineers	27,300.00
Office at works	7,999.00
Insurance	1,618.52
Temporary construction	3,642.85
Building	62,285.77
Machinery foundations	2,389.02
Boiler plant	45,979.27
Draft system	2,995 13
Feed-water system	2,958.47
Condenser system	45,281.80
Piping	30,930.33
Coal and ash-handling machinery	9,212.48
Generating equipment	44,827.89
Switchboard and wiring	7,116.81
Auxiliary equipment	452 06
Construction equipment	2,060.90
Material supplied from central station stock	2,920.43
Interest on construction loans	12,687.37
Total $125 per kilowatt additional rating	$322,192 16

New Stack Holds Tackle for Dismantling Old Stacks

BY MEANS OF tackle supported from the top of the new concrete stack of a plant of the Little Rock Railway & Electric Company three old steel stacks were dismantled. The height of the new stack is about 285 ft. (85 m.), its diameter 20 ft. (6 m.) at the bottom and 15 ft. (4.5 m.) at the top. The old stacks were 150 ft. (46 m.) high and 7 ft. (2.1 m.) in diameter. As there was no ladder on the outside of the new stack, about three days was taken in rigging up the tackle at the top of the stack. Each one of the steel stacks was taken down in three sections, and it required about eight days for each stack to be taken down.



TACKLE FOR DISMANTLING OLD STACKS WAS ATTACHED TO THE NEW

JACK ABBOTT,
Little Rock, Ark. Chief Engineer.

Conditions to Be Met in Paralleling Interpole Generators

FIVE conditions must be met to operate compound-wound interpole generators in parallel: (1) The machines must be adjusted for the same no-load voltage; (2) they must have the same polarity; (3) they must have the same external voltage characteristic (change of voltage with load) both with series field out of circuit and with series field in circuit; (4) the series-field circuits of the machines must have resistances inversely proportioned to the ampere ratings, that is, the series field circuit of a machine rated for 1,000 amp. must have one-half the resistance of a machine rated for 500 amp; (5) the equalizer resistance must be low.

Conditions Nos. 1 and 2 (equal no-load voltage and same polarity) need no explanation. To explain condition No. 3 it must be remembered that the external voltage characteristic of a generator is the relation between terminal voltage and load. If the voltage rises with load, the machine is overcompounded and is said to have a rising external characteristic, while if the voltage falls with load it has a drooping characteristic. Any machine to compound properly must have a drooping characteristic when operated as a plain shunt machine.

To test this, the machine can be loaded by taking the current off the equalizer terminal instead of the regular main. It does not make any difference what the cause of the droop is, so long as it exists, and sometimes the engine speed dropping with load will give a drooping characteristic to a machine which otherwise would not droop. An interpole machine with its series field cut out may or may not droop, this depending on the effect of the interpoles. Sometimes they compound and give a rising voltage with load and sometimes the opposite.

After setting the brushes on no-load neutral, if paralleling trouble still exists, test the external characteristic of each machine with the series field out of circuit. If the test shows a rising curve, it will be necessary to shift the brushes forward with rotation until the curve becomes drooping. This may bring the brushes to a place where they will spark, and if so, the droop may have to be obtained by some other means. One means of producing droop is to have the driving speed drop off with the load, but when the generator is driven by a synchronous motor this cannot be done.

As a last resort, the droop can be secured by inserting a resistance in series with the armature. The amount of droop, which should be 2 per cent or more of rated voltage when the machine is operated without the series field, must be very nearly the same in each of the machines to be paralleled. In addition to having the same characteristic curve with the series field out of circuit, each machine must show the same characteristic curve with series field in circuit.

In regard to condition (4), machines of the same type will have the same series field resistance without adjustment, but if they are of widely different types—for instance, an engine type and a turbo type—extra resistance may be required. The machine which has too little series resistance in proportion to its rating will grab the load because it will get more than its proper share of compounding current, the extra current coming from the other machine through the equalizer.

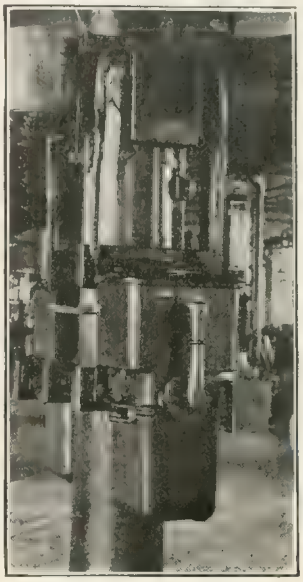
Cleveland, Ohio. JAMES DIXON.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control,
Testing and Repair of Equipment Required

Method for Mounting Starters on Round Column

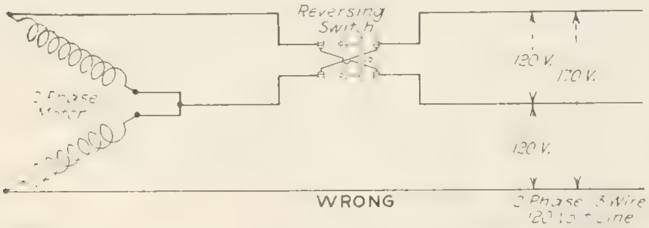
A SIMPLE and substantial method for mounting two starters for 25-hp. motors on a round column, as shown here, makes use of four wooden strips held to the column by long ½-in. (1.3-cm.) bolts. Four bolts hold each pair of the 2¼-in. x 3¼-in. (5.6-cm. x 8.2-cm.) wood strips and the starters are bolted to the strips, one on each side of the column. These starters control 25-hp. motors in the New England Westinghouse plant which are driving groups of machines adjacent to the column. The mounting is easy to make, is strong, conserves space and is economical. It is well adapted to control of group drives.



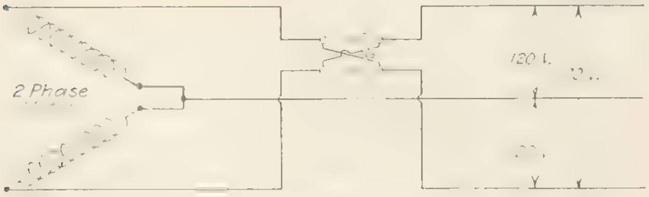
TWO MOTOR STARTERS SECURELY MOUNTED IN SMALL SPACE

Reversed Connections Cause Fan Motor to Heat

IMPROPER connections on a reversing switch recently caused serious overheating of a two-phase fan motor used in ventilating a large New York theater. This fan was intended to be run in both directions, for drawing air out of the theater and for forcing air into it. Usually the fan drew the air out of the theater and operated satisfactorily when running in this direction. However, when the reversing switch was thrown, the motor overheated in about three minutes.



WRONG



CORRECT

IMPROPER CONNECTIONS OF REVERSING SWITCH WHICH CAUSED MOTOR TO HEAT

Investigation showed that the reversing switch was connected across the neutral and one outside wire of the two-phase, three-wire line. With this connection, when the fan was reversed to draw air into the theater, one phase of the motor received 170 volts instead of the 120 volts for which it was designed, and consequently the motor overheated. To remedy the trouble the neutral wire was connected straight through to the motor, and the two outside wires were connected to the reversing switch. After this change was made the motor operated in both directions without any further trouble.

New York, N. Y. **FRED SOLLER.**

Gaging and Adjusting Motor Air Gaps

GAGING the air gap of an electrical machine, besides giving warning of danger from rotor rubbing, serves also as check on bearing wear. A new motor should always have its air gap checked before starting, as well as a motor that has been taken apart and reassembled. If the belt has been shifted to pull in a different direction, gaging should be done before and after the belt is put on. The frequency of gaging motors in service depends on the drive, but as motors are ordinarily cleaned at certain intervals the gaging can be done at the same time. In the plant with which the writer is connected the air gap is checked up every two weeks. Belt, chain and gear drives ordinarily cause more bearing wear than those that are directly connected.

Ordinarily an air-gap gage comes for each motor, but an experienced man can carry a few different sizes and by using the largest gage that will go into each motor tell how the air-gap is holding up. It is even preferable to use various sizes of gages to find out if the air gap is decreasing, rather than to take a minimum-size gage and use that until the air gap decreases to it.

To check for an eccentric rotor, mark one spot on the starter and then insert the gage at that point for various positions of the rotor. If the rotor is not true, the air gap at this point will vary when the rotor is turned. If it is out enough to cause trouble, the rotor should be put in a lathe to investigate the cause. If the trouble lies in the shaft, it may be straightened or replaced. If the cause is due to high laminations, they can be ground off.

The stator laminations also may be uneven. To detect this condition mark one spot on the rotor and turn the rotor to various positions, inserting a gage each time at the marked point on the rotor but for various points on the stator.

If thin slat wedges warp they should always be attended to as the coil may work out and rub on the rotor. Motors having adjustable heads are provided with bolts (two on each head) designed to hook onto the frame and threaded on the other end with a nut outside the head. By raising or lowering these nuts the heads may be shifted up and down or sideways. When adjusting the air gap the belt must be taken off or made very slack, and for direct-connected motors the coupling should be separated. It is generally necessary to make the gap at the top of motor slightly large to allow for the rotor rising when the heads are tightened up again.

With the heads loose the motor should be adjusted by means of the adjusting bolts so that it will have a clear gap all around. Care should be used to make the gap even on both ends of the rotor. It is customary to adjust the air gaps to give a slightly greater clearance on the side where wear will come—*i.e.*, in a belt drive on the side where the belt pulls and in direct-connected motors on the bottom.

After the air gap is adjusted and the heads are tightened the rotor should be moved (not rotated) in all directions to see that it cannot rub. H. L. HAYES,

Woodland, Me. Chief Electrician.

Spare Parts Required for Motors in Steel Mills

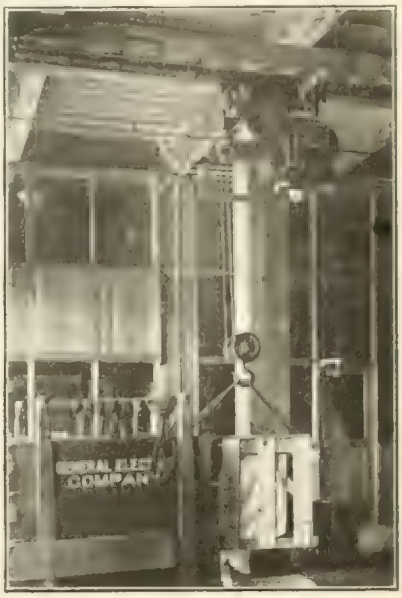
IN A STEEL mill motor-driven equipment consisting of ten direct-current mill-type motors working within their rated capacity usually requires a stock of "spares" comprising one complete motor, one complete armature with bearings, one commutator, two complete sets of armature coils, one complete set of field coils, one complete set of brush holders, two sets of brushes, besides miscellaneous insulation, band wire, etc. This statement is based on the assumption that not more than five or six of the ten motors are used on severe reversing service subject to plugging and that the remainder of the motors are doing comparatively light work. Unless the service is unusually severe, the number of motors could probably be increased to fifteen or eighteen without adding to the number of "spares." If the number of motors were increased to thirty, another spare armature with bearings, an additional set of armature coils, two extra sets of brushes, and one more commutator should be added to the reserve stock.

Other things being equal, speed is the greatest factor in determining the life of mill motors on reversing service. Slow-speed motors give longer service before repairs are required than higher-speed motors when operated at the same load. Alternating-current squirrel-cage motors, driving fans, pumps, saws or any constant-speed, non-reversing machines should have one complete spare motor for the first ten motors of a kind in service. In addition, there should be one set of stator coils and bearings for the ten motors, two sets for twenty-five motors and three sets for forty motors of a kind. These figures apply to motors up to 75 hp., rated at 500 r.p.m. or 750 r.p.m.

Large alternating-current motors of say 500 hp. or over are usually of such slow speed and so well built that one-quarter of a set of stator coils with insulation, one set of bearings, one set of brushes, one-quarter of a set of brush holders, etc., will be found sufficient material to keep in the storeroom for emergencies.

If the plant is divided up into sections, each section should carry its own spare parts, such as armatures, bearings, field coils and complete motors if necessary. This may seem a rather expensive procedure, but the cost is small compared with the total cost of the equipment in a steel mill and considering the loss that would result from extended shutdowns due to failures of electrical equipment. The information for this article was obtained from papers presented by C. A. Menk of the Carnegie Steel Company, Munhall, Pa., and T. E. Tynes of the Lackawanna Steel Company, Buffalo, N. Y., at a convention of the Association of Iron and Steel Electrical Engineers.

Monorail Hoist Saves Time in Loading Trucks



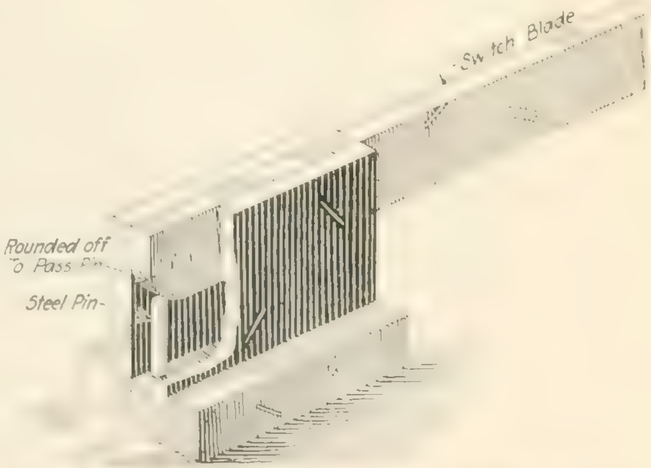
THIS HOIST DOES THE WORK OF FIVE TO TEN MEN AT 1 CENT PER TON

A 3-TON monorail electric hoist at the San Francisco warehouse of the General Electric Company handles material for a cost of approximately 1 cent per ton, with a saving of from 60 to 90 per cent of time of manual loading on low-bed trucks with heavy material. There is 90 ft. (27 m.) of track laid out in the form of a "T," one arm of which runs to the railroad spur, the other arm to the storage space, and the stem of the "T" runs to the truck-loading platform. The rail is bolted to a 12-in. x 12-in (30-cm. x 30-cm.) beam slung from the ceiling by 2-in. (5-cm.) strap-iron stirrups. A 220-volt direct-current reversing motor furnishes the power.

San Francisco, Cal. ERNEST BURCHARD.

How to Put 90-Deg. Stop on Knife Switches

FOR applying a 90-deg. stop to a knife switch a steel pin may be used, as shown in the accompanying drawing. The procedure for applying the stop is as follows: Pry loose the hinge pin and the washer which is spun on. Drill a hole between the contacts



DETAILS FOR PLACING 90-DEG. STOP ON A KNIFE SWITCH into the base of the switch and insert a piece of $\frac{5}{32}$-in. (4-mm.) drill-rod steel. The hole may be drilled through the copper block since the pin will be held in place by the switchboard panel and the switch blade. It is preferable to make a tight fit for the drill rod, but in any case the steel pin is prevented from falling out by the switch blade. Slightly round off the lower corner of the switch blade just enough to pass the pin as shown in the sketch. The other corner of the blade must remain square. Reassemble switch blade and spin on the washer to make a good contact between the hinge post and the blade.

The drill rod should be copperized by treating with blue vitriol to prevent rusting. A $\frac{5}{32}$-in. drill-rod pin is suitable for switches up to 300 amp. Only one blade of a multipole switch need be equipped with a stop. This method may be used on any switch which has square ends on its blades. Stops of 90 deg. are not always desirable, but in many cases they are necessary where space on the panel is limited.

Atlas Electric Devices Co.
Chicago, Ill.

H. E. WEIGHTMAN,
Chief Engineer.

Varnishes to Use for Electrical Work

VARNISHES for electrical machines vary in general from the clear baking varnishes to the air-drying varnishes and the finishing varnishes. Baking varnishes are of course superior to any of the others as insulators. Air-drying varnishes come next, while finishing varnishes are used only to protect the under coat of insulating varnish against moisture and to provide a smooth surface which will not become dulled when the apparatus is cleaned of oil and dirt with a benzine-saturated cloth.

A fact of primary importance concerning insulating varnishes, and one which is not generally understood by repairmen, is that their dielectric resistance increases directly with the length of their baking or drying period, the slow-drying varnishes giving the highest degree of insulation and flexibility. Slow-drying varnishes contain higher percentages of gums and oils which blend as the solvent gradually evaporates, whereas the highly volatile material used in quick-drying varnishes evaporates so rapidly that blending is impossible and the result is a granular, crystalline coating which soon becomes a mass of minute moisture-absorbing cells. In the two classes of baking varnishes black varnish should be selected in preference to clear varnish in all cases where a transparent coating is not essential, as the black varnishes produce a more flexible and better insulating film than the clear varnishes of their respective class. Clear varnish should be baked from eight to twelve hours or more at 100 deg. C. (212 deg. Fahr.). This baking varnish is usually proof against oil, acid and water and is employed for impregnating coils, linen, cotton, tape, canvas, paper, fiber, armatures, etc.

The air-drying varnishes dry in from one-half hour to two hours, are moisture-proof and acid-proof to a certain extent and are fairly good insulators. As in the baking varnishes, the black varnish is better and more elastic than the clear varnish and should be used whenever possible.

The finishing varnishes dry quickly, in one-quarter hour to one hour, and produce an insulating coating which protects against oil, water and acid. They are neither so tough nor so elastic as the other types of varnish and are not intended for use as insulators.

Qualities to Look For in Selecting Brush Holders

THE following are the most desirable features of brush holders. The brush holder should:

Be cheap, simple and strong.
Quick to follow an imperfect commutator.
Easy to keep clean and able to operate even when dirty.
Small, covering as little of the commutator as possible.
Not liable to catch and injure operator's hands.
Have easy but sure spring tension, adjustable while running.
Have no tendency to chatter or bounce.
Be constructed so that it is easy to renew brush.
Easy to see when brushes are worn out.
Impossible for brush to stick in holder and should be constructed for long life of brushes.

The various holders in common use can be judged for their quality by their fulfillment of these points.

Any holder may cause friction heating due to too heavy tension when handled by ignorant operators. Brush tension should be uniform and not over 5 lb. per square inch (0.4 kg. per sq.cm.) or under 2 lb. per square inch (0.16 kg. per sq.cm.), depending on the type of holder and service conditions. Any loose-box type must have some clearance between brush and box to prevent possible sticking in dirty or oily places. On the other hand, too much clearance allows chattering. Either sticking or chattering may cause sparking.

Brushes for box holders must have ample pigtails or shunts to carry current directly from brush to arm; otherwise current will go through springs and joints, causing heating which draws the temper of springs, pits the pivots and causes arms to stick. In general, a radial brush gives greater friction for the same pressure than a sloping brush. The brush and moving parts of the holder should be light so that the spring can move them quickly and keep the brush on the commutator. This is particularly important in high-speed or vibrating machines.

There are only two kinds of trouble that can be cured by changing holders. These are heating by excessive friction and sparking or kindred troubles due to poor contact. Heating by excess friction is not uncommon. If tension is reduced enough to eliminate heating, there may not be enough pressure to make good contact and the sparking will be bad. In such a case a different holder with better spring action will be necessary. Commutator trouble due to poor contact is fairly common. Engine-shaft throw, poor foundations, gear drive, bent shaft, commutator out of "true," worn bearings or bad belt splice may cause the commutator to jump away faster than the holders can follow. This results in sparking, which burns away the copper, leaving a gray surface and high mica. When the cause cannot be eliminated a cure can sometimes be effected by using a more lively holder.

In general, all moving parts should act freely without binding but should not be loose enough to rattle. Spring tension should be heavy enough to prevent sparking. Spacing should be accurate within half a bar. Studs must be firm so that holders cannot vibrate. Holders should be set down close to the commutator, in general not over $\frac{1}{8}$ in. (3 mm.) away. If holders are set too far away, there is a great tendency for them to bounce around and chatter. Holders should be staggered so that the commutator will not wear in ridges.

Cleveland, Ohio. JAMES DIXON.

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

Reliable Power Spells Industrial Salvation

AN AUTOMOBILE trip through any part of New England, declared Samuel Ferguson, vice-president of the Hartford (Conn.) Electric Light Company, in a recent address, will show how early New England factories were built on all available streams. There are now three classes of such factories: "Prosperous," "struggling" and "abandoned." The first-named have rail connections and have supplemented mechanical water power with steam, which is either now in use or in turn has been supplemented by electricity. The "struggling" factories also have steam plants, but labor under the disadvantage of carting fuel. The "abandoned" plants are evidence of the impossibility of competing when handicapped by unreliable power.

TYPICAL FACTORY WITH WATER, STEAM AND ELECTRIC POWER

The danger to New England as an industrial center, the speaker said, lies in the absorption of labor by the Middle West, the cost of fuel and lack of transportation facilities. The evolution of the power development of a typical New England factory presents the following stages: Originally operated wholly by water power; a steam engine added to supplement the stream in time of low water; more steam equipment installed to care for business the year around; the addition of electric motors for further increases; the abandonment of the steam apparatus, replacing the same with electric motors. Frequently there is a final step which is not sound, the abandonment of the waterwheels on account of the superior speed regulation and flexibility of the electric drive.

The first five steps may be seen by many a roadside—the mill-pond, the steam plant, either in operation or dismantled, and the high-tension wires running to transformers installed beside the factory. These same high-tension wires are becoming the salvation of the struggling plants and are even bringing to life abandoned ones where labor is still available.

$106,264 Profit from Merchandising Departments

OPERATION of the merchandising and jobbing departments of the subsidiary companies of the United Gas & Electric Engineering Corporation for the year 1919 shows a profit of $106,264 on a gross business of $597,653. A comparison of the gross revenue, expenses and net earnings of the merchandise and jobbing departments during the past four years follows:

Merchandise and Jobbing Departments

	1919	1918	1917	1916
Gross Revenue ..	$597,653	$471,660	$485,744	$429,265
Expenses	491,389	424,648	484,495	457,294
Net earnings	$106,264	$ 47,012	$ 1,249	*$ 28,029
Promotion Expenses:				
Total promotion expense charged to gas, electric and steam operations...	$ 74,443	$ 61,169	$ 83,695	$118,214
Excess or deficiency of merchandise and jobbing earnings over company's total promotion expense.	$ 31,821	*$ 14,157	*$ 82,446	*$146,243

* Deficit

The items, promotion expenses, are charged to gas, electric and steam operations and were not charged direct to the cost of merchandising and jobbing. In 1917 the company began to change its policy of operating the sales departments and planned to make the profits of this department sufficient to pay all the department expenses and ultimately to yield sufficient profit to pay all of the promotion expenses of the company in soliciting and advertising for new business. In 1919 this goal was reached and the company's total profits exceeded all expenses by $31,821.

Pensions for Employees of Ontario Hydro-Electric Commission

IN accordance with an act passed by the Ontario Legislature, the Ontario Hydro-Electric Commission has inaugurated pension, insurance and sick-benefit plans for male employees and savings accounts for women employees. The pension will be an annual payment of one-eightieth of the pensioner's average salary for the previous five years, multiplied by the number of years he has been in the service. In the savings accounts to be opened for each woman employee, 5 per cent of her salary will be deposited each year, and the amount thus accrued will be paid to her when she leaves the service. No assessment to cover the cost of the benefits is to be made on the employees, about 2,500 of whom will be affected by the plan.

Industrial Heating Display in Chicago

BY A. F. ALLSOP
Industrial Heating Engineer Commonwealth Edison Company, Chicago

IN ORDER to show its customers the possibilities of electrically heated industrial devices and small motor-driven tools and appliances, the Commonwealth Edison Company has placed on exhibition a sample of virtually all of such devices manufactured by thirty different companies in this country. About 1,000 sq.ft. (93 sq.m.) of retail floor space in the heart of the "loop district" of Chicago was set aside for this purpose, and circuits have been installed so that every tool and device can be demonstrated for the benefit of prospective customers and other interested parties. The exhibits come under the following five general classifications: Motor-driven tools, electrically heated tools and instruments, electrically heated ovens, etc., for industrial processes, electrically heated hotel equipment, and electric heating units. The number and the description of the devices under each heading are given in the accompanying table.

MOTOR-DRIVEN TOOLS AND INDUSTRIAL HEATING DEVICES

Tools	Number of Manufacturers	Number of Types
Motor-Driven Tools:		
Drills	5	22
Hammers	2	6
Compressors	2	4
Buffers	3	12
Grinders	3	14
Polishers	3	14
Blowers	2	10
Exhaust fans	2	4
Sewing-machine motors	2	2
Cloth cutters	1	1
Hand magnets	1	1
Wood routers	1	1
Electrically Heated Tools and Instruments:		
Glue pots, ½ pt. to 5 gal	7	23
Soldering irons	6	18
Branding irons	2	2
Tailors' irons	6	19
Laundry irons	4	15
Burnishing irons	1	1
Hatters' irons	1	2
Shoe irons	1	2
Disk stoves	5	18
Sealing-wax pots	2	2
Hat-flanging bags	1	1
Sterilizers	2	4
Muffle furnaces	1	3
Incubators	2	2
Crucible furnaces	1	3
Tube furnaces	1	2
Thermometers	2	3
Pyrometers	2	4
Control panels, hand-operated	2	2
Control panels, automatic	1	1
Soldering iron furnace	1	1
Metal melting pots	2	3
Linotype pots	2	2
Chocolate warmers	2	2
Can cappers	1	1
Flask heaters	3	4
Water heaters	4	10
Electrically Heated Ovens, Etc., for Industrial Processes:		
Japanning	2	2
Drying ovens	1	1
Oil-tempering baths	1	1
Tempering ovens	1	1
Rivet heaters	1	1
Electric Heating Units:		
Strip	3	5
Bayonet	5	11
Cartridges	1	22
Flat	2	5
Coil	1	1
Grid	1	3
Disk	2	2
Electrically Heated Hotel Equipment:		
Toasters	2	2
Automatic toaster	1	1
Broilers	2	2
Grills	1	1
Ranges	2	2
Hot plates	1	18
Doughnut stoves	2	2
Bake ovens	2	2
Coffee urns	2	3
Steam tables	1	1
Water urns	2	2
Fry kettles	1	1

The industrial heating exhibit is another step in the process of education and development which the Commonwealth Edison Company has been carrying on for the last seven or eight years. In that time the industrial heating load has been built up to a connected load of more than 50,000 kw. The company's experts have developed many new applications for industrial electric heating and have designed heating elements to meet the particular requirements of different industries. The company tells its customers that if they cannot get standard heating units to do the work they want, the company will suggest modifications in their machines or will design units to meet their requirements.

Intercompany Visits a Success in New England

MEMBERS of the Commercial Section of the New England Section, N. E. L. A., are carrying out a plan of intercompany visits which is working exceedingly well. Different members of the committee have been assigned companies to visit as representatives of the N. E. L. A. in their general localities, and up to date forty such calls have been made. The object of the visits is to promote the interchange of ideas and experiences, with the giving and taking of helpful suggestions along commercial lines.

A central-station man from Portland, Me., for example, is assigned to visit three or four companies in the "Down East" section of the state. Upon arrival he calls upon the manager of the local company and inquires as to various commercial practices which may be in effect, finding out what "the other fellow" is doing, and receiving in turn new impressions and a fresh viewpoint on mutual problems. Free discussion is cultivated, the attitude of employees in one office or another toward the public may be touched upon, constructive comment may be offered as to the efficacy of electric signs used by the company, plans for bettering commercial relations in local districts may be reviewed, and so on. The development of industrial and mercantile lighting, of range campaigns, rates, industrial heating, power-factor matters and many other points may be covered in these visits. In effect, the two or more men taking part in each visit virtually "put through" a miniature convention, short though the time may be for conference. About 120 visits are scheduled before fall.

Nebraska Company Builds Special Line for Farm Service

IN THE construction of a 25-mile, 16,500-volt transmission line recently completed by the Nebraska Gas & Electric Company, Plattsmouth, Neb., to serve the towns of Mynard, Murray, Union and Nehawka, twenty-five farmers were connected along the route. Service to these customers was supplied from a special farm line constructed and financed as an independent item.

Just under the 16,500-volt line, which supplies energy to substations in the towns, is carried a 6,600-volt line of No. 6 aluminum wire to which the farm services are connected. Transformers are either set direct on this line, or if necessary a spur is built to the farmhouse and the transformer installed at the end of this line. Iron wire is generally used for the spur lines which are protected with choke coils and lightning arresters. The cost of the transformer and lightning arrester, including their installation, was approximately $150 for each customer served. Transformers and spur lines were paid for direct by the farmers, after which the company assumed their maintenance. The financing of the 6,600-volt trunk line was done by the farmers through their purchase of the company's preferred stock to an amount covering the cost of the line.

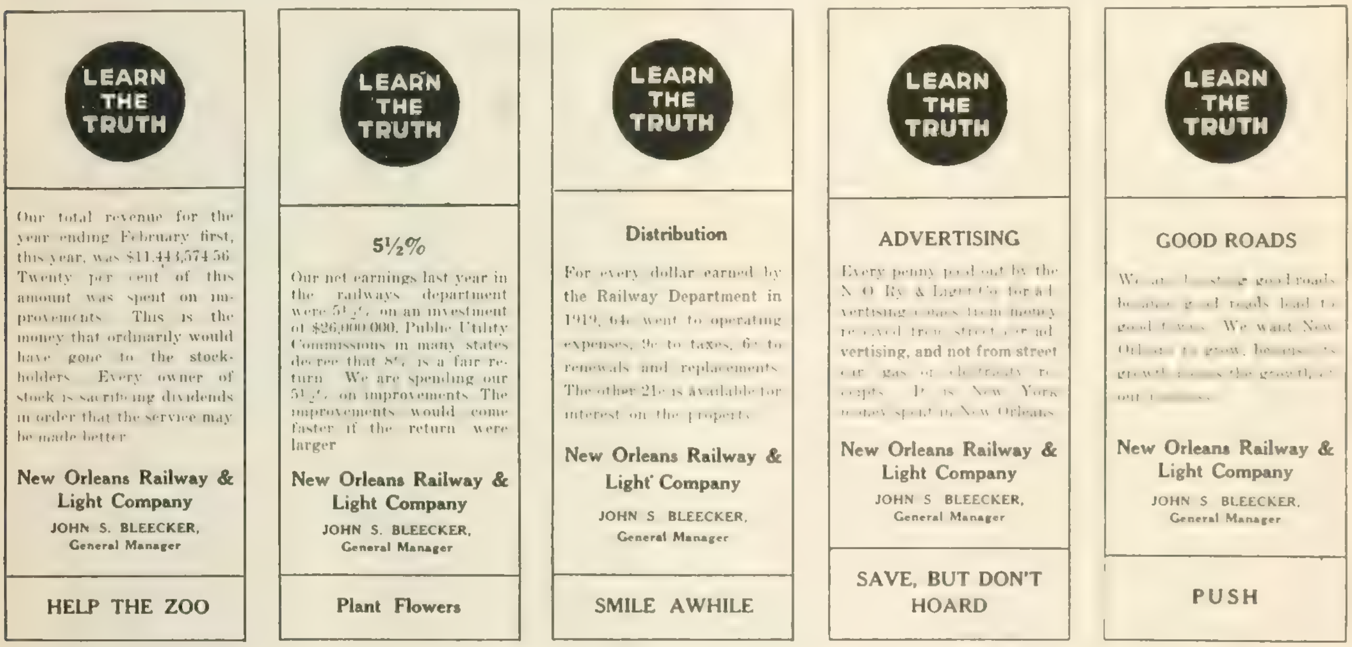
A minimum annual guarantee of $60 is required of each customer, and energy is billed at the following rates: Lighting, 15 cents per kilowatt-hour; power, 8 cents; cooking, 4 cents. Average bills have been about $8 per month per customer, although in some cases bills have been as high as $20. It was found that the farmers, as a rule, were willing to make an expenditure up to $1,000 for a spur line and transformer in order to obtain the sevice.

This information was furnished the ELECTRICAL WORLD by J. C. Kuykendall, district manager of the Nebraska Gas & Electric Company, who promoted the financing of the farm line and supervised its construction.

"Learn the Truth" Advertising Aids New Orleans Company

THROUGH a series of advertisements, entitled "Learn the Truth," John S. Bleecker, general manager of the New Orleans Railway & Light Company, succeeded in gaining much popular favor for his company. The "ads" occupied a space of seventy-five lines each and appeared in the same position every day in two of the newspapers of New Orleans. Copy was never repeated—a different story was told each time, and the frank presentation of facts concerning the operating problems and the expenses as compared to the income of the company awakened the public to the fact that an improved public utility service in New Orleans depended largely upon a changed public attitude toward utility corporations.

At the bottom of each "ad," as shown in the accompanying cut, a timely saying or slogan of general interest was carried which added considerably to the effectiveness of the advertising.



LEARN THE TRUTH

Our total revenue for the year ending February first, this year, was $11,443,574.56. Twenty per cent of this amount was spent on improvements. This is the money that ordinarily would have gone to the stockholders. Every owner of stock is sacrificing dividends in order that the service may be made better.

New Orleans Railway & Light Company
JOHN S. BLEECKER,
General Manager

HELP THE ZOO

5½%

Our net earnings last year in the railways department were 5½% on an investment of $26,000,000. Public Utility Commissions in many states decree that 8% is a fair return. We are spending our 5½% on improvements. The improvements would come faster if the return were larger.

New Orleans Railway & Light Company
JOHN S. BLEECKER,
General Manager

Plant Flowers

Distribution

For every dollar earned by the Railway Department in 1919, 64c went to operating expenses, 9c to taxes, 6c to renewals and replacements. The other 21c is available for interest on the property.

New Orleans Railway & Light Company
JOHN S. BLEECKER,
General Manager

SMILE AWHILE

ADVERTISING

Every penny paid out by the N. O. Ry. & Light Co. for advertising comes from money received from street car advertising, and not from street car, gas or electricity receipts. It is New York money spent in New Orleans.

New Orleans Railway & Light Company
JOHN S. BLEECKER,
General Manager

SAVE, BUT DON'T HOARD

GOOD ROADS

We are boosting good roads because good roads lead to good towns. We want New Orleans to grow, because its growth means the growth of our business.

New Orleans Railway & Light Company
JOHN S. BLEECKER,
General Manager

PUSH

TYPE OF NEWSPAPER ADVERTISEMENTS USED BY THE NEW ORLEANS RAILWAY & LIGHT COMPANY

Baltimore Company Requires Certificates of Inspection for Connecting New Wiring

THE Consolidated Gas, Electric Light & Power Company of Baltimore, Md., has recently announced to its customers that certificates of inspection will hereafter be required from the National Board of Fire Underwriters before connecting new interior wiring for the use of its service. This announcement was made by Herbert A. Wagner, president of the company, in a circular letter as follows:

> For the better protection of electric consumers, and at the request of the Fire Underwriters, we have decided to require their certificate of inspection before connecting new interior wiring for the use of our service. This is now the almost uniform practice throughout the country.
>
> In the matter of eliminating fire hazards the interests of property owners and the insurance companies are practically one, and we feel that we cannot refuse to co-operate in every reasonable way to bring to our consumers and to the people of Baltimore the maximum degree of protection and the fullest safeguards. This inspection will supplement, and will in no way interfere with or displace the inspection afforded by the city building inspector. Even double inspection is not too great a safeguard, and it more than warrants the expense to the property owner, more especially when building operations are being rushed and rapidly increased, as at the present time.
>
> All of our contracts for electric service contain the following provision, which has been approved by the Public Service Commission: "All wiring upon the customers' premises must be installed and maintained in accordance with the requirements of the statutes and the rules of the national and state Board of Fire Underwriters, the rules and regulations of the municipal authorities and those of the company."
>
> Schedules of fees for inspection will be furnished from the office of the electrical department of the Association of Fire Underwriters of Baltimore City. The wiring contractor will be expected to collect the inspection fee as part of the cost of the wiring, and it is suggested, for uniformity in practice, that all your bids for wiring should include the inspection fee as part of the cost.
>
> In accordance with the foregoing we now notify you that Fire Underwriters' inspection certificates will be required as a condition of connection on and after June 1, 1920, on all work contracted for after May 1, 1920.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Standard Carbon Brushes.—L'Union des Syndicats d'Electricité recently adopted a set of standard specifications for carbon brushes used in electrical machinery (excepting traction motor brushes) as a guide for future construction. Four different types of carbon brushes were defined, and standard dimensions of series of successive sizes were agreed upon. These standard brushes are shown on tracings, and tables of dimensions and allowances are also given.—*Revue Générale d'Electricité*, March 20, 1920.

Aluminum in the Electrical Industry.—FRANK BROADBENT.—This article deals with the development of the aluminum industry and its application in electrical manufactures in Germany. In the table given below it is shown that practically the whole of the German aluminum industry was developed during the war:

Country	Pre-War Production	War Increase	Present Productive Capacity
Germany	1,000	39,000	40,000
Austria-Hungary and Switzerland	11,000	14,000	25,000
France	18,000	2,000	20,000
England	7,500	4,500	12,000
Italy	1,000	6,000	7,000
Norway	1,500	14,500	16,000
United States	28,000	45,000	73,000
Total	68,000	125,000	192,000

The production of aluminum in large quantities in Germany was taken up because of the difficulty in obtaining copper. It is claimed that the success attained by the use of aluminum is such that machines and transformers wound with aluminum equal in many respects those made with copper and surpass the latter in strength. This applies more particularly when soldered joints are avoided. It is said that a successful process of copper-plating aluminum has been developed which permits coppering and tinning all terminals with which connection has to be made, thus preventing the heating up of contacts due to oxidation. Welded joints made by means of a suitable flux are said to be as sound and durable as the aluminum conductor itself. The use of aluminum was not confined to small machines. Reference is made to a synchronous converter of 3,800 kva. capacity which is wound throughout with aluminum.—*Beama* (London), March, 1920.

Lamps and Lighting

Intensive Street Lighting.—W. D. A. RYAN.—The author states that a new system in street lighting has been inaugurated, called the "Intensive White Way" and developed for certain Pacific Coast cities, which is rapidly spreading. The features of this system of street lighting are given as follows: (1) The cosmopolitan atmosphere and dignified effects of the standards by day as well as by night; (2) the minimized window reflections on account of the height of the lamps; (3) the intensity of the illumination and the uniformity of distribution on the street and building façades, with emphasis on the corners in both the light and the design of the standards; (4) the readiness with which features of people in the street can be distinguished, particularly in automobiles with the tops up; (5) the brilliancy and sparkle and good simultaneous contrast of the luminous-arc units with the window and sign lighting; (6) the illumination of the building façades and sharpness of the cornice lines against the sky; (7) the increased intensity as compared with the lighting of intersecting streets, clearly marking the main thoroughfare; (8) the golden tone of the glassware, which gave San Francisco's Market Street the name of the "Path of Gold." Several installations of this sort are described by the writer and interesting cost data are given.—*General Electric Review*, May, 1920.

Generation, Transmission and Distribution

High-Tension Insulator Porcelain.—W. D. A. PEASLEE.—Porcelain used in the manufacture of high-tension insulators must meet certain requirements as to mechanical strength, ability to resist sudden changes of temperature, porosity, homogeneity and temperature coefficient of resistivity. The author discusses the possible influence of the Piezo electric effect in the displacement of the very small crystals which make up the porcelain body. This effect may account for the deterioration of seemingly perfect porcelain. The author also points out the possible improvements in the art of porcelain manufacture and predicts important progress in the manufacture of porcelain insulators.—*Journal A. I. E. E.*, May, 1920.

Economic Voltage of Long Transmission Lines.—HENRY H. PLUMB.—The scope of the paper is to present a rapid solution of the economic copper conductor as determined by Kelvin's law, and, using this as a stepping stone, the solution of the economic line voltage is developed. The theory is then extended to conductors other than copper. Capacity and skin effect are purposely ignored in obtaining the approximate solution. It is suggested that these refinements can be applied later. The writer then proceeds to develop charts for the solution of the problem.—*Journal A. I. E. E.*, April, 1920.

Traction

Current Losses from Direct-Current Railway Track Circuits.—GIROUSSE.—An elaboration of the note to French Academy which was referred to in the Digest for March 13. The author now shows in more detail how to establish and solve the system of differential equations relating to track potential and track current for certain of the simpler cases. These equations lead to solutions in terms of hyperbolic sines and cosines, which permit a determination of current loss from the track circuit. The author also suggests methods for applying the results of this idealized analysis to problems of practice where curves, feeders, etc., complicate matters.—*Revue Générale d'Electricité*, March 20 and 27, 1920.

Installations, Systems and Appliances

Hydro-Electric Development at Ranney's Falls.—This is another development of the Hydro-Electric Power Commission of Ontario on the Trent Canal. The conditions for development are said to be ideal at this site, and two 5,000-hp. units operating under 47-ft. (14-m.) net head are to be installed.—*Canadian Engineer*, May 13, 1920.

The Peak Load Steam Plant in Vasteras.—In a careful translation of an article which appeared some time ago in the *Teknisk Tidskrift, Elektroteknik*, a detailed description is given of the steam generating plant erected at Vasteras, Sweden, by the Swedish Water Power Administration. The plant is designed for a capacity of 40,000 kw. and is intended to supply load peaks and to be used as a reserve for the Trollhättan and Alvkarleby systems during seasons of water-power shortage. So far two units of 5,000 kw. each have been installed, one a Stal and one with an Asea-de Laval turbo-generator. Careful efficiency tests have been made with this equipment, and it was found that at full load the Stal unit required 4.72 kg. steam at 323 deg. C. per kilowatt-hour (10.4 lb.), while the De Laval turbine required 5.55 kg. (12.24 lb.) steam per kilowatt-hour.—*Elektrotechnische Zeitschrift*, Feb. 5, 1920.

Electrophysics and Magnetism

Magnetic Field Around a Submerged Alternating-Current Cable.—LICHTE.—In connection with some work on a ship-guiding system with submerged single-conductor, alternating-current cables, the magnetic field surrounding such a cable was explored at different frequencies. It was found that at low frequencies the field maintains its ordinary form, the lines of force forming concentric circles, but at about 500 cycles or 1,000 cycles an inversion takes place due to induced currents in the water. The maximum response in a coil receiver with telephones decreases exponentially with distance from the cable sending end and also exponentially with the depth of the cable under the water surface.—*Elektrotechnische Zeitschrift*, Jan. 29, 1920.

Electrochemistry and Batteries

A Peculiar Type of Intercrystalline Brittleness of Copper.—HENRY S. RAWDON and S. C. LANGDON.—A copper rod used as cathode in a bath of molten sodium chloride, mild steel being the anode, with an emf. of approximately 6 volts, was made brittle to a very appreciable extent. No such result occurred when the copper was the anode of a similar set-up. The change of microstructure which occurred in the first case suggests that metallic sodium is formed by electrolysis, which alloys with the copper along the boundaries of the crystals and so induces the brittleness observed. The results throw some light upon brittleness of copper wire and rods which sometimes occurs in commercial practice in the annealing in a bath of fused salt if the copper is in contact with iron or a similar metal.—*Technical Paper No. 158, U. S. Bureau of Standards*, April 10, 1920.

Units, Measurements and Instruments

The Corona Voltmeter and the Electric Strength of Air.—J. B. WHITEHEAD and T. ISSHIKI.—An improved form of the corona voltmeter is described. Precision measurements of crest values of high alternating voltage taken in the high-tension circuit are compared with the indications of the corona voltmeter. The law of corona has been determined to a higher degree of accuracy, and a modification in the form of the law as heretofore accepted is revealed. As based on the precision voltage measurements, the corona voltmeter is proposed as a natural secondary standard of high voltages. Its advantages as a standard and its practical operation are described at length by the authors.—*Journal A. I. E. E.*, May, 1920.

Telegraph, Telephone and Signals

Absolute Measurements of Magnetic Field Strength in an Antenna Radiation Field.—RAUSCH VON TRAUBENBERG.—The current induced in a coil of known dimensions (thirty turns, 9 ft. square) and resistance was measured by a vacuum thermocouple, the coil being tuned to a distant station by a series condenser. If smaller field strength than $H = 10^{-6}$ gauss were to be measured, the thermocouple was replaced by a crystal detector with a high-sensitivity galvanometer, and after observing the maximum deflection when receiving the distant station, the same deflection was reproduced by inducing the exploring coil by means of a small coupling coil, fed from an auxiliary triode oscillator. The mutual inductance between the coupling coil and the exploring coil was determined by calculation from the geometry of the system, and, knowing the oscillator current and frequency, the magnetic field vector thus could be computed.—*Jahrbuch der Drahtlosen Tel. und Tel.*, November, 1919.

Multiple-Grid Vacuum Tubes.—SCHOTTKY.—The author discusses the advantages to be derived from inserting in vacuum tubes of the audion type, besides the controlling grid, one or more extra polarizing grids, to be kept at given, positive potentials with respect to the filament. The two-grid tubes may be divided into two classes. Either (1) the polarizing grid is inserted between filament and controlling grid and, being positively charged, serves to neutralize the space charge, thus permitting a high anode current to flow in spite of the strong negative polarization usually employed on the control-grid, or else (2) it is put between grid and plate and serves to screen the electron stream from the fluctuations in plate voltage which are due to the output impedance drop. Voltage amplification values of 20 to 30 appear to be easily obtained in double-grid tubes. The article offers much curve material and other data relating to different types of Siemens & Halske double-grid tubes.—*Archiv für Elektrotechnik*, Dec. 8, 1919.

Miscellaneous

Oil as a fuel from the Producer's Viewpoint.—HENRY THOMAS.—The world's production of petroleum in the year 1918 was 514,208,715 barrels of 42 gal., produced by the following countries in the order of their quantity as reported by the United States Geological Survey: The author discusses the use of petroleum as a fuel and oil burning equipment both for marine and power plant use.—*Journal Engineers' Club of Philadelphia*, February, 1920.

Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

AERIAL, PLATE TYPE.
An investigation has been completed which shows that an advantageous type of radio aërial is a condenser consisting of two large metal plates. This type of aërial has many of the advantages of the coil aërial.—*J. H. Dellinger, Bureau of Standards, Washington, D. C.*

CIRCUIT BREAKER, SUBSTITUTE FOR OIL.
Tests have been made on a 300-amp. oil circuit breaker by short-circuiting a 12,000-volt, 20,000-kva. turbo-generator, at reduced voltages, through a considerable length of cable. With the usual mineral oil the breaker began to show considerable distress at 10,000 volts. The breaker was then equipped with hollow brass tubes in place of the usual solid contact rods, with a venting arrangement at the upper end for relieving gases generated in the arc. The wells were filled with a special liquid, known under the trade name of "S. & C. Excello Liquid," which is a chlorine derivative very much less volatile than carbon tetrachloride. Under these conditions the breaker showed a marked improvement in performance and opened the short circuit at 12,000 volts successfully without showing any distress.—*C. J. Hejda, Commonwealth Edison Company, Chicago, Ill.*

CORONA FORMATION IN GASES OTHER THAN AIR.
An investigation is under way of the critical, or corona-forming, voltages in gases other than air under both continuous and alternating voltages.—*J. B. Whitehead, Johns Hopkins University, Baltimore, Md.*

GLASSES, COLORED, ULTRA-VIOLET, AND VISIBLE TRANSMISSION OF.
During the last three years the spectral transmissions of a great number and variety of glasses have been measured throughout the ultra-violet, visible and infra-red parts of the spectrum. Such data have been collected for a large number of American and imported samples of glass, so that it is possible to compare their relative merits.—*K. S. Gibson, E. P. T. Tyndall, H. J. McNichols, Bureau of Standards, Washington, D. C.*

LEAD, INTERCRYSTALLINE BRITTLENESS OF.
Sheet lead sometimes assumes a very brittle granular form during service, owing to corrosion. An explanation which has been offered by previous investigators for this change in properties is that it is due to an allotropic transformation, the product resulting from the change being analogous to the well-known "gray tin." Contact with an electrolyte, particularly a week acid solution of a lead salt, has been held to be the agency by which the transformation is brought about. Metallographic examination of the granular "allotropic" lead shows that each grain has the characteristic properties of the ordinary form of lead. The intercrystalline cohesion of the grains for one another, however, has been so weakened that the material has a granular appearance. The rate at which the intercrystalline brittleness is brought about is proportional to the amount of impurities and to the concentration of acid in the solution in which the lead is placed. Practically all the impurities which are found in lead are lodged in between the grains. The preferential attack by the corroding agent for these impurities, and perhaps also for the "amorphous intercrystalline cement," accounts for the brittleness produced. Investigation showed that specimens of exceptionally pure lead (99.993%), when immersed for twenty-four days in a neutral solution of lead acetate, became appreciably embrittled by the formation of minute intercrystalline fissures. No evidence of the existence of an allotropic form of lead similar to gray tin could be obtained.—*Henry S. Rawdon, Bureau of Standards, Washington, D. C.*

PHOTOMETER, PHOTOELECTRIC.
Certain difficulties have heretofore prevented the use of photoelectric cells in routine photometry. The use of a thermionic amplifier to increase current readings promises better results, as does also the use of a filter to reduce the proportion of blue light and to render the indications proportional to the photometric value. With such equipment lamps are compared by varying their distances to the cell, until the deflection of the galvanometer is the same as that given by the standard lamp.—*Arthur H. Compton, Research Laboratory, Westinghouse Lamp Company, Bloomfield, N. J.*

Suggestions for Research

ANNEALING, ELECTRIC, OF NON-FERROUS METALS.
Electric annealing of non-ferrous metals has many advantages over the present method of using gas-fired or oil-fired furnaces. With the electric method there is much less oxidation, a better control of temperature, etc. The field has hardly been touched and its importance to both the electrical and other industries can hardly be exaggerated. Annealing may be done electrically in two ways: (1) Using ordinary furnaces electrically heated; (2) heating the material to be annealed by passing an electric current through it. In developing an annealing process, either of the types above mentioned or of any other, the important points to be considered are simplicity and output; that is, the ability to anneal at least as many pounds of metal with a given size of furnace as in the ordinary gas or oil furnace. What is needed first is a good electric annealing method; the cost of electricity will in many cases take care of itself.—*N. S. Diamant, Lockport, N. Y.*

DIATHERMY.
The use of the electric current for raising the temperature of the human body in the treatment of diseases is receiving ever-increasing attention. High-frequency currents are used with success to heat malignant growths so as to coagulate and to destroy the tissue and also to kill certain micro-organisms which thrive at the temperature of the body but cannot live at a few degrees above it. The purely electrical side of the problem involves: (a) generation of suitable currents by means of proper apparatus; (b) study of the resistance, inductance and capacity of the human body, and (c) the mode of propagation of high-frequency currents through the human body. Those interested in this subject should consult medical works and transactions of American and foreign electro-medical societies.—*Editorial Suggestion.*

DIELECTRICS, LEAKY, POTENTIAL DISTRIBUTION IN.
The fundamental problem of determining the potential gradient in a leaky dielectric subjected to a given over-all voltage drop still awaits solution. Plane metallic electrodes are to be assumed normal to the direction of electric displacement within the field. Polarization is not excluded, nor the conduction current, nor the displacement current. After the initial stage of application of potential the medium is of course not homogeneous as regards ionic concentration. The difficulty lies in determining the relation between the concentration gradients and the corresponding potential gradients. While the charge distribution is a function of the potential gradient, the latter is itself a function of the ionic distribution and displacement.—*P. G. Nutting, Westinghouse Research Laboratory, Pittsburgh, Pa.*

DISTRIBUTING LINE, DEAD-ENDING HEAVY FEEDERS.
For dead-ending heavy feeders on moderate-voltage lines (up to 13,000 volts) two or more strain insulators are commonly used in series. The cost of turning a corner with this construction is quite high as compared with supporting the same feeder on the tangent. A more economical and reliable method of dead-ending is desirable.—*Editorial Suggestion.*

FURNACE, ELECTRIC, ELECTRODE JOINTS FOR.
As a carbon electrode is consumed a new length is added on top, connected to the old by a thread joint, somewhat as two metal rods would be connected end to end. The thread being molded out of carbon material sometimes gets loose. The binding material also gets loose, owing to a high temperature and to a periodic tilting of the furnace. An improved type of joint is desired, simple, reliable, and one that would remain mechanically strong and electrically would give a good contact with very large currents.

IGNITION OF AEROPLANE ENGINES.
This is a most promising field for experimental investigation. Owing to the fact that modern engines develop explosion pressures of from 400 lb. to 600 lb. per square inch (28 kg. to 42 kg. per sq.cm.) and a mean effective pressure of 120 lb. to 135 lb. (8.4 kg. to 9.4 kg.) the problem of spark plugs is a difficult one. The insulation must be capable of withstanding the enormous temperatures developed, and the plug must not leak. A slight leak past the insulation for a period of thirty minutes would cause complete failure of the plug. The spark points of the plugs must be maintained at a sufficiently high temperature to prevent an accumulation of carbon on them, and yet their temperature must not be high enough to cause pre-ignition of the combustible charge. This means that the spark points must be maintained within a critical temperature zone. The chief trouble encountered with spark plugs up to date has been that at low engine power the temperature of the spark points is so low that the points rapidly become carbonized and the plug is short-circuited. This carbonizing can be corrected by a better system of lubrication. Heating and expansion of the insulated electrode tends to cause the insulator to fail by cracking or otherwise, and the fact that all good electrical insulators are poor conductors of heat makes it difficult to keep the temperature of the insulator down and to protect it from injury by overheating. References to this subject may be looked up in the *Journal* of the Society of Automotive Engineers under the headings of "Ignition" and "Spark Plugs."—*Bureau of Aircraft Production, War Department, Washington, D. C.*

INSTRUMENTS, MEASURING, BETTER MATERIALS FOR.
Considerable improvement could be achieved in the accuracy and permanency of calibration of measuring instruments by the use of magnet steel of greater coercive force and spring materials having less elastic fatigue.—*H. B. Brooks, Bureau of Standards, Washington, D. C.*

REACTANCES, CURRENT-LIMITING, IN POWER PLANTS.
Some trouble has been experienced with current-limiting reactance coils used in generator leads and between sections of busbars, on account of insufficient mechanical strength. Owing to continuous vibration these choke coils in time become loose, and sometimes the turns get short-circuited. The mechanical strength of the supporting frame must be figured out on the basis of the most severe short circuit possible. An investigation is desired to determine the magnitude and the direction of the mechanical forces under such extreme conditions.—*Editorial Suggestion.*

Books of Technical and Industrial Interest

Radio Engineering Principles. By Henri Lauer and H. L. Brown. New York: McGraw-Hill Book Company, 295 pages, 241 illustrations, 12 plates.

Until the publication of this book few textbooks on radio communication have exactly met the requirements of college courses on the subject. In this book the authors have recognized the weaknesses of former works as general textbooks by avoiding being too elementary, mathematical or theoretical and have covered the principles of new and extensive developments during the war except those which Signal Corps authorities have seen fit to keep secret. Because of the authors' responsibilities in preparing training literature for Signal Corps service during the war they are particularly fitted to discuss the subject. From the outset the authors assume that their readers have a knowledge of general electrical theory, and they start from this point by explaining electrical phenomena in vacuum and matter, the electron theory of matter and the underlying principles of radio communication. Then they consider properties of oscillatory circuits, radiation characteristics of antennas and principles of damped and undamped wave radio-telegraphy. Particular attention is given to the characteristics and use of the three-electrode vacuum tube, which is fortunate, since around this device the present and future of radio science seem to center. Older radio apparatus is treated with sufficient fullness to inform the student on essential principles of radio communication. The description of specific apparatus is avoided and only the principles of operation are dealt with, although the general means of utilizing these principles in practical work are given. The last three chapters are devoted to the principles underlying radio-telephony, directional radio, the loop antenna, elimination of interference and miscellaneous applications of radio such as to airplanes and submarines. Twelve page illustrations of recent apparatus are included, with more than 240 circuit diagrams, details of construction and characteristic curves.

Steam Turbines. By James Ambrose Moyer. New York: John Wiley & Sons, Inc. 496 pages, 225 illustrations.

This is the fourth edition of Professor Moyer's book on the subject and not an entirely new discussion of steam turbines. Hence, like some other books which have passed through several stages of revision and amplification, it comes more nearly meeting the needs of student and practicing engineer because the author has had an opportunity to determine and correct the shortcomings of previous editions. It is particularly valuable coming out at this time because there has been such an extensive development of turbines in the last year or two that the old books are relatively behind the times. The author, having been connected with two large turbine manufacturers and having had successful experience as a teacher and director of mechanical studies, is well qualified to present this subject in an effective and authoritative manner. In a relatively small volume are presented results of practical experience that should serve as a useful manual to practicing engineers as well as to students. As distinguished from the three preceding editions, the features of this book are the more extensive discussions on governing and on calculating the strength of disk-type blade wheels. The latest information on gas turbines is also included. For the engineer using steam turbines the chapters on testing and steam-turbine economics will probably be particularly welcome. Just enough mechanics and thermo-dynamics are included to refresh one's memory on those factors which are essential to the design and operation of steam turbines. Instead of discussing the intricacies of blading in the beginning of the book, the more simple problems of nozzle design are presented first. The entropy-total heat chart which accompanies the book should be found more useful than some charts of this character because it is laid out with lines of constant heat instead of constant temperature. Discussions of new turbine applications and chapters on low-pressure turbines and reaction-turbine design are other features.

Elementary Principles of Electricity and Magnetism. By John E. Hoyt, Ph.D. Published by the author. 101 pages, 51 illustrations.

This little volume is in no sense a treatise on the subject, but a brief textbook, the outgrowth of the needs of students in an elementary engineering school. It is well adapted for impressing the fundamental ideas of the subject on the student. It is fully equipped with practical problems associated with each division of the subject and very well suited to enforce the principles which have been laid down. It makes no pretence to be wider than this in scope.

Books Received

Hoisting Apparatus. Bulletin No. 33 in the "Safe Practices" series. National Safety Council, Chicago, Ill.

Silver. By Benjamin White. London, England: Sir Isaac Pitman & Sons, Ltd. 140 pages, illustrated. Price, $1.

The Engineering Index, 1919. New York: American Society of Mechanical Engineers. 528 pages. Price, $4.

Electrical Machinery. By Terrell Croft. New York: McGraw-Hill Book Company, Inc. 318 pages, 302 illustrations.

The How and Why of Radio Apparatus. By H. W. Secor. New York: Experimenter Publishing Company. 160 pages, illustrated. Price, $1.75.

America's Greatest Dam. By William Benjamin West, Massachusetts Institute of Technology. Published by author. 64 pages, illustrated. Price, $1.

Cours Pratique d'Electricité Industrielle. By H. Chevallier. Paris and Liege, France: Librairie Polytechnique. 404 pages, 436 illustrations. Price, 24 francs.

School of Practical Electricity. Book II. Fundamentals of Continuous Currents of Electricity. By O. Werwath. Milwaukee, Wis.: Electroforce Publishing Company. 134 pages, 90 illustrations.

Robison's Manual of Radio Telegraphy and Telephony. By Capt. S. S. Robison, U. S. N., Annapolis, Md.: United States Naval Institute. 308 pages, 144 illustrations.

News in Brief

Summary of Market Conditions and of Recent and Approaching Happenings of Importance to the Industry

Throughout the field in general supply sales have been holding in good volume. The damper on the market is still the reduced stocks from which jobbers are trying to make shipments. Holes in these stocks are being temporarily plugged by the receipt of cars of isolated materials, but these stocks dwindle away rapidly when applied to back orders and a few "rush" new orders.

Freight is moving in better volume than it was a week ago, but it is not yet supplying the manufacturers or the jobbers in any satisfactory way. Steel mills are operating under better conditions and copper is moving in a little larger volume, but a coal shortage is looming up again at the mines.

Much attention is being given by jobbers to credits. The undercurrent of feeling is that the peak of buying is off in the non-electrical trades, and this will undoubtedly be reflected in the electrical trade in due time. Consequently jobbers are being urged to consider the advisability of checking over their long-term collection customers with a view to clearing their books of those who are most likely to fall by the wayside in case of a falling off in business.

In the electrical construction field there has been a falling off in activity, and in several sections of the country engineers and electricians are not so scarce as they have been.

Shipments of fans have not been sufficient to carry over the first hot spell of the year without breaking.

Emphasis is being placed on the heavy lamp demand this summer. Stocks are not full, and manufacturers have been unable to get lamps away from their factories in sufficient quantities to fill them. Industrial lighting sizes, the smaller type C, are quite short.

Strikes in New England electrical factories are impeding deliveries of weatherproof wire and copper bars for commutators and threatening to throw thousands of persons out of work by breaking the continuity of production in many lines of apparatus.

A new "fuel clause" has superseded the former "coal clause" in the rate schedules of the Narragansett Electric Lighting Company, Providence, R. I.

The municipal plant at Danvers, Mass., one of the oldest in the country, has shut down and central-station energy is being purchased.

Work on the Tugaloo River development of the Georgia Railway & Power Company has been halted because of lack of funds, all except thirty workmen being laid off.

Active participation in the affairs of the Kansas City Railways Company has been assumed by the security holders' protective committee under the chairmanship of Arthur Reynolds. James D. Mortimer, until recently president of the North American Company and its subsidiaries, has been retained to represent the committee.

Rules governing distribution circuits in rural districts were discussed at a hearing before the Public Utility Commission of Illinois.

An increase of approximately 20 per cent in lighting and power rates has been embodied in an ordinance of the Seattle City Council affecting the municipal plant. This ordinance has been vetoed by the Mayor but may be passed over his veto.

An industrial lighting code has been adopted by the Industrial Commission of Ohio. It is based on the code of the Illuminating Engineering Society.

Planks of the national Republican platform adopted at Chicago declare for arbitration of strikes on public utilities and condemn the President for not signing the water-power bill.

High praise of the plan of employee representation in force at the Lynn (Mass.) works of the General Electric Company has been expressed by Richard H. Rice, manager of the factory.

Elihu Thomson, acting president of the Massachusetts Institute of Technology, in his address to the graduating class defended the patenting of inventions as opposed to their free donation to the public.

Pasadena, Cal., has been authorized by the Railroad Commission of California to absorb the distribution system of the Southern California Edison Company in that city into the municipal system.

Asking leave to intervene in railroad freight adjustment cases now before the Interstate Commerce Commission, the Consolidated Gas Company of New York points out the interest of public utilities in depreciation charges against railroads affecting transportation.

A completely equipped electrical home has been opened for public inspection in San Francisco as a part of the work undertaken by the California Electrical Co-operative Campaign.

No statement on the present status of the water-power bill was forthcoming from the White House or the Department of Justice up to Thursday morning. A rumor that the President had finally signed the bill was unconfirmed.

That the delivery of coal to Great Lake ports since navigation opened has not covered current requirements and that central stations must turn to the local lignite supply is declared by the North Central Electric Association to be the fuel situation in that geographic section.

Illinois newspapers, at the instigation of the Committee on Public Utility Information, are devoting much space to fair discussion of utility problems.

Five amendments to its constitution were adopted by the Illuminating Engineering Society at its annual meeting. Gen. George H. Harries was elected president.

Co-operation between the Society for Electrical Development and the California Electrical Co-operative Campaign is to be promoted.

All the governors of the New England States have been urged to attend a conference at Washington under the leadership of Governor Coolidge of Massachusetts on behalf of increasing the bituminous coal supply.

A readjustment of its ninety-nine-year contract to deliver 60,000 hp. to St. Louis has been obtained by the Mississippi River Power Company. By this arrangement the company is assured increased income of $2,500,000 from that source from Aug. 1, 1918, to Aug. 1, 1928.

Completion of the merger of Dwight P. Robinson & Company and Westinghouse, Church, Kerr & Company is announced.

News of the Industry

Chronicle of Important Events and General Activities in the
Technical, Commercial and Manufacturing Fields With Announcements and
Reports of Association Meetings and Conventions

Outcome of Water-Power Bill Situation Still in the Dark

A STATEMENT which will set forth the legal situation in which the water-power bill was involved by the Attorney-General is expected daily at the White House. The statement also is expected to contain an explanation of the President's action with reference to this legislation. Hope was held out on both Tuesday and Wednesday of this week that the statement would be issued before night, but no explanation is forthcoming as to the delay.

While the impression exists in some quarters that the President has signed the bill, it is the opinion of employees at the State Department who for many years have been in charge of editing, indexing and promulgating laws that the bill has not been signed. This assumption is based on the fact that it is the invariable custom to enroll the law immediately after its signature.

The Department of Justice declines absolutely to give out any further information with regard to the Attorney-General's informal opinion concerning the signing of bills after the adjournment of a session of Congress. It is expected, however, that his opinion will be made public in its entirety along with the forthcoming statement from the White House.

The President's secretary has been advised of the wave of protest which followed the announcement that the President had withheld his approval of the water-power bill.

North Central Electric Association Finds Use of Lignite Coal Imperative

THE first annual convention of the North Central Electric Association, the first geographic section meeting of the National Electric Light Association, assembled Tuesday, June 15, at the Hotel Radisson in Minneapolis. Tuesday was devoted to registration and the officers' reception and ball. The duty of the public utility operator to take his part in civic affairs because of his position in the community and the necessity of frank and honest dealing with the public were emphasized by Mayor Meyers of Minneapolis in an address of welcome. F. D. Crocker of Minneapolis, president of the association, told briefly the object of the new organization, which comprises the States of Minnesota and North and South Dakota.

The serious phases of the fuel situation were set forth. Delivery of coal since the opening of navigation on the Great Lakes has so far not covered current requirements, and the development and use of the local lignite coal supplies were declared to be a necessity. The financial and labor problems were briefly touched upon. The importance of local financing of light and power utilities because of the money situation and the responsibility on the part of operators to educate the public to a knowledge of utility problems were the features of a paper presented on Wednesday by H. D. Thrall, vice-president Minnesota Loan & Trust Company.

M. H. Aylesworth, executive manager of the National Electric Light Association, outlined the work to be accomplished by the new geographic sections, and F. R Winders of the Railroad Commission of Wisconsin presented a discussion of rules governing rural service extensions in Wisconsin. The convention sessions extended over Friday, June 18, when the fuel and transportation situation as well as present-day tendencies in electric cooking were discussed. An excursion, with a supper and entertainment on Thursday evening, was a feature of the convention.

Rates of Seattle Municipal System May Be Increased

ON JUNE 1 the Seattle City Council passed an ordinance providing for an increase of approximately 20 per cent in light and power rates for energy furnished by the municipal lighting system. On June 10 Mayor Caldwell vetoed the ordinance, principally because the Council in framing it did not take into consideration recommendations of Superintendent of Lighting J. D. Ross, who believes present rates are adequate. Mr. Ross, however, is not opposed to certain increases. He is of the opinion that better results can be obtained by increasing present commercial rates 20 per cent and eliminating any rate below 1.5 cents per kilowatt-hour. Mr. Ross says that the municipal plant is making an excellent profit on electric cooking and that the rate of 2 cents per kilowatt-hour is about all the business will stand and permit development of this load.

The rate increase as authorized in the vetoed ordinance may be effective without the Mayor's approval. Six votes are required to pass the ordinance over the veto, and the prevailing opinion is that the Council will resort to this action.

Entertainment Program for A. I. E. E. Convention

THE program of entertainment for the White Sulphur Springs (W. Va) convention of the American Institute of Electrical Engineers, June 29-July 2, has been arranged to include outdoor events on all four days. A golf tournament and a tennis tournament will go on simultaneously each day, beginning at 2:30 p.m., and there will be a baseball game at 3 p.m. on Thursday, July 1. On that day also transportation will be provided to the Kates Mountain Club, where tea will be served. An informal reception and dance will be held in the ballroom of the Greenbrier at 9 p.m. on Tuesday, June 29. On Wednesday evening there will also be dancing and Prof. Vladimir Karapetoff of Cornell University will give a piano recital, while on Thursday at 8:30 p.m. a ladies' bridge and hearts tournament will take place. Other events will be announced at the convention. Automobile drives can be arranged for at reasonable rates.

The program of the technical sessions of the convention was published in the ELECTRICAL WORLD for May 22, page 1213.

Increased Cost of Money Recognized in Higher Rates Allowed Utility

THIS spring the Newport News & Hampton (Va.) Railway, Gas & Electric Company found itself facing a deficit of $78,000 owing to the increased cost of labor and materials. It required $250,000 for capital expenditures to maintain its standard of service. These facts were laid before the Common Councils of Newport News, Hampton and Phœbus, the three municipalities interested, with a full statement of earnings and values, and the matter was left in the hands of the municipal authorities, the sole suggestion made by the company being that as new capital would probably cost 8 per cent, rates should be fixed with this in mind.

In granting increases to meet the situation the Councils recognized the right of the company to receive 6 per cent on the capital invested in the property prior to 1920 and 8 per cent on capital to be invested thereafter or during the two-year period when the new rates are to be in effect.

Illinois Newspapers According Fair Treatment to Public Utilities

REPRESENTATIVE newspapers throughout Illinois have begun to publish editorials advocating a fair treatment of public utilities as a result of the campaign of education conducted by the Illinois Committee on Public Utility Information. The committee picked out forty-two editorials which were published during a period of about six weeks and had them all printed on one large sheet of news paper, which was distributed to the utilities of the State last week. Only about one-half of the favorable editorials that appeared were reprinted by the committee, and these are in addition to between 3,000 and 4,000 column inches of news items furnished by the committee, which are printed by the newspapers of the State every month.

The Illinois Committee on Public Utility Information has for some time been urging the editors to give their views on public utility questions. When the editors make erroneous statements the committee corrects them in a manner which the editors seem to appreciate.

Heavy Reservations Made for Supply Manufacturers' Convention

WITH all arrangements completed for the convention of the Associated Manufacturers of Electrical Supplies at the Griswold, Eastern Point, New London, Conn., June 28, 29 and 30, requests for reservations have been received in greater number than for conventions of previous years. Many members are planning to arrive on the twenty-sixth, to remain over the next week's holiday. During the session each section will elect its own officers for the coming year.

The first day, June 28, has been set aside for sectional meetings on air circuit breakers, outlet boxes, armored conductor, rigid conduit, non-metallic conduit, wire and cable and weatherproof wire. That evening will be given to the only open meeting for members.

Although on the second day there are scheduled sectional meetings on industrial lighting, heating appliances, fuses, molded insulation, lamp receptacles and sockets, attachment plugs, snap switches and carbon, it is possible that one or more of these may be changed to accommodate the members. The signaling apparatus, knife switch and panelboard and switchboard sections will meet Wednesday in addition, with possible hold-over meetings. An important session will be held by the general standards committee.

I. E. S. Elects Officers and Adopts Constitutional Amendments

ELECTION of the following officers of the Illuminating Engineering Society for the year 1920-1921 was confirmed by the council at the annual meeting of the society on June 11: President, Gen. George H. Harries; vice-presidents, H. F. Wallace, Dr. George A. Crampton, J. J. Kirk; general secretary, Clarence L. Law; treasurer, L. B. Marks; directors, Adolph Hertz, Walton Forstall, Frank S. Price. These officers, together with Past-presidents Samuel E. Doane and G. H. Stickney, will constitute the membership of the council for the ensuing year. The election of the following section chairmen also was confirmed: Dr. Ralph E. Myers, chairman New York Section; N. W. Gifford, chairman New England Section; C. E. Clewell, chairman Philadelphia Section; J. L. Stair, chairman Chicago Section.

The five proposed amendments to the constitution were declared adopted. These amendments were made for the following purposes: (1) To create a new class of members to be known as student members: (2) to lower age limit for associate members from twenty-one to eighteen, clarify provisions for membership application and provide for affiliates in sections and chapters; (3) to increase income of the society to meet rising costs by increasing the annual dues of all classes of members; (4) to provide for increased local representation beyond the more formal sections by the establishment of chapters upon the petition of ten or more members of the society; (5) to make amendments to the constitution effective Oct. 1, instead of twenty days after adoption.

Creation of the class of student members makes it possible for college students to participate in meetings and subscribe to the *Transactions*. Provision for the class of affiliates allows non-members to take part in local meetings, present papers and discussions, act on local committees and contribute to assessments for local dues. Increase in membership dues has been necessitated by the increased cost of conducting the work of the society. The establishment of local chapters will enable the society to cover a much larger territory. Coincident with the adoption of this amendment the council authorized the formation of the San Francisco Bay cities chapter, of which L. E. Voyer is chairman.

The council has authorized the printing of the third edition of the school lighting code and also the publication of a correspondence or extension course on illumination to be sold schools or colleges which can render the proper service to correspondent students.

Edward Caldwell's Thirty Years of Technical Publishing Celebrated

ON TUESDAY evening the business assotiates of Edward Caldwell, treasurer of the McGraw-Hill Company, publisher of the ELECTRICAL WORLD, and the McGraw-Hill Book Company, tendered him a dinner at the Engineers' Club to commemorate his thirty years of service with these companies. Mr. Caldwell became assistant editor of the ELECTRICAL WORLD on June 15, 1890, at which time Dr. Louis Bell was editor. Mr. Caldwell was graduated from the University of Michigan in 1886 with an A.B. degree and two years later as mechanical engineer from Cornell. He spent the next year with the Sprague Electric Railway & Motor Company, just at the beginning of electric railway development. He worked on the first electric railway in New England at Salem, Mass. The following year he started in the publishing business on the editorial staff of *Modern Light and Heat,* a paper devoted partly to electricity and partly to gas.

For two and a half years Mr. Caldwell was assistant editor on the ELECTRICAL WORLD, and in January, 1893, he went to Chicago as editor of the *Street Railway Gazette,* where he first became associated with James H. McGraw. In June, 1894, he became business manager for the *Street Railway Journal,* now the *Electric Railway Journal,* and he continued in this work until January, 1897, when he became associated with Hugh J. Grant, former Mayor of New York City, in street-car advertising. After a year spent in this work he devoted a year to trade-paper advertising agency work. In January, 1899, he returned to the McGraw Publishing Company and took charge of the book department. At that time the department had to its credit between thirty and thirty-five book titles. In 1909 this department was consolidated with a similar department of the Hill Publishing Company, thereby forming the McGraw-Hill Book Company. Since that time the company, of which Mr. Caldwell is treasurer and director, has grown until it now has more than 1,000 titles on its list.

In September, 1902, *Electrochemical Industry,* the forerunner of *Chemical and Metallurgical Engineering,* was formed in Philadelphia, with the late Dr. E. F. Roeber as editor. Along with his other duties Mr. Caldwell was business manager of this publication in its infancy.

Two years ago Mr. Caldwell became treasurer of the McGraw-Hill Company, at the same time retaining his connection with the book company.

Mr. Caldwell has always kept closely in touch with electrical engineering progress, and for many years has been a member of the American Institute of Electrical Engineers.

New York Edison's Gross Earnings Increase $3,464,069

GROSS earnings of the New York Edison Company for the year ended Dec. 31, 1919, were $28,793,272, an increase of $3,464,069 over 1918, according to its annual report submitted to the Public Service Commission. After the deducting of operating expenses, taxes and other charges the net revenue available for dividends and surplus was $7,246,137, or $2,062,392 more than the year previous.

The increased gross earnings are due largely, it was stated at the office of the company, to new business which has been secured through the closing down of private plants. Labor and fuel costs have made the operation of isolated plants almost prohibitive, and the New York Edison Company now has under construction extensive increases in the capacity of its distribution system in order to serve adequately the volume of additional business.

Dual-Type-Lamp Lighting System Inaugurated at Saratoga Springs

SARATOGA SPRINGS, N. Y., officially inaugurated its new street and park lighting system on June 19, the first installation of its type. It consists of 140 units on Broadway and 53 in Congress Spring Park. Lighting of the main street presented an unusual problem as a high degree of illumination was desired without in any way sacrificing the large trees which line the street. A survey of conditions brought the recommendation of high-candlepower lighting units placed close enough together to produce practically a floodlighting effect.

The main street standards were equipped with two globes, each containing a 1,000-cp. lamp for the principal lighting and a 250-cp. lamp directly above it for after-midnight lighting. These units are shifted from high to low candlepower by means of a relay cutout in the fixture casing operated by short-circuiting the transformer at the power station. This change can be made within three seconds and is accomplished without duplication of lighting circuits. The park standards are smaller and have only one 250-cp. lamp each, which burns all night.

THE NEW SYSTEM IN COMPARISON WITH THE OLD

The installation, which was designed by W. D'A. Ryan of the General Electric Company was financed by the Adirondack Electric Power Corporation for about $42,000, the city having signed a ten-year contract at $13,000 a year, for which it will receive fifteen times the candlepower and ten times the average illumination that were obtained from the fifteen 600-cp. mast-arm pendent units which had been used formerly to light nearly a mile of the street.

Detroit Edison Company Asks 20 per Cent Increase

THE Detroit Edison Company wants a general increase of nearly 20 per cent in its rates, but before taking the matter up with the Michigan Public Utilities Commission the company notified the Detroit City Council, which discussed the matter on Monday, June 14. While it is understood that the municipality has no jurisdiction in the matter and that the right of regulation rests with the commission, the hearing before the City Council was conducted at the request of Alex Dow, president of the Detroit Edison Company, presumably as a matter of public policy. It is reported that the proposed residential rate increase amounts to 17.8 per cent. The company asks that new rates be made effective on July 1.

Asks 60 per Cent Increase, Gets 10 per Cent

A DIFFERENCE of opinion between the Idaho Power Company and the Idaho Public Utilities Commission over the amount of the increase that the company should have to enable it to meet the conditions of efficient service and attract needed new capital developed when the company's request for a 60 per cent increase on irrigation service was met by the allowance of 10 per cent increase on existing business and 20 to 25 per cent on new irrigation contracts. The 10 per cent raise, moreover, is equivalent only to a discontinuance of the discount all consumers have hitherto been allowed.

The commission declared that "increases in rates, when necessary to enable a utility either to keep its service at the point the public demands or to attract new capital with which to make needed increases, are justified." After hearing testimony for twenty-five days, however, it determined that the rates just mentioned should be enforced for 1920, with such subsequent revision of the price for irrigation pumping as may be found necessary after a general valuation of the company's property shall have been made.

Rural Business to Be Discussed at Iowa Section, N. E. L. A., Convention

THE annual convention of the Iowa Section of the National Electric Light Association will be held at the Colfax Hotel, Colfax, Iowa, on June 23, 24 and 25. Rural business and the conditions affecting all rate, service and public utility questions are the principal subjects to be covered in a very full program which is given in detail below:

Wednesday Morning — President's address; general discussion on the ways in which the association can be made of more value to its member companies.

Wednesday Afternoon — Report of farm-line committee, by John M. Drabelle, Cedar Rapids; "Electric Service from Rural Transmission Lines," by Ceda B. Campbell, Ames; report of industrial interference committee, by John M. Drabelle.

Thursday Morning—"Valuation and Rate of Return," by B. J. Denman, Davenport; general discussion on state versus municipal regulation in Iowa.

Thursday Afternoon—"Determination of Rates for Electric Service," by W. J. Greene, Cedar Rapids; general discussion on fire and liability insurance for public utilities; general discussion on unprofitable and undesirable customers.

Thursday Evening—Banquet; address on the future of the public utility by M. H. Aylesworth, executive manager National Electric Light Association.

Friday Morning — "Customer Ownership of Securities," by E. V. Graham, Middle West Utilities Company, Chicago; general discussion on proposed Iowa committee of public utility information.

Friday Afternoon—Reports of special committees; election of officers.

Arrangements have been made to have a prepared discussion on each item on the program. Following the banquet on Thursday evening there will be a dance.

Merger of Engineering Companies Completed

OFFICIAL announcement has been made of the completion of the merger of Dwight P. Robinson & Company, Inc., and Westinghouse, Church, Kerr & Company, Inc. Officers of the new concern, which was formed in Virginia and bears the name of Dwight P. Robinson & Company, Inc., are: President and chairman of the board, Dwight P. Robinson; first vice-president, T. N. Gilmore; vice-presidents, I. W. McConnell, A. K. Wood, R. M. Henderson, L. H. Bean and H. H. Kerr; secretary, W. L. Murray.

As a result of the merger, Vice-president L. H. Bean stated to a representative of the ELECTRICAL WORLD, the new company has on hand uncompleted contracts amounting to approximately $30,000,000 for the construction of power plants, industrial buildings, transmission lines, fertilizer plants, railroad shops and steel mills.

Pacific Coast Interests to Co-operate with Society for Electrical Development

CLOSER co-operation between the Society for Electrical Development and the California Electrical Co-operative Campaign is expected in the near future, J. M. Wakeman, general manager of the society, stated the other day to a representative of the ELECTRICAL WORLD. Mr. Wakeman recently returned from the N. E. L. A. and jobbers' conventions. During his trip he visited the leading electrical men of the Pacific Coast, who, he said, assured him of their approval of a plan whereby the California Electrical Co-operative Campaign will support the Society for Electrical Development, because of the national character of its work, the value of which the California association has recognized. Plans for this co-operation are now being worked out by the executive committees of both organizations.

Pasadena Authorized to Buy Local Edison System for $533,262

IN AN order issued June 10 by the California Railroad Commission transfer of the electrical distribution system of the Southern California Edison Company in the city of Pasadena to the municipality was authorized for a consideration of $533,262.33. The arrangement by which the city of Pasadena was to remove the chief competitor with its municipal electrical system has been in progress since April, 1918, and since that time Pasadena has bonded itself to provide the money for the purchase of the Edison system. The commission authorized the company and the city to execute the final agreement of sale.

Completely Equipped Electrical Home Opened in San Francisco

A COMPLETELY equipped electrical home has been built and furnished by the California Electrical Co-operative Campaign, the San Francisco Electrical Development League and the Mason-McDuffie Company. It is a modern two-story house and is situated in one of the restricted residence districts of San Francisco. In the home various appliances will be demonstrated under the exact conditions that prevail in the average home.

The formal opening took place on June 11. John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, presided, and the principal address was made by acting Mayor Ralph McLaren. Following the ceremony demonstrations were started of every kind of electrical appliance that can be used in the home. Various days have been set aside for the inspection of the home by architects and home-building societies and by the electrical societies. The house will be open for inspection to the public daily.

Work on Tugaloo River Project Again Halted

LACK of funds to carry on the work of constructing the huge dam across the Tugaloo River at Toccoa, Ga., has caused the Georgia Railway & Power Company to lay off all but thirty of the men who have been engaged in the work. When the company again began work on the project a short time ago several hundred men were transported to Toccoa, and since that time the work has been progressing favorably. On June 5, however, nearly all of the men were laid off, those in charge of the work stating that the company was compelled to take this action because of lack of funds. The thirty men still retained will continue laying the railroad track to Panther Creek, 3 miles from the Tugaloo River. Work on this project had previously been suspended for eighteen months owing to conditions caused by the war.

Employee Representation Plan Praised at Lynn G. E. Works

HIGH praise of the plan of representation employed for the last eighteen months at the Lynn (Mass.) works of the General Electric Company was accorded in an address last week to newly elected representatives of the employees by Richard H. Rice, manager of the Lynn factory. Mr. Rice said that as an instrument of the "square deal" the plan of representation has not only been of immense value since its inception, but that it offers great opportunities for future benefits to both employees and company through its recognition of their mutual interests. The importance of selecting the best men to serve on employee committees was emphasized. The Lynn Works payroll, Mr. Rice said, is now $30,000,000 a year, and even 10 per cent adjustments run heavily into money.

Touching upon immediate problems faced by the management, Mr. Rice pointed out that business is today restricted by the liquidation of merchandise following the calling in of loans by the Federal Reserve banks, by transportation difficulties, underproduction in many plants and the inadequacy of the coal supply. The Lynn works burns 1,000 tons of coal a week, has but three weeks' stock on hand and has but 800 tons in transit. Coal now costs the plant $13 to $14 a ton. The company, realizing the condition of business, is instituting economies and reducing expenditures. The amount of money locked up in raw materials and finished stock is far bigger than ever before.

Republican Party Favors Tribunal to Settle Utility Labor Troubles

WHILE the planks favored by the National Association of Manufacturers failed of inclusion in the platform adopted by the national Republican convention at Chicago last week, that convention adopted several planks of interest to public utilities and the business interests. Chief among these is the following pronouncement on industrial relations:

> There are two different conceptions of the relations of capital and labor. The one is contractual, and emphasizes the diversity of interests of employer and employee. The other is that of copartnership in a common task.
>
> We recognize the justice of collective bargaining as a means of promoting good will, establishing closer and more harmonious relations between employer and employee and realizing the true end of industrial justice.
>
> The strike or the lockout as a means of settling industrial disputes inflicts such loss and suffering on the community as to justify government initiative to reduce its frequency and limit its consequences.
>
> We deny the right to strike against the government; but the rights and interests of all government employees must be safeguarded by impartial laws and tribunals.
>
> In public utilities we favor the establishment of an impartial tribunal to make an investigation of the facts and to render a decision to the end that there may be no organized interruption of service necessary to the lives and health and welfare of the people, the decisions of the tribunal to be morally but not legally binding, and an informed public sentiment to be relied on to secure the acceptance. The tribunal, however, should refuse to accept jurisdiction except for the purpose of investigation as long as the public service be interrupted. For public utilities we favor the type of tribunal provided for in the transportation act of 1920.
>
> In private industries we do not advocate the principle of compulsory arbitration, but we favor impartial commissions and better facilities for voluntary mediation, conciliation and arbitration, supplemented by that full publicity which will enlist the influence of an aroused public opinion. The government should take the initiative in inviting the establishment of tribunals or commissions for the purpose of voluntary arbitration and investigation of this issue.

The platform indorses the national budget system, favors investigation of the federal departments and bureaus with a view to their more efficient organization, advocates a simplification of the tax laws, opposes government or employee operation of the railroads, declares for a fair return to the owners of the roads upon their actual value and for favorable working conditions for employees, encourages water transportation, approves the existing laws against monopoly and combinations, pledges an immediate resumption of trade relations with every nation with which the United States is at peace, postpones any consideration of tariff changes until foreign trade assumes a more settled aspect, and insists on a privately owned merchant marine.

On the water-power bill the platform says: "The recent passage of the coal, oil and phosphate leasing bill by a Republican Congress and the enactment of the water-power bill, fashioned in accordance with the same principle, are consistent and landmarks in the development of the conservation of our national resources. We denounce the refusal of the President to sign the water-power bill, passed after ten years of controversy."

Ohio Adopts Industrial Lighting Code

AN INDUSTRIAL lighting code has just been adopted by the Industrial Commission of Ohio as a "guide for inspection" to be used by the factory inspectors of the commission in issuing orders for the improvement of industrial lighting systems. It is expected that the code will be used in this way for about a year before it is given the force of a general law. During this period an educational campaign will be carried on by the safety department of the commission.

This code is based on the Illuminating Engineering Society's code, which it follows quite closely in most of its provisions. It differs from the latter chiefly in having an additional grade of ½ foot-candle minimum for very rough work and in the omission of the rules for emergency lighting and controlling apparatus. There are also several notes intended to make the rules more specific. The appendix is entirely different. Its most notable feature is a list of industrial operations with recommended foot-candles.

With the exception of opposition from a single important industry, practically no objection has been made to the code in its present form. Nine public hearings of one day each were held in six different cities.

Rules for Rural Line Extensions Proposed in Illinois

RULES governing the construction, ownership and maintenance of distribution circuits in rural districts were discussed at a hearing in Chicago before the Public Utility Commission of the State of Illinois on June 10. The proposed rules provide that where rural consumers have formed a corporation for the construction of lines to serve all applicants along the route any public utility must refuse to connect the circuits of the new company until it has obtained a certificate from and filed rates with the commission.

If a mutual organization to furnish consumers without a profit is organized, the utility furnishing the electricity must make certain that the construction installed by the mutual company meets the requirements of the rules for overhead electrical construction.

Should the consumers receive service as individuals the arrangements must be such that the title to the necessary lines and equipment when completed will vest in the electric public utility, which must be responsible for their maintenance and operation. The construction for this class of consumers may be undertaken either by the utility, which must secure a certificate of convenience and necessity, or by the consumers.

Before extending its service into rural territory or connecting to any distribution circuit the utility furnishing energy must file rate schedules with the commission and a statement describing the lines to be constructed, give the proportion of cost to be borne by the consumers, a statement concerning the ownership, maintenance, operation and replacement of the lines and equipment and an explanation of the basis upon which additional consumers will be served.

The proposed rules provide that rates to individual rural consumers shall consist of a service charge and an energy charge, the former to cover the excess cost over town service. Such items of excess cost as maintenance, reading of meters, transformer energy losses, interest, depreciation and maintenance on the increased investment may be considered in the service charge.

Objection to wording of the tentative rules that might be construed as forcing the extension of rural service in territories not now served was raised in the hearing. The testimony pointed out that rates must be such as to make a fair return on the investment if incentive toward the development of rural service was to be provided.

Missouri Supreme Court Sustains Rights of the Cupples Company

JUDGMENT in the suit of the State of Missouri against the Cupples Station Light, Heat & Power Company, brought to determine the right of this company to furnish electrical energy in St. Louis and referred by the October term of the court to Charles G. Revelle as commissioner, has just been handed down by the Supreme Court of Missouri, which sustains the right of the Cupples company to continue to do business and denies the writ of ouster for which application was made. The case was an extremely complicated one involving many disputed matters of fact regarding the franchise of the respondent company. The company's relations to Washington University, which used its conduits free of charge, and the allegation that under the name of the state a private competitor, the Union Electric Light & Power Company, was attacking its right to do business formed important features of the case.

The commissioner found that, while there had not been any direct recognition of the respondent company as a public service corporation by the Municipal Assembly or other legislative bodies, the respondent had since 1913 been recognized by various official acts as being such a corporation by both the Public Service Commission of the State and the City Board of Public Improvements, and his finding in favor of the legality of both the overhead and the underground installations of the Cupples company and also against its forfeiture of rights because of alleged non-use or abandonment was concurred in with slight modification by the court.

Sanford Robinson Favors Valuation at Present Construction Costs

SANFORD ROBINSON of New York City has addressed to the Interstate Commerce Commission a letter in which he withdraws his apparent approval of the idea that in arriving at property valuations "it seems to be a fair thing today to take the prices of 1914 and add the actual expenditures for additions and betterments made since then." The quoted words are attributed to Mr. Robinson in the official report of the commission, but Mr. Robinson asserts that the statement is broader than he intended to make. He states his position on this point as follows:

"No greater weight should be given to the 1914 prices in passing upon the question of the value of an old property than is given to such prices in the case of a new property constructed during the period of higher price level. To make a distinction in this regard between old and new properties would be to distort the relations of value and might lead to different values being assigned to identical properties, dependent upon the time of their construction. It does not seem to me that there is good reason for using a different price base for the property included in the original valuation from that which is used in fixing additions and betterments made subsequent thereto."

National Research Council Elects Officers

OFFICERS of the National Research Council for the year beginning July 1 are announced as follows: Chairman, H. A. Bumstead, professor of physics and director of the Sloane Physical Laboratory, Yale University; first vice-chairman, C. D. Walcott, president of the National Academy of Sciences and secretary of the Smithsonian Institution; second vice-chairman, Gano Dunn, president of the J. G. White Engineering Corporation, New York; third vice-chairman, R. A. Millkan, professor of physics University of Chicago; permanent secretary, Vernon Kellogg, professor of biology Stanford University; treasurer, F. L. Ransome, treasurer of the National Academy of Sciences.

The council, which was organized in 1916, recently received an endowment of $5,000,000 from the Carnegie Corporation, part of which is to be expended for the erection of a suitable building in Washington for the joint use of the council and the National Academy of Sciences. Other gifts have been made to it for the carrying out of specific scientific researches.

Carelessness of Users the Chief Cause of Electrical Fires

THE comprehensive record of fires and their causes which is being prepared each year by the National Board of Fire Underwriters shows, according to a statement by President F. J. T. Stewart to the National Fire Protection Association at the twenty-fourth annual meeting in May, that electricity has caused fires which have resulted in a greater property loss than that due to any other one cause.

"An analysis of these losses," he said, "clearly indicates that this heavy fire loss is due chiefly to carelessness on the part of users of electricity rather than to any fault of the electrical industry or the various authorities which supervise the construction and installation of electrical appliances. It would therefore seem that there is urgent need for a campaign of education to impress upon the public the safeguards which are necessary to be taken in connection with flexible cord, pressing irons and other devices. A creditable effort has already been made by the electrical industry to prepare and circulate leaflets containing well-illustrated descriptions of such precautions, and I should like to urge upon you the importance of extending this educational campaign. Members interested should consult the chairman of our electrical committee."

Geological Survey's Figures on Energy Production and Fuel Consumption

FIGURES for January, February and March, 1920, covering the production of electrical energy and the consumption of fuel by the public utility power plants in the United States have been issued by the United States Geological Survey. These figures are based on returns from about 2,800 power plants rated at 100 kw. or more, including central stations, electric railways and other plants, the capacity of the plants submitting reports being about 90 per cent of the capacity of all plants listed.

According to the Geological Survey's report, the average daily production of electricity during January was 124,600,000 kw.-hr., during February 119,800,000 kw.-hr., and during March 121,800,000 kw.-hr. Of this 33 per cent in January and February and 38 per cent in March was produced by water power. To help produce this energy 10,247,947 tons of coal, 3,481,742 barrels of oil and 4,553,228 cu.ft. of gas were consumed.

A revised curve previously issued by the Geological Survey and indicating the total production of electricity by public utility plants during 1919 shows a total of 38,900,000,000 kw.-hr., or 341,000,000 kw.-hr. more than indicated in the survey published by the ELECTRICAL WORLD for April 3, page 785. As this disparity would just about equal the output of those electric railway power houses not included in the ELECTRICAL WORLD'S figures but forming part of the Geological Survey's, the two compilations are in close agreement.

Thirty-Year-Old Municipal Plant Shut Down

ONE of the oldest municipal plants in the United States, that at Danvers, Mass., established in 1889 has just shut down, and central-station energy is now being purchased. This plant shown on the left, was engine-driven and rated at 1,000 kw. It is replaced by the 23,000-volt, 1,000-kva. outdoor substation in the [illegible], to which energy is supplied by the [illegible] Massachusetts Electric Company.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Energy Output at Panama.—The total power output at the Gatun hydroelectric station and at the Miraflores plant, Canal Zone, during March was 5,432,790 kw.-hr. Of this output, 12.5 per cent was lost in transmission or in transformation or used in power-plant auxiliaries.

Pacific Gas & Electric Company Acquires More Pit River Rights.—The Mount Shasta Power Corporation, a subsidiary of the Pacific Gas & Electric Company, is to buy the water rights and property of the California Power & Manufacturing Company on Fall River, which is the main tributary of the Pit River and its chief source of water supply. This purchase will make possible the most effective use of the waters of Pit and Fall Rivers and the early development of power on these streams.

A Well-Put Complaint.—In a petition filed with the City Commission the Sandusky (Ohio) Gas & Electric Company asks permission to advance its rates. The company complains that the prevailing rates were fixed when coal was cheap and that since the price has advanced many industries have found it cheaper to purchase electricity for motive power than to burn coal and have drawn upon the service accordingly. "In other words," said Major C. B. Wilcox, chairman of the board of directors, "we are compelled to buy coal at present prices and generate electricity to be sold at before-the-war prices to consumers who have taken advantage of our predicament to such an extent that anything like good service is impossible."

Spanish Hydro-Electric Companies' Progress.—The capital of the Sociedad Hidroeléctrica Ibérica has been increased from 20,000,000 pesetas ($3,800,000) to 60,000,000 pesetas, of which 15,000,000 pesetas paid-up stock has been issued to the present stockholders. Net profits last year were 2,941,377 pesetas. The Hidroeléctrica Española and other electrical companies have organized the Sociedad de Electrificación Industrial for the electrification of transportation, utilization of water power and manufacture of electrical machinery. A third hydroelectric company has been formed at Madrid for the purpose of constructing and exploiting waterfalls, especially in the center of Spain. Energy up to 15,000 hp. will be transmitted 40 miles at 100,000 volts over the first line constructed as a part of this comprehensive project.

Turin Steel Works Use No Coal.—Electricity derived from water power is now the sole source of lighting and power at the Fiat steel works, Turin, Italy, which consume 15,000 kw. daily, or more than a fourth of the entire consumption of the city. Energy is furnished by the Mont Cenis Hydraulic Power Company.

N. E. L. A. Christmas Literature.—The Commercial Section of the N. E. L. A. has already prepared a booklet and a folder for Christmas trade, attractively printed in colors and designed for distribution by merchandising departments. Two score or more useful gifts are illustrated and many more are listed.

Flasher Lamps Aid Daylight Advertising.—A row of 25-watt lamps mounted in Colonial pattern translucent shades aided greatly in a window display recently made by the S. S. Pierce Company, grocers, Boston. The commodities shown were placed in artistically designed niches behind a cardboard screen run along the window front. Although the lamps were at the extreme front of the window and were operated on a flasher circuit in broad daylight, they gave life to the display without glare.

Osaka's Four Big Hydro-Electric Projects.—According to *Denkinotomo*, a Tokyo electrical contemporary, Japan has now in contemplation four large hydro-electric developments, intended to relieve the existing shortage of power in Osaka and its vicinity. These projects are (1) that of the Nippon Water Power Company, capital $25,000,000, which proposes to develop 105,000 kw. from the Shokawa River for transmission to Osaka; (2) that of the Nippon Electric Power Company, capital $25,000,000, which has in contemplation the development of a maximum capacity of 102,300 kw. from various rivers for transmission over 212 miles at 125,000 volts; (3) that of the Osaka Electric Transmission Company, capital $10,000,000, to develop from the Kiso River 35,000 kw., to start with, for transmission to Osaka, a possible future total of 350,000 kw. being contemplated, and (4) that of the Taisho Water Power Company, capital $5,000,000, with a total installation of 24,500 kw., for serving Kobe and Osaka over a short transmission line. With the existing supply it is said that Osaka will in the near future have a total installed capacity of 800,000 kw.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Iowa Section, N. E. L. A.—The annual convention of the Iowa Section, N. E. L. A., will be held at Colfax, Iowa, June 23 to 25.

American Society for Testing Materials.—The annual meeting of this society will be held on June 22 to 25 at Asbury Park, N. J. W. D. A. Peaslee will read a paper on testing the porosity of electric porcelain.

Inspection Trip by A. I. and S. E. E.—The Pittsburgh and Cleveland District Sections of the Association of Iron and Steel Electrical Engineers will make their joint inspection trip to the plant of the Trumbull Steel Company, Warren, Ohio, on June 26. "Electric Drives for Steel-Strip Mills" will be the subject of a paper by W. F. Rese and A. W. Mohrman.

New York Electrical Society.—The following officers were elected for the ensuing year at the annual meeting of this society last week: President, W. N. Dickinson; vice-presidents, Ernest W. Muller, Charles E. Speirs, J. M. Buchanan; secretary, George H. Guy; treasurer, Thomas F. Honahan. Mr. Guy's term will be his twenty-third. The society now has 845 members, of whom 182 were elected in the past year.

Empire State Gas and Electric Association.—A meeting of the electric production and electric distribution sections of this association will be held in the Hotel Utica, Utica, N. Y., on Wednesday and Thursday, June 23 and 24. A paper is to be given on hydraulic power-plant records by Frank Howes, one on recent developments in hydro-electric plant equipment, one on the selection of oil circuit breakers, and one on load dispatching. The Trenton Falls plant of the Utica Gas & Electric Company will be visited by the delegates.

New York State Association of Electrical Contractors and Dealers.—The annual convention of this association will be held at the Hotel Utica, Utica, N. Y., on Thursday and Friday, June 24 and 25. Among the papers to be presented are the following: "Effects from the Central Station's Viewpoint of Co-operative Selling Campaigns," by T. E. Steel, vice-president Utica Gas & Electric Company; "Results of Years of Co-operation Between the Central Station and the Contractor-Dealer," by A. A. Anderson, Albany, N. Y.; "Modern Methods of Estimating and Figuring Overhead Costs," by a speaker not yet selected, and papers by H. B. Kirkland and Samuel A. Chase.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Preferential Rates to Sign Maintenance Companies Disapproved.—The Public Service Commission of Missouri has approved the action of the Union Electric Light & Power Company of St. Louis in withdrawing a special schedule of rates made for companies regularly engaged in the rental and maintenance of outdoor electric signs and signboards and requiring such companies to pay standard commercial rates.

Free Service to Employees and Others.—In passing upon a modification of rates for electric service applied for by the Plentywood Electric Company, the Montana Public Service Commission ordered that the rendering of free electric service to employees, whether as part of their remuneration or otherwise, should be discontinued. It did not disapprove of free lighting furnished to a church and parsonage in consideration of a lease for ninety-nine years of the tract of ground upon which the electric plant is built, this contract appearing to be an advantageous one to the utility.

Purpose of Depreciation Fund—Connected Load Charge.—The depreciation reserve established by the Montana Public Service Commission is, as laid down in a recent decision of that commission, intended to take care of the future and not to provide a reimbursement for neglected renewals and maintenance in the past, and replacements and renewals must be charged to the reserve and not to operating expenses. A connected load charge is equitable as a service charge to be paid by the consumer irrespective of the energy consumed and is intended to pay for the depreciation, insurance and taxes on the portion of the equipment devoted exclusively to that particular consumer, the utility taking the risk that the consumer will use sufficient energy to pay operating expenses and return on the investment

California Commission's Stand on Raising Rates.—In granting to the Southern California Edison Company a temporary increase in all its rates of 27 per cent from April 20 until the end of the year, the Railroad Commission of California thus stated its views that a substantial rate increase was a public necessity: "We believe it to be in the interest of the consumers that they pay rates sufficiently reasonable to enable the company to earn a fair and reasonable return upon the actual investment. Unless this is done, it is plain that the utility cannot borrow sufficient funds to carry forward necessary developments. It is of great importance that this program of development go forward. Should there be any halt in this program it is evident that tremendous losses will result to the whole community.

Idaho Commission Asserts Jurisdiction Over Standby Service to Municipal Plant.—The Utah Power & Light Company having applied to the Idaho Public Utilities Commission for authority to enforce its scheduled rate for standby service in the case of the city of Idaho Falls, and that city having resisted the application on the ground that inasmuch as a contract between it and the predecessor of the Utah company antedated the establishment of the commission the latter body had no jurisdiction, the commission has declared that, while it has no jurisdiction over municipal plants as such, it has jurisdiction to fix the rates which a public utility shall charge for standby service rendered to a municipal plant.

Comparative Rates for Merchant and Residence Customers.—While granting increased rates to the Montana Range Power Company, the Public Service Commission of that state criticised the company's initial schedule of charges as being improperly balanced, the residence customer being asked to pay a maximum rate of 12 cents a kilowatt-hour as against a merchants' rate of 6½ cents. "Giving full force to the inherent difference between the two classes of service," the commission said, "no convincing reason is offered for the spread indicated. Owing to early closing precluding consumption by stores of more electricity than residences, to the limited number of merchant consumers and to the extra installation cost of furnishing such service, both services more nearly approach an identical theoretical cost, demanding substantial identity in revenue charge." The commission made a physical valuation of the utility's properties as a basis for a new rate schedule.

Special Rates for Steam Heat Discriminatory.—Special rates for steam heat furnished apartment houses and others by the Pacific Gas & Electric Company and the Great Western Power Company in cases where the steam consumers also use electric power have been declared discriminatory by the California Railroad Commission as the outcome of an application by the companies for an order approving the special rates, and the order has been refused. "Such special contracts," the commission declares, "are the result of active competition. The steam-heating business was apparently entered into for the purpose of extending or retaining electric service by offering at a very low rate steam heat, upon the condition that the consumer would agree to take electric service from the company furnishing the heating service. The commission is faced with the fact that to continue these special contracts would be to permit continuation of discriminatory rates, which are expressly prohibited by the public utilities act."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Responsibility of Employer in Accident.—Liability of a master for the aggravation of an injury to an employee caused by failure of the master to furnish proper medical aid is not recognized by the workmen's compensation act of New York, according to the Supreme Court of that state. (180 N.Y.S. 560.)

Machinery in Power-House Inclosure Not an "Attractive Nuisance."—The Supreme Court of Kansas has held, in passing upon a suit for damages because of the death of a child who entered the power house of a gas and oil company and was killed by the pumping machinery, that in such a case the doctrine of "attractive nuisance" is not applicable, the machinery not having been left unguarded and the negligence, if any, being chargeable to the child's parents. (189 P. 137.)

Facts and Testimony Before Commission Not Subject to Judicial Review.—Facts deduced at a commission hearing are not reviewable and testimony is not to be weighed in court proceedings, according to a finding of the Supreme Court of Michigan. What return a public utility shall be entitled to earn upon its invested capital and what items should be considered as properly going to make up the sum total of that invested capital are questions of fact for the determination of the commission, and its conclusions are unassailable unless it can be affirmatively asserted that the resultant rate is unreasonable and unlawful.

Incorporation Did Not Give Power Company Contract Rights to Lands Included in Development Scheme.—A hydro-electric power company incorporated under Ohio laws did not, the Supreme Court of the United States has decided, by filing its articles of incorporation, specifying the streams across which dams were to be built and maintained, acquire contract rights to have lands embraced in its subsequently adopted plan for the development and sale of power subjected to its use, exclusive of other persons or corporations; and the acts or claims of a traction company whose incorporation antedated plaintiff's incorporation could not be attributed to the state as an impairment of plaintiff's contract rights. The case at issue was that of the Cuyahoga River Power Company vs. the Northern Ohio Traction & Light Company as to rights of eminent domain, in which the United States courts were held by the decision to have no jurisdiction. (40 S. C. R. 404.)

Men of the Industry

Changes in Personnel and Position—
Biographical Notes

Carl H. Reeves, who has been appointed Superintendent of Public Utilities of Seattle, Wash., by Mayor Hugh M. Caldwell of that city, succeeds Thomas M. Murphine, who resigned following the municipal elections several weeks ago. Since Mayor Caldwell took office the Public Utilities Department has been reorganized and in its place two departments have been formed, one having charge of the Seattle municipal street railway and the other of the electric lighting and other public service works of the city. The latter department, of which Mr. Reeves is superintendent, will have no connection with the railway department. Mr. Reeves has for a number of years been engaged in engineering work in connection with the Seattle traction system and on construction of other city utilities. A resident of Seattle for the past twenty-seven years, he served in the office of the city engineer for a number of years prior to 1906, and while serving in that capacity designed a large part of the city's sewer system and other municipal projects. From 1906 to 1916 he was assistant engineer of the Seattle Electric Company, resigning to perform special work for the Public Service Commission of the state, after which he took up private practice. During the war Mr. Reeves as major in the Engineers Corps directed engineering work at Camp Fremont, California, at Puget Sound forts, at Camp A. A. Humphreys and at other camps.

C. H. REEVES

Ralph H. Wiley, formerly assistant chief, has been appointed chief of the department of electricity of San Francisco, succeeding Arthur Kempston, who has resigned to become chief engineer of the fire detection department of the Pacific Fire Extinguisher Company.

J. D. Orr has recently been appointed manager of the Idaho Light & Power Company, with headquarters at Pocatello. He succeeds Charles Neely, Mr. Neely having been transferred to Twin Falls as manager in that vicinity. Mr. Orr has served the company as district manager in the Boise territory.

Arthur F. Barnes, formerly dean of engineering the New Mexico State College, has become associated with Barglebaugh & Whitson, architects and consulting engineers with offices at Dallas, Tex. Mr. Barnes will hold the position of mechanical and industrial engineer and manager for Barglebaugh & Whitson in the district comprising the States of New Mexico and Arizona.

James Martin, district manager of the Pacific Gas & Electric Company, has been appointed superintendent of construction for the company to carry on the work on the Pit River project. He succeeds O. W. Peterson, who resigned the position to become affiliated with the Shattuck Construction Company. This company has the contract for the construction of one of the tunnels on the Caribou development of the Great Western Power Company.

Charles A. Volz has been appointed chief of the division of light, heat and power, New York State Public Service Commission, Second District. Mr. Volz is a graduate of Cornell University. 1911, and has had wide experience with public utility properties. During the world war he served as a first lieutenant with the 302d Engineers, 77th Division, and later as a captain in the engineer officers' training school, Camp Humphreys, Va.

Lieut.-Col. Charles W. Kutz, chairman of the District of Columbia Public Utilities Commission, has been elevated to the rank of colonel of the Engineers' Corps. Colonel Kutz is also engineer commissioner of the District of Columbia.

Obituary

Charles W. Johnson, assistant director of engineering in charge of developments with the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa., who died recently, was graduated from the Ohio State University as an electrical engineer in 1896. He began work in the drafting department of the Steel Motor Company of Johnstown, Pa., and in 1897 became a draftsman with the Bullock Electric Manufacturing Company of Cincinnati, Ohio, advancing to be successively chief draftsman, engineer and production manager. In February, 1904, he was transferred to Montreal, Canada, and made manager of the electrical department of the Canadian Bullock Electric Manufacturing Company. Three years later he joined the Westinghouse Electric & Manufacturing Company at East Pittsburgh and was soon appointed chief inspector. In January, 1910, he was appointed assistant manager of works. In March, 1912, he was made general superintendent, a position he held until 1919, when his chief activities were transferred to the industrial relations of the company with its employees.

Charles Blizard, third vice-president of the Electric Storage Battery Company, died on June 12 after a prolonged illness. Mr. Blizard came to the electrical industry almost thirty years ago, when he was called to straighten out the affairs of the Franklin Accumulator Company in 1891. Here he learned the storage-battery business from the manufacturing as well as the sales end. In 1893 he joined the Electric Storage Battery Company as manager of the New York office and seven years later became manager of sales for the company, with headquarters in Philadelphia. Later he became third vice-president in charge of sales, which position he held at the time of his death. Mr. Blizard was recognized as among constructive and forward thinkers in the commercial phase of the industry. He had been one of the governors of the Associated Manufacturers of Electrical Supplies since the beginning and for a number of years was chairman of the finance committee of that association.

CHARLES BLIZARD

William J. Rose, who for many years was prominently connected with the electric light and power industry of the State of Ohio, died recently at his home in Alliance, Ohio. Prior to entering the real estate business in 1917, Mr. Rose was treasurer of the Alliance (Ohio) Gas & Power Company. In 1915-16 he was president of the Ohio Electric Light Association.

Harry T. Willett, former secretary of the Springfield (Ill.) Light, Heat & Power Company, died at Decatur, Ill., June 9.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler
and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities
and Business Methods

Sales Policy Through Jobber Upheld in Electric Specialty

A RATHER new departure in the sale of an electric specialty is being followed by a prominent manufacturer of electric hand tools, whereby all orders received by the factory direct are turned over to the purchasers' jobber to be filled. Where it may be necessary to fill these orders from the factory, credit is passed to the proper jobber, says the manufacturer. The plan is merely to sell all the factory output through jobbers and not to compete with them through direct factory sales.

This is not a new policy in many lines of supplies carried by electrical supply jobbers, but it is rather an innovation in the case of an electric specialty which has only comparatively recently come into general use and is rather little handled by supply jobbers.

The Black & Decker Manufacturing Company announces the foregoing as its sales policy and furthermore states that it believes the most important thing a manufacturer can do to assist the jobber is to center his efforts on advertising and selling for the jobber. Exclusive selling rights are not granted to any jobber.

Phenomenal Lamp Demand Keeps Summer Stocks Low

LAMP demands have held up surprisingly well for the summer season, while stocks in distributers' hands are in general not up to snuff. Pacific Coast distributers, according to reports, are in a better way than others as regards stocks, and this condition is being watched with a great deal of care, with a view toward possible transfer of surplus to points less favorably situated.

Particular shortage in the East is shown in the smaller type C sizes. This presupposes activity in industrial lighting installations, and it is found that there is a good amount of work being done this summer in that field.

Lamp factories are making shipments, but only in slightly better volume than a few weeks ago. Freight movement of lamps has been given as only about 50 per cent normal. Producers are still unable to get all the materials they require, and, although they are unable to produce in excess of sales, they are not manufacturing for stock. At the present demand and under present receipt of raw products and shipment of finished goods, the outlook for fall stocks is not too bright at this writing.

Stocks of Insulation Materials in General Low

MANUFACTURERS of insulating material report that demand is heavy but not so strong as it should be. Within the past two weeks an appreciable slackening has been noted. This is not taken to indicate a curtailment of new construction work, but rather that buyers of insulation are holding off for possible new developments as regards transportation, prices, etc.

There is no shortage of varnish, but the production of varnished tape, cloth, etc., has suffered from the partial shutdown of the textile mills. Added to this is the freight tie-up, interfering with deliveries. A recent survey of conditions in this field throughout the country reveals the fact that distributers' stocks are very low. Isolated instances occur where dealers are able to fill orders from stock, but this is the result of foresight in buying.

Deliveries vary according to the class of insulation desired. Pressboard, for instance, is quoted at two to three months, while paper insulation requires only two to three weeks. Deliveries of fiber insulation can be made in about six weeks, webbing in two months, and varnished cloth runs from two to four weeks. Deliveries for all these classes of material average double those of normal times.

The tendency of prices has been upward, though for the past two months the market has very generally held steady. No cancellations of orders have been reported.

First Fan Buying Reacts on Already Low Stocks

PRELIMINARY surveys in the fan-motor market show that buying has set in rather late, because of continued cool weather in May and early June. At the same time, stocks are relatively small. This late season has proved rather a life saver than a detriment because it has prevented what might have been an acute situation. Certain distributers throughout the country received fair stocks from their manufacturers quite early in the year, but since the advent of conditions now existing in the transportation field, the movement of fans has been light up to this time.

Early buying has left some distributers with low and broken stocks. In the East the 9-in. alternating-current oscillating fans are having rather a better call than was expected. This may be on account of the cost of larger sizes or because more are being bought for household use. Ceiling fans and 220-volt fans are in good demand.

On the West coast the season has been good and stocks are well cleared out. The Northwest market has, on the other hand, been poor to date. Stocks there are in good condition. Buying has not been active in New England, but there the weather has been cool. Stocks are rather small.

Because of the limited stocks on hand, dealers and distributers are being cautioned to call their prospective customers' attention to the types which can be delivered promptly, in order to satisfy as nearly as possible the demand which is felt really to exist.

Ten-Year Expansion Program in Czecho-Slovakia

THE national assembly of the Czecho-Slovakian republic has appropriated 75,000,000 crowns, at a normal value of 20 cents United States currency, to be expended within the period of the next ten years for "the most complete and perfect utilization of national resources of energy and its economical distribution for the public benefit," according to a report made to the Bureau of Foreign and Domestic Commerce by Vladimir A. Geringer trade commissioner at Prague, Czecho-Slovakia. It is expected that 6,000,000 tons of coal will be saved thereby. The money is to be used for the erection of hydro-electric power houses and for Government participation in electric plants which would form a substantial part of the systematic electrification of the republic.

Through the law which was passed last July, the Government or the municipality affected, or both, or with an existing co-operative electric association, will secure public control to the extent of 60 per cent of the capital stock of each enterprise, while private capital can invest only to the extent of 40 per cent of the entire capital stock. This law is considered as a step toward complete nationalization of electric power houses, which, however, to the degree indicated maintains private enterprise. Existing electric concerns can attain the classification of "public utility" and receive the benefits enjoyed by such.

According to the Czecho-Slovakian year book of 1919, the total energy consumed in the republic, excluding railways, was 2,500,000,000 kw.-hr., furnished by 345 electrical concerns selling their product to the general public. Future plans are for systematic electrification, with one distributing network at 22,000 volts to 100,000 volts fed from central stations at coal mines and from hydro-electric stations. It is estimated that the construction of hydro-electric plants will cost about 2,000,000,000 crowns, while steam plants, primary and secondary networks will add 1,500,000,000 crowns. This total construction period would cover twenty years for the steam plants and networks and fifty years for the hydro-electric. In addition, the electric railway would increase this consumption of power considerably.

At the present time, the work is hindered very badly because of the difficulties of getting copper and other installation materials. The domestic production of copper is insignificant, while its purchase in the United States is made hard because of the present rate of exchange.

Business Outlook Warrants Care in Credit Affairs

IT IS hardly possible for business men today to manage the affairs of their business without realizing an undercurrent of feeling throughout the country that there is slack water ahead. Regardless of the individual's feelings in the matter of whether or not there is a coming business depression and whether that depression will be heavy or light, he cannot but feel that the question has been brought up and is constantly recurring.

Let it be said sufficiently often and by men sufficiently in authority in the financial and business world that the buying fever is subsiding and that the pendulum is about ready to swing back and the average business man is liable to take thought as to how he may best protect himself in a coming storm, be it large or small.

The part of setting one's business house in order for what the future may bring was well brought out at a recent meeting of credit men in the electrical industry on the Pacific Coast. There was no attempt at forcing a crisis, but merely the suggestion of seeking out a haven of refuge at the first rumblings of thunder.

It was brought out that before and during the war a great many merchants came into the electrical field who up to that time were unknown. It has not been difficult in the last few years to sell electrical merchandise, and the condition of sale has generally narrowed down to the question of shipment. Correct business methods have frequently been lost sight of in the prosecution of the business, and real competition on a dollars and cents basis has frequently been a missing factor in the transaction. It is foreseen that in a period of depression the return of business on a real price level will again be met and incompetent business will be eliminated from the race.

Few business failures have been reported in the last few years, but a period of business depression, large or small, will most certainly increase this number. Impossible business organizations will undoubtedly die hard and in their dying may help to carry down to destruction many houses which otherwise would weather the storm. The real question comes in segregating those dangerous customers from those which would not be dangerous, and, further, how soon it would be good policy to begin to effect this segregation. The whole matter seems to boil down to getting one's house prepared for an eviction of tenants who, through present and past business methods, give promise of inability to pay bills when they themselves shall be hard pressed for credit and capital. In this case a small house with well-paying boarders seems to be a safer proposition for eventualities than a large house with some questionable tenants.

Some electrical supply jobbers have recently reported that because of extra careful watching of their credits and collections their average of collections has kept up in a satisfactory manner. In the electrical industry it is still a sellers' market, and sellers have great leeway in picking and choosing their customers. Consequently, it would seem that the present would be a good time to exercise still greater watchfulness over present outstanding and possible future indebtedness, with a view toward keeping company assets in as liquid a state as possible. No doubt exists that the time will come when stocks will once more be plentiful on the shelves and price and service will form the consideration in the transaction. That is the time when the house of unsound business methods will be forced to cut prices to a point below the margin of profit in order to move stocks and liquidate as far as possible, and that house will prove no asset on a manufacturer's or jobber's books.

Longer Shipments Ruling in High-Tension Insulator Field

DEMAND for porcelain high-tension insulators continues to rule strong. One representative manufacturer states that he is booked up solidly with orders until January and February and cannot promise deliveries of present orders before then. He further says that the volume of insulator buying on the part of the railroads has greatly increased since the government relinquished its control. Foreign demand is also beginning to make itself felt strongly, coming especially from the Scandinavian peninsula, Italy and France. Producers were looking to the hydro-electric field as a source of demand which would result in heavy orders, but the President's failure to sign the water-power bill has put off the development of this market. Agents report practically no stocks on hand, while manufacturers are from five to seven months behind on orders, compared with normal shipments of from four to six weeks.

An important factor in checking production has been the general shortage of raw material. This is reported as caused by the irregularity of shipments rather than by an actual dearth of sand, clay, etc. In the light of these conditions the general trend of insulator prices has been upward, although since March and April the market has held steady. One of the largest dealers in insulators in the country reports that he is unable to obtain any quotations on the porcelain high-tension types, while another company says it is now able to get quotations for six months ahead but the prices listed are high enough to guard against any fluctuation within that period.

In view of these facts the number of order cancellations has been exceedingly small, a local manufacturers' agent reporting only one cancellation within the past year. This would seem to indicate the continuance of construction programs.

Foreign competition is spoken of in many quarters but is not greatly feared. For one thing, American models of porcelain insulators made rapid strides while European production was at a standstill during the war. These countries have not sufficiently recovered from their industrial chaos to provide sufficient insulators to affect the market very seriously at this time.

Easier Labor Market Seen in Field of Electrical Construction

WITHIN the past few weeks has appeared one of the more tangible signs of a general hesitancy in the building construction field. While real estate interests have been recording rather numerous instances where plans have been filed, building operators have experienced a decided falling off in actual operations. Reports show that in the Middle West and in the Middle Atlantic States this decline has been very pronounced as compared with earlier months of the year. Southern cities and the Pacific Coast and Northwest are just about holding their own, and the one bright spot is shown in New England operations. Here a satisfactory advance is reported. This lessened building activity and retrenchments in the automobile, textile and leather industries have acted to convert a short labor market into one where a surplus may be found.

In the Chicago section, although wages are still as high as ever, it is reported possible to obtain labor whenever needed and, owing to the lessened ease with which a new job may be obtained, employers are able to demand greater efficiency. The Northwest also announces that there is a surplus of labor in that territory.

Representative electrical contractors in the East, who are close to the industrial construction market, say they are having no difficulty in getting sufficient skilled labor to fill all their needs. Helpers are not so plentiful because they are still able to find work at other trades at a slightly higher rate. It has just been brought to notice that one of the larger Eastern electrical engineering and contracting companies is releasing some of its engineers because of a falling off in engineering construction.

These cases are isolated, it is true, but they show a trend toward the easing up of labor in the electrical field. It is possible, however, that with a better flow of building construction material this market may change. Many projects on the boards have been held up, but because of the time-lag by which the electrical industry follows the beginning of construction it is probable that much of this building would not call upon the electrical industry for some months.

Metal Market Situation

BUYING in the copper market remains slack and, because of traffic and coal conditions, hope is not held out of a quick resumption of buying interest. Transportation of raw and refined copper has improved but not to a satisfactory extent. Coal in the copper regions is very low, and in Michigan it is selling at $12 per ton at the copper mines.

Electrolytic price is merely nominal with the producers quoting 19 cents for nearby and third quarter. In the outside market small amounts of the metal can be found as low as 18.25 cents delivered for prompt and July. At that, the call is lacking. August and September shipments are drawing virtually no interest. Standard copper in London is off again, this time to £86 5s.

Leading interests in the lead market reduced prices in New York to 8.25 cents a pound. More spot is available in New York because of export cancellations, but the market is quiet under a fairly good demand.

Zinc producers are offering little of the metal, which is quoted at 7.95 cents at New York, and the outside traders seem to have more inclination to buy than to sell. Buying is being carried on in fair quantities and inquiries are good, even to late year deliveries.

Copper and brass scraps are shown off a fraction and the demand is very light. Lead scrap is holding under a good demand. Tin scraps have reflected the heavy decline in tin occurring over the past two weeks.

NEW YORK METAL MARKET PRICES

	June 9	June 15
Copper	£ s d	£ s d
London, standard spot	90 0 6	86 5 0
	Cents per Pound	Cents per Pound
Prime Lake	18.75	18.50
Electrolytic	19.00	19.00
Casting	17.75	17.62
Wire base	22.50 23.00	22.50 23.00
Lead, trust price	8.50	8.25
Antimony	8.50 8.75	7.7
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Zinc, spot	8.00	7.95
Tin	48.75	45.50
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.75 to 16.00	15.50 to 15.75
Brass, heavy	9.00 to 10.00	9.00 to 10.00
Brass, light	7.50 to 8.00	7.00 to 7.50
Lead, heavy	7.00 to 7.37	7.25 to 7.37
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

SALES of supplies and apparatus are keeping up at a good rate in the East, while in the other sections they seem to have dropped off, owing, probably, to lack of stocks and the tendency to curtail long-term buying. Movement of materials has become better in the past week, but is still far from satisfactory. Strikes in New England brass mills are acting against continued shipment of weatherproof wire and some schedule material parts.

Building activity has been most pronounced in New England and in the South; other districts report a decided falling off in contracts. Building materials are still moving very slowly. Structural steel, however, is gradually being turned out in better quantity. Supply of motors is short in all sections, but contractors are picking up sufficient for most of their immediate needs, although at a considerable expense of time and effort.

Most sections have had sufficiently warm weather to start fan movements, while the hot spell of the early part of this week is expected to provide further impetus to the market.

Few noteworthy price changes have taken place during the week. Collections in general are not falling off in any startling manner because jobbers are using more care in this regard.

NEW YORK

Buying is holding up at a good rate and goods are being received in a little bit better volume. There is no great increase in receipts, but just a general upward trend. The newly formed citizens' transportation committee, for the handling of dock freight by the merchants themselves, has begun to operate and a big tonnage has already left the piers. Promise is held out of still better movement of harbor freight.

Warm weather has started to cut into jobbers' fan stocks, and some styles are already short. Lamp sales are holding very strong for the summer months, and stocks are broken in small type "C" sizes.

Pipe and armored-conductor receipts have been rather small and have been quickly applied on back orders. Motor stocks are in the poorest shape of all apparatus, but of these there are fair quantities of motors for multiple sewing-machine drive. Jobbers have some lamp cord, but manufacturers are quoting twenty to forty weeks' shipments.

Although large commercial building projects are reported almost daily, the general awarding of contracts is falling off. Movement of construction materials is still extremely slow. Collections are holding in pretty fair shape, with no special features this week.

Friction Tape.—Demand is strong and shipments fair, although a slight shortage still exists. Stocks on hand vary. Turnover has increased 50 per cent in the last three months. Prices average 55 cents per lb. in 100-lb. lots.

Rigid Conduit.—Stocks are badly depleted, with almost no shipments in sight. Demand is strong, and jobbers are turning down orders. Prices for ½-in. black pipe range from $86 to $105 per 1,000 ft., and 1-in. black at $168 to $200.

Rubber-Covered Wire.—Shipments are coming in well and jobbers' stocks are good. Demand is strong at prices of $11.50 to $14 per 1,000 ft. for No. 14 in coil lots or over.

Flexible Armored Conductor.—Shortage is being relieved somewhat, although jobbers' stocks are generally low. Shipments are poor and new orders are frequently turned down. Prices range from $105 to $130 per 1,000 ft. in coil lots, depending upon the customer.

Vacuum Cleaners.—Shipments are coming in fair, with deliveries quoted at two months. Jobbers' stocks vary. Demand has slackened since spring but is still strong.

Washing Machines.—Demand is much stronger than in the corresponding period last year and is still on the increase. Shipments are fair, with deliveries averaging two months. Stocks on hand are small, and jobbers are sold ahead.

Motors.—No improvement is seen in distributer's stocks, while demand continues heavy. With considerable hunting contractors are generally able to pick up some kind of a motor to suit their immediate needs. Motors for group sewing-machine drive are in fair though broken stock, while the needle trade is slack.

Insulators.—Demand for glass insulators is strong and stocks are spotty. Some shipments can be made at once, but from there up to four weeks is quoted. Raw-material shortage at the mills is an adverse factor in better shipments. The last price increase was 10 per cent and went into effect May 17.

Industrial Reflectors.—A good demand is experienced this summer, with no slump in sight. Belated shipments have been received in the territory and some stocks are now available. Steel is a little freer at the factory. The 100, 150 and 200-watt sizes are the best sellers.

BOSTON

Jobbers report business better than ever, the principal drawback being unsatisfactory delivery conditions. Considerable improvement has been effected in railroad service, however, within the last two or three weeks. Underproduction by labor is still holding back shipments in many factories, and strikes in the Waterbury (Conn.) and Providence (R. I.) districts are hampering the brass and insulated wire trades. Curtailment of business in the textile and leather industries is having some effect on labor psychology. A strike of molders at the Lynn Works of the General Electric Company is causing some trouble at this writing. Collections are better than many credit men expected would be the case at this time. Stocks are low in rigid conduit, pole-line hardware, motors and weatherproof wire. Prices are firm and steady, barring a 10 per cent advance in fiber conduit. New England building and engineering contracts from June 3 to June 10 totaled $8,826,000, against $5,728,000 last year between the same dates.

Motors.—Famine conditions prevail in small motors. A few odd sizes and speeds can be picked up in the local market, but in general deliveries are quoted on a four to five months' basis. Prices are firm.

Fiber Conduit.—An advance of 10 per cent followed the withdrawal of prices a few days ago by a leading distributer. Stocks are low and demand very active.

Fans.—Buying is sluggish on account of cool weather. Stocks are relatively small. The opinion is expressed in the trade that present prices represent the maximum which can be obtained, but these are likely to hold firm for some weeks.

Rigid Conduit.—Light stocks and broken lines are the rule. A few old orders are coming into town, but no accumulation of smaller sizes is apparently possible.

Sockets.—Trade is brisk, but so far manufacturers have met the demand well. Stocks are fair, with steady prices. In case lots, pulls stand at 50 cents each, net; keys at 28 cents, and keyless at 26 cents. Labor troubles in the brass industry have not seemed to affect the supply of sockets to any extent.

Pole-Line Hardware.—Business is very active and stocks are hard hit. Deliveries are slow.

Wire.—Weatherproof wire is very scarce, some jobbers reporting not a foot in stock. Strike conditions in Rhode Island factories are the explanation. Prices are erratic, base quotations running from 29 to 32 cents. Rubber-covered wire is steady and fairly plentiful at $11.50 per 1,000 ft. in 5,000-ft. lots. Bare copper wire, Boston stock, is quoted at 26.5 cents, with good supplies, notwithstanding factory troubles.

Flexible Armored Conductor.—Liberal stocks are in hand, with prices and demand steady, No. 14 single-strip bringing $110 per 1,000 ft. in 1,000-ft. lots.

Non-Metallic Flexible Conduit.—Shipments are absorbed about as fast as received. The $\frac{7}{16}$-in. size brings $40 per 1,000 ft. in coil lots and $38.50 in 1,000-ft. lots, corresponding prices on $\frac{7}{32}$-in. being $37 and $35.

Meters.—Demand is very heavy, and in some cases house-wiring installations are being given service without meters, subject to estimated monthly bill until deliveries can be made.

Flashlamps.—The demand is increasing, owing to the vacation season and vigorous publicity. Supplies are good at present.

CHICAGO

Chicago jobbers seem to be in worse shape today, as regards stocks and the receiving and shipping of goods, than ever before. Transportation troubles, which for a few weeks showed tendencies to lessen, are now at a worse stage than ever. Railroads are unable to handle more than a small portion of goods offered for shipment, so that, in addition to having stocks seriously depleted by the lack of incoming shipments, it is now impossible to ship out what few items jobbers are still able to supply.

Business remains fairly good in spite of all handicaps. In view of various checks on trade, it is a rather surprising fact that the net amount of unfilled orders on the books of the leading jobbers remained about the same on June 1 as it was on May 1. Each of the preceding months of the year has shown a gain, thus indicating that new orders have fallen off. This reduction is not so pronounced in electrical lines as in other branches of trade, some of which, notably machinery, report a 40 per cent shrinkage in new orders placed. Certain public-utility interests in the Mid-West are showing reluctance about taking orders for new or enlarged service installations.

Unexpected hot weather, coming suddenly on the heels of a cold spring, has boosted retail sales in all manner of household devices, particularly fans. This is reflected in calls on the jobber, and those who were not well protected in stocks are wholly unable to meet the demand. No marked change is noted in the building situation.

Fans.—Demand on the retail trade is very heavy, a prolonged period of midsummer heat being the cause. Most dealers were fairly well stocked but are having difficulty in replenishing stock, as shipments from factory are slow. One jobber reports a consignment on the way for seven weeks, still undelivered. A standard make 12-in. non-oscillating fan is quoted at $28 and a 16-in. fan at $33.

Wire.—As stated last week, all wire stocks are practically exhausted and receipts are apportioned to orders immediately on arrival. While all kinds of wire share in the shortage, it is most seriously felt on magnet wire. No price changes are noted.

Motors.—Several cars of motors have been received in the past week, but the volume of back orders is so great as to make the supply seem inconsequential. Manufacturers in this section are seriously hampered in production by raw material shortages.

Poles.—Some shipments are moving. Leading interests point to subnormal production last winter and abnormal demand this summer as indicating shortage in the coming fall. Supply stocks throughout the country are low, and some substitution is necessary in meeting current demand. Prices are firm, and while no immediate change is anticipated, show a decided upward tendency.

Cross-Arms.—Six-foot, six-pin Washington fir cross-arms, $3\frac{1}{4}$ in. x $4\frac{1}{4}$ in., are priced at $123.90 and are in scant supply. The shortage seems to be largely local. Western yards are reported as having quantities on hand for which they are unable to obtain shipping facilities.

Household Appliances.—With stocks of heating devices short in all lines except flat-irons, retail demand has, with the advent of summer weather, become strong. Recent price advances seemingly are having no deterrent effect on trade. Manufacturers' output is being maintained with difficulty, owing to trouble in getting materials.

ATLANTA

Reports from the district indicate that there is a renewal of building activities throughout the Southeastern territory, which is expected to hold up in the face of the shortage of housing facilities and the demand for additional commercial and industrial space.

The strike of the carpenters and plumbers in Atlanta has been called off and construction is being pushed at a maximum rate. Manufacturers report their conditions more favorable than for some time past. The backbone of the railway clerks' strike has been broken and a number of the roads have lifted the embargo on freight shipments. The effects of the strike are still being reflected in the severe congestion that exists at all central points and which has caused a great deal of delay in all classes of freight shipment.

The demand for money is strong, and interest rates are quoted at 6 and 7 per cent. Collections as a whole are satisfactory, though jobbers report customers in the automobile accessory line as slow and the small contractor payments as unsatisfactory, a condition caused in all probability by small operators having overreached themselves the earlier part of the year.

Conduit.—One of the largest jobbers reports nine cars of conduit received for this section in the past week, only one of these cars, however, being for the Atlanta trade. There are no stocks on hand and all receipts are absorbed by back orders. Prices, less than 2,500 lb., ½-in., black, $8.98; ¾-in., black, $11.80; 1-in., black, $17.44. Galvanized: ½-in., $9.40; 1-in., $18.46; 1½-in. $29.87.

Poles.—The demand is probably the heaviest in recent years, cypress and chestnut poles leading the list. Shipments are fairly good on the poles produced locally, but on the Western product deliveries are unsatisfactory. Price, chestnut, 30-ft., $8.

Safety Switches.—The local ordinance regarding this device has caused an increase in demand of approximately 20 per cent. Very good stocks of assorted sizes are reported on hand and deliveries continue to hold up fairly well. Price, lots less than twenty-five, two-pole, 30-amp., $2.46 each.

Wire.—The wire situation is not so good as was reported several weeks ago, embargo and labor troubles at the manufacturing centers having severely depleted local holdings. A price advance is noted on No. 14 rubber-covered, the market standing at the present time at $12 per 1,000 ft. Jobbers anticipate that local conditions will improve in the next two weeks.

Fuses.—Stock of non-renewable cartridge fuses continue spotty, though renewable fuses are reported on hand in good quantities. Deliveries run from ten days to three months, depending on the sizes desired. Plug fuses are quoted at from eight to ten weeks. Local stocks are in fair shape, with the exception of the 10-amp. sizes. The demand continues good and prices are steady.

Pole-Line Material.—As is usual in the spring, the demand for all classes of line material continues strong. With the exception of porcelain insulators and steel products, local stocks are reported in fair shape with deliveries fairly good. Porcelain insulators are practically unobtainable, and the glass insulators, of which there are fair stocks on hand, are being substituted for porcelain. Pine cross-arms are plentiful, but transportation difficulties have exhausted the supply of fir arms.

SEATTLE-PORTLAND

From the standpoints of both jobber and retailer, the past week has been rather quiet as regards sales volumes, inquiries and actual business transacted. Abundant rain, which assures sufficient moisture for field crops throughout this section, is given as one reason for decreasing sales volumes. Building activity shows a big decrease in spite of the fact that the retail price of lumber and shingles in the Puget Sound and Portland district has taken a drop of between 10 and 20 per cent. The lumber mills of the Northwest are still suffering from car shortage.

At present there is a surplus of labor in the cities, although the agricultural sections east of the mountains in Washington and in Oregon report a scarcity. Stock shortages throughout the entire district still obtain and the freight situation shows no improvement. No price changes of importance have been announced recently, although the general tendency seems to be downward, and some authorities are inclined to the opinion that a noticeable decrease is about due. Collections, generally speaking, are good and credits are being scrutinized more closely than ever.

The Portland district reports general business conditions still of a downward nature, although very little change occurs from week to week. There is a general tightening of credit, and this in turn has a tendency to reduce the purchasing of goods to actual need. Collections are appreciably slower than they have been for months. A few dealers are reporting increased demands for credit, but in general this is not true. Retail stores however, while reporting business dull for this time of year, also state that it is considerably ahead of last year. The general feeling among both jobbers and retailers is rather pessimistic. Contractors report that there is less business in prospect than there has been for some time and that at present there is no trouble whatever in securing all the skilled labor that is needed.

Metal Molding.—Demand is on the increase and jobbers are having considerable difficulty in meeting the growing needs. Stocks are in poor shape and deliveries range from six weeks to three months.

Conduit.—Stocks are in poor condition, but as the demand is light the situation is not serious. A considerable quantity is in transit with deliveries ranging from two to four months.

Motors.—Fractional-size motors are next to impossible to obtain in face of a good demand. The call for large-size motors and heavy power apparatus is at a minimum. Prices on motors are holding fast; if anything, the tendency is upward.

Fans.—Sales so far this season are almost nil. Movement is always light in the Puget Sound district, but apparently this year will establish new low sales records. There is plenty of stock on hand for anticipated demand.

SAN FRANCISCO

Wiring business has decreased slightly and counter business has decreased appreciably after a period of sharp fluctuation; prices now are fairly steady. United States officials report the lowest levels in mountain streams and lakes on record. The June lake levels are what they normally are in August. However, provisions already made are expected to take care of the irrigation and pumping loads for the rest of the season.

Lamps.—Lamp deliveries are good. Sales, of course, have slowed up during the summer months, and a careful scrutiny of agents' stocks on hand has caused a severe limitation of new shipments to them. Provisions are being made for a heavy sale of Christmas tree outfits.

Fans.—This has been the best fan season for several years. Stocks have been nicely cleaned out, and in some cases even at this late date the dealers' stock orders are being held for Eastern shipments, which have been hurt by freight embargoes. Sales of ceiling fans have been particularly good. Prices seem to cut no figure in the demand.

Household Devices.—The California Electrical Co-operative Campaign, in its annual report, shows a large increase in the sale of household appliances during 1919 over 1918, which was the best of the previous years. Such increases as 138 per cent on vacuum cleaners, 104 per cent for percolators, 100 per cent for toasters, 187 per cent for washers and 137 per cent for ironers speak for themselves. Even the standard appliances such as 6-lb. flatirons with 33 per cent and radiant heaters with 41 per cent show the value of new methods of merchandising.

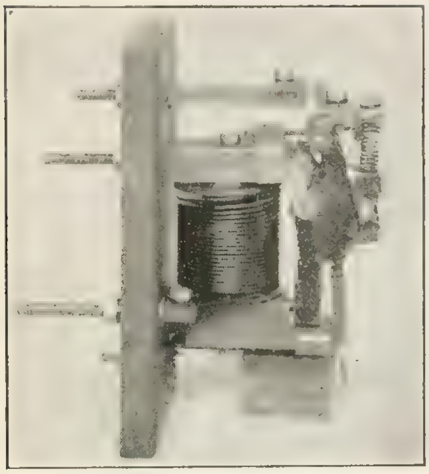
Conduit.—Conduit, both metallic and non-metallic, rigid and flexible, is still one of the scarcest lines, and as yet comparatively small shipments have reached the coast

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Automatic Direct-Current Motor Starter

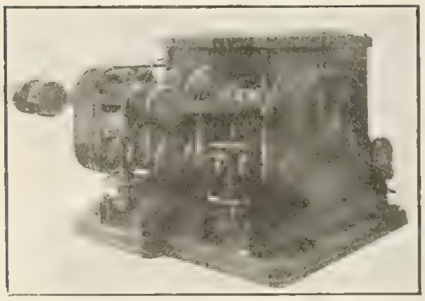
To control series, shunt-wound and compound-wound direct-current motors, the General Electric Company has developed type CR-4301 automatic motor starter. The parts of the various contactors, of which from one to three series accelerating contactors are mounted on a panel, have been standardized so that they are mutually interchangeable, the manufacturer says. A new form of spring adjuster is used. Terminals are provided for energizing extra circuits for pilot lights, etc.



CONTACTOR PARTS ARE MUTUALLY INTERCHANGEABLE

Automatic Spot Welder for Pressed-Steel Channels

To form an I-beam by welding together two pressed-steel channels, the Federal Machine & Welder Company, Warren, Ohio, has developed an automatic spot welder. Two spots at a time may be made in two pieces of ¼-in. material at the rate of sixty welds per minute, the manufacturer says. The two welding transformers are for 220 volts primary, are air cooled, and the current is controlled in eight equal steps from 65 per cent to full line voltage. Parts carrying welding circuit are water cooled. The copper-welding disks can be adjusted to weld I-beams from 4 in. to 16 in., and welds can be made from 4-in. to 12-in. centers. A variable-speed motor controls the speed of material through the machine from 25 ft. to 60 ft. per minute.



WELDS TWO SPOTS IN ¼-IN. MATERIAL

Electric Script-Letter Sign

The Indestructible Sign Company, Columbus, Ohio, is offering a new style of electric script-letter sign, consisting of an iron oblong box 18 in. x 48 in., within which all wiring is concealed and on both faces of which are the letters. These are drilled into the box in polished aluminum. The sign weighs about 150 lb.

Extension Light

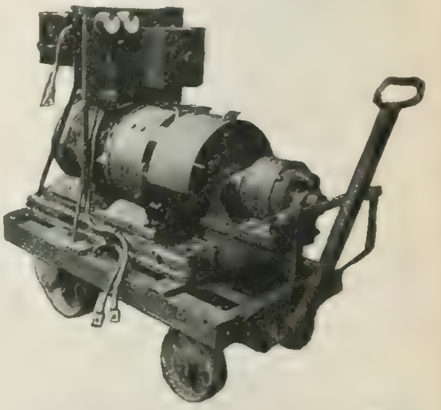
For use where a portable electric light is necessary, the Wood-Craft Company, St. Paul, Minn., is marketing an extension light with 25 ft. of 16-gage reinforced waterproof cord on a reel, equipped with socket, switch, etc.

PORTABLE HAND LIGHT

Single-Operator Electric Welding Outfit

In the single-operator electric arc-welding equipment manufactured by the Westinghouse Electric & Manufacturing Company the generator operates at arc voltage and no resistance is used in circuit with the arc. The generator is designed to stabilize the arc inherently, has a rated capacity of 175 amp. and is the company's standard design and construction, provided with commutating poles and an exceptionally long commutator. There are twenty-one steps provided from 50 amp. to 225 amp. Motors can be supplied for either direct-current or alternating-current circuits. Where an alternating-current motor is used leads are brought outside the motor frame for connecting for either 220-volt or 440-volt circuits. Ball bearings are used on the single-operator motor-generator set.

Where the equipment is required for portable service the motor-generator set with the control panel is mounted on a fabricated steel truck equipped with roller bearing wheels. Motor generators are supplied in capacities of 300, 500, 750 and 1,000 amp.

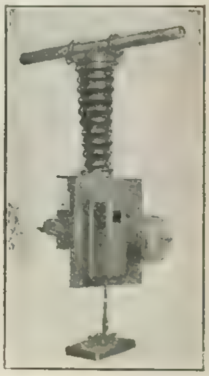


NO RESISTANCE IS USED IN CIRCUIT WITH ARC

The generator is compound-wound to deliver 60 volts at no load and also at full load.

Overload Relays for High-Voltage Alternating-Current Circuits

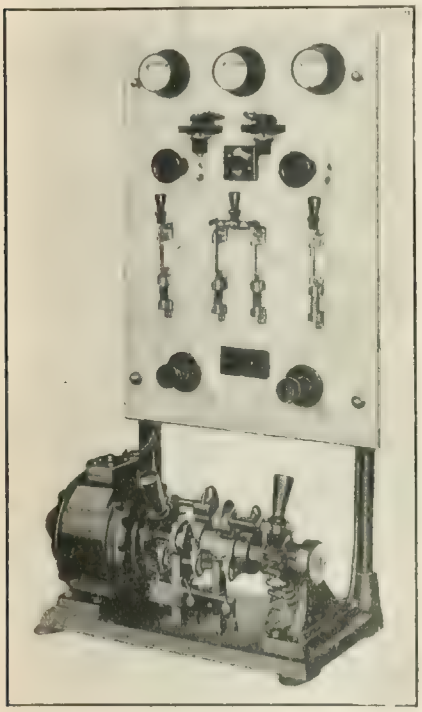
For the protection of high-voltage alternating-current circuits of 100 amp. or less the Westinghouse Electric & Manufacturing Company has developed the type CB overload relay, which precludes the use of high-voltage current transformers. With this device ample overload protection is obtained and an approximate time element afforded at a minimum cost, according to the manufacturer. The relay is designed for indoor use and is arranged for pipe mounting. It consists of a circuit-closing element operated by means of a



ARRANGED FOR PIPE MOUNTING FOR INDOOR USE standard current transformer, an overload relay and a special transfer relay, all mounted on one base, which is in turn supported from an insulator. The overload relay has a 4-amp. to 12-amp. range and a two-second inverse-definite-minimum-time limit. The current transformer, it is said, can be used on all voltages, since it is thoroughly insulated from ground and from the remainder of the system.

Motor Rectifier for Battery Charging

The Advance Electric Company, 131 East Sixth Street, Los Angeles, Cal., is producing a motor rectifier for storage-battery charging. The set consists of a ⅓-hp. special-type motor with extended shaft upon which are mounted three collector rings and two special commutators. The motor acts only to drive the shaft, says the manufacturer, and the alternating current is converted into direct current in two separately controlled circuits, in graduated voltages of 22-volt steps to 110 volts and normal capacity of 10 amp. per circuit. The switchboard is of marble and carries the necessary switches, meters, automatic cut-outs, regulators and transformer.



TWO KILOWATTS DELIVERED ON TWO CIRCUITS

Bank Protection System

In announcing the development of its new "Faraday" bank protection system, Stanley & Patterson, West and Hubert Streets, New York City, point out that every piece of the apparatus—circuit wiring, connections, etc.—is electrically supervised at all times by a flow of current, and that derangement of circuit wiring will instantly sound a trouble bell. In addition, "telltale" lamps may be installed in any of the offices. All alarm signals are operated by a control cabinet.

Variable Wireless Condenser

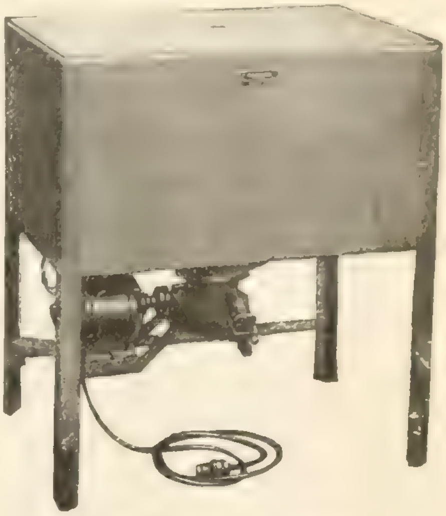
The Connecticut Telephone & Electric Company, Meriden, Conn., is producing a variable condenser for wireless work, for which compactness, stability and simplicity of design are claimed. Two metal plates of 0.17 sq.cm. area, one of which is movable to and from the other without rotation, are separated by a mica sheet, so that a capacity of 700 micro-microfarads is obtained. The capacity is distributed over a scale length of 360 deg., and the manufacturer says that smooth variation may be had to the extreme end of the scale. The instrument measures 2⅞ in. in diameter and is 1⅜ in. in height to the dial plate. Effective resistance is given as a few tenths of an ohm.

Lineman's Test Set

Without opening the circuit, it is claimed, locations of grounds and other forms of trouble may be made by the Anderson portable lineman's test set, marketed by the West Manufacturing Company, Abilene, Kansas. A combination telephone and test set is used, in addition to a flashlight battery.

Electric Dishwasher

An improved model of the Mermaid electric dishwasher is announced by the Wolcott Manufacturing Company, Hartford, Conn. The new design embodies improvements in gearing and motor suspension, a sliding castor, table-top cover and other small refinements.



NEW FLAT TOP WASHER

Notes on Recent Appliances

Washing Machine

An electric clothes washer with revolving and tilting container has been developed by the Little Giant Washing Machine Company, Indianapolis, Ind.

Electric Table Stove

The Redtop Electric Company, Inc., 8 West Nineteenth Street, New York City, has placed on the market a combined toasting and cooking stove.

Clothes Washer

A clothes washer of the vacuum-cup type is being made by the Wash-Kosh Manufacturing Company, Oshkosh, Wis.

Interconnection Cable Box

An interconnection cable box for annunciator systems has been developed by the Auth Electrical Specialty Company, 422 East Fifty-third Street, New York City.

Unit Dry Battery

The French Battery & Carbon Company, Madison, Wis., is marketing a four-dry-cell unit in a single casing.

Waterproof Portable Light

Two types of portable lamps for marine use are being manufactured by Charles Cory & Son, Inc., Hudson Street, New York City.

Ground Clamp

Improvement has been made in the ground clamp manufactured by the H. B. Sherman Manufacturing Company, Battle Creek, Mich.

Washing Machine

A washing machine, the Berkshire, with electrically operated pump, has been developed by the Pittsfield Machine & Tool Company, Pittsfield, Mass.

Stair-Routing Machine

The American Router & Manufacturing Company, Ligonier, Pa., has developed an electric stair-routing machine.

Ignition Trouble Finder

For locating ignition faults, the Testall Electric Manufacturing Company, San Antonio, Tex., has developed a trouble finder.

Buzzer

A two-cell dry-battery buzzer is being made by the Electric Signal Manufacturing Company, Inc., Orange, N. J.

Double Busbar Support

A new type of double busbar support has been manufactured by the Delta-Star Electric Company, 2433 Fulton Street, Chicago.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE BUDA COMPANY, Harvey, Ill., announces the appointment of H. M. Sloan as treasurer, which became effective June 1. He was formerly assistant to the president of the Chicago, Milwaukee & St. Paul Railway, and also served upon the War Industries Board during the war.

NEIL CURRIE, Jr., has been appointed engineer of the power motor engineering department, Pittsfield (Mass.) works, General Electric Company, succeeding J. P. Catlin, who has been appointed managing engineer, motor division, Bridgeport (Conn.) factory of the company. Mr. Currie has been assistant engineer of the department and has been associated with the latter since 1910.

THE ADVANCE ELECTRIC COMPANY, 6315 Maple Avenue, St. Louis, Mo., will soon ask for bids for the construction of a one-story addition to its works, 50 ft. x 100 ft., to cost about $100,000.

THE ELECTRIC HAMMER CORPORATION has been organized with a capital stock of $1,000,000 to take over the business and property of the Reciprocating Electric Tool Company, St. Louis, Mo. James K. Jarvis is president.

THE STANDARD BATTERY MANUFACTURING COMPANY, Fort Worth, Tex., contemplates building an addition to its plant to double the present capacity.

THE BAYER STEAM SOOT BLOWER COMPANY, St. Louis, has recently completed its new plant at 4067 Park Avenue, to provide for the increasing business in soot blowers, as well as the business of its subsidiary companies, the Bayer Valve Company and the Bayer Brass Foundries Company. The main machine shop building is 200 ft. x 120 ft., and the foundry building is 175 ft. long, the latter providing space for thirty molders on brass and aluminum castings.

W. J. JEANDRON, sole selling agent for the "Le Carbone" carbon brushes, has been in France for the past month visiting the factory in order to obtain a larger supply of carbon brushes to care for the great increase in demand that is expected in this field.

THE NEW ENGLAND MACHINE & ELECTRIC COMPANY, Pawtucket, R. I., has had plans prepared for the erection of a manufacturing plant.

EDWARD MILLER & COMPANY, Meriden, Conn., manufacturers of lamps, heaters, etc., are planning to erect a five story addition to their plant.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY is making further expansions to its East Springfield (Mass.) plant to meet the demand for small motors for washing machines and automobile starting and lighting apparatus. A new punching shop is being equipped with direct-connected motor-driven tools, and a machine shop is under construction for the production of starting and lighting sets. It is expected that the branch of the engineering department which has charge of the designing and application of electrical equipment for automobiles will be transferred to Springfield soon.

THE BARDEN ELECTRIC & MACHINERY COMPANY, Houston, Tex., has recently added two men to its sales department.

DOUGLAS SPRAGUE and CHESTER A. SLOCUM, associate consulting engineers, announce the opening of offices at 167 West Thirteenth Street, New York City.

THE CENTRAL ELECTRIC & LOCK COMPANY, 12 North Thirteenth Street, Philadelphia, is preparing to remove its plant to 1309 Arch Street, where it has recently acquired a building.

THE UNITED STATES HARDWARE & MANUFACTURING COMPANY, Pawtucket, R. I., recently organized, will manufacture insulator brackets and break arms for the electrical trade and miscellaneous products for the plumbing trade. John D. Sawyer is president and general manager of the company.

THE LOCOMOTIVE ELECTRIC WASHING MACHINE COMPANY, Belleville, Ill., has been organized to take over the plant and property of the Remmert Manufacturing Company, Belleville. William Remmert has severed his connection with the company. A. H. L. Klimme is secretary of the new company.

RAUCH & LANG, INC., Chicopee Falls, Mass., recently incorporated to take over the Baker, Rauch & Lang Company, Cleveland, Ohio, will soon start work on its proposed new manufacturing plant at Chicopee Falls.

THE LEEDS & NORTHRUP COMPANY, 4901 Stenton Avenue, Philadelphia, has acquired a site on Germantown Avenue, near Wayne Junction, for its proposed new works.

THE ELECTRIC STORAGE BATTERY COMPANY, Nineteenth Street and Allegheny Avenue, Philadelphia, has filed plans for a two-story addition to its plant, 82 ft. x 160 ft., to cost with equipment about $125,000.

THE PITTSBURGH GAGE & SUPPLY COMPANY, Thirtieth Street and Liberty Avenue, Pittsburgh, Pa., manufacturer of electrically operated washing machines, has started work on construction of a building, 64 ft. x 105 ft., one-story, at 3026 Liberty Avenue, to cost about $50,000.

THE WESTINGHOUSE LAMP COMPANY, 165 Boadway, New York City, has purchased a site at East St. Clair and East Michigan Streets, Indianapolis, Ind., on which it will erect a plant for the manufacture of electric incandescent lamps, to be a duplicate of the one at Trenton, N. J. The building will be four stories high and will have a daily capacity of from 50,000 to 70,000 lamps.

THE ELECTRIC STORAGE BATTERY COMPANY, Allegheny Avenue and Nineteenth Street, Philadelphia, has removed its Cleveland offices from 1217 Citizens' Building to Chester Avenue and East Twenty-fourth Street. H. F. Sauer is acting manager of the Cleveland office

THE HANSON & VAN WINKLE COMPANY, 269 Oliver Street, Newark, N. J., manufacturer of generators, motors, spare parts, etc., is planning extensions and improvements to its plant, to cost about $14,500.

THE AMERICOLITE COMPANY, 101 Park Avenue, New York City, manufacturer of lighting fixtures, lamp reflectors, etc., has purchased the property of the Standard Steel Box Company, near Bridgeville, Pa., for its proposed new plant. The factory, it is understood, will be equipped at once, and operations will be started at an early date.

THE SUNNY HOME ELECTRIC COMPANY, 1469 East Grand Boulevard, Detroit, has filed plans for the erection of a one-story machine shop, 78 ft. x 160 ft., on Scotton Avenue.

THE COMMERCIAL WELDING COMPANY, Seattle, Wash., contemplates the construction of a new welding and repair plant in the near future.

THE JOHNSON ELECTRIC WASHER COMPANY, 2074 Market Street, San Francisco, has awarded contract for the erection of a factory building at Fortieth and Adeline Streets, Emeryville, Cal., to cost about $40,000.

THE GAS ENGINE & ELECTRIC COMPANY, Charleston, S. C., has filed notice of an increase in capital stock from $50,000 to $100,000 for general business expansion.

THE BRYANT ELECTRIC COMPANY, Bridgeport, Conn., has awarded contracts for construction of an addition to its factory, 60 ft. x 130 ft., four stories, to cost about $125,000, and for a four-story storehouse, 60 ft. x 160 ft., with an ell, 60 ft. x 66 ft., to be erected on Organ Street, to cost about $200,000.

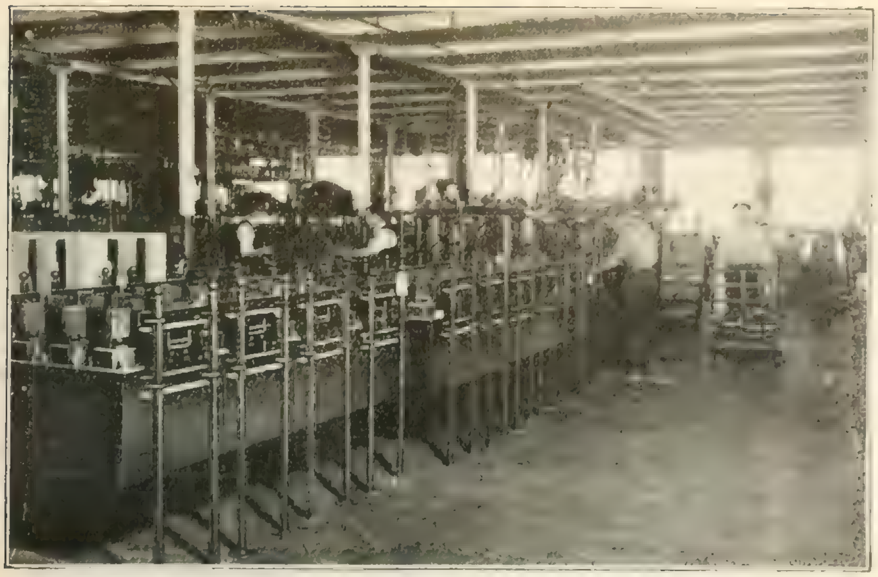
THE DRIVER-HARRIS COMPANY, Harrison, N. J., manufacturer of electrical resistance wires, special metal alloys and pure metals for electrical work, is offering a new issue of $750,000 in 7 per cent cumulative sinking fund preferred stock. Of the new issue $250,000 has been reserved for employees and stockholders.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., is preparing to install machinery at its plant on Columbia Avenue, Baltimore, Md., recently acquired from the United States government. While the present buildings will be utilized for the present, it is proposed at a later date to rebuild and remodel the existing structures. Switches and electric controlling devices will be manufactured at this plant, and when operating at full capacity it will give employment to about 4,000 operatives.

THE WIRT COMPANY announces that it is now established in its new two-story factory and offices at 5221-27 Green Street, Germantown, Philadelphia.

THE ELECTRICAL CREDIT ASSOCIATION of the Pacific Coast held its fifteenth annual meeting and dinner in San Francisco on April 15. R. J. Holterman, manager of the Holabird Electrical Company, was elected president. The retiring president, H. J. Zweifel, presided during the business session, which consisted of reports from the auditing committee, a report of the secretary-treasurer and one from the nominating committee. The toastmaster, A. H. Elliot, introduced the following speakers: L. J. Brown, assistant sales manager Western Electric Company; R. J. Holterman; C. W. Banta, vice-president Wells-Fargo Nevada National Bank; C. E. Listenwalter, Listenwalter & Gough, Inc., Los Angeles, and F. P. Vose, secretary National Credit Association. A spirit of optimism pervaded this meeting, which concluded the eighteenth year of the existence of the association.

PACIFIC COAST ELECTRICAL CREDIT ASSOCIATION'S FIFTEENTH ANNUAL DINNER



SECTION OF ASSEMBLY OF OIL CIRCUIT BREAKERS, CONDIT ELECTRICAL MANUFACTURING COMPANY

THE CHASE-SHAWMUT COMPANY CHANGES HANDS. Stone & Webster have sold the controlling interest in the Chase-Shawmut Company, Newburyport, Mass., to Sears B. Condit, Jr., of Boston, Mass., president of the Condit Electrical Manufacturing Company, who will operate the concern independently of his other business interests.

THE INGERSOLL-RAND COMPANY OF ILLINOIS and A. S. Cameron Steam Pump Works, Chicago branch, announce the removal of their offices to 709 Fisher Building, Chicago, Ill.

THE FRANKLIN ELECTRIC COMPANY, Hartford, Conn., manufacturer of electrical products, has filed notice of dissolution.

THE CONNECTICUT ELECTRIC MANUFACTURING COMPANY, Bridgeport, Conn., has started operations at the former plant of the Standard China Works, Prospect and Globe Streets, Trenton, N. J., for the manufacture of electrical porcelain specialties. The new works will be conducted by a subsidiary organization, to be known as the Connecticut Porcelain Company. It is proposed to develop an aggregate capacity of about 350 barrels of material a week.

WILLIAM G. MEROWIT application engineer, has removed his operating quarters to 707 Ellicott Square, Buffalo, N. Y. He is representing the Monitor Controller Company, Baltimore, Md., and the Union Electric Manufacturing Company, Milwaukee, Wis., in western New York and nearby Canada.

THE WORTHINGTON PUMP & MACHINERY CORPORATION, 115 Broadway, New York City, has entered the field of ship engine-room equipment and will manufacture marine engines, pumps, air compressors and auxiliary oil engines generating electricity for all ship purposes.

THE LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, wishes to correct a misunderstanding which may arise regarding its sales policy with the Fairbanks Company, in connection with the distribution of Lincoln motors by the latter company, as mentioned in these columns on Jan. 24, 1920. A. F. Davis, sales manager of the Lincoln Electric Company, announces that in the contract recently signed with the Fairbanks Company the latter will act for the Lincoln company as general jobbers. The Lincoln Electric Company retains, however, the right in any case to sell direct, and also to handle the sale of all motors to the manufacturers of motor-driven machinery, this latter classification being withheld absolutely from the Fairbanks Company.

THE HABIRSHAW ELECTRIC CABLE COMPANY, New York City, has declared a quarterly dividend of 37½ per cent per share on the outstanding stock of no par value, payable July 1.

WILLIAM R. MARSHALL has been appointed manager of the industrial division, New York office of the Westinghouse Electric & Manufacturing Company, to succeed Harlan A. Pratt, who has resigned to become sales manager of the Atlantic Elevator Company, New York. Mr. Marshall was graduated from the North Carolina Agricultural and Mechanical College in 1909 and entered the graduate students' course at the East Pittsburgh works of the Westinghouse company, where he remained for two years studying shop and erection problems. In 1911 he was transferred to the New York office as salesman in the power division.

THE TECHNICAL ADVISORY CORPORATION has recently been organized, with headquarters at 132 Nassau Street, New York City, by Campbell Scott, president; Ernest P. Goodrich, William D. Ennis, Walter Rautenstrauch, Arthur W. Hixson, Fred E. Rogers and Rumsey W. Scott, all of New York City; Col. Frank B. Maltby, Philadelphia, and George B. Frankforter, Minneapolis, Minn., all of whom were members of the technical advisory committee of the War Claims Board. Campbell Scott is president of the corporation.

ELECTRICAL INTERESTS TO HOLD "GET-TOGETHER MEETING." To obtain a closer working agreement between the electrical contractor-dealers, jobbers, central stations and manufacturers of western Pennsylvania, a "get-together meeting" will be held at the Fort Pitt Hotel, Pittsburgh, on June 23. This meeting will be held in connection with the meeting of the Pennsylvania State Association of Electrical Contractors and Dealers in Pittsburgh in the week ending June 26.

Foreign Trade Notes

THE LANCASHIRE DYNAMO & MOTOR COMPANY, LTD., Manchester, Eng., and the Crypto Electrical Company, Ltd., Willesden, Eng., have made arrangements for amalgamation of interests. It is proposed that all machines below about 10 hp. shall be manufactured at the Willesden works, and that machines above this size shall be manufactured at Manchester. The Crypto works at Willesden are being enlarged to provide for the production of approximately four times the present output of motors from about ½ boiler hp. to 10 boiler hp. The selling organizations of the two companies have been combined throughout the British Isles. The associated firms have branch offices in London, Glasgow, Newcastle, Birmingham, Dublin, Cardiff and Bristol.

THE AMERICAN ELECTRIC MANUFACTURING COMPANY, Harrisburg, Pa., has completed negotiations for the construction of a new factory in Toronto, Ontario, Can., for the manufacture of electrical specialties. Orders have been placed for machinery and work will soon start on construction of the building.

ADDITIONAL CAPITAL NEEDED IN GERMAN ELECTRO-TECHNICAL INDUSTRY.—According to an economic report recently written regarding a large electrical industry in Germany, the average price of the products has increased sixteenfold since 1914, owing to the increased wages, prices of material and the depreciation of the mark. Before the war general expenses could be calculated for all contracts, but the price fixed at January 1, [illegible] 1,000 per cent. One of the reasons why the working capital required has [illegible] greater than formerly is that the time consumed in the manufacture of articles has increased. For instance, in October, 1918, the monthly output of the electrode factory was 3,360 kilos per man; in June, 1919, it was only 1,850 kilos. The decrease in the productivity of individual workmen is partly due to the inauguration of the eight-hour day, but principally to the strikes and the coal shortage. For several weeks during the past year the works were running only three days in the week.

THE WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY, East Pittsburgh, Pa., has issued, Vol. 1, No. 2, for May, of its new magazine. The publication, which is printed in English, is for foreign distribution and contains engineering, semi-technical, merchandising and popular articles, together with international electrical news. Beginning with the July issue, portions of the magazine will be printed in Spanish and Portuguese.

DEVELOPMENT OF TRADE IN ELECTRICAL MACHINERY IN THE FAR EAST. Lists of importers of and dealers in electrical machinery and apparatus in the Far East may be obtained at the Bureau of Foreign and Domestic Commerce, Washington, D. C., for the following countries by referring to the corresponding file numbers: Japan, FE-11015; China, FE-13026; Hongkong, FE-15015; Dutch East Indies, FE-19009; Burma, FE-20013; India, FE-21013; Australia, FE-23012; New Zealand, FE-24008.

THE AMERICAN CHAMBER OF COMMERCE IN FRANCE, 32 Rue Taitbout, Paris, has established a catalog file system for the benefit of French purchasers seeking American goods, where catalogs of business houses may be placed on file.

THE NORTHERN ELECTRIC COMPANY, 121 Shearer Street, Montreal, Quebec, Can., will soon start work on construction of an addition to its plant.

THE CANADIAN HART ACCUMULATOR COMPANY, St. George Street, St. Johns, Que., is planning to erect an addition to its plant and install equipment.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An industrial organization in the Caucasus (No. 32,990) desires to purchase and secure agencies for electrotechnical implements, etc.

A company in England (No. 32,964) desires to purchase generators for motor-car lighting and starting and for use in large and small vehicles and motorcycles. This firm desires to become the sole agents for these generators.

A company in Sweden (No. [illegible]) is desirous of being placed in communication with steel manufacturers with a view to representing one or more firms in that country. It is especially interested in transformer plates, generator plates, etc.

DEE HENDERSON & COMPANY, [illegible] Maiden Lane, New York City, have received an inquiry from a native combination of financial interests in Calcutta, India, for electrical supplies and small electric lighting plants. Catalogs and prices are desired.

Trade Publications

HYDRO-ELECTRIC AND STEAM-POWER PLANTS.—Viele, Blackwell & Buck, New York City, in bulletin No. 9, reproduce photographs of some of their engineering and construction work.

MOTORSHIP MACHINERY.—The Worthington Pump & Machinery Corporation 115 Broadway, New York City, has issued a small pamphlet describing its engine-room equipment, including oil-engine driven generating sets for marine work.

MOTORS AND LAMPS FOR COAL MINES.—Bulletin 196 of the Bureau of Mines, entitled "Coal-Mine Fatalities in the United States, 1919," includes a list of permissible electric lamps and motors for use in coal mines.

PORT AND TERMINAL EQUIPMENT.—The Wellman-Seaver-Morgan Company, Cleveland, Ohio, has issued bulletin No. 47, describing its machinery used for loading and unloading ships, handling freight at docks, etc.

ILLUMINATION.—The Luminous Unit Company, division of the St. Louis Brass Manufacturing Company, St. Louis, has published catalog No. 7, entitled "Brascolite," covering the different types of "Brascolite" lighting fixtures, and also "Industrolite," the factory fixture, and "Aglite," all glass fixtures, etc.

VACUUM CLEANER PARTS.—Repair parts price list No. 2 and instruction sheet have been issued by the Eureka Electric Vacuum Cleaner Company, Detroit, Mich.

DATA ON INSULATING VARNISHES.—The characteristics of insulating varnishes are explained on five loose leaf sheets published by the Sherwin-Williams Company and entitled "Efficiency Information on Sherwin-Williams Ajax Insulating Varnishes and Compounds."

HOISTING MACHINERY.—The Wellman-Seaver-Morgan Company, Cleveland, Ohio, is distributing bulletin No. 44, which describes with illustrations its hoisting and mining machinery.

GRATES.—George S. Herrick, Syracuse, N. Y., has issued a thirty-two-page booklet on Herrick shaking grates.

COMBUSTION.—The General Fuel Saving Corporation, Rochester, N. Y., is issuing a small booklet describing the use of its "Oxy-Blast" in connection with gaining complete combustion of fuel.

HYDRAULIC TURBINES.—The Wellman-Seaver-Morgan Company, Cleveland, Ohio, describes and illustrates some of its hydraulic turbines in bulletin No. 43.

TRIPLEX PUMPS.—The National Transit Pump & Machine Company, Oil City, Pa., has issued bulletin No. 302-A, in which it describes its Transit power pumps.

WALL OUTLETS.—Harvey Hubbell, Inc., Bridgeport, Conn., is circulating a sixteen-page booklet on the uses of Hubbell receptacles about the home.

PLUGS AND RECEPTACLES.—The Delta-Star Electric Company, Chicago, is distributing bulletin No. 303, describing its 100-amp., 600-volt, three-phase plugs and receptacles for extra heavy duty.

New Incorporations

THE PALISADE STORAGE BATTERY COMPANY, Englewood, N. J., has been incorporated with a capital stock of $25,000 to manufacture storage batteries. The incorporators are J. R. and B. M. Mirsh and C. W. Hadden, Yonkers, N. Y.

BEATTIE McINTYRE, LTD., Toronto, Ontario, Canada, has been incorporated by Geoffrey W. Adams, Bank of Hamilton Building; Mervil Macdonald, Edwin Smily and others. The company is capitalized at $150,000 and proposes to maufacture electrical apparatus, machinery, etc.

THE INDUSTRIAL ENGINEERING COMPANY OF CANADA, Toronto, Can., has been incorporated by Ronald G. Lee, 15 Harvard Avenue; Harry C. Bertram and others of Toronto. The company is capitalized at $20,000 and proposes to manufacture electrical equipment, tools, etc.

BASTIAN-MORLEY, LTD., Toronto, Can., has been chartered with a capital stock of $300,000 to manufacture stoves, heaters, lighting and heating systems, etc. The incorporators are James P. Morley, Oliver A. Ludlow, Laporte, Ind.; John M. Godfrey, Toronto, and others.

THE ELECTRO MEDICAL APPLIANCE COMPANY, Toronto, Can., has been chartered with a capital stock of $50,000 by George F. Davis, 24 Toronto Street; William J. Herdman, 216 Seaton Street, Arthur J. Layzell and others.

ELECTRO LIFE CHEMICALS COMPANY, Brooklyn, N. Y., has been incorporated with a capital stock of $15,000 to manufacture hospital supplies. The incorporators are F. C. and J. A. Hecker and R. Rodrian, 229 East Nineteenth Street Brooklyn.

THE WOODCOCK-VANDY ELECTRIC CORPORATION, Rochester, N. Y., has been incorporated with a capital stock of $15,000 by W. C. Woodcock, C. B. Vandy and G. W. Lockman.

THE UNION ELECTRIC MOTOR COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $200,000. The incorporators are F. R. Hinsell, J. Vernon Pimm and E. M. McFarland of Philadelphia, Pa.

THE DENGLER, LIDDY, BURD ELECTRICAL COMPANY, 207 Broad Street, Elizabeth, N. J., has been incorporated by Edward J. Dengler, Thomas A. Liddy and Frank R. Burd. The company is capitalized at $100,000 and proposes to manufacture electrical specialties.

THE TOMPKINSVILLE (KY.) LIGHT COMPANY has been incorporated with a capital stock of $5,000 by Ernest H. Herbert, C. Smith and Otto L. Smith.

THE CLAIBORNE COUNTY LIGHT & POWER COMPANY, Tazewell, Tenn., has been organized with a capital stock of $25,000 to erect an electric transmission line to connect at Cumberland Gap with the system of the Kentucky Utilities Company, Louisville, Ky. J. P. Ritchie, New Tazewell, is president.

THE WINONA (MINN.) ELECTRIC CONSTRUCTION COMPANY has been incorporated with a capital stock of $50,000 by Melvin C. Berrum and others.

THE SOLRAY ELECTRIC COMPANY, Fargo, N. D., has been incorporated with a capital stock of $25,000 by F. B. Messing and others.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

DOVER, N. H.—The Twin State Gas & Electric Company has recently taken over the property of the Cloutman Gas & Electric Company at Farmington and will extend its transmission line to supply electricity there and will also extend its service to Alton. Contract, it is understood, has been placed by the company for a new turbine for its power station on Cocheco Street, which will nearly double the output of the plant.

EAST BRIDGEWATER, MASS.—The Edison Electric Illuminating Company of Brockton has petitioned the Department of Public Utilities for authority to acquire lands and right-of-way for the erection of a transmission line from East Bridgewater to Stoughton, a distance of about 10 miles, to cost approximately $83,000, of which $24,000 would be for right-of-way and lands.

EVERETT, MASS.—The Malden Electric Company of Malden contemplates the erection of a local substation. Equipment includes step-down transformers and switchboard apparatus. The total cost is estimated at about $65,000.

MEDFORD, MASS.—Work will soon be started on the construction of a local substation by the Malden Electric Company of Malden, to cost about $65,000, including equipment. Charles Tenney, 201 Devonshire Street, Boston, is engineer.

SALEM, MASS.—The Salem Electric Light Company contemplates the erection of an addition to its existing power plant and the installation of equipment, to cost about $650,000. Charles Tenney, 201 Devonshire Street, Boston, is engineer.

BRISTOL, CONN.—The City Council is considering the erection of a central fire station and the installation of an alarm system.

HARTFORD, CONN.—Plans filed for the Hartford Rubber Company, a subsidiary of the United States Rubber Company, Broadway and Fifty-eighth Street, New York, N. Y., for the construction of a new plant include the erection of an electric power plant, to cost about $260,000.

NEW BRITAIN, CONN.—Contract has been awarded by the American Hardware Corporation to the William H. Allen Company, Hungerford Place, for the construction of a new transformer house at its plant.

WATERBURY, CONN.—The installation of a fire-alarm system is under consideration by the City Council.

WATERBURY, CONN.—The Connecticut Light & Power Company, 111 West Main Street, has awarded contract to D. Wooster, 39 Harvard Street, for the erection of a two-story addition to its power station, to cost about $10,000.

Middle Atlantic States

BROOKLYN, N. Y.—The Brooklyn Edison Company has had plans prepared for the construction of a power house on Washington Avenue, to cost about $40,000.

BUFFALO, N. Y.—The Buffalo General Electric Company has had plans prepared for the construction to a power station at Babcock and Hannah Streets, to cost about $25,000.

BUFFALO, N. Y.—Frank C. Perkins, Commissioner of Public Affairs, has introduced an ordinance in the City Council for the purpose of compelling railroads entering Buffalo to electrify their systems. The project would cost the railroads about $80,000,000. Commissioner Perkins has also recommended to the Council that Corporation Counsel Rann be instructed to draft a bill which would enable the city to build a power plant at Niagara Falls with a distribution system and transmission lines.

DUNKIRK, N. Y.—Application has been made by the Niagara & Erie Power Company, Marine Bank Building, Buffalo, for permission to construct an addition to its power plant and extend its electric distribution system at Dunkirk.

GRAND ISLAND, N. Y.—The Tonawanda Power Company has applied to the Public Service Commission for permission to erect an addition to its Grand Island power plant.

LE ROY, N. Y.—Extensions to the ornamental street-lighting system are under consideration.

NEW YORK, N. Y.—The American Traction & Light Company, 120 Broadway, has arranged for a note issue of $6,000,000, part of the proceeds to be used for extensions and betterments to its properties at Milwaukee and Madison, Wis., St. Paul, Minn., San Antonio, Tex., and other districts.

BOONTON, N. J.—The Boonton Electric Company has been granted franchise to extend its electric distribution system to the Jacksonville and Lincoln Park sections.

CASSADAGA, N. Y.—Lyman P. Hapgood, superintendent of the department of water and lighting, is planning to install at the Cassadaga station three 150-hp. water-tube boilers with equipment, two steam-driven centrifugal pumps, two steam-driven air compressors, compound two-stage, capable of delivering sufficient air under 80 lb. pressure to equal 160-hp. pumping engines; two motor-driven centrifugal pumps not to exceed 1,200 r.p.m., 440-volt, three-phase, 60-cycle, and equipment; two direct-connected steam-turbine generators to generate current at 440 volts, three-phase, 60-cycle, capacity 378 kw., turbine capacity 540 hp.; two motor-driven, two-stage air compressors sufficient to furnish air at 80 lb. pressure to produce 160 hp.

CAMDEN, N. J.—The installation of a new street-lighting system on Hadden Avenue, Westmont, is contemplated by the town committee.

ESSEX FELLS, N. J.—The Borough Council is considering the purchase of a local electric lighting plant for establishment as a municipal plant. The plant has been offered by the Essex Fells Electric Light & Power Company for $175,000.

NEWARK, N. J.—The Schofield Oil Company, Avenue R, has awarded contract to E. M. Waldron Company, Firemen's Building, for the erection of a power house, to cost about $30,000.

BLOSSBURG, PA.—Plans have been completed by the Board of Managers for the construction of a power house and laundry building at the Blossburg Hospital, to cost about $20,000.

CHESTER, PA.—The Chester Steel Casting Company plans to rebuild the power house at its local plant, which was recently destroyed by fire, causing a loss of $50,000.

ELWOOD CITY, PA.—The American Steel Company, Park Building, Pittsburgh, has awarded a general contract to the Duquesne Construction Company, Bessemer Building, Pittsburgh, for the erection of a power house, 38 ft. x 60 ft. M. B. Kelly is president.

NANTICOKE, PA.—Work has been started on the construction of a power plant for the Delaware, Lackawanna & Western Railroad of Scranton, to cost about $75,000.

PHILADELPHIA, PA.—The Enterprise Manufacturing Company, Third and Dauphin Streets, has had plans prepared for the construction of a new power house at its hardware plant on Bodine Street, to cost about $28,000.

PHILADELPHIA, PA.—Contract has been awarded to W. D. Lukins, 132 West Walnut Street, North Wales, Pa., by the L. H. Gilmer Company, Cottman and Keystone Streets, Philadelphia, for the erection of a power house and a warehouse, to cost about $200,000.

PHILADELPHIA, PA.—Plans have been prepared for the erection of an addition to the power plant of the Hale Kilbourne Corporation, Eighteenth and Lehigh Streets, to cost about $60,000.

SPANGLER, PA.—The Penn Central Light & Power Company of Altoona is having plans prepared for the erection of a transformer station. Day & Zimmerman, Inc., 611 Chestnut Street, Philadelphia, are engineers.

BALTIMORE, MD.—Bids will be received by the Delinn Tire Company until July 1 for the construction of a factory, office and power plant, to cost about $150,000. N. C. Prico, president, 131 Mount Royal Avenue, is in charge.

HAGERSTOWN, MD.—The report on the estimated cost of extension to the "white way" street-lighting system, submitted by City Light Supervisor Grubmyer, shows that the probable expenditure would be about $18,000.

PETERSBURG, VA.—The Chesterfield Manufacturing Company contemplates the erection of a power plant on Swift Creek. William C. Whitney, Virginia Railway & Power Building, Richmond, is engineer.

MILLVILLE, W. VA.—The Hagerstown & Frederick Railway Company of Hagerstown contemplates the erection of an electric transmission line from Millville to Winchester. M. A. Pooler is general manager.

WASHINGTON, D. C.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has had plans prepared for the erection of a power plant at Ohio River Dam No. 48, near Cypress, Ind., to cost about $45,000. Col. G. M. Hoffman, Post Office Building, Louisville, Ky., is in charge.

WASHINGTON, D. C.—Bids will be received by the Commissioners of the District of Columbia, 509 District Building, Washington, D. C., until July 5, for electric generating set, exciter, switchboard and accessories for central power plant at the District of Columbia institutions, Lorton, Va. Plans and specifications may be obtained from the purchasing officer, 320 District Building.

WASHINGTON, D. C.—Bids are being received by the construction officer, Walter Reed Hospital, for improvements to the power plant at the institution.

North Central States

BATTLE CREEK, MICH.—The erection of a new power plant at the Battle Creek Sanitarium, to cost about $50,000, is contemplated.

ST. JOSEPH, MICH.—Plans have been prepared by the General Electric Company for a curb street-lighting system for the business section of St. Joseph.

AKRON, OHIO.—The substation of the Northern Ohio Traction & Light Company at Thompson's Corners was recently destroyed by fire, causing a loss of about $50,000.

COLUMBUS, OHIO.—The erection of a two-story factory, 140 ft. x 190 ft., and a power plant is contemplated by the Climax Rubber Company, Citizens' Bank Building.

McARTHUR, OHIO.—Franchise has been granted to the McArthur Light & Power Company to furnish light for the streets.

MIDDLETOWN, OHIO.—The Colin Gardner Paper Company has awarded contract to the Ferro Concrete Construction Company, Richmond and Harriet Streets, Cincinnati, for the erection of a turbine power plant, to cost about $45,000.

TOLEDO, OHIO.—Contract will soon be awarded for the construction of a pumping station, 116 ft. x 39 ft. Equipment, including switchboard, electric crane, four 300-hp. motors, one 200-hp. motor, two vacuum pumps, five centrifugal pumps, etc., will be required. Fuller & McClintock, Broadway, New York, N. Y., are engineers and architects.

ANDERSON, IND.—Plans are under way for additions to the municipal electric light and power plant, to cost about $300,000. C. Brossman, 1503 Merchants' Bank Building, Indianapolis, is engineer.

GOSHEN, IND.—The city officials plan to operate the water plant by electricity to be purchased from the Hawks Electric Company.

TELL CITY, IND.—Petition has been made for permission to distribute electric current from the municipal plant to persons outside of the city.

WILLIAMS, IND.—The Southern Indiana Power Company contemplates the erection of a 60,000-volt transmission line from its central plant at Williams to Edwardsville. W. E. Murchie is manager.

GALESBURG, ILL.—The installation of electric lights in Lincoln Park is contemplated. Frank Connelly is city engineer.

ELROY, WIS.—The city officials are considering the purchase of electric power from Reedsburg or Maustin, and the erection of a transmission line from Reedsburg is also contemplated. J. W. Cadby, Washington Building, Madison, is engineer.

HALLOCK, MINN.—Bids will be received by F. J. Wickie, village clerk, Hallock, Minn., until June 28, for labor and materials required for electric power equipment to be erected at the present power station. Plans and specifications are on file in the office of the village clerk and in the office of Earl D. Jackson, consulting engineer, St. Paul, Minn.

KENNEDY, MINN.—Bids will be received by C. N. Fowler, village clerk, until June 28, for labor and materials required for the construction of an electric distribution system for the village of Kennedy. Plans and specifications are on file in the office of the village clerk and in the office of Earl D. Jackson, consulting engineer, St. Paul, Minn.

HARTLEY, IOWA.—The construction of an electric power plant is under consideration by the city officials. H. T. Broders is city clerk.

MILBANK, S. D.—Bids will be received by the City Council until June 26 for the construction of an ornamental street-lighting system to include approximately 3,300 lineal feet of No. 8 duplex conductor cable, thirty-one ornamental lamp posts and one pole-type constant-current transformer with automatic time switch. Plans and specifications may be seen and blank proposals may be obtained at the office of A. A. Blomquist, city auditor.

LA CYGNE, KAN.—Bids will be received by M. S. Bunch, city clerk, until June 25 for furnishing materials and labor required for improvements to the municipal waterworks plant, to include the installation of two 200-g.p.m., 50-ft.-head, horizontal-motor-driven centrifugal pumps; one 75-kw. steam generating unit, including simple slide-valve engine, three-phase, 60-cycle, 2,300-volt generator exciter and switchboard panel, one 500-g.p.m. compound duplex, non-condensing double-acting plunger-type pumping engine, etc.

Southern States

KINSTON, N. C.—Work has been started on the construction of two dormitories, a power plant and minor buildings at the Caswell Training School, to cost about $300,000. Dr. C. Banks McNairy is superintendent.

UNION, S. C.—At an election to be held on June 22 a proposal to issue $30,000 in bonds for improvements and extensions to the municipal electric light system will be submitted to the voters.

CLARKSVILLE, TENN.—The Kentucky Public Service Corporation, Bowling Green, Ky., contemplates the erection of a local electric generating station. A. D. Couch, Ithaca, N. Y., is engineer.

COPPERHILL, TENN.—The Tennessee Copper Company, 61 Broadway, New York, N. Y., is having plans prepared for the complete electrification of its local plant.

ISABELLA, TENN.—The Ducktown Sulphur, Copper & Iron Company will soon use 2,000 kw. in addition to power it now purchases.

BALDWYN, MISS.—Bonds to the amount of $5,000 have been voted for improvements to the electric light and water systems.

CLAREMORE, OKLA.—Plans are being prepared for extensions and improvements to the municipal electric light and power systems, including the installation of machinery and equipment consisting of rotating field alternator, exciter, switchboard and cables, pumping units, etc.

SAN ANGELO, TEX.—E. L. Wells, city manager, has been instructed by the City Commission to secure estimates covering probable cost of the installation of a municipal lighting plant. It is proposed to submit a bond issue of $500,000.

Pacific and Mountain States

KLAMATH FALLS, ORE.—An estimate regarding cost of installation, running expense, etc., of the establishment of a public-owned light and power plant for the Main Street section has been submitted.

RIVERSIDE, CAL.—The Southern Sierras Power Company is having plans prepared for the construction of an addition to its local power plant, to cost about $50,000.

SAN FRANCISCO, CAL.—The Great Western Power Company has been authorized to issue $1,500,000 preferred stock to complete the Caribou hydro-electric plant on the Feather River. It was originally estimated that the cost of the development would be $4,321,430, but plans have been revised and the cost is now estimated at $6,246,100.

CEDAR CITY, UTAH.—Bonds to the amount of $15,000 have been voted for the installation of an electric street-lighting system.

RICHFIELD, UTAH.—The installation of an ornamental street-lighting system, requiring thirty-six large standards and 6,500 ft. of parkway cable, is contemplated. Elizabeth Hansen is city recorder.

HAILEY, IDAHO.—Estimates are being made by B. Green of the Green Construction Company, Salt Lake City, Utah, on the construction of a hydro-electric plant on the east fork of the Wood River to furnish power for the Mascot Mine and Mill, 5 miles north of the plant.

LAS VEGAS, N. M.—Improvements to the street-lighting system are contemplated.

Canada

ESQUIMAULT, B. C.—Bids will soon be received by the Department of Public Works of the Dominion of Canada for the construction of a drydock to cost about $1,500,000. Considerable electrical equipment will be required. R. C. Desrochers, Ottawa, Que., is secretary of the department.

THORNBURY, ONT.—Work will soon be started on the construction of an electric lighting plant by the Thornbury Electric Lighting Company, to cost about $15,000. Harry Pedwell is chairman.

TORONTO, ONT.—The Temiskaming & Northern Ontario Railway commission contemplates the following work this year: Renewing telegraph and telephone pole line equipment and stringing circuit from Matheson to Porguis Junction, estimated cost $5,000; additional telephone circuits between North Bay and New Liskeard, $20,000; five metallic telephone circuits between Swastika and Kirkland Lake, $2,500; erecting telephone line from Cobalt to Porguis Junction, $25,800, etc. S. B. Clement, North Bay, Ont., is chief engineer.

MONTREAL, QUE.—The Montreal Light, Heat & Power Company, 83 Craig Street, West, has awarded contract to John Quinlan & Company, Green Avenue, Westmount, Que., for the erection of a power house, to cost about $22,000.

Record of Electrical Patents

Notes on United States Patents

(Issued May 18, 1920.)

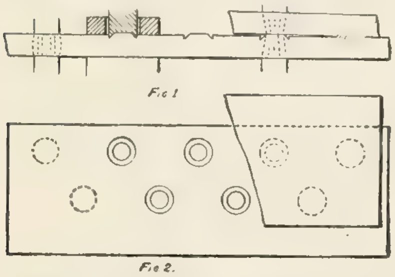
14,861 (reissue). MOTOR-CONTROL SYSTEM; Reuben L. Wright, Wickliffe-on-the-Lake, Ohio. App. filed Aug. 6, 1918. For two or more mechanically connected to same load.

14,863 (reissue). CODE-RINGING TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Oct. 21, 1916. Applying code ringing to local battery line.

1,338,987. SYSTEM OF ELECTRICAL GENERATION AND CONTROL; Charles F. Kettering, Dayton, Ohio. App. filed Dec. 18, 1916. Prevents operation of electric machine as a motor when lubricant supply of engine reaches low point.

1,340,170. METHOD OF JOINING METALS BY ELECTRIC WELDING; Charles H. Kicklighter, Macon, Ga. App. filed Oct. 27, 1919. Welding by electric current and pressure.

1,340,636. STORAGE BATTERY; Norman D. Sturges, Bellerose, Queens, N. Y. App. filed Feb. 27, 1920. Celluloid binder for storage battery.



1,340,170. Method of Joining Metals by Electric Welding

1,340,637. STORAGE BATTERY; Norman D. Sturges, Bellerose, Queens, N. Y. App. filed Feb. 27, 1920. Glass jar with walls of uniform thickness.

1,340,644. REINFORCED WELDED JOINT; David H. Wilson, Ridgewood Park, N. J. App. filed Sept. 14, 1918. For uniting cast iron or other metals together.

1,340,668. AUTOMATIC ELECTRIC SWITCH FOR ELECTRIC FLUID HEATERS; Antonio Papini, Philadelphia, Pa. App. filed June 12, 1919. Automatic switch for fluid heater.

1,340,678. REGULATOR FOR ELECTRIC MOTORS; George H. Whittingham, Bancroft Park, Md. App. filed Oct. 23, 1917. Controls speed of shunt-wound motors.

1,340,698. ELECTROMAGNETIC DEVICE; C. W. Burrows, Washington, D. C. App. filed April 27, 1917. Electromagnet with adjustable pivoted armature.

1,340,716. ELECTRIC CIGAR LIGHTER; Reginald J. H. Hill, London, England. App. filed Sept. 16, 1919. Has renewable tip.

1,340,736. ELECTRIC SOLDERING; Harold K. Parsons and Harry H. Styll, Southbridge, Mass. App. filed Sept. 30, 1919. Automatically regulates temperature and amount of deposit.

1,340,795. ELECTRIC LIGHT REGULATOR; Louis Sawyer-Soucy and Albert G. Sawyer-Soucy, Lynn, Mass. App. filed Feb. 25, 1920. Variable resistance in socket.

1,340,807. TELEPHONE RECEIVER; Augustus Umholtz, Port Carbon, Pa. App. filed April 7, 1919. Air vents allow holding close to ear.

1,340,813. PROCESS OF MANUFACTURING INSULATORS; Pierre J. H. Bernard, Montreal, Quebec, Canada. App. filed Dec. 27, 1919. Mica and asbestos insulators for heaters.

1,340,826. ELECTROLYTIC PROCESS; William E. Greenwalt, Denver, Col. App. filed Feb. 24, 1914. For obtaining metals from impure salts.

1,340,839. FLEXIBLE CORD; William L. Runzel, Chicago, Ill. App. filed May 19, 1917. Switchboard cord with concentric conductors.

1,340,856. ATTACHMENT PLUG; Gilbert W. Goodbridge, Bridgeport, Conn. App. filed Dec. 31, 1917. For "Edi-Swan" sockets.

(Issued May 25, 1920.)

1,340,908. DENTAL ENGINE; Oscar H. Pieper and Alphonse F. Pieper, Rochester, N. Y. App. filed May 27, 1912. Has counterbalanced motor.

1,340,918. SWITCHING APPARATUS; William M. Scott, Tredyffrin Township, Chester County, Pa. App. filed Nov. 26, 1919. Motor-operated circuit breakers.

1,340,933. ELECTRICAL TESTING SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed July 26, 1917. For automatic telephone.

1,340,934. AUTOMATIC TELEPHONE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed Dec. 4, 1917. Systems employing machine switching.

1,340,936. TESTING SYSTEM; Roy D. Conway, Chatham, N. J. App. filed May 9, 1918. Testing marginal relays.

1,340,940. TELEPHONE-EXCHANGE SYSTEM; Amos F. Dixon and Frank N. Reeves, Newark, N. J. App. filed May 7, 1917. Device at first operator's position exhibits number of line at second operator's position.

1,340,942. SIGNALING SYSTEM; George D. Edwards, East Orange, N. J. App. filed Nov. 28, 1917. Elimination of telegraphic impulses from telephonic circuit.

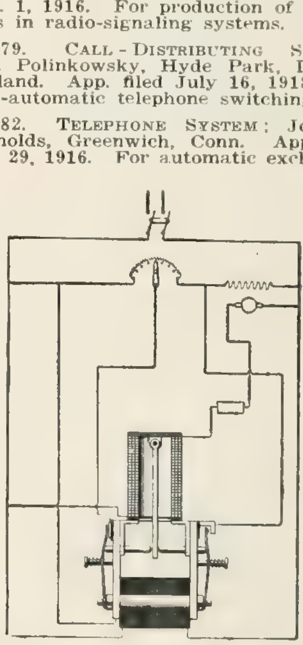
1,340,951. SMELTING TIN AND OTHER ORES; James H. Gray, New York, N. Y. App. filed March 18, 1919. Resistor furnace.

1,340,955. TELEPHONE SET; Raymond R. Herrmann, New York, N. Y. App. filed March 25, 1918. One-piece hand set.

1,340,963. RESONANT CONVERTER; Walter S. Lemmon, New York, N. Y. App. filed Sept. 1, 1916. For production of oscillations in radio-signaling systems.

1,340,979. CALL-DISTRIBUTING SYSTEM; Lipa Polinkowsky, Hyde Park, London, England. App. filed July 16, 1918. For semi-automatic telephone switching.

1,340,982. TELEPHONE SYSTEM; John N. Reynolds, Greenwich, Conn. App. filed Dec. 29, 1916. For automatic exchange.



1,340,678. Regulator for Electric Motors

1,340,997. MACHINE-SWITCHING TELEPHONE SYSTEM; Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed Oct. 10, 1917. Moving switch hook does not affect operation.

1,341,006. IONIZED-CHAMBER DEVICE; Clifford D. Bagcock, New York, N. Y. App. filed Oct. 11, 1916. Parts secured before inclosing.

1,341,007. TELEPHONE SET; William T. Booth, East Orange, N. J. App. filed June 30, 1917. Vestibule telephone.

1,341,054. PLURAL SOCKET; David D. Gordon, Chicago, Ill. App. filed Aug. 25, 1917. Plurality of plugs fit in one socket.

1,341,105. TELEPHONE; Ernest A. Bohlman, Chicago, Ill. App. filed May 25, 1918. Supporting bracket for telephone.

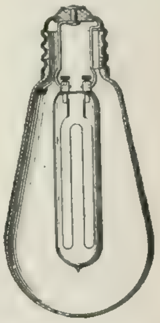
1,341,232. WIRELESS TRANSMISSION OF SPEECH; Earl C. Hanson, Washington, D. C. App. filed June 18, 1917. Wireless telephone.

1,341,280. TELEPHONE HAND SET OR HAND PIECE; Herman G. Pape, New York, N. Y. App. filed June 24, 1918. One-piece hand micro-telephones.

1,341,282. MAGNETO FOR IRREGULAR IGNITION; Leon W. Rosenthal, New York, N. Y. App. filed Oct. 2, 1918. For internal-combustion engines.

1,341,284. SAFETY TROLLEY FINDER; Harry B. Sawyer, Ogden, Utah. App. filed July 20, 1917. Guides swing in position when trolley is off.

1,341,293. ELECTRIC WELDING DEVICE; William P. Bovard, Mansfield, Ohio. App. filed Oct. 24, 1919. Current controlled at electrode.



1,341,581. Electric Incandescent Lamp

1,341,311. MODULATION OF HIGH-FREQUENCY CURRENTS; Raymond A. Heising, East Orange, N. J. App. filed Aug. 25, 1915. For wireless telegraphy or telephony.

1,341,327. SYSTEM OF ELECTRICAL GENERATION; Charles F. Kettering and William A. Chryst, Dayton, Ohio. App. filed Oct. 27, 1915. Farm-lighting plant.

1,341,336. CONDENSER AND METHOD OF MAKING SAME; Byron MacPherson, Roxbury, Mass. App. filed Nov. 19, 1919. Mica condenser for high potentials.

1,341,337. METHOD OF UNITING DISSIMILAR METALS; George A. Mead, Mansfield, Ohio. App. filed Jan. 8, 1920. Bonding track rails by electric welding.

1,341,339. ELECTRICAL CONNECTOR; John R. Pattee, New York, N. Y. App. filed May 21, 1917. Spring-clip lamp socket.

1,341,340. MAGNETO-ELECTRIC TRANSFORMER; Parnell Rabbidge, Neutral Bay, New South Wales, Australia. App. filed Dec. 24, 1919. Changes direct-current voltage.

1,341,348. SPARK-GAP DEVICE; Richard F. Van Meter, Minneapolis, Minn. App. filed May 26, 1919. To intensify spark-plug fire.

1,341,358. ACOUSTIC STAND FOR TELEPHONE RECEIVERS; Byron E. Chapin, Oklahoma, Okla. App. filed Aug. 26, 1918. Eliminates necessity for holding receiver directly against head.

1,341,362. IGNITION DEVICE; Leo Ranney, John W. Dissette and Franklin E. Tyrrell, Washington, D. C. App. filed June 10, 1919. For spark plugs.

1,341,468. SEPARABLE ATTACHMENT PLUG; John J. Kenney, Pittsburgh, Pa. App. filed July 23, 1915. Body and cap positively locked.

1,341,469. SECONDARY OR STORAGE MULTIVOLT BATTERY; William E. Kershaw, Philadelphia, Pa. App. filed Aug. 23, 1918. Durable storage battery.

1,341,471. PORTABLE ELECTRIC HAND LANTERN; James W. Knoblock, Elmira, N. Y. App. filed June 19, 1917. With storage battery.

1,341,473. MACHINE-SWITCHING TELEPHONE SYSTEM; Alben E. Lundell, New York, N. Y. App. filed March 25, 1918. Operates stepping magnets.

1,341,581. ELECTRIC INCANDESCENT LAMP; Frank W. Peterson, Peoria, Ill. App. filed Feb. 4, 1919. Filament in removable inner globe.

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician
Published by McGraw-Hill Company, Inc.

W. H. ONKEN, Jr., Editor D. H. BRAYMER, Managing Editor
S. B. WILLIAMS, Assistant Managing Editor A. M. PERRY, Engineering Editor J. C. MARTIN, Western Editor ROBERT SIBLEY, Pacific Coast Editor H. S. KNOWLTON, New England Editor
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Volume 75 New York, Saturday, June 26, 1920 *Number* 26

The Federal Water-Power Act

THE country is indeed to be congratulated on the final enactment of the water-power bill which in various forms has been before Congress for the last eight years. The story of the vicissitudes of the bill is a striking example of legislative inefficiency under the shifting pressure of warring factions and clashing interests. At last the bill is law, and the thanks of the country are due to those who have consistently fought to secure its enactment. Opposition was due to various forces, some of them raising debatable questions as to the rights of the states, others based on socialistic propaganda, and still others having their origin in the bogie of a water-power trust. As we have repeatedly pointed out, there is not, and never was, any such thing as a water-power trust, but only a growing recognition on the part of banking interests of the value of hydro-electric development as an investment looking to the future of American industries. Certainly the government will have it fully within its power through its commission to see to it that no menace to the public shall spring from this appreciation of values. In the actual working out of water-power development under this act the Federal Power Commission has almost plenary authority. It is composed of the Secretaries of War, the Interior and Agriculture, the three departments whose activities are most closely touched by the law. As a working body the efficiency of the commission will largely depend on the executive secretary and his staff, operating under the guidance of the Cabinet members named. It is just here that we hope the government will give the commission a very free hand to secure the best expert advice obtainable, for on this will hinge the ultimate success of the movement. The commission is charged with many administrative, constructional and financial duties which require a close detailed knowledge of hydro-electric propositions. The general provisions of the bill are sound and the practical difficulties will be those due to detail. One of the questions which involve some very nice adjudication of authority is the division of powers between the federal commission and the commissions of the several states. The interstate relations of the larger transmission systems have already come in for serious consideration, and as the plants develop under the provisions of this bill the situation will become more complicated. Especially will this be the case when and if the United States takes over part of a somewhat generalized project and has to determine equitably both net investments and the severance damages.

Such questions as these are, of course, for the future rather than the present, but they point out the necessity of a commission carefully and thoroughly organized for very intricate and varied activities. The important thing just now is the great step that has been taken in freeing vast amounts of water power for immediate development. At this time, when the fuel situation is monthly growing more acute, especially from difficulties of transportation, the help available from water powers is of vital importance, and the government cannot act too quickly in organizing the commission and laying the groundwork of something more than a local and limited system of distribution. The time has come for working on a large scale with a broad view of the industrial needs of the country. Our most earnest congratulations to the wise and far-sighted legislators who have seen the needs of the country and joined in putting through what promises to be one of the great constructive projects of the nation's history.

An Outgrown Point of View

A VIEW on public commission regulation expressed recently by the president of a prominent public utility company in the South, that the commission "may be likened to a board of arbitration every member of which was appointed by the other side," doubtless expresses what appears to him the attitude of the body with which his company has to deal, but it is a view that will not bear close analysis. Public service commissions are not boards of arbitration appointed by the public to settle disputes between itself and the utilities. They are to all intent and purpose permanent judicial bodies, and no more than other judges, who are also either elected directly by the people or appointed by those who are, do the commissioners come into court with minds prejudiced for plaintiff or defendant. We do not mean to say that always and everywhere the proceedings of public service commissions have been in accordance with this statement, but simply that this is the theory that naturally dominates their creation and their hearings. To dwell on the threatened public predicament of utilities starved to death and citizens without service, as was done both by the official alluded to and by the director of the Federal Reserve Bank of Chicago in recent public testimony, is to paint a picture lacking in verisimilitude. Not cessation of service but public ownership and operation is the alternative to the inability of an essential utility to function. To render service of such excellence and in such spirit that this alternative will gain no support is the problem of the public service companies. Every consideration of justice and public expediency demands that in return for such service the properly managed and financed utility shall make an adequate profit. We believe that citizens everywhere can be brought to realize this where they have not already done so, but to expect that rate fixing will ever revert to the control of company executives would be vain.

Utilities Must Convince the Public of Their Service Ideals

CONSERVATIVE ideas and the traditions of a bygone day in public utility management unfortunately persist to the disadvantage of the utilities in dealing with present-day problems. No matter how honest or well meaning a business man may be, the major part of his success depends on his ability to imbue the public with a thorough understanding of his honesty. Only in this way can a basis of mutual confidence be established. A public utility depends on the confidence of investors for its ability to finance and therefore to perpetuate itself. The confidence of the investor is in turn based on the confidence of the public, on which the utility must depend for its profits to attract the investor.

The management of a public utility is therefore under as urgent a necessity of bringing the public to realize its honesty as any other business, and inherently it has a more difficult task because competition cannot be made the factor that it is in the ordinary business undertaking. Public utilities have too often concealed entirely legitimate and honorable policies behind a veil of secrecy for which there has been no excuse other than a fancy that the average run of human beings cannot be trusted to face facts. Under such conditions petty politicians have made the best possible use of this policy of silence and have told their story loudly and at length, with the result that the service ideals of the public utility are not always understood. For this condition public utilities are largely at fault.

The solution is in broad-gaged publicity. No specific rules can be laid down to fit all cases. Each instance must be met and handled in accordance with existing conditions, but one thing that is needed is the placing of the facts regarding utility work before the public vigorously and effectively. Since the basis of real publicity is mutual confidence, until the utilities are able to bring this about suspicion must persist to hamper utility financing and development. Frank and fearless telling of the facts is one of the effective methods by which service ideals can be impressed upon the public.

Some Phenomena of Arc Welding

SOME extremely interesting details regarding the transfer of metal which occurs in arc welding are given by O. H. Eschholz in this issue. He points out that there may be three somewhat distinct causes for the flow of metal across the arc. First, there may be complete vaporization of the metal and its transport into the arc stream; second, the occluded or generated gases in the electrode ends may blow out a certain quantity of liquid metal, and finally this may be transported by the ordinary molecular forces that cause surface tension and adhesion of one substance to another. Experiments carried on to determine the source of metal flow lead Mr. Eschholz to believe that the cause last mentioned is the really effective one.

Vaporization is barred, as anything more than a contributing cause, by the fact that the energy put into the arc is very much less than is sufficient to account for the vaporization of the amount of material which actually goes over. The whole energy spent in the arc is only a modest fraction of that required to vaporize the necessary amount of iron. Mr. Eschholz estimates that of the total energy required per pound of electrode carried away about 60 per cent goes into liquefaction of the material, approximately 26 per cent into vaporization of some portion of this liquefied material and about 14 per cent into ordinary thermal losses. The effect of gas expansion in forcing the molten metal away from the electrode is at times noticeable, but is often pernicious in its effects. The normal operation of welding seems to require that the effect of occluded gases should be very modest. This by a process of exclusion leads to listing the ordinary forces of surface tension, adhesion, and sometimes gravity as counter effect, as the active forces in the transfer of metal.

This view is strongly borne out in Mr. Eschholz's photographic study of the process of metal transport. Most of it seems to be carrying over in the form of liquid globules, while the current density is very high. In working with a short arc there seems to be a globular accumulation of molten metal at the electrode end until contact is made with the anode surface wet with its own liquefaction, when the globule passes on to the plate, to be followed by others.

In bessemer steel the occluded gas is considerable and its expansion produces cavities in the liquefied electrode and on the whole tends to interfere with the process of making a smooth and homogeneous weld. Mr. Eschholz's studies of the details of the transference of metal in welding show the general character of the action very clearly and throw considerable light on the conditions necessary to making a uniform and reliable weld.

Results Achieved in Burning Oil

NEW interest in oil-fired boilers brought about by the high price of coal makes particularly pertinent a brief article in this issue on operating results. Despite the large amount of fuel oil now used, most of the published results have dealt rather with general conditions and economies than with definite tests, so that the exact data here given are altogether welcome as furnishing a very needful basis for further work on oil-burning practice. The general advantages of oil as a fuel are quite obvious. Not only is it readily utilized and particularly convenient for forcing boiler output, but owing to the ease with which the fire is managed it becomes possible to insure virtually complete combustion with very little excess of air and to keep flue gases within reasonable temperatures. Of course, from the economic standpoint the whole matter hinges on the relative price of coal and oil and the permanence of the ratio between them, which is the most considerable matter of doubt. In making the comparison, however, the advantage of the oil in cutting out ash-disposal expense must not be left out of account. As to what oil really will do in the way of thermodynamic efficiency of boiler and furnace information has not generally been so precise as is desirable.

The tests deal with fuel oils ranging from 18,000 to a little over 19,000 B.t.u. per pound (2,052 cal. to 2,166 cal. per kg.), and the boilers were operated in some cases fairly near the rated capacity and in others at considerable over load or under load. The pressures ran in general from 175 lb. to nearly 200 lb. (12.3 kg. to 13.8 kg. per sq.cm.) and superheat from a little over 80 deg. to more than 180 deg. It will be observed, however, that neither pressure nor superheat was in any way outside of every-day practice. In every instance the oil showed excellent results. The evaporation from and at 212 deg. per pound was in the main over 15 lb., except in cases of severe overload, and the steam used for the oil burners was, save in a single instance, quite moderate, roughly from 1 to 2½ per cent. The net efficiency, including steam, thus used at normal loads averaged very nearly 80 per cent, which will be recognized as an extremely good result judged from the standards of coal burning. The lowest efficiency recorded was 74 per cent in the case of a boiler worked at nearly double its rated capacity. The general indications of this series of tests confirm strongly the current opinion that oil burning has very great possibilities, always provided that the cost of the material can be to a certain extent stabilized. Here is the real difficulty of the situation and one which should be very carefully considered before embarking on any considerable change of power plants to oil fuel. It is pretty well understood that not only is American oil tied up in very few hands but that fuel-oil supply outside the United States is quite generally under British control. It therefore appears only too plain that any large demand for fuel oil on the part of power plants has remarkable possibilities in the way of bulling the market.

Reactive Power Indicators

THERE are few subjects relating to alternating-current systems which are more indefinitely discussed and loosely understood than reactive power, although this is a very important subject to central-station engineers.

If a simple single-phase circuit is reactanceless or contains resistance only, as is practically the case with a short distribution circuit supplying lamps only, then a wattmeter connected to the circuit will show the average power expended by the circuit.

If, however, the circuit is led through magnetizing coils, such as motor windings, the magnetic field developed in these windings when the current flows requires energy to create it of the type LI^2 joules, where L is the inductance in henries and I is the instantaneous current in amperes. This energy of magnetism is a maximum when the alternating current is at a crest value and disappears when the current is at zero. It is necessary to develop power when such magnetic energy is rapidly supplied to and removed from the coils. This power is just as truly watts as the power developed in the lamps, except that the average of the magnetic power is zero; because it is not expended but is only power of circulating energy lent to the coils and then withdrawn once in each current alternation. The magnetizing watts are also in quadrature to the dissipated or heating watts.

If now the same single-phase circuit supplies 20 amp. of active current to lamps at 100 volts and also 5 amp. of reactive current to coils or motors, it will develop 2,000 active watts in heat, which will be expended and will leave the circuit. It will also develop 500 reactive watts in magnetic energy storage and release, which power is not expended and does not leave the circuit. Reactive power and energy are reclaimed. The main ammeter will show the vector sum of $20 - j5$ or 20.6 amp., lagging 14 deg. behind the impressed voltage. The active wattmeter will show 2,000 watts and the reactive wattmeter 500 watts. The total vector power is the vector sum of $2{,}000 - j500$, or 2,060 watts, lagging 14 deg. behind the active power.

Development of High-Tension Insulators

IN ITS report at the recent National Electric Light Association convention the overhead systems committee as usual presented much valuable information. In particular we note the report on insulator tests conducted at Leland Stanford Junior University for the last three or four years.

The tests referred to record the vicissitudes of thirteen varieties of suspension insulators, 50 to 100 of each type going into the test. The immediate result was to show startling differences as between the several groups, even when of about the same period and of a similar character in design. Two types of 1912, for instance, showed a total percentage of failures, on tests of between two and three years, of 5.6 and 60.3 respectively, while one 1916 insulator showed no failures out of fifty-six specimens and another of the same date showed twenty-five complete failures out of seventy-six specimens. Careful analysis of the very thorough tests made seem to bring out three chief factors in deterioration. First, the porcelain must be of high grade and thoroughly fired, but not overfired. Second, the securing of one insulator to its neighbor in the string is a problem requiring a great deal of study. The porcelain-to-metal joint is the conspicuous weak point in the suspension insulator, and the mechanical working of such joints has been a fruitful source of failure. Various plans of somewhat elastic cementing have been worked out with fair success, but right here is an inherent difficulty that required the most careful investigation. Next, it was clearly brought out by the experiments that the daily and seasonal changes of temperature are chargeable with a considerable proportion of insulator failures. This thermal fatigue is probably the main factor in deterioration. Not only do changes of temperature affect the joints but they also produce a startling change in the actual electrical resistance of the porcelain. A variation from 20 deg. to 40 deg. C. means at least a ten to one reduction in the insulation resistance. The exact cause for so great a temperature coefficient at such low temperatures is not easy to fathom, but the fact cannot be forgotten in relation to the final results. On a string of insulators the upper units tend to shield the lower ones from extreme temperature changes, and where the whole string is inside the station and temperature changes are relatively small the insulators show considerably better endurance.

Finally, the tests bring out strongly the desirability of electrostatic grading along the insulator strings. Without this the voltage duty of the disks next the line is unnecessarily severe. A grading system applied to the connected disks is found to equalize the strains along the string in a very striking manner so that the variation between maximum and minimum voltage duty can be changed from seven to one or more down to two to one. Even a single shield may reduce the voltage duty on the first disk by more than 20 per cent. The moral of this is obvious, that in working to the higher voltages grading is fundamentally necessary; without it the factor of safety of the string becomes greatly reduced.

Hugh L. Cooper

Designer of developments rated at a million and a half hydro-electric horsepower—Harnesser of the Mississippi and most active engineer in behalf of sound water-power legislation

UNFAILING to the call, day or night, for the last seven years, no matter where he was, Hugh L. Cooper has rushed to the assistance of those who have been trying to give the country sound and fair water-power legislation. The experience of the designer of developments totaling 1,500,000 hp. was, without thought of compensation, at the beck and call of that small band of enthusiasts whose vision convinced them that national conservation would be best served by the full utilization of the now wasting waters. Faced at the age of eighteen, when he was graduated from high school, with the career of a miller in his father's grist mill at Rushford, Minn., young Cooper decided to shift for himself otherwise. Carrying planks for the construction of a small wooden bridge marked his entrance into the profession of engineering. Rapidly advancing in the field of bridge building, he gradually became impressed with the possibilities that lay in water-power utilization. The development of 11,000 hp. on the Missouri River for the Montana Power Company was his first piece of hydro-electric engineering. Other developments quickly followed, notably the Niagara Falls plant of the Toronto Power Company, the Pennsylvania Water Power Company's station at McCall's Ferry on the Susquehanna, the Feather River plant of the Great Western Power Company, and later Lock 12 on the Coosa River for the Alabama Power Company. But his work was by no means confined to this country and Canada. Important plants of his design are now in operation in Mexico, Brazil and Japan, and work will probably be started next year in Egypt, on his design for damming the Nile. Above all of his accomplishments, however, there stands out one that will ever be a monument to the man's forcefulness and skill—harnessing the Mississippi at Keokuk. Staking all his resources and reputation on this project and faced time and again with almost certain disaster, his courage stood the test. He had the will to win.

Now that he has twice tasted the fruits of hard-earned victory, first on the Mississippi and later at Washington, the untamed engineer in Hugh L. Cooper calls for greater deeds. He is at this time actively working on two projects which will total 1,500,000 hp. He is also engaged by the United States government as consulting engineer on the Muscle Shoals nitrogen fixation development. During the war Mr. Cooper was commissioned colonel of engineers and placed in charge of all dock and wharf construction for the A. E. F. in France. Colonel Cooper was born April 28, 1865, at Rushford, Minn. He is a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Engineers' Club and the Railroad Club.

Synopsis of New Water-Power Law[*]

Purport and Main Provisions Succinctly Stated—Projected Developments Totaling More Than 4,000,000 Hp. Have Been Held Up Awaiting Passage of the Bill — Complete Text of the Measure

By **HENRY J. PIERCE**[†]
President Columbia Valley Reclamation Company, Seattle, Wash.

THE new water-power law, which received the signature of President Wilson on June 11, is the result of eight years of work by committees of Congress and is one of the greatest pieces of constructive legislation ever enacted by the federal government. Some think its terms are too restrictive to be inviting to capital, but practical water-power men consider it to be reasonably fair.

A federal power commission is created by this new law, to be composed of the Secretaries of War, the Interior and Agriculture. To this commission authority is delegated over all matters pertaining to the development of water powers in which the federal government has jurisdiction or in which it is interested as the owner of land or other property necessary to such undertakings. The commission may issue preliminary permits, allowing applicants three years in which to make examinations of water-power projects, to prepare plans and to make financial arrangements. The commission may also issue licenses for a period of fifty years from the expiration of preliminary permits. The commission may reserve projects the development of which in its opinion should be undertaken by the United States government and report to Congress its opinions and suggestions regarding them, and it must give preference to states and municipalities in cases where it deems different projects equally well adapted to utilize the water resources of the region concerned.

HENRY J. PIERCE

Encouragement is given to the building of headwater storage reservoirs with a view to equalizing power production, preventing floods, and in arid states promoting the use of water for irrigation purposes on the lowlands after the water has been utilized for the generation of power. Provision is made for the construction of locks in power dams in navigable streams with a view to extending navigation into the upper reaches of such waters.

At the expiration of the fifty-year license the government will have the option of purchasing the hydro-electric plants by paying the licensee his net investment in them, or it may issue a new license to the original licensee, upon reasonable terms, or to a new licensee, who shall in that event pay the original owner his net investment in the plant. Under the terms of the law the United States may take over and operate any water-power plant under license during time of war for manufacture of explosives or for any purpose involving the safety of the country. The commission is authorized to make reasonable charges to cover the administration of the act and for the use of government lands and property and to take up excess profits which cannot be reached through regulation. Licensees are placed under supervision of state public service commissions as to rates to be charged consumers for power, and also as to regulation of service. Severe penalties are provided for noncompliance with the terms of the act.

Through failure of Congress to pass water-power laws under which money could be safely invested with a prospect of a fair return, water powers now going to waste in navigable streams have been held back from development for years in at least twenty-two states of the Union. The best information obtainable is to the effect that developments are projected having a total capacity of more than 2,000,000 hp. The completion of these projects would open up to navigation more than 4,000 miles of the upper reaches of our streams and rivers. The cost of these river improvements, if undertaken by the government, would be upward of $800,000,000, but if accomplished by private capital for the purpose of power production, instead of through taxation, they would not cost the government a dollar except for the locks and removal of minor obstacles in those portions of the streams not connected with power development. Passage of the measure means the extension of navigation for an aggregate of 4,000 miles in thirty-five rivers, traversing twenty states, in such widely different sections of the country as Connecticut, Massachusetts, Pennsylvania, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Alabama, Georgia, Tennessee, Florida, Arkansas, Ohio, Kentucky, Missouri, Wisconsin,

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[*] A history of water-power legislation will be found in the ELECTRICAL WORLD for June 5, page 1328.

[†] Mr. Pierce has been associated more intimately probably with water-power legislation in the past seven years than any one else outside of official Washington. Mr. Pierce as president of the Columbia Valley Reclamation Company has desired to develop the now wasting water power of the Priest Rapids in the Columbia River, in the center of the State of Washington. This water power is situated in a desert country which has but 4 in. of rainfall per annum, but the soil, given water, will raise every crop that can be produced in the temperate zone. The Columbia Valley Reclamation Company owns the 12,000 acres of land which will be overflowed by the dam to be installed and has acquired all the necessary rights from the state. It also owns about 100,000 acres of agricultural land which it expects to bring under cultivation by water from that development. The capacity of this plant will be 300,000 all-the-year-round primary horsepower, and during the six months of the irrigation season the river rises sufficiently to develop another 300,000 hp. This auxiliary power can be used for agricultural purposes without disturbing in any way the primary power, which will be available for industrial uses, electrification of railroads and various other purposes.—EDITOR.

Minnesota, Washington and Idaho. In this way cheap water transportation would be afforded to districts now sparsely settled and congestion of traffic relieved in thickly populated centers through the investment of private capital instead of through river and harbor appropriations by Congress. It is believed that in addition to the above water-power projects others having an aggregate capacity of more than 2,000,000 hp. would be undertaken on non-navigable streams in the public domain in the States of Oregon, California, Montana, Nevada, Arizona, Wyoming, Colorado and Utah.

WATER-POWER DEVELOPMENT NOT A SECTIONAL CONCERN

To encourage water-power development is a national duty. It cannot be considered a local or a sectional question. It concerns every citizen of the United States, whether he dwells in the vicinity of a water power, in the city or upon the plains. The things used and consumed in every household are affected by the price at which those things can be produced under the cheapest of conditions. The cost of food, of clothing, of fertilizers, of explosives, and the convenience and facility of transportation, would all be beneficially affected by the development of water power to the utmost extent of its usefulness. Coal shortage shows the folly of having left unused the nation's vast resources of water power. The more these are developed the less desperate will be the fuel stringency. The waste is not alone one of money. It extends in its final direct result to public health and life itself, because these are affected by inability to get coal for heating and for the production of the necessities of life. Some experts estimate that at the present rate of coal consumption, and taking into consideration the increase that will come with access of population, all of our anthracite deposits and all of our high-grade deposits of bituminous coal will be exhausted within one hundred years. This statement has been denied more than once, but it is as strenuously affirmed.

The labor of one man is released for other uses every time 50 hydro-electric horsepower is developed, and every 150 hydro-electric horsepower developed releases one freight car from haulage for other duties.

WATER-POWER DEVELOPMENT IN EUROPE

Other countries are awake to the necessity of developing their water powers. A French corporation with $250,000,000 of capital is seeking funds in America to make possible the utilization of 700,000 hp. now wasting in the River Rhône, and incidentally these improvements will, through canalization, make it possible for steamers to go up the Rhône to its connection with the River Rhine and thence down the Rhine to the North Sea. Italy, which is virtually without coal, is about to develop her water powers on an immense scale. Spain is offering liberal concessions looking to the development of the water powers now wasting in the Pyrenees and other mountain ranges. Sweden is paying $46 per ton for coal, which she has to obtain from England, and is proceeding with the work of developing as much as possible of the entire 5,000,000 water horsepower contained within its boundaries. The enactment of the new water-power law places the United States in a position where it will not need to fall behind European countries in conserving its coal deposits and in developing the vast amount of cheap electrical energy contained in its wasting water power.

All the available water power in the United States should be developed in the quickest time possible, in the interest of the economic development of the country, of its social regeneration and of its wealth, and in order to permit it to obtain its share of the export markets of the world. Hydro-electric energy provides the means of saving coal, enabling electricity to be produced at a lower price and thus lowering in many cases industrial costs of production and improving agriculture. It will become the surest weapon in the economic struggle which faces us.

The new federal water-power law removes the sole cause which has prevented for fifteen years past the development of our wasting water powers. The removal, however, of federal government restrictions comes at a time when increased cost of labor and materials makes the expense of water-power development from two to three times what it would have been before the European war began, and scarcity of labor and material even at present prices will delay the work; but readjustment on a safer economic basis will undoubtedly come before long and enable this work of conservation to proceed.

The complete text of the bill follows, the section headings not being part of the act, but supplied by the ELECTRICAL WORLD:

AN ACT

To create a Federal Power Commission and to define its powers and duties, to provide for the improvement of navigation, for the development of water power, for the use of lands of the United States in relation thereto, to repeal Section 18 of "An act making appropriations for the construction, repair and preservation of certain public works on rivers and harbors, and for other purposes," approved Aug. 8, 1917, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That a commission is hereby created and established, to be known as the Federal Power Commission (hereinafter referred to as the commission), which shall be composed of the Secretary of War, the Secretary of the Interior and the Secretary of Agriculture. Two members of the commission shall constitute a quorum for the transaction of business, and the commission shall have an official seal, which shall be judicially noticed. The President shall designate the chairman of the commission.

The Executive Secretary

SEC. 2. That the commission shall appoint an executive secretary, who shall receive a salary of $5,000 a year, and prescribe his duties, and the commission may request the President of the United States to detail an officer from the United States Engineer Corps to serve the commission as engineer officer, his duties to be prescribed by the commission. The work of the commission shall be performed by and through the Departments of War, Interior and Agriculture and their engineering, technical, clerical and other personnel, except as may be otherwise provided by law.

All of the expenses of the commission, including rent in the District of Columbia, all necessary expenses for transportation and subsistence, including, in the discretion of the commission, a per diem of not exceeding $4 in lieu of subsistence incurred by its employees under its orders in making any investigation, or conducting field work, or upon official business outside of the District of Columbia and away from their designated points of duty, shall be allowed and paid on the presentation of itemized vouchers therefor approved by a member or officer of the commission duly authorized for that purpose; and in order to defray the expenses made necessary by the provisions of this act there is hereby authorized to be appropriated such sums as Congress may hereafter determine, and the sum of $100,000 is hereby appropriated, out of any moneys in the Treasury not otherwise appropriated, available until expended, to be paid out upon warrants drawn on the Secretary of the Treasury upon order of the commission.

Definition of Terms

SEC. 3. That the words defined in this section shall have the following meanings for the purposes of this act, to wit:

"Public lands" means such lands and interest in lands owned by the United States as are subject to private appropriation and disposal under public-land laws. It shall not include "reservations," as hereinafter defined.

"Reservations" means national monuments, national parks, national forests, tribal lands embraced within Indian reservations, military reservations and other lands and interests in lands owned by the United States, and withdrawn, reserved or withheld from private appropriation and disposal under the public-land laws; also lands and interests in lands acquired and held for any public purpose.

"Corporation" means a corporation organized under the laws of any state or of the United States empowered to develop, transmit, distribute, sell, lease or utilize power in addition to such other powers as it may possess and authorized to transact in the state or states in which its project is located all business necessary to effect the purpose of a license under this act. It shall not include "municipalities" as hereinafter defined.

"State" means a state admitted to the Union, the District of Columbia and any organized Territory of the United States.

"Municipality" means a city, county, irrigation district, drainage district or other political subdivision or agency of a state competent under the laws thereof to carry on the business of developing, transmitting, utilizing or distributing power.

"Navigable waters" means those parts of streams or other bodies of water over which

Congress has jurisdiction under its authority to regulate commerce with foreign nations and among the several states, and which either in their natural or improved condition, notwithstanding interruptions between the navigable parts of such streams or waters by falls, shallows or rapids compelling land carriage, are used or suitable for use for the transportation of persons or property in interstate or foreign commerce, including therein all such interrupting falls, shallows or rapids; together with such other parts of streams as shall have been authorized by Congress for improvement by the United States or shall have been recommended to Congress for such improvement after investigation under its authority.

"Municipal purposes" means and includes all purposes within municipal powers as defined by the constitution or laws of the state or by the charter of the municipality.

"Government dam" means a dam or other work, constructed or owned by the United States for government purposes, with or without contribution from others.

"Project" means complete unit of improvement or development, consisting of a power house, all water conduits, all dams and appurtenant works and structures (including navigation structures) which are a part of said unit, and all storage, diverting or forebay reservoirs directly connected therewith, the primary line or lines transmitting power therefrom to the point of junction with the distribution system or with the interconnected primary transmission system, all miscellaneous structures used and useful in connection with said unit or any part thereof, and all water rights, rights-of-way, ditches, dams, reservoirs, lands or interest in lands the use and occupancy of which are necessary or appropriate in the maintenance and operation of such unit.

"Project works" means the physical structures of a project.

"Net investment" in a project means the actual legitimate original cost thereof as defined and interpreted in the "classification of investment in road and equipment of steam roads, issue of 1914, Interstate Commerce Commission," plus similar costs of additions thereto and betterments thereof, minus the sum of the following items properly allocated thereto, if and to the extent that such items have been accumulated during the period of the license from earnings in excess of a fair return on such investment: (a) Unappropriated surplus, (b) aggregate credit balances of current depreciation accounts, and (c) aggregate appropriations of surplus or income held in amortization, sinking fund or similar reserves, or expended for additions or betterments or used for the purposes for which such reserves were created. The term "cost" shall include, in so far as applicable, the elements thereof prescribed in said classification, but shall not include expenditures from funds obtained through donations by states, municipalities, individuals or others, and said classification of investment of the Interstate Commerce Commission shall in so far as applicable be published and promulgated as a part of the rules and regulations of the commission.

Powers of the Commission

SEC. 4. That the commission is hereby authorized and empowered—

(a) To make investigations and to collect and record data concerning the utilization of the water resources of any region to be developed, the water-power industry and its relation to other industries and to interstate or foreign commerce, and concerning the location, capacity, development costs and relation to markets of power sites, and whether the power from government dams can be advantageously used by the United States for its public purposes, and what is a fair value of such power, to the extent the commission may deem necessary or useful for the purposes of this act. In order to aid the commission in determining the net investment of a licensee in any project, the licensee shall, upon oath, within a reasonable period of time, to be fixed by the commission, after the construction of the original project or any addition thereto or betterment thereof, file with the commission, in such detail as the commission may require, a statement in duplicate showing the actual legitimate cost of construction of such project, addition or betterment, and the price paid for water rights, rights-of-way, lands or interest in lands. The commission shall deposit one of said statements with the Secretary of the Treasury. The licensee shall grant to the commission or to its duly authorized agent or agents, at all reasonable times, free access to such project, addition or betterment, and to all maps, profiles, contracts, reports of engineers, accounts, books, records and all other papers and documents relating thereto.

(b) To co-operate with the executive departments and other agencies of state or national governments in such investigations; and for such purpose the several departments and agencies of the national government are authorized and directed upon the request of the commission, to furnish such records, papers and information in their possession as may be requested by the commission, and temporarily to detail to the commission such officers or experts as may be necessary in such investigations.

(c) To make public from time to time the information secured hereunder, and to provide for the publication of its reports and investigations in such form and manner as may be best adapted for public information and use. The commission, on or before the first Monday in December of each year, shall submit to Congress for the fiscal year preceding a classified report showing the permits and licenses issued under this act, and in each case the parties thereto, the terms prescribed and the moneys received, if any, on account thereof.

(d) To issue licenses to citizens of the United States or to any association of such citizens, or to any corporation organized under the laws of the United States or any state thereof, or to any state or municipality, for the purpose of constructing, operating and maintaining dams, water conduits, reservoirs, power houses, transmission lines or other project works necessary or convenient for the development and improvement of navigation, and for the development, transmission and utilization of power across, along, from or in any of the navigable waters of the United States, or upon any part of the public lands and reservations of the United States (including the Territories), or for the purpose of utilizing the surplus water or water power from any government dam, except as herein provided: Provided, that licenses shall be issued within any reservation only after a finding by the commission that the license will not interfere or be inconsistent with the purpose for which such reservation was created or acquired, and shall be subject to and contain such conditions as the Secretary of the department under whose supervision such reservation falls shall deem necesary for the adequate protection and utilization of such reservation: Provided, further, that no license affecting the navigable capacity of any navigable waters of the United States shall be issued until the plans of the dam or other structures affecting navigation have been approved by the Chief of Engineers and the Secretary of War. Whenever the contemplated improvement is, in the judgment of the commission, desirable and justified in the public interest for the purpose of improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, a finding to that effect shall be made by the commission and shall become a part of the records of the commission: Provided further, that in case the commission shall find that any government dam may be advantageously used by the United States for public purposes in addition to navigation, no license therefor shall be issued until two years after it shall have reported to Congress the facts and conditions relating thereto, except that this provision shall not apply to any government dam constructed prior to the passage of this act: And provided further that upon the filing of any application for a license which has not been preceded by a preliminary permit under subsection (e) of this section, notice shall be given and published as required by the proviso of said subsection.

(e) To issue preliminary permits for the purpose of enabling applicants for a license hereunder to secure the data and to perform the acts required by Section 9 hereof: Provided, however, that upon the filing of any application for a preliminary permit by any person, association or corporation the commission, before granting such application, shall at once give notice of such application in writing to any state or municipality likely to be interested in or affected by such application, and shall also publish notice of such application for eight weeks in a daily or weekly newspaper published in the county or counties in which the project or any part thereof or the lands affected thereby are situated.

(f) To prescribe rules and regulations for the establishment of a system of accounts and for the maintenance thereof by licensees hereunder; to examine all books and accounts of such licensees at any time; to require them to submit at such time or times as the commission may require statements and reports, including full information as to assets and liabilities, capitalization, net investment and reduction thereof, gross receipts, interest due and paid, depreciation and other reserves, cost of project, cost of maintenance and operation of the project, cost of renewals and replacements of the project works, and as to depreciation of the project works and as to production, transmission, use and sale of power; also to require any licensee to make adequate provision for currently determining said costs and other facts. All such statements and reports shall be made upon oath, unless otherwise specified, and in such form and on such blanks as the commission may require. Any person who, for the purpose of deceiving, makes or causes to be made any false entry in the books or the accounts of such licensee, and any person who, for the purpose of deceiving, makes or causes to be made any false statement or report in response to a request or order or direction from the commission for the statements and reports herein referred to, shall, upon conviction, be fined not more than $2,000 or imprisoned not more than five years, or both.

(g) To hold hearings and to order testimony to be taken by deposition at any designated place in connection with the application for any permit or license, or the regulation of rates, service or securities, or the making of any investigation, as provided in this act; and to require by subpoena, signed by any member of the commission, the attendance and testimony of witnesses and the production of documentary evidence from any place in the United States, and in case of disobedience to a subpoena the commission may invoke the aid of any court of the United States in requiring the attendance and testimony of witnesses and the production of documentary evidence. Any member, expert or examiner of the commission may, when duly designated by the commission for such purposes, administer oaths and affirmations, examine witnesses and receive evidence. Depositions may be taken before any person designated by the commission or by its executive secretary, and empowered to administer oaths, shall be reduced to writing by such person or under his direction and subscribed by the deponent. Witnesses summoned before the commission shall be paid the same fees and mileage that are paid witnesses in the courts of the United States, and witnesses whose depositions are taken and persons taking the same shall severally be entitled to the same fees as are paid for like services in the courts of the United States.

(h) To perform any and all acts, to make such rules and regulations and to issue such orders not inconsistent with this act as may be necessary and proper for the purpose of carrying out the provisions of this act.

Preliminary Permits

SEC. 5. That each preliminary permit issued under this act shall be for the sole purpose of maintaining priority of application for a license under the terms of this act for such period or periods, not exceeding a total of three years, as in the discretion of the commission may be necessary for making examinations and surveys, for preparing maps, plans, specifications and estimates, and for making financial arrangements. Each such permit shall set forth the conditions under which priority shall be maintained and a license issued. Such permits shall not be transferable and may be canceled by order of the commission upon failure of permittees to comply with the conditions thereof.

Fifty-Year Licenses

SEC. 6. That licenses under this act shall be issued for a period of not exceeding fifty years. Each such license shall be conditioned upon acceptance by the licensee of all the terms and conditions of this act and such further conditions, if any, as the commission shall prescribe in conformity with this act, which said terms and conditions and the acceptance thereof shall be expressed in said license. Licenses may be revoked only for the reasons and in the manner prescribed under the provisions of this act, and may be altered or surrendered only upon mutual agreement between the licensee and the commission after ninety days' public notice.

Preference to States and Municipalities

SEC. 7. That in issuing preliminary permits hereunder or licenses where no preliminary permit has been issued and in issuing licenses to new licensees under Section 15 hereof the commission shall give prefer- [illegible] municipalities, provided the plans for the same are deemed by the commission equally [illegible] time to be fixed by the commission be made equally well adapted, to conserve and utilize in the public interest the navigation and water resources of the region; and as between other applicants, the commission may give preference to the applicant the plans of which it finds and determines are best adapted to develop, conserve and utilize in the public interest the navigation and water resources of the region, if it be satisfied as to the ability of the applicant to carry out such plans.

That whenever, in the judgment of the commission, the development of any project should be undertaken by the United States itself, the commission shall not approve any application for such project by any citizen, association, corporation, state or municipality, but shall cause to be made such examinations, surveys, reports, plans and estimates of the cost of the project as it may deem necessary, and shall submit its findings to Congress with such recommendations as it may deem appropriate concerning the construction of such project or completion of any project upon any government dam by the United States.

The commission is hereby authorized and directed to investigate and, on or before the first day of January, 1921, report to Congress the cost and, in detail, the economic value of the power plant outlined in project numbered three, House Document numbered 1400, Sixty-second Congress, third session, in view of existing conditions, utilizing such study as may heretofore have been made by any department of the government; also in connection with such project to submit plans and estimates of cost necessary to secure an increased and adequate water supply for the District of Columbia. For this purpose the sum of $25,000, or so much thereof as may be necessary, is hereby appropriated.

Transfer of Licenses

SEC. 8. That no voluntary transfer of any license, or of the rights thereunder granted, shall be made without the written approval of the commission; and any successor or assign of the rights of such licensee, whether by voluntary transfer, judicial sale, foreclosure sale or otherwise, shall be subject to all the conditions of the license under which such rights are held by such licensee and also subject to all the provisions and conditions of this act to the same extent as though such successor or assign were the original licensee hereunder: Provided, that a mortgage of trust deed or judicial sales made thereunder or under tax sales shall not be deemed voluntary transfers within the meaning of this section.

Information Required of Applicants

SEC. 9. That each applicant for a license hereunder shall submit to the commission—

(a) Such maps, plans, specifications and estimates of cost as may be required for a full understanding of the proposed project. Such maps, plans and specifications when approved by the commission shall be made a part of the license; and thereafter no change shall be made in said maps, plans or specifications until such changes shall have been approved and made a part of such license by the commission.

(b) Satisfactory evidence that the applicant has complied with the requirements of the laws of the state or states within which the proposed project is to be located with respect to bed and banks and to the appropriation, diversion and use of water for power purposes and with respect to the right to engage in the business of developing, transmitting, and distributing power, and in any other business necessary to effect the purposes of a license under this act.

(c) Such additional information as the commission may require.

Conditions of Licenses

SEC. 10. That all licenses issued under this act shall be on the following conditions:

(a) That the project adopted, including the maps, plans and specifications, shall be such as in the judgment of the commission will be best adapted to a comprehensive scheme of improvement and utilization for the purposes of navigation, of water-power development and of other beneficial public uses; and if necessary in order to secure such scheme the commission shall have authority to require the modification of any project and of the plans and specifications of the project works before approval.

(b) That except when emergency shall require for the protection of navigation, life, health or property, no substantial alteration or addition not in conformity with the approved plans shall be made to any dam or other project works constructed hereunder of a capacity in excess of one hundred horsepower without prior approval of the commission; and any emergency alteration or addition so made shall thereafter be subject to such modification and changes as the commission may direct.

(c) That the licensee shall maintain the project works in a condition of repair adequate for the purposes of navigation and for the efficient operation of said works in the development and transmission of power, shall make all necessary renewals and replacements, shall establish and maintain adequate depreciation reserves for such purposes, shall so maintain and operate said works as not to impair navigation, and shall conform to such rules and regulations as the commission may from time to time prescribe for the protection of life, health and property. Each licensee hereunder shall be liable for all damages occasioned to the property of others by the construction, maintenance or operation of the project works, or of the works appurtenant or accessory thereto, constructed under the license, and in no event shall the United States be liable therefor.

(d) That after the first twenty years of operation out of surplus earned thereafter, if any, accumulated in excess of a specified reasonable rate of return upon the actual, legitimate investment of a licensee in any project or projects under license the licensee shall establish and maintain amortization reserves, which reserves shall, in the discretion of the commission, be held until the termination of the license or be applied from time to time in reduction of the net investment. Such specified rate of return and the proportion of such surplus earnings to be paid into and held in such reserves shall be set forth in the license.

(e) That the licensee shall pay to the United States reasonable annual charges in an amount to be fixed by the commission for the purpose of reimbursing the United States for the costs of the administration of this act; for recompensing it for the use, occupancy and enjoyment of its lands or other property, and for the expropriation to the government of excessive profits until the respective states shall make provision for preventing excessive profits or for the expropriation thereof to themselves, or until the period of amortization as herein provided is reached, and in fixing such charges the commission shall seek to avoid increasing the price to the consumers of power by such charges, and charges for the expropriation of excessive profits may be adjusted from time to time by the commission as conditions may require: Provided, that when licenses are issued involving the use of government dams or other structures owned by the United States or tribal lands embraced within Indian reservations the commission shall fix a reasonable annual charge for the use thereof, and such charges may be readjusted at the end of twenty years after the beginning of operations and at periods of not less than ten years thereafter in a manner to be described in each license: Provided, that licenses for the development, transmission or distribution of power by states or municipalities shall be issued and enjoyed without charge to the extent such power is sold to the public without profit or is used by such state or municipality for state or municipal purposes except that as to projects constructed or to be constructed by states or municipalities primarily designed to provide or improve navigation licenses therefor shall be issued without charge; and that licenses for the development, transmission or distribution of power for domestic, mining or other beneficial use in projects of not more than one hundred horsepower capacity may be issued without charge except on tribal lands within Indian reservations; but in no case shall a license be issued free of charge for the development and utilization of power created by any government dam, and that the amount charged therefor in any license shall be such as determined by the commission.

(f) That whenever any licensee hereunder is directly benefited by the construction work of another licensee, a permittee, or of the United States of a storage reservoir or other headwater improvement, the commission shall require as a condition of the license that the licensee so benefited shall reimburse the owner of such reservoir or other improvement for such part of the annual charges for interest, maintenance and depreciation thereon as the commission may deem equitable. The proportion of such charges to be paid by any licensee shall be determined by the commission. Whenever such reservoir or other improvement is constructed by the United States the commission shall assess similar charges against any licensee directly benefited thereby, and any amount so assessed shall be paid into the Treasury of the United States, to be reserved and appropriated as a part of the special fund for headwater improvement as provided in Section 17 hereof.

(g) Such further conditions not inconsistent with the provisions of this act as the commission may require.

(h) That combinations, agreements, arrangements or understandings, express or implied, to limit the output of electrical energy, to restrain trade, or to fix, maintain or increase prices for electrical energy or service are hereby prohibited.

(i) In issuing licenses for a minor part only of a complete project, or for a complete project of not more than one hundred horespower capacity, the commission may in its discretion waive such conditions, provisions and requirements of this act, except the license period of fifty years, as it may deem to be to the public interest to waive under the circumstances: Provided, that the provisions hereof shall not apply to lands within Indian reservations.

Promotion of Needs of Navigation

SEC. 11. That if the dam or other project works are to be constructed across, along or in any of the navigable waters of the United States, the commission may, in so far as it deems the same reasonably necessary to promote the present and future needs of navigation and consistent with a reasonable investment cost to the licensee, include in the license any one or more of the following provisions or requirements:

(a) That such licensee shall, to the extent necessary to preserve and improve navigation facilities, construct, in whole or in part, without expense to the United States, in connection with such dam, a lock or locks, booms, sluices or other structures for navigation purposes, in accordance with plans and specifications approved by the Chief of Engineers and the Secretary of War and made part of such license.

(b) That in case such structures for navigation purposes are not made a part of the original construction at the expense of the licensee, then whenever the United States shall desire to complete such navigation facilities the licensee shall convey to the United States, free of cost, such of its land and its rights-of-way and such right of passage through its dams or other structures, and permit such control of pools as may be required to complete such navigation facilities.

(c) That such licensee shall furnish free of cost to the United States power for the operation of such navigation facilities, whether constructed by the licensee or by the United States.

Construction of Locks

SEC. 12. That whenever application is filed for a project hereunder involving navigable waters of the United States, and the commission shall find upon investigation that the needs of navigation require the construction of a lock or locks or other navigation structures, and that such structures cannot, consistent with a reasonable investment cost to the applicant, be provided in the manner specified in Section 11, Subsection (a) hereof, the commission may grant the application with the provision to be expressed in the license that the licensee will install the necessary navigation structures if the government fails to make provision therefor within a time to be fixed in the license and cause a report upon such project to be prepared, with estimates of cost of the power of development and of the navigation structures, and shall submit such report to Congress with such recommendations as it deems appropriate concerning the participation of the United States in the cost of construction of such navigation structures.

Two-Year Limit for Beginning Works

SEC. 13. That the licensee shall commence the construction of the project works within the time fixed in the license, which shall not be more than two years from the date thereof, shall thereafter in good faith and with due diligence prosecute such construction, and shall within the time fixed in the license complete and put into operation such part of the ultimate development as the commission shall deem necessary to supply the reasonable needs of the then available market, and shall from time to time thereafter construct such portion of the balance of such development as the commission may direct, so to supply adequately the reasonable market demands until such development shall have been completed. The periods for the commencement of construction may be extended once but not longer than two additional years, and the period for the completion of construction carried on in good faith and with reasonable diligence may be extended by the commission when not incompatible with the public interests. In case the licensee shall not commence actual construction of the project works, or of any specified part thereof, within the time prescribed in the license or as extended by the commission, then, after due notice given, the license shall, as to such project works or part thereof, be terminated upon written order of the commission. In case the construction of the project works, or of any specified part thereof, have been begun but not completed within the time prescribed in the license, or as extended by the commission, then the Attorney General, upon the request of the commission, shall institute proceedings in equity in the district court of the United States for the district in which any part of the project is situated for the revocation of said license, the sale of the works constructed and such other equitable relief as the case may demand, as provided for in Section 26 hereof.

Privilege of Recapture by United States

SEC. 14. That upon not less than two years' notice in writing from the commission the United States shall have the right upon, on or after the expiration of any license, to take over and thereafter to maintain and operate any project or projects as defined in Section 3 hereof, and covered in whole or in part by the license, or the right to take over upon mutual agreement with the licensee all property owned and held by the licensee then valuable and serviceable in the development, transmission or distribution of power and which is then dependent for its usefulness upon the continuance of the license, together with any lock or locks or other aids to navigation constructed at the expense of the licensee, upon the condition that before taking possession it shall pay the net investment of the licensee in the project or projects taken, not to exceed the fair value of the property taken, plus such reasonable damages, if any, to property of the licensee valuable, serviceable and dependent as above set forth, but not taken, as may be caused by the severance therefrom of property taken, and shall assume all contracts entered into by the license with the approval of the commission. The net investment of the licensee in the project or projects so taken and the amount of such severance damages, if any, shall be determined by agreement between the commission and the licensee, and in case they can not agree, by proceedings in equity instituted by the United States in the district court of the United States in the district within which any such property may be located: Provided, that such net investment shall not include or be affected by the value of any lands, rights-of-way or other property of the United States licensed by the commission under this act, by the license, or by good will, going value or prospective revenues: Provided further, that the values allowed for water rights, rights-of-way, lands or interest in lands shall not be in excess of the actual reasonable cost thereof at the time of acquisition by the licensee: Provided, that the right of the United States or any state or municipality to take over, maintain and operate any project licensed under this act at any time by condemnation proceedings upon payment of just compensation is hereby expressly reserved.

Provision for New License

SEC. 15. That if the United States does not, at the expiration of the original license, exercise its right to take over, maintain and operate any project or projects of the licensee, as provided in Section 14 hereof, the commission is authorized to issue a new license to the original licensee upon such terms and conditions as may be authorized or required under the then existing laws and regulations, or to issue a new license under said terms and conditions to a new licensee, which license may cover any project or projects covered by the original license, and shall be issued on the condition that the new licensee shall, before taking possession of such project or projects, pay such amount and assume such contracts as the United States is required to do, in the manner specified in Section 14 hereof: Provided, that in the event the United States does not exercise the right to take over or does not issue a license to a new licensee, or issue a new license to the original licensee, upon reasonable terms, then the commission shall issue from year to year an anual license to the then licensee under the terms and conditions of the original license until the property is taken over or a new license is issued as aforesaid.

War Powers of Government

SEC. 16. That when in the opinion of the President of the United States, evidenced by a written order addressed to the holder of any license hereunder, the safety of the United States demands it, the United States shall have the right to enter upon and take possession of any project or part thereof, constructed, maintained or operated under said license, for the purpose of manufacturing nitrates, explosives or munitions of war, or for any other purpose involving the safety of the United States, to retain possession, management and control thereof for such length of time as may appear to the President to be necessary to accomplish said purposes, and then to restore possession and control to the party or parties entitled thereto; and in the event that the United States shall exercise such right it shall pay to the party or parties entitled thereto just and fair compensation for the use of said property as may be fixed by the commission upon the basis of a reasonable profit in time of peace, and the cost of restoring said property to as good condition as existed at the time of the taking over thereof, less the reasonable value of any improvements that may be made thereto by the United States and which are valuable and serviceable to the licensee.

Indian Reservation Proceeds

SEC. 17. That all proceeds from any Indian reservation shall be placed to the credit of the Indians of such reservation. All other charges arising from licenses hereunder shall be paid into the Treasury of the United States, subject to the following distribution: Twelve and one-half per centum thereof is hereby appropriated to be paid into the Treasury of the United States and credited to "miscellaneous receipts"; 50 per centum of the charges arising from licenses hereunder for the occupancy and use of public lands, national monuments, national forests and national parks shall be paid into, reserved and appropriated as a part of the reclamation fund created by the act of Congress known as the reclamation act, approved June 17, 1902; and 37½ per centum of the charges arising from licenses hereunder for the occupancy and use of national forests, national parks, public lands and national monuments, from development within the boundaries of any state, shall be paid by the Secretary of the Treasury to such state; and 50 per centum of the charges arising from all other licenses hereunder is hereby reserved and appropriated as a special fund in the Treasury to be expended under the direction of the Secretary of War in the maintenance and operation of dams and other navigation structures owned by the United States or in the construction, maintenance or operation of headwater or other improvements of navigable waters of the United States.

Operation of Navigation Facilities

SEC. 18. That the operation of any navigation facilities which may be constructed as a part of or in connection with any dam or diversion structure built under the provisions of this act, whether at the expense of a licensee hereunder or of the United States, shall at all times be controlled by such reasonable rules and regulations in the interest of navigation, including the control of the level of the pool caused by such dam or diversion structure, as may be made from time to time by the Secretary of War. Such rules and regulations may include the maintenance and operation by such licensee at its own expense of such lights and signals as may be directed by the Secretary of War and such fishways as may be prescribed by the Secretary of Commerce; and for willful failure to comply with any such rule or regulation such licensee shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished as provided in Section 25 hereof.

Regulation of Rates and Charges

SEC. 19. That as a condition of the license every licensee hereunder which is a public service corporation or a person, association or corporation owning or operating any project and developing, transmitting or distributing power for sale or use in public service shall abide by such reasonable regulation of the services to be rendered to customers or consumers of power, and of rates and charges of payment therefor, as may from time to time be prescribed by any duly constituted agency of the state in which the service is rendered or the rate charged. That in case of the development, transmission or distribution or use in public service of power by any licensee hereunder or by its customer engaged in public service within a state which has not authorized and empowered a commission or other agency or agencies within said state to regulate and control the services to be rendered by such licensee or by its customer engaged in public service, or the rates and charges of payment therefor, or the amount or character of securities to be issued by any of said parties, it is agreed as a condition of such license that jurisdiction is hereby conferred upon the commission, upon complaint of any person aggrieved or upon its own initiative, to exercise such regulation and control until such time as the state shall have provided a commission or other authority for such regulation and control: Provided that the jurisdiction of the commission shall cease and determine as to each specific matter of regulation and control prescribed in this section as soon as the state shall have provided a commission or other authority for the regulation and control of that specific matter.

Interstate and Foreign Commerce

SEC. 20. That when said power or any part thereof shall enter into interstate or foreign commerce the rates charged and the service rendered by any such licensee, or by any subsidiary corporation the stock of which is owned or controlled directly or indirectly by such licensee, or by any person, corporation or association purchasing power from such licensee for sale and distribution or use in public service, shall be reasonable, non-discriminatory and just to the customer and all unreasonable, discriminatory and unjust rates of services are hereby prohibited and declared to be unlawful; and whenever any of the states directly concerned has not provided a commission or other authority to enforce the requirements of this section within such state or to regulate and control the amount and character of securities to be issued by any of such parties, or such states are unable to agree through their properly constituted authorities on the services to be rendered or on the rates or charges of payment therefor, or on the amount or character of securities to be issued by any of said parties, jurisdiction is hereby conferred upon the commission, upon complaint of any person aggrieved, upon the request of any state concerned, or upon its own initiative, to enforce the provisions of this section, to regulate and control so much of the services rendered and of the rates and charges of payment therefor as constitute interstate or foreign commerce and to regulate the issuance of securities by the parties included within this section, and securities issued by the licensee subject to such regulations shall be allowed only for the bona fide purpose of financing and conducting the business of such licensee.

The administration of the provisions of this section, so far as applicable, shall be according to the procedure and practice in fixing and regulating the rates, charges and practices of railroad companies as provided in the act to regulate commerce, approved Feb. 4, 1887, as amended, and that the parties subject to such regulation shall have the same rights of hearing, defense and review as said companies in such cases.

In any valuation of the property of any licensee hereunder for purposes of rate-making no value shall be claimed by the licensee or allowed by the commission for any project or projects under license in excess of the value or values prescribed in Section 14 hereof for the purposes of purchase by the United States, but there shall be included the cost to such licensee of the construction of the lock or locks or other aids of navigation and all other capital expenditures required by the United States, and no value shall be claimed or allowed for the rights granted by the commission or by this act.

Right of Eminent Domain

SEC. 21. That when any licensee cannot acquire by contract or pledges an unimproved dam site or the right to use or damage the lands or property of others necessary to the construction, maintenance or operation of any dam, reservoir, diversion structure or the works appurtenant or accessory thereto, in conjunction with an improvement which in the judgment of the commission is desirable and justified in the public interest for the purpose of improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, it may acquire the same by the exercise of the right of eminent domain in the district court of the United States for the district in which such land or other property may be located, or in the state courts. The practice and procedure in any action or proceeding for that purpose in the district court of the United States shall conform as nearly as may be with the practice and procedure in similar action or proceeding in the courts of the state where the property is situated: Provided, that United States district courts shall only have jurisdiction of cases when the amount claimed by the owner of the property to be condemned exceeds $3,000.

Extension of Contracts

SEC. 22. That whenever the public interest requires or justifies the execution by the licensee of contracts for the sale and delivery of power for periods extending beyond the date of termination of the license, such contracts may be entered into upon the joint approval of the commission and of the public service commission or other similar authority in the state in which the sale or delivery of power is made, or if sold or delivered in a state which has no such public service commission, then upon the approval of the commission, and thereafter, in the event of failure to issue a new license to the original licensee at the termination of the license, the United States or the new licensee, as the case may be, shall assume and fulfill all such contracts.

Existing Permits and Rights-of-Way Not Affected

SEC. 23. That the provisions of this act shall not be construed as affecting any permit or valid existing rights-of-way heretofore granted, or as confirming or otherwise affecting any claim or as affecting any authority heretofore given pursuant to law, but any person, association, corporation, state or municipality holding or possessing such permit, right-of-way or authority may apply for a license hereunder, and upon such application the commission may issue to any such applicant a license in accordance with the provisions of this act, and in such case the provisions of this act shall apply to such applicant as a licensee hereunder: Provided, that when application is made for a license under this section for a project or projects already constructed, the fair value of said project or projects, determined as provided in this section, shall for the purposes of this act and of said license be deemed to be the amount to be allowed as the net investment of the applicant in such project or projects as of the date of such license, or as of the date of such determination, if license has not been issued. Such fair value may, in the discretion of the commission, be determined by mutual agreement between the commission and the applicant, or, in case they cannot agree, jurisdiction is hereby conferred upon the district court of the United States in the district within which such project or projects may be located, upon the application of either party, to hear and determine the amount of such fair value.

That any person, association, corporation, state or municipality intending to construct a dam or other project works across, along, over or in any stream or part thereof, other than those defined herein as navigable waters and over which Congress has jurisdiction under its authority to regulate commerce between foreign nations and among the several states, may in their discretion file declaration of such intention with the commission, whereupon the commission shall cause immediate investigation of such proposed construction to be made, and if upon investigation it shall find that the interests of interstate or foreign commerce would be affected by such proposed construction, such person, association, corporation, state or municipality shall not proceed with such construction until it shall have applied for and shall have received a license under the provisions of this act. If the commission shall not so find, and if no public lands or reservations are affected, permission is hereby granted to construct such dam or other project works in such stream upon compliance with state laws.

Reservation of Land Applied For Against Entry

SEC. 24. That any lands of the United States included in any proposed project under the provisions of this act shall from the date of filing of application therefor be reserved from entry, location or other disposal under the laws of the United States until otherwise directed by the commission or by Congress. Notice that such application has been made, together with the date of filing thereof and a description of the lands of the United States affected thereby, shall be filed in the local land office for the district in which such lands are located. Whenever the commission shall determine that the value of any lands of the United States so applied for, or heretofore or hereafter reserved or classified as power sites, will not be injured or destroyed for the purposes of power development by location, entry or selection under the public land laws, the Secretary of the Interior, upon notice of such determination, shall declare such lands open to location, entry or selection, subject to and with a reservation of the right of the United States or its permittees or licensees to enter upon, occupy and use any part or all of said lands necessary, in the judgment of the commission, for the purposes of this act, which right shall be expressly reserved in every patent issued for such lands; and no claim or right to compensation shall accrue from the occupation or use of any of said lands for said purposes. The United States or any licensee for any such lands hereunder may enter thereupon for the purposes of this act, upon payment of any damages to crops, buildings or other improvements caused thereby to the owner thereof, or upon giving a good and sufficient bond to the United States for the use and benefit of the owner to secure the payment of such damages as may be determined and fixed in an action brought upon the bond in a court of competent jurisdiction, said bond to be in the form prescribed by the commission: Provided, that locations, entries, selections or filings heretofore made for lands reserved as water-power sites or in connection with water-power development or electrical transmission may proceed to approval or patent under and subject to the limitations and conditions in this section contained.

Penalty for Non-Compliance

SEC. 25. That any licensee or any person who shall willfully fail or who shall refuse to comply with any of the provisions of this act, or with any of the conditions made a part of any license issued hereunder, or with any subpoena of the commission, or with any regulation or lawful order of the commission, or of the Secretary of War, or of the Secretary of Commerce as to fishways, issued or made in accordance with the provisions of this act, shall be deemed guilty of a misdemeanor, and on conviction thereof shall, in the discretion of the court, be punished by a fine of not exceeding $1,000, in addition to other penalties herein prescribed or provided by law; and every month any such licensee or any such person shall remain in default after written notice from the commission, or from the Secretary of War, or from the Secretary of Commerce, shall be deemed a new and separate offense punishable as aforesaid.

Revocation of Permits or Licenses

SEC. 26. That the Attorney General may, on request of the commission or of the Secretary of War, institute proceedings in equity in the district court of the United States in the district in which any project or part thereof is situated for the purpose of revoking for violation of its terms any permit or license issued hereunder, or for the purpose of remedying or correcting by injunction, mandamus or other process any act of commission or omission in violation of the provisions of this act or of any lawful regulation or order promulgated hereunder. The district courts shall have jurisdiction over all of the above-mentioned proceedings and shall have power to issue and execute all necessary process and to make and enforce all writs, orders and decrees to compel compliance with the lawful orders and regulations of the commission and of the Secretary of War, and to compel the performance of any condition imposed under the provisions of this act. In the event a decree revoking a license is entered, the court is empowered to sell the whole or any part of the project or projects under license, to wind up the business of such licensee conducted in connection with such project or projects, to distribute the proceeds to the parties entitled to the same, and to make and enforce such further orders and decrees as equity and justice may require. At such sale or sales the vendee shall take the rights and privileges belonging to the licensee and shall perform the duties of such licensee and assume all outstanding obligations and liabilities of the licensee which the court may deem equitable in the premises; and at such sale or sales the United States may become a purchaser, but it shall not be required to pay a greater amount than it would be required to pay under the provisions of Section 14 hereof at the termination of the license.

State Laws Not Interfered With

SEC. 27. That nothing herein contained shall be construed as affecting or intending to affect or in any way to interfere with the laws of the respective states relating to the control, appropriation, use or distribution of water used in irrigation or for municipal or other uses, or any vested right acquired therein.

Right to Amend or Repeal Law

SEC. 28. That the right to alter, amend or repeal this act is hereby expressly reserved; but no such alteration, amendment or repeal shall affect any licensee theretofore issued under the provisions of this act or the rights of any licensee thereunder.

San Francisco Rights Maintained

SEC. 29. That all acts or parts of acts inconsistent with this act are hereby repealed: Provided, that nothing herein contained shall be held or construed to modify or repeal any of the provisions of the act of Congress approved Dec. 19, 1913, granting certain rights-of-way to the city and county of San Francisco, in the State of California: Provided further, that Section 18 of an act making appropriations for the construction, repair and preservation of certain public works on rivers and harbors, and for other purposes, approved Aug. 8, 1917, is hereby repealed.

UPWARD OF 2,000,000 KW. WILL BE DEVELOPED ON GOVERNMENT LAND AS A RESULT OF THIS LEGISLATION

Metal Deposition in Arc Welding—I

Mechanism of Metal Transfer from Electrode to Plate Is Explained by the Aid of Photography —Evidence Indicates that 85 Per Cent of Metal Is Carried Across Arc in Liquid Form by Molecular Forces

By O. H. ESCHHOLZ
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THE flow of metal from a wire electrode across the arc to the surface of the fused members is distinctive of metallic electrode arc welding. The phenomena of metal transport, therefore, must be of fundamental importance in the determination of weld and circuit characteristics. As this view is receiving increasing consideration by electrode manufacturers, apparatus designers and welding engineers, the author submits a few pertinent observations with the hope of stimulating further discussion and investigation.

The conversion of electrical to thermal energy is a well-known characteristic of the arc. The concentration of this energy at the terminal of the wire electrode causes an intermittent flow of metal across the arc stream. Careful examination of the performance of a variety of bare electrode wires indicates that metal transfer may be accomplished in part by:

1. Vaporization and condensation of electrode material.
2. Expulsion of vaporized and liquefied metal by the expansion of gases confined or generated in the electrode ends.
3. Transport of liquefied metal due to the forces of molecular attraction, gravity, surface tension, adhesion, cohesion.

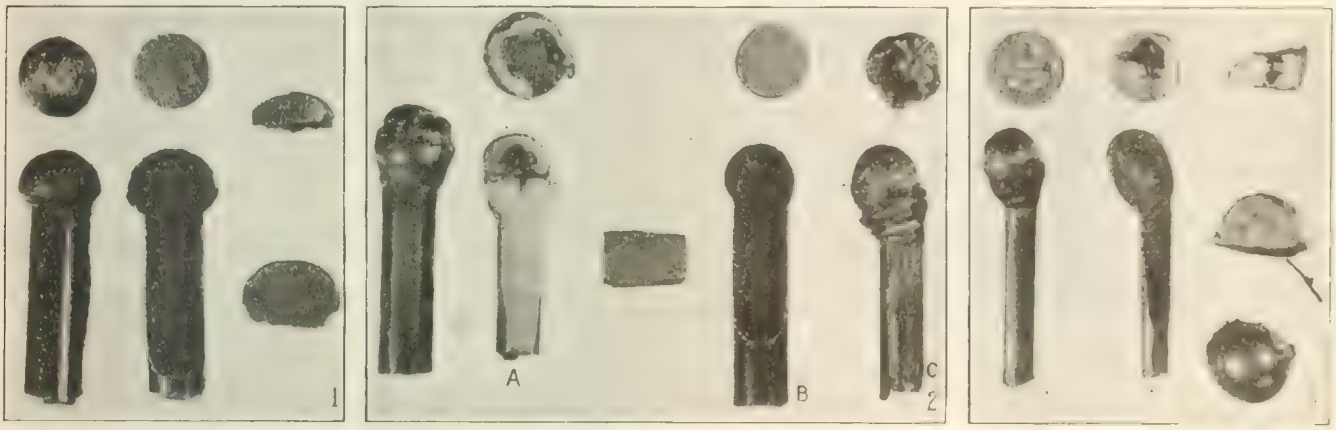
While all three of these means are available for the deposition of metal, it is the author's conclusion that under good welding conditions at least 85 per cent of the deposited metal is transmitted in liquid form through the action of molecular forces.

Proportion of Electrode Vaporized Is Small

The importance of this factor may be evaluated by determining the rate at which the filler or wire electrode metal is consumed and comparing the energy absorbed at the bare wire, negative electrode terminal with that obtained by calculating the energy necessary to vaporize an equivalent amount of metal.

It has been found by test on welding with an 18-volt, 150-amp. arc that a mild steel electrode, 5/32-in. (3.9 mm.) in diameter, is consumed at the rate of 3.1 lb. (1.4 kg.) per hour. The distribution of arc voltage is estimated to be as follows: Anode drop, 9 volts; cathode drop, 7 volts; arc-stream drop, 2 volts.

The energy input at the negative arc terminal is, therefore, of the order of 1,200,000 watt-seconds per pound of electrode metal. The energy required just to vaporize one pound of iron is of the order of 3,100,000 watt-seconds, assuming a boiling point of 2,450 deg. C., a latent heat of fusion of 1,120 therm-grams and a specific heat of liquid iron of 0.20. It is at once evident that under normal welding conditions only a small proportion of the electrode metal may be vaporized. Overhead welding tests in which the choice of electrodes and arc length were such as practically to eliminate metal transfer due to gas expansion or molecular attraction indicated the amount of metal deposited by condensation to be of the order of 5 per cent. A reasonable estimate of the distribution of negative arc terminal energy on welding downward appears to be as follows:



FIGS. 1 AND 2—APPEARANCE OF ELECTRODES AND GLOBULES FOR DIFFERENT MATERIALS. FIG. 3—CAVITIES PRODUCED BY SLAG AND OCCLUDED GASES IN ELECTRODES

Fig. 1—Solid section and regular globules obtained with ⅛-in. drill rod. Fig. 2—Results with mild steel wire: (A) Oxidized appearance when arc is broken in air. Deposited metal, however, is solid. (B) Section free from cavities when arc is broken in inert or reducing atmosphere. (C) Arc broken in air. Well-defined line between solid and oxidized metal indicates zone of oxygen penetration. Fig. 3—The cavities formed in the deposited metal are produced by slag and gases contained in electrode.

	Watt-Secs.	Energy, Per cent
Liquefaction (2,000 deg. C.) of 90 per cent of wire electrode	[illegible]	[illegible]
Vaporization (2,450 deg. C.) of 10 per cent of wire consumed	[illegible]	[illegible]
Radiation, conduction, convection losses	[illegible]	14
Approximate energy per pound of wire electrode consumed	1,200,000	100

This effect is present to some degree in all commercial welding wires. It is well known that metals absorb gases readily, the quantity varying greatly with their characteristics, preparation and exposure. Iron has been found to contain under some conditions fifty times its volume of gas. Upon striking an arc with electrodes high in occluded gas, the pressure obtained by the rapid expansion of the confined atmosphere exerts a propulsive force on the inclosing fluid metal, scattering it approximately radially from the electrode end. This may be confirmed by dipping a welding rod in an acid (H_2SO_4, HCl, etc.) for a few minutes to permit the occlusion of hydrogen and then striking an arc. An increase in the volume and agitation of arc gases, as well as scattering of metal, may be observed at once. This performance characterizes an abnormal electrode. Tests made with electrodes high in various occluded gases have failed to indicate an increased deposition rate due to the functioning of the gaseous blasts. Moreover, the emission of such blasts distinctly served to destabilize the arc stream and thereby prevent the maintenance of a short arc length, particularly essential for overhead welding.

Some electrode wires contain relatively large quantities of included iron oxide and slag. Upon heating the electrode end such impurities disintegrate and liberate oxygen, which then combines with the carbon present to form carbon monoxide and carbon dioxide. The expansion of these generated gases tends also to propel the fluid metal across the arc stream. However, again no increased deposition rate was evident during test owing to metal transferred in pellet form. It is characteristic of low carbon steels that the metal becomes pasty over a critical temperature range. This condition permits the influx of oxygen with the resultant generation and expansion of gases in the interior of the electrode terminal. This effect is obtainable, apparently, to an appreciable degree only upon welding with a long arc.

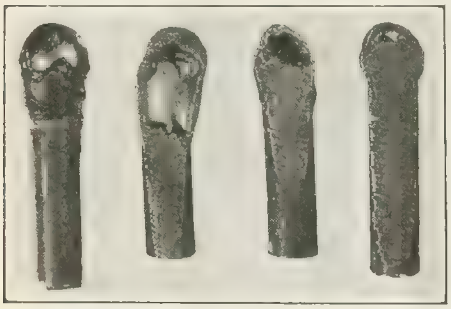


FIG. 4—RESULTS WITH LONG ARC, OXIDIZING ATMOSPHERE AND LOW-CARBON ELECTRODES

Expansion of occluded or generated gases occurs to only a slight degree when holding a short arc length with wires that comply with the specification drawn by the American Welding Society. The effect obtained is not explosive in action, but may be described as a slow enlargement of the globular electrode terminal. Expansive forces of this order appear to aid metal deposition by decreasing the forces of cohesion and surface tension retaining the globule on the end of the wire electrode. If the arc is interrupted in a neutral atmosphere the globular electrode tip may be observed to decrease in size, owing to the diffusion of confined gases and shrinking of the liquid metal.

When the use of welding wires high in occluded or generated gases is unavoidable, the arc should be stabilized by coating the electrode with a flux, increasing the circuit voltage or reactance. Metal plates, shapes, etc., are also found occasionally with a high gas content, particularly if they have been preheated in a gas furnace. This condition may be recognized by a vicious, snapping, sputtering arc, frequent arc interruption and tendency for the arc stream to move rapidly from the initial point of electrode contact. Welding conditions may be improved by the use of a very short arc, blocks of copper or like material on both sides of the zone to be welded, flux-covered electrodes and increased circuit voltage or reactance.

MOLECULAR FORCES CAUSING DEPOSITION

Most of the pencil electrode metal appears to be transported and deposited in globular, liquid form, upon either welding downward or overhead, when the electrode current density is of the order of 8,000 amp. per square inch. The metal transfer appears to be accomplished by:

A. *Downward Welding* (1) *Long Arc.*—Formation and growth of a liquid globule at electrode terminal until its weight, or gravitational force, exceeds the sum of the forces of surface tension and cohesion, tending to retain the globule at the electrode.

(2) *Short Arc.*—Growth of globular end until contact is made with a wetted surface (plate metal liquefied by anode energy), the forces of adhesion and surface tension at the plate surface then assisting the gravitational force in drawing the globule to the plate.

B. *Overhead Welding* (1) *Long Arc.*—Slight deposition due only to condensation of vaporized metal or pellet impact.

(2) *Short Arc.*—Globular growth until contact is made with liquefied plate or deposit surface, whereupon the forces of adhesion and surface tension at the plate overcome the combined forces of gravitation, cohesion and surface tension acting to hold the globule to the electrode surface.

CHARACTERISTICS OF DIFFERENT ELECTRODE MATERIALS

Globular formation at electrode terminal is characteristic of bare, coated and covered wires. The size, appearance and homogeneity of such globules vary greatly with wire analysis, diameter, covering, polarity, current density, arc length, impurities and perhaps mechanical working and heat treatment. Bare electrodes that have been examined by the author may be classified in four groups.

Group 1.—The globular formation is most evident upon welding with drill rod. As this steel is made by the crucible process, it is low in impurities and gas content. Sections through the globule show, therefore, solid metal even after holding a long arc. The high carbon content (1.2 per cent to 1.4 per cent) serves to generate a thick envelope of carbon-oxide gases which greatly reduces the further oxidation of the electrode surface, maintaining it in the approximate form visible during the welding. Such globules may be readily obtained upon drawing an arc with a drill rod ⅛-in. (3.2 mm.) in diameter, using a welding current of 100 amp. and lengthening the arc stream as the globule increases in size. When a long arc, $\frac{3}{16}$ in. (4.7 mm.), is held, the electrode end enlarges until a characteristic maximum diameter is secured. At this diameter the weight of the globule equals the attractive forces holding to the electrode, so that further enlargement causes the liquefied metal to fall from the electrode end, dropping to the plate in downward welding, or flowing down the electrode in overhead welding. On holding a short arc length the growth is limited by contact with the plate surface, when the forces of surface tension and adhesion assist in metal transfer.

In Fig. 1 are shown exhibits of drill-rod globules.

The particular characteristics are regular contour, slight oxidation and solid section. In Fig. 5a* are shown both the arc stream and globular end; in Fig. 5b the globular end has been released, while in Fig. 5c globules are shown deposited on the plate with one forming at the electrode terminal. Fig. 5f shows the contour of the globule immediately after interrupting the arc, the exothermic reaction of atmospheric oxygen and surface carbon developing sufficient radiant energy to permit photographing the terminal. A slight irregularity in contour due to such oxidation may be noted.

Group 2.—Mild carbon steel is frequently employed as welding wire. Upon forming a globular end and breaking the arc atmospheric oxygen rapidly attacks the unprotected incandescent iron, often leaving only a perforated iron oxide shell. In Fig. 2a are shown typical exhibits of such oxidized globular ends. During welding, however, the metal is exposed to a much slower rate of oxidation, due to the protection offered by the inclosing gases. To obtain a true exhibit of globule conditions during welding it is necessary to cool the electrode, after interrupting the arc, in an inert atmosphere. The characteristic formation then obtained is shown in Fig. 2b. The solid section and contour now resemble those secured with drill-rod electrodes. This formation may be obtained by holding an arc from the bottom of a hole 2 in. (5.1 cm.) deep, ¾ in. (1.9 cm.) in diameter, and interrupting the welding current when the electrode is surrounded by dense arc fumes. Fig. 5d shows the small globular electrode end on welding with a short arc, while Fig. 5e shows the electrode end shortly after the release of the globule.

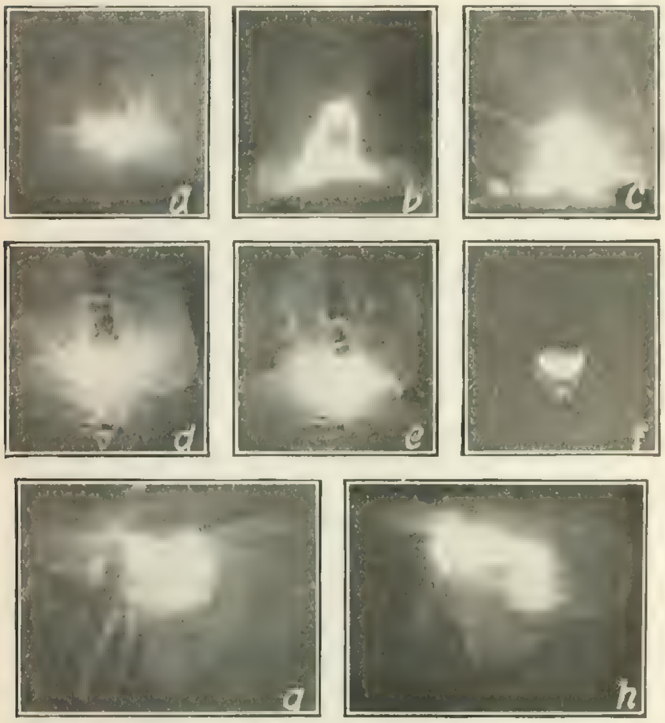


FIG. 5—APPEARANCE OF METALLIC ELECTRODE TERMINAL AND ARC STREAM

(a, b, c) Downward welding with long arc and drill rod, showing globular terminal, globule in transition and deposition. (d, e) Downward welding with short arc and mild steel electrode, showing appearance of terminal before and after globule release (f) End of drill-rod electrode shortly after interrupting arc. (g) Overhead welding, short arc, mild-steel electrode; note globular end, deposited layer of metal. (h) Overhead welding, long arc, mild-steel electrode; note absence of deposit, striated electrode surface caused by downward flow of liquid electrode metal.

Group 3.—The presence of occluded or generated gases is practically unavoidable in steels made by the bessemer and puddling processes. The expansion of such gases in the liquefied electrode end produced characteristic cavities in the wires examined. These cavities occurred singly or in groups, varying widely in size and distribution. Deposit tests indicated that the cavitous condition could be readily obtained in the transferred metal. Fig. 3 shows typical electrode and deposit exhibits of this group.

Group 4.—Upon breaking a long arc held with a low-carbon-content wire electrode, an interesting modification in globular structure may be obtained. It is well known that commercially pure iron passes through a critical temperature range, in the neighborhood of 950 deg. C., in which the metal assumes a pasty form. This condition obviously facilitates the penetration of atmospheric gases and therefore the formation and expansion within the fluid globular body of carbon oxide gases. This expansion causes the globule to enlarge in the typical hollow forms shown in Fig. 4. Mild steel electrodes also possess this characteristic, although to a less degree, as is shown in Fig. 2c. In the latter exhibit a distinct line of demarcation is visible between the globular shell and solid electrode, where, presumably, the critical temperature zone existed, facilitating oxygen penetration.

The structures shown in Figs. 2c and 4 are, to the author's knowledge, characteristic only of long arc welding and should not therefore occur while following correct welding procedure. This is substantiated by the fact that welds are made with either Group 2 or Group 4 electrodes, comparatively free from perceptible gas pockets.

Engineering Service on North Carolina Farms

PIONEER work in the extension of engineering service to farms and country communities is being carried on by the North Carolina State Highway Commission in collaboration with the Bureau of Extension of the University of North Carolina. That state is said to be the first to provide a special fund by legislative grant for such a purpose, and to aid in its promotion the university organized a new division of its extension work which has been called the "division of country home comforts and conveniences." The staff is made up of members of the university's engineering departments. In the six months since the work was organized assistance has been given directly to more than 100 persons in rural communities.

Electric light and power are chief among the conveniences that it is hoped to bring to rural sections all through the state. North Carolina has many small water-power sites, many streams scattered through the state having enough fall to develop from 1 hp. to 10 hp. of hydro-electricity. A model installation of this kind is to be made at the site of the university in Chapel Hill, where waterwheels, generators and auxiliary apparatus will be shown and explained. Farm-lighting sets have also been carefully studied with a view to aiding the farmers in their choice of apparatus. The extension of rural telephones is to be promoted. P. H. Daggett is the director of the division staff of the university.

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*These photographs were obtained with the high-speed camera described by J. Legg in the December, 1919, *Electric Journal*.

Reactive Volt-Ampere Indicators

It Is Shown How Standard Indicating Wattmeters May Be Applied to the Measurement of Reactive Volt-Amperes by Selecting Suitable Scales and Making Proper Connections in the Circuit

By H. C. YEATON
Lynn, Mass.

THE load on a circuit is increased very little by quadrature component of the current, but the heating effect of this quadrature component should be considered carefully. In most power-plant installations it is such an important factor that it has been deemed necessary to install reactive volt-ampere indicators in order to determine the exact character of the circuits.

The best way to measure the reactive volt-amperage of a circuit is to use an electric dynamometer type of wattmeter, which has a fixed current and a movable potential coil. It is necessary only to have the wattmeter provided with a suitable scale, with a zero center preferably, and to connect it into the circuit correctly. Single-phase, two-phase and three-phase circuits are considered in detail.

The instrument should meet the following requirements:

1. The current and voltage coils should be connected 90 electrical degrees out of phase. Then the instrument will indicate 90-electrical-degrees-out-of-phase volt-amperes, or, in other words, reactive volt-amperes.

2. The instrument should have a zero-center scale in order that it may indicate the quadrature component when the current is either lagging or leading the potential.

3. As the reactive volt-amperage of a circuit probably would not be more than half the power of the circuit, a scale of one-half this power is selected for the instrument. This scale will not be satisfactory, however, if the instrument is to indicate true watts as well as reactive volt-amperes, for, obviously, the instrument should have a scale that would indicate the whole power in the circuit, when the power-factor is unity.

Single-Phase, Two-Wire Circuits.—To measure the reactive volt-amperage of a single phase, two-wire circuit, use a single-phase wattmeter having a resistance-reactance box. This box is to produce the 90 electrical degree displacement between the current coil and the potential coil. Connections of the box are shown in Fig. 1.

Unless otherwise specified, the instrument will be provided with a scale having a zero center and a range of approximately one-half of the total power in the circuit. This scale is found by the formula, Scale $= EI/_2$, in which $E =$ line volts and $I =$ line amperes.

As the reactive volt-amperes probably will not be more than one-half the total power of the circuit, the numeral 2 appears in the formula. The instrument having a zero-center scale, the torque is proportionately the same as that of a standard wattmeter without a zero-center scale.

The calibrating watts are obtained from the formula, Calibrating watts $= S/CP$, in which $S =$ value of range of scale in volt-amperes, $C =$ current transformer ratio and $P =$ potential transformer ratio.

Two-Phase, Three-Wire and Four-Wire Circuits (Polyphase Instruments).—To measure the reactive volt-amperage of a two-phase, three-wire circuit or of a two-phase, four-wire circuit, a two-phase wattmeter should be employed and so connected in the circuit that the current and the voltage in each element will be 90 electrical degrees out of phase, as shown in Fig. 2 for two-phase, four-wire circuits and in Fig. 3 for two-phase, three-wire circuits.

Unless otherwise specified, the instrument will be provided with a scale having a zero center and a range of approximately one-half the total power in the circuit.

The scale is found by the formula, Scale $= 2EI/2$. There being two phases, the numeral 2 appears in the numerator—and as the reactive volt-amperage probably will not be more than one-half the total power of the circuit, the numeral 2 is used in the denominator. As the instrument has a zero center, the torque is proportionally the same as that of a standard wattmeter without a zero center.

Calibrating watts (per element) $= S/CP2$. There being two elements in the instrument, the numeral 2 is used in the denominator.

Two-Phase, Three-Wire and Four-Wire Circuits (Single-Phase Instruments).—A single-phase wattmeter may be used to measure the reactive volt-amperes of a two-phase, three-wire circuit, or of a two-phase, four-wire circuit, if the phases are well balanced. In either case it is necessary so to connect the instrument that the current coil will be in series with one phase and the potential coil will be across the other phase. These connections cause the voltage and the current in the instrument to be 90 electrical degrees out of phase. Connections for the two-phase, three-wire circuits are shown in Fig. 4 and for the two-phase, four-wire circuits in Fig. 5.

Unless otherwise specified, the instrument will be provided with a scale having a zero center and a range of approximately one-half the total power in the circuit. The scale and calibrating watts are found precisely as for the polyphase meter on the two-phase circuits. Scale $= 2EI/2$. Calibrating watts $= S/CP2$.

If a two-phase, three-wire or four-wire wattmeter is used to measure both the true watts and the reactive volt-amperes of a two-phase, three-wire circuit, or of a two-phase, four-wire circuit, the instrument should be connected as follows:

When employed as wattmeter, the current and the voltage coils of one element would be connected to one phase and the current and the voltage coils of the other element would be connected to the other phase.

When used as a reactive volt-ampere indicator, the current coil of one element would be connected to one phase and the voltage coil of the same element connected to the other phase; also, the current coil of the other element would be connected to one phase and the voltage coil of the same element would be connected to the other phase as shown in Fig. 2, thereby obtaining the 90-deg. phase displacement required.

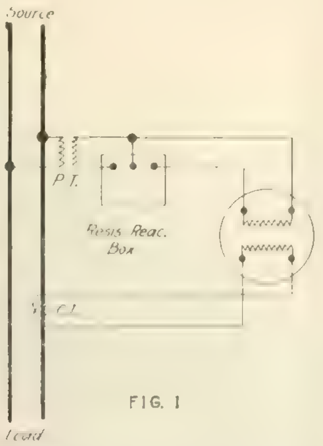

FIG. 1

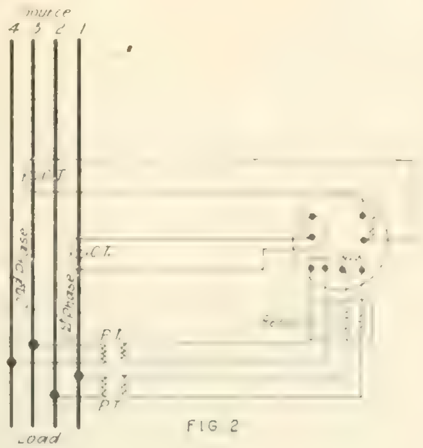

FIG. 2

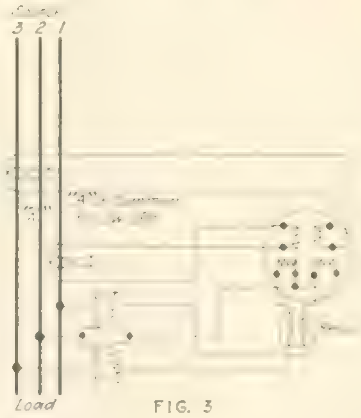

FIG. 3

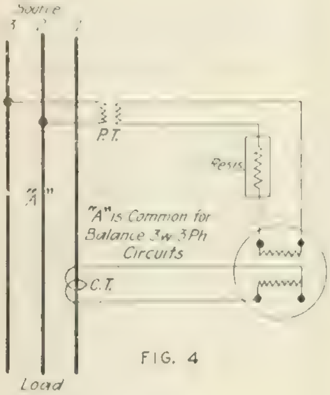

FIG. 4

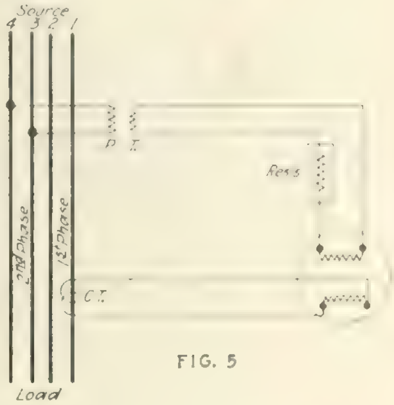

FIG. 5

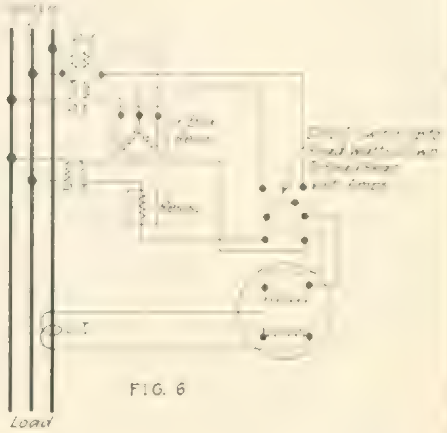

FIG. 6

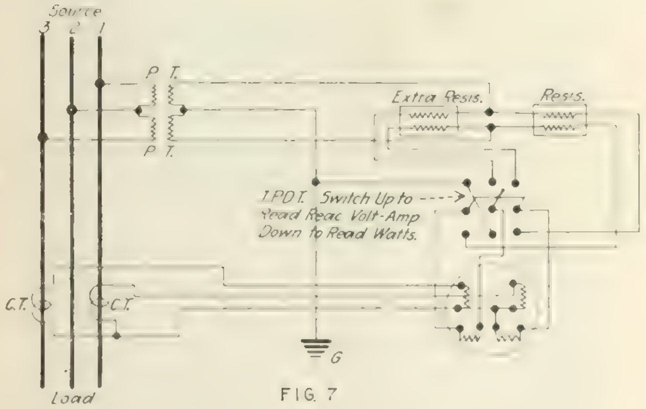
Source
3 2 1
P T.
P T.
Extra Resis.
Resis.
T.P.D.T. Switch Up to Read Reac Volt-Amp Down to Read Watts.
C.T.
C.T.
G
Load

FIG. 7

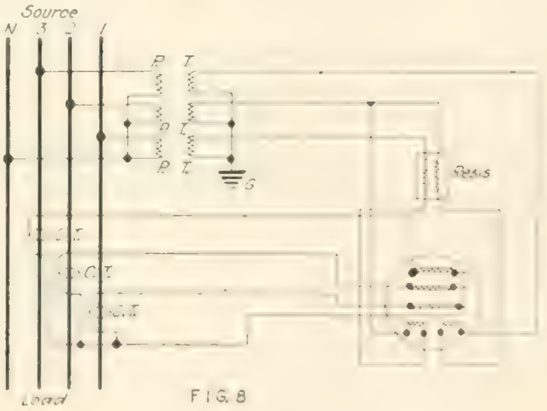

FIG. 8

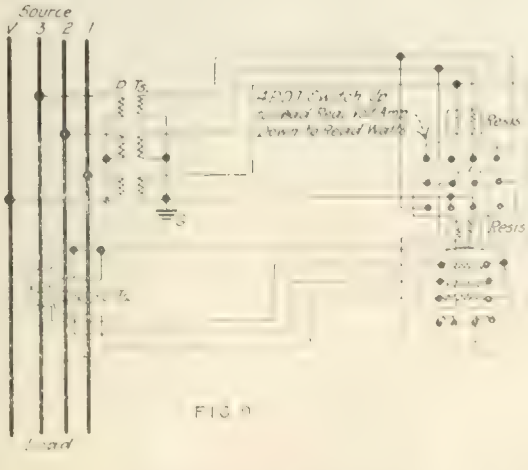

FIG. 9

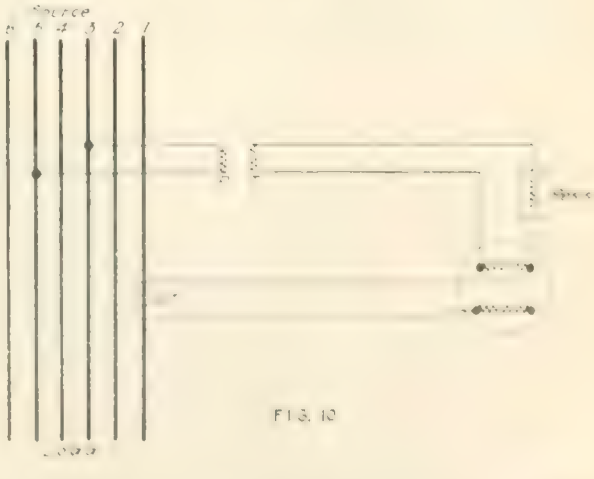

FIG. 10

CONNECTIONS FOR USING INDICATING WATTMETERS FOR THE MEASUREMENT OF REACTIVE VOLT-AMPERES

Three-Phase, Three-Wire Circuits (*Single-Phase Instruments*).—It is possible to measure the reactive volt-amperage of a three-phase, three-wire circuit with a single-phase wattmeter, provided the phases are well balanced. The instrument should be so connected in the circuit that the current and the voltage of the element will be 90 electrical degrees out of phase, as shown in Fig. 4. The instrument should be provided with a scale having a zero center and a range of approximately one-half the total power of the circuit.

The scale = $(EI\sqrt{3})2$, in which E = line volts and I = line amperes. There being three phases, the quantity $\sqrt{3}$ appears in the numerator. As the reactive volt-amperage probably will not be more than one-half the total power of the circuit, the numeral 2 appears in the denominator. The instrument having a zero-center scale, the torque is proportionally the same as that of a standard wattmeter without such a scale.

Calibrating watts = $S/CP\sqrt{3}$. The instrument being single-phase, the quantity $\sqrt{3}$ appears in the denominator.

If it is required to use a single-phase wattmeter to measure both true watts and the reactive volt-amperes of a balanced three-phase, three-wire circuit, two resistance boxes must be used with the instrument—a box for reading reactive volt-amperes and a box for reading the true watts, as shown in Fig. 6.

Such an instrument would be provided with a scale having a zero center and a range of approximately the total power of the circuit, since it would be used to indicate also the true watts in the circuit.

The scale is found by the formula, Scale = $\sqrt{3}EI$. When the instrument is used as a reactive volt-ampere indicator, the calibrating watts are obtained from the formula, Calibrating watts = $S/CP\sqrt{3}$.

To use the instrument for measuring true watts, it is necessary to have a Y box, the amount of the resistance in each leg of the box being expressed as follows: Resistance of instrument used as reactive volt-ampere indicator divided by $\sqrt{3}$.

Three-Phase, Three-Wire Circuits (*Polyphase Instruments*).—To measure the reactive volt-amperes of a three-phase, three-wire circuit, a polyphase wattmeter should be employed and should be so connected in the circuit that the current and the voltage in each element will be 90 electrical degrees out of phase, as seen in Fig. 3. Unless otherwise specified, the instrument will be provided with a scale having a zero center and a range of approximately one-half the total power of the circuit.

The scale should be: Scale = $EI\sqrt{3}/2$. The instrument having a zero-center scale, the torque is, proportionally the same as that of a standard wattmeter without such a scale.

The calibrating watts are obtained from either of the following formulas: Calibrating watts (per element) = $S/CP2 \times 0.85$, or, Calibrating watts (per element) = $S/CP2$. The latter formula is used when the resistance of the instrument has been increased 15 per cent. This method is considered the best, for the instrument is simply a standard polyphase wattmeter with 15 per cent additional resistance, and it is easy to have a polyphase wattmeter for measuring true watts and reactive volt-amperes. Fig. 7 shows the necessary connections.

A polyphase wattmeter employed to measure the true watts and the reactive volt-amperage of a three-phase, three-wire circuit has the external resistance in two boxes so that it is only necessary to change boxes by means of a three-pole, double-throw switch, as in Fig. 7.

The switch in one position throws in the extra resistance box, which contains 15 per cent more resistance than the total resistance of the instrument and other resistance box. This position adapts the instrument for reading reactive volt-amperes.

Three-Phase, Four-Wire Circuits (*Polyphase Instruments*).—If an instrument is needed to measure the reactive volt-amperage of a three-phase, four-wire circuit, a three-phase, four-wire wattmeter should be employed and be connected in the circuit as shown in Fig. 8. Unless otherwise specified, the instrument will be provided with a scale having a zero center and a range of approximately one-half the total power of the circuit.

The scale is found by the formula, Scale = $3EI/2$, in which E = neutral volts and I = line amperes. The numeral 3 appears in this numerator as in the numerator of the ordinary scale formula for four-wire, three-phase circuits.

Calibrating watts (per element) = $S/CP4\sqrt{3}$. This formula resembles that used to determine the calibrating watts of a wattmeter used to measure the true power in a four-wire, three-phase circuit. It differs in containing the quantity $\sqrt{3}$, used because the potential circuits of the elements are connected across the legs of the circuits; or, in other words, the delta voltage is impressed upon the instrument instead of the Y voltage which is used for the standard four-wire, three-phase wattmeter.

To measure both the true watts and the reactive volt-amperes of a four-wire, three-phase circuit, use a three-phase, four-wire wattmeter. Make the connections as shown in Fig. 9. When the instrument is used as a wattmeter it should have a scale capable of measuring the total power of the circuit and should have also a zero center, because the wattmeter will have to indicate volt-amperes with the current either leading or lagging.

As in the case of the ordinary four-wire, three-phase wattmeter, the scale is obtained from the formula, Scale = $3EI$, in which E = volts and I = line amperes.

The calibrating watts are obtained from the formula, Calibrating watts (per element) = $S/CP4$.

From the above description it can be seen that, as the instrument now stands, it is a standard four-wire, three-phase wattmeter with a zero-center scale. If this instrument is to measure the reactive volt-amperage of the circuit, connect the instrument in the circuit so that the current and the voltage of each element are 90 electrical degrees out of phase. These connections are shown in Fig. 9. The potential coils have to be connected across the delta voltage of the circuit, thereby increasing the voltage across the instrument in the proportion of $\sqrt{3}:1$. Therefore, by increasing the resistance of the instrument 73 per cent (using another box) and connecting the instrument in the circuit, as shown in Fig. 7, it will indicate either true watts or reactive volt-amperes.

Six-Phase, Six-Wire Circuits (*Single-Phase Instruments*).—To measure the reactive volt-amperes of a six-phase, six-wire circuit, if the phases are well balanced, a single-phase wattmeter should be used and so connected in the circuit that the current and voltage of the element are 90 electrical degrees out of phase, as shown in Fig. 10.

Unless otherwise specified, the instrument will be provided with a scale having a zero center and a range of approximately one-half the total power of the circuit.

The scale is found as follows: Scale = $\sqrt{3}EI2/2$, in which E = line volts and I = line amperes. The instrument having a zero-center scale, the torque is proportionally the same as that of a standard wattmeter without such a scale.

The calibrating watts are obtained from the formula. Calibrating watts = $S/CP2\sqrt{3}$.

Testing Insulators for Resistance to Thermal Changes

Weathering and Storage Tests of Suspension Insulators Show that Temperature Changes Are Serious Cause of Failures

IMPORTANT tests of suspension insulator units conducted by Prof. Harris J. Ryan at Leland Stanford Junior University during the last four years were reported at the recent National Electric Light Association convention at Pasadena. These tests indicate that the effect of temperature change is a most serious cause of insulator failure and that the quality of porcelain is of even greater importance than electrical design. While there has been a decided improvement in suspension insulators during recent years, the weathering tests indicate that some tests should be devised to subject insulators to thermal fatigue in a brief period of time. The importance of such research work and testing in connection with insulator design and manufacture is emphasized by the results given in the accompanying table.

The insulators used in the tests are of a variety of types and makes, some having seen service on the lines of Western companies while others were taken directly from factory shipments. It is interesting to note the high percentage of failures of the different types when the insulators are not subjected to either voltage or mechanical load but simply to weather conditions. These test results tend to emphasize several points which have been clearly established by tests and operating experience.

The majority of suspension insulator failures, especially among units manufactured during the last six years, have been due to temperature changes, voltage duty and loading in most cases having very little effect. From the table it will be noted that insulators 1-13A, LA, BL and S, after four years of yard treatment, following their previous service record, show a rate of failure of from 12½ per cent to 15 per cent per annum for the four-year period. This test checks with what has been found under service conditions with the same class of insulators on Western transmission lines.

It is also interesting to note at this point that where insulators of the class mentioned above were placed in even temperature storage the rate of depreciation was materially reduced and in some cases was negligible. For example: The 1-13A class insulators over a 750-day period were failing at a rate of 43.8 per cent under yard treatment, while the rate of failure under basement treatment was only 4.35 per cent. With the LA insulators the failure under yard treatment was 36.8 per cent, while under basement treatment the failure was 0 per cent. The BL class failed under the last period of yard treatment at 47.4 per cent, while under basement treatment the failure was only 9.52 per cent. The S lot had a failure under yard treatment of 29.4 per cent and a failure under basement treatment of 3.85 per cent.

SUSPENSION TYPE INSULATOR TESTS

Series	A	1-13A	LA	B	BL	C	F	G	H	J	Q1	Q2	S	Total
Date of manufacture	1912	1912	1912	191	1913	1913	1917	1908	1916	1916	1916	1916	1912	
Total insulators received for test	74	92	98	58	92	82		59	15	92	47	47	102	858
Failed prior to yard treatment	0	15	19	1	8	13	.	2	0	0	0	3	11	72
Available for yard treatment, December 1916	74	77	79	57	84	69		57	15	92	47	44	91	786
Failed after 195 days' yard treatment, June 1917	0	10	21	0	18	5		0	0	2	4	9	24	93
Percentage of failure, yard treatment	0	13.0	26 6	0	21.5	7.2		0	0	2 2	8 5	20 4	26 4	
Available for test, June 1917	74	67	58	57	66	64	21	57	15	90	43	35	67	714
Withdrawn from test	0	0	1	0	0	1	0	0	0	0	0	0	2	4
Continued in yard treatment, June 1917	74	34	29	57	33	32	21	57	15	90	43	35	33	553
Failed after 115 days' yard treatment, October 1917	1	15	10	0	13	4	1	0	0	1	4	8	12	69
Percentage of failure, yard treatment	1.35	44.1	34.5	0	39 3	12.5	5 23	0	0	1 11	9 3	22 8	36.4	
Started basement treatment, June 1917	0	33	28	0	33	31	0	0	0	0	0	0	32	157
Failed after 115 days' basement treatment		10	9		12	2							6	39
Percentage of failures, basement treatment		30.4	32.1		36.4	6.45							18.7	
Available for test, October 1917	73	42	38	57	41	57	20	57	15	89	39	27	47	602
Withdrawn from test	2	3	0	1	1	4	2	2	2	0	15		4	36
Continued in yard treatment, October 1917	71	16	19	56	19	24	18	55	13	89	51		17	448
Failed after 750 days' yard treatment, December 1919	3	7	7	0	9	3	9	2	3	1	0		5	49
Percentage of failure, yard treatment	4.23	43 8	36.8	0	47.4	12 5	50 0	3.64	23.1	1 12	0		29 4	
Continued in basement treatment, October 1917		23	19		21	29							26	118
Failed after 750 days' basement treatment		1	0	..	2	2							1	6
Percentage of failure, basement treatment		4 35	0		9 52	6 90	.						3 85	
Insulators starting yard treatment	74	77	79	57	84	69	21	57	15	92	91		91	807
Total withdrawals	2	3	1	1	1	5	2	2	2	0	15		6	40
Insulators to figure in percentages	72	74*	78*	56	83*	64*	19	55	13	92	76		85	767
Total failures	4	43	47	0	54	16	10	2	3	4	25		48	256
Percentage of failure	5.6	58.2	60 3	0	65.1	25 0	52.6	3 6	23 1	4 4	32 9		56 5	33 3

Average duration of yard treatment was 1060 days.

*Groups marked with a star had half their number in the basement for an average of 865 days.

**These insulators failed under repeated tests at very short intervals.

From the table it will be noted that under the first period of basement treatment the difference in number of failures between yard and basement treatment was not considerable, but after a continuation of two years it was quite pronounced. This basement treatment explains to a large extent the reason why insulators installed in stations have given good service while the same kind of units installed on lines have been the source of a great amount of trouble.

It is also of interest to note the difference between LA and B insulators. Both were manufactured by the same company, one in 1912 and the other in 1916. One shows a 60 per cent depreciation in four years of yard treatment and the other no depreciation. These facts are borne out by practice as well as test, as insulators made in 1914 of the B class show no depreciation after more than five years of line service, while insulators made one to two years prior to that time show a depreciation of from 6 per cent to 10 per cent per annum under service conditions.

The record of insulators marked G is gratifying, as these units were manufactured in the early stages of the suspension insulator art—1907 and 1908—doing duty under severe line conditions on 100-kv. circuits up to 1914, when they were removed from the line and shortly afterward sent to the laboratory for test. This insulator is of poor electrical design, having a low margin of safety between flash-over and puncture. The distribution of stresses is not well taken care of as with units of later design, as heavy streamers form under flash-over conditions, cracking the porcelain bodies by excessive heating. In spite of such defects, these insulators show only a 3.6 per cent depreciation during the four years yard treatment. It must be remembered that these units are the old cap and stud type, using cement. The surfaces are untreated, no gaskets or yielding material having been used in their assembly. This simply emphasizes the fact that a high grade of porcelain is more essential in the suspension insulator unit than good electrical design. It also indicates the fact that with proper care good life can be obtained from insulators of the cap and stud type.

It will be noted that type H insulators made in 1916 by the same manufacturer as the G group show a much higher rate of depreciation. These records tend to show the relatively greater merits of the units which were manufactured by the same company eight years previously.

Another point clearly brought out by the tabulated results concerns insulators marked F. These units were not made of porcelain, but of a fused material which is molded while in a liquid state and the hardware attached by cement in the usual manner, or an alloy is used. Regarding the difference between cement and alloy, the results would indicate no particular preference, but it is clearly shown that any material having a mortality of over 50 per cent in two years of yard treatment is inherently unfit for service, either because of improper design or other deficiency.

Severe Service for Dead-End Units

The results, taken as a whole, seem to indicate clearly why insulators next to the tower in suspension strings and those used in dead-end positions have a higher rate of depreciation than other units. That is, these particular units pass through wider daily and seasonal temperature ranges than the other units, as the one in suspension next to the tower is a sunshade for the others. In stations insulators are protected both from extreme temperature variations and from absorbing moisture, hence these insulators give better service, all of which is shown by laboratory and field results.

All tests to date seem to establish clearly that thermal fatigue is apparently the major factor in suspension insulator deterioration. Therefore it seems logical that some method should be devised to develop a test whereby suspension units could be given, in a comparatively short interval of time, an aging effect equivalent to that of from ten to fifteen years' service.

The tests were reported by the sub-committee on suspension insulator research, of which J. A. Koonte, Jr., is chairman. The committee feels that these tests should be continued and investigations made to predetermine, where possible, the effectiveness of insulator improvements.

Vacuum Cleaner to Remove Dust from Indirect Lighting Fixtures

With the idea of providing adequate illumination which at the same time will not expose over-bright sources of light, the Emporium, one of the largest department stores of San Francisco some time ago adopted the indirect system of lighting. The results have been most satisfactory, but the system employed has brought up several problems in the maintenance of efficiency which were not involved in the former system using translucent globes.

The fixtures in use, designed by Louis C. Mullgardt, are novel in that when they are lighted the inverted bowls seem to be made of marble and apparently contain a lamp bulb. In reality, however, they are made of plaster of paris so perforated that the light shines through to illuminate the under surface of the dome-like shape and gives the effect of translucency. The resulting fixture is inexpensive and most artistic in appearance and still gives the amount of light required in a store with high ceilings.

INDIRECT LIGHTING SYSTEM IN DEPARTMENT STORE

It was soon found, however, that the problem of cleaning was essential to good results but difficult to handle. The lamps are exposed to the air in a trough on the upper surface of the fixture, in a position where they collect dust. Tests revealed that the light given off grew gradually less and less on account of the dust until it ceased to be sufficient for the exacting demands of department-store service. At first an attempt was made to dust the fixtures carefully once a month, using a long ladder and an ordinary duster in the process. The record of broken filaments, however, soon showed that this policy was unsatisfactory. Next a bellows was used to better effect. This removed the dust sufficiently without breaking so many lamps in the process, but the difficulties attending the use of a ladder still remained. At the present time the Emporium is planning to adopt a vacuum cleaner operated from a ladder that can be moved from place to place from above. The ladder can be folded up when not in use.

Why Utilities Pay High Rates for Money*

Conditions Surrounding the Issues of Bonds—Financing by Short-Term Notes Condemned—Preferred and Common Stock Issues Placed with Local Investors Provide the Most Desirable Solution of the Problem—Educating the Public

By **HENRY D. THRALL**
Vice-president Minnesota Loan & Trust Company

IMMEDIATELY after the armistice the United States entered upon a program of commercial expansion unparalleled in history. It was our ambition to wrest at once from all competitors a large portion of foreign trade. At the same time, home demands were unprecedented along certain lines, especially that class of commodities which are generally known as luxuries, particularly the automobile trade. There was a steadily growing demand for capital, due partially to the expansion of trade and partially to the decreased purchasing power of money, which increased the cost of doing business. These demands have very recently reached their peak, the credit machinery of the country has been unprepared to carry this unexpected overload, and the reserves of the banking system have been materially reduced. At the present moment our financial institutions find themselves in the position of forcing liquidation for the purpose of checking this expansion in certain lines and allowing the development of other industries perhaps more necessary for the good of the people and whose development must be given earnest consideration if the country is to show an even, well-balanced growth.

Among the principal industries of the country coming under this head are the public utilities. Industrial growth cannot take place merely through financial acceleration. There must at all times be a corresponding increase in materials, man and machinery power. The public utilities of the country have been called on more and more of late to furnish the necessary sinews controlling this industrial machinery, without the ability on their part to satisfy this demand satisfactorily. The staggering demand for capital due to the industrial growth and the unprecedented earnings of many corporations extending over a period of years has bid up the price of free money to a point where those interested in public utilities must necessarily give earnest thought to the present and future needs of their companies. In addition, there are certain internal conditions of the public utilities of this country that add to the burden.

CHANGES WROUGHT IN LAST FEW YEARS

Up to only a few years ago—I think, to be exact, about the year 1916—the credit of the public utilities was as good as that of any other corporations in the country. Franchises were very readily obtained. Light and power facilities as we know them now were still in the novelty stage in a great many places. Earnings were good. Money was easily borrowed on long-time securities at from 5 to 5½ per cent. The issues of good light and power companies were in demand all over the country. There was a great deal of exploitation. Companies were bought up everywhere, developed and resold to more comprehensive holding corporations.

A condition of this sort is always dangerous, as it finally results in an overexpansion and in abuse of credits. Eventually this to some extent happened. The market was oversaturated, and in some few cases corporations took advantage of their borrowing opportunities—made loans on their prospective profits rather than actual earnings—and the great investing public turned to new fields for outlets for its money. At the same time the politicians began a concentrated effort to reduce rates, talk of municipal ownership was heard everywhere, and credits fell still lower.

Fortunately for the light and power companies, earnings have on the whole not declined. In fact, the trend as shown by statistics is an increase. This increase is not, however, sufficient to justify the re-establishment of credit in the eyes of the public.

PUBLIC UTILITY SECURITY SITUATION

There are two usual forms of credit advances to public utility companies, the bond and the short-time note. Up through the year 1918 it was very easy for a sound corporation to get long-time financing done on from a 5 to 5½ per cent basis. Many of the 5 per cent bonds of well-known utility companies were selling even at a premium, whereas the same bonds may today be selling on a 7 per cent basis or even lower. This decline in price is not entirely due to market conditions. A great deal of the change is due to the fact that the people know that in order to keep up with the growth of the country vast sums of money must be spent in the next few years on utilities, that they cannot maintain their present condition without the expenditure of these amounts, and that in the face of existing conditions it would be impossible to finance future expenditures on a paying conservative basis.

Perhaps I can best illustrate this by an example. A few years ago it was quite customary to finance construction on a large and well-managed property on a baisis of 80 per cent of cost. Five per cent interest was the usual rate on first mortgage bonds. Twice the interest charges was assumed to be sufficient margin of safety for loan purposes. Now, assuming that cost of construction and interest rates have gone up proportionately since that time, I would say that a corresponding interest rate today would be at least 7 per cent. Therefore, based on our proposition, if cost of construction is increased proportionately to the cost of money, 140 per cent would be the cost of construction today as compared with the old cost.

It is true that net earnings of the utilities of the country as a whole have probably increased to some extent. However, the large increase has unquestionably been with the hydro-electric companies and not with those companies that generate with steam. This differentiation must be borne in mind in considering the general increased net earnings. The hydro-electric companies have been especially fortunate in their position during this period of high cost of production by coal. Furthermore, it is very questionable whether, taking the country over, the amounts set aside by the corporations for maintenance, renewals and depreciation have been increased proportionately to the rise in costs, so that it is very doubtful whether the average net earnings of light and power companies show an actual increase. The balance left after interest is all the funds that the company has available to take care of proper sinking funds and to pay dividends. This amount should be greater today than ever before because of the increased risk of doing business.

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*Part of an address on the financial situation as it affects public utilities, made before the first annual convention of the North Central Electric Association at Minneapolis, Minn., June 15-18.

The bondholders always want to know that the stockholders are well taken care of. It is not their desire to run any chance of becoming the operators of the company. In view of these conditions is it surprising that the bond buyers of public utilities as a class, who in the main are individuals, have turned their attention to those securities that can show net earnings of several times interest requirements for a period of several years past?

High money rates always tend to shorten the maturity of issues; consequently the most popular recent form of financing has been securities in so-called short-term note issues, maturing usually in from one to ten years.

Public utilities through necessity have in some cases financed themselves by a certain amount of these notes. In the opinion of the banker, however, they are not a legitimate type of financing for utilities. The presumption of any note is that it will be paid when due, and most industrial corporations which have financed in this way have been in position to meet maturities either through liquidation of assets or through earnings. The public utility, however, has nothing with which to liquidate. Its holdings are presumed to be continuous, and the issuance of short-time notes in any except limited quantities means that they are merely a makeshift and will have to be refunded at maturity or converted into some other form of security. This is a dangerous procedure, especially under the conditions through which we have recently passed, as we have seen that there is at the present time a very effective blockade on the avenues for credit financing of utilities. In addition, the cost is prohibitive.

OWNERSHIP SECURITIES RECOMMENDED

The most practical method left for obtaining money at the present time seems to be through ownership securities. By ownership securities I refer to stocks, either preferred or common. In the early days before the period of exploitation this was the usual method of financing companies, and perhaps under present conditions it is the best method to pursue. The logical type of financing is the preferred stock, a very customary method. However, the preferred-stock market has also been overdone for outside investors, and in the open market at the present time it is difficult to underwrite an issue.

Temporarily the financing of utilities by large underwritings in outside markets is in abeyance, and you will find yourselves relying upon the local interest of your community to stand by you and supply you with the money necessary to build up your properties, which are such an essential factor in its prosperity.

I believe it will be a blessing in disguise for you and your communities for you to have to devise means of interesting your local investors in your properties. You will get more than their financial support, you will receive their moral help. Their suggestions will be most opportune and their confidence and influence may be the very means of helping your companies over many of your obstacles. There certainly should be much less talk of municipal ownership, complaints of poor service will be reduced, and the community itself will be behind your organization to put it in shape to compete with organizations of similarly situated and competitive municipalities.

INTERESTING LOCAL INVESTORS

Perhaps in order to interest your communities it may be necessary to offer something more than a mere promise of say 7 per cent. It may be necessary to give them a participating preferred stock, paying them a definite rate of dividends and giving them an interest in the accrued earnings of the company over and above this amount, or possibly it may even be desirable to sell them some common stock or a combination of common and preferred. But whatever means is necessary to accomplish the purpose I feel sure will in the end justify the cost.

So much for the methods of financing as they appear at the present. I think it is very safe to assume that the time when property can be purchased with an idea of building it up and reselling it at an immediate profit has passed. Those conditions only exist when there is cheap money. The task before the public utility operator is one of personal application to his property. The management is the greatest element in the success of any proposition, and careful, efficient management is what the bankers will look for when your properties again command the credit which should be theirs.

In the question of management no one thing is of more importance than the careful analysis of earnings statements. It is a mistake to fool yourselves with exaggerated ideas of net income. Net earnings of a corporation on paper and in fact may show two very different sets of figures. The conservative operator will provide sufficient funds to guard against all contingencies. He will not skimp his depreciation charge, consoling himself with the idea that the value of his property has appreciated sufficiently to offset the usual wear and tear and obsolescence. He will remember that while his depreciation may be figured on original costs, nevertheless his replacements may have to be paid for at present prices, and unless the proper amounts have been set aside for this purpose, when the day of reckoning comes the statement will disappoint no one so much as it will himself.

I have had a good deal to say regarding the duty of the public utility to the community it serves. Now just a word regarding the duty of the people to the utilities of the country. You have seen the changes the decrease in the purchasing value of a dollar has caused in the costs of operation and the costs of construction and extension of properties.

There has been, in fact, an increase in everything except rates. When the people thoroughly realize that your copper costs twice what it did a few years ago, your labor is more than double what it used to be, and the price of coal is rising as fast as the thermometer on a July day—in fact, that you have to pay two dollars today for that for which previously you paid one dollar—they will at the same time realize that it is not a fair proposition for them to pay you one dollar today for the same amount of that commodity that they paid you one dollar for five or six years ago.

Economies Obtained in Burning Oil

Best Recorded Results Were Obtained in Three Arizona Stations—Flue Gas Analysis and Temperature Are Good Measures of Efficiency—Importance of Air Regulation and Keeping Tubes Clean

By ROBERT SIBLEY and C. H. DELANY

WHEN a boiler is fired with oil there are no ashes to carry away unburned fuel, there are no banked fires to cause poor efficiency at light loads, and as it is possible to secure perfect combustion with very little excess air, the efficiency of an oil-fired boiler is naturally higher than that of a coal-fired boiler.

In the tabulated data submitted herewith is given a table of the results of actual tests that have been made from time to time on oil-fired boilers at different locations and under various conditions. These tests give the best results that can be expected from oil-fired boilers under operating conditions. Actual results obtained in regular operation are not usually so good as the results obtained from tests, but they can be made as good if the same care is exercised in keeping the boilers clean, regulating the air supply and looking after all the minor details.

There are very few data available to show just how closely modern power plants approximate to test results in every-day operation, as there are few plants that keep records complete enough and accurate enough to determine the daily boiler efficiency separately from the complete plant efficiency. The usual method of recording the daily efficiency of an oil-burning central station is by the ratio of kilowatt-hours generated to barrels of oil burned. While this is an excellent method of determining the over-all efficiency of the plant as a whole, it is a poor method of comparing an oil-burning plant with a coal-burning plant or of comparing one oil-burning plant with another. There are so many factors that enter into the over-all efficiency that the mere statement of kilowatt-hours generated per barrel of oil does not give much idea of what efficiency is being obtained from the oil-burning boilers unless a complete detailed description of the plant is included.

The best recorded results of oil-burning plants are those obtained at the three Arizona plants described in C. R. Weymouth's paper, entitled "Economy of Certain Arizona Steam-Electric Power Plants Using Oil Fuel," presented at the June, 1919, meeting of the American Society of Mechanical Engineers. This paper shows that a plant having 6,000-kw. turbines operating with a steam pressure of 175 lb. (123 kg.) and 100 deg. Fahr. (55 deg. C.) superheat and 2 in. to 3 in. (about 65 mm.) absolute back pressure generates from 257 to 294 kw.-hr. per barrel of oil. Another plant, having 250 lb. (175 kg.) steam pressure and 150 deg. Fahr. (83 deg. C.) superheat and 1.66 in. to 2.14 in. (about 45 mm.) absolute back pressure, generates from 287 kw.-hr. to 326 kw.-hr. per barrel of oil. Monthly boiler-room records of the former plant show combined net efficiency of boilers and economizers of approximately 83 per cent, which corresponds to 79½ per cent net efficiency for the boilers alone.

It is probable that the general average of present-day oil-burning central stations generate from 200 kw.-hr. to 240 kw.-hr. per barrel of oil when operated at a fair load factor. This is equivalent to from 25,000 to 30,000 B.t.u. per kilowatt-hour. At very light loads, such as occur in standby service, the efficiency may drop to less than 100 kw.-hr. per barrel.

While records giving the actual efficiency of oil-fired boilers under regular operating conditions are rare, a very close approximation of the performance of the boilers can be obtained from the flue-gas analysis and the temperature of the escaping gases. It will therefore be of interest to note some of the actual Orsat readings taken from boilers in regular service.

The following readings were obtained from a 600-hp. Stirling boiler with a Peabody-Hammel furnace. No special adjustments were made and the object of taking these readings was to obtain some idea of the performance of the boiler as it is usually fired:

	CO_2	O	CO	Per Cent Excess Air Calculated
	13.8	3.0	0	16
	14.2	2.1	0.1	12.5
	14.0	2.2	0	14
	12.0	5.2	0	32
Average,	13.5	3.1	0.02	[illegible]

The following readings were obtained from a 750-hp. boiler of the water-leg (Heine) type, with vertical baffles and burners set in the front wall:

	CO_2	O	CO	Per Cent Excess Air
	11.4	5.4	0	39
	12.2	4.5	0	30
	12.0	4.8	0	32
	12.3	4.5	0	29
Average,	11.9	4.8	0	32

At this point an effort was made to reduce the excess air by partly closing the damper, after which the following readings were obtained:

CO_2	O	CO	Per Cent Excess Air
13.6	2.8	0	17

The following readings were obtained from a 773-hp. Parker boiler with horizontal baffles with the burners set in the front wall, the furnace extending the full length of the boiler:

CO_2	O	CO	Per Cent Excess Air
14.9	1.2	0.2	7
15.4	0.5	0.9	4

Since these readings show the presence of carbon monoxide (CO), an effort was made to obtain perfect combustion by opening the damper and ashpit doors wide, with the following result:

CO_2	O	CO	Per Cent Excess Air
15.2	0.6	0.5	5

Since CO was still present, the fires were cut down, slightly reducing the capacity of the boiler, with the following result:

CO_2	O	CO	Per Cent Excess Air
14.3	2.4	0	12

TABLE I—RESULTS OF TESTS ON OIL-BURNING BOILERS

	Redondo, Cal.		Fruitvale, Cal.	San Francisco, Cal.		Oakland, Cal.		Handley, Tex.		Inspiration, Ariz.	
Type of boiler	B. & W.	B. & W.	Parker	B. & W.	B. & W.	Parker	Parker	B. & W.	B. & W.	Stirling	Stirling
Type of oil burner	Hammel	Hammel	Owens	Hammel	Hammel	S. & P.	Owens	Hammel	Hammel	.	......
Heating surface, sq.ft.	6,042	6,042	6,080	3,500	3,500	7,734	7,734	6,000	6,000	7,129	7,129
Date	8/11/10	9/5/10	3/18/11	2/9/12	2/10/12	2/24/12	2/26/12	6/25/14	6/27/14	5/29/15	6/4/15
Duration, hours	7	7	10	10	10	8	8	9	9	10	6
Gravity of oil at 60 deg. Fahr., deg. Baumé	13.3	12.9	15.37	......	......	14.32	14.32	25.9	26.3	......	......
Specific gravity of oil at 60 deg. Fahr	......	......	0.9627	......	......	......	......	......	......	......	......
Steam pressure (gage), lb. per sq.in.	184.7	184.9	179.7	179.6	179.8	185.3	194.2	148 5	161.3	187.4	182.3
Oil pressure at burner, lb. per sq.in.	25.4	61.6	92	..		50.4	126	......	......	22	9
Temperature of feed water, deg. Fahr	93.4	101 2	123 4	188 1	195 6	169.1	172	187.6	209.5	210.15	191
Temperature of oil at burner, deg. Fahr	142.3	141.7	113	.	...	96	90	......	......	187.8	186
Temperature of gases leaving boiler, deg. Fahr	406.2	537.5	394	433	..	370	440	426.8	507.6	470.5	389.8
Draft between damper and boiler, in. water	0 044	0.230	0.15	....	..	0.34	0.48	0.035	0.46	0.076	0.020
Draft in furnace, in. water	0.014	0.188	+0.016	..	.	0 06	0.057	0.02	0 20	......	......
Draft in ashpit, in. water	0.046	0.471	0.02	.....	...	0.06	0.08	......	......	......	......
Degree of superheat, deg. Fahr	83.7	144.3	181.7	.....	.....	148	161.5	81.6	125.7	122.1	111.0
Per cent of water in oil	0.4	0.6	0.6	0.11	0.12	0.7	0.5	......	......	0.49	0.49
Oil free from water per hour, lb	1,439	2,869	1,401	812.3	1,546 3	1,872	3,043	1,312*	2,355*	1,666	905
Evaporation pér hour from and at 212 deg., lb.	22,639	40,375	22,422	12,600	22,273	30,227	46,380	......	......	26,159	14,564
Evaporation per hour from and at 212 deg. per square feet of heating surface, lb	3.75	6.68	3.69	3.6	6.37	3.9	6.0	3.56	6.18	3.67	2.04
Rated capacity of boiler, b.hp	604	604	645	350	350	773	773	600	600	712.9	712.9
Percentage of rated capacity developed, per cent.	108.6	193.8	100.8	102.8	182.6	113.3	173 8	103	179	106.7	59.2
Evaporation from and at 212 deg. per pound from water oil free, pound	15.73	14.07	16.01	15.53	14.43	16.14	15.24	16.27*	15.80*	15.70	16.1
Per cent of total steam used by burner, per cent	2.4	2.13	4.16	1.41	0.97	......	......	2.03	1.97	......	......
Net evaporation from and at 212 deg. per pound, from water oil free, pound	15 35	13.77	15.35	15.31	14.28	....	.....	15.94*	15.49*	......	......
Calorific value of 1 lb. oil as received, B.t.u	18,253	17,985	18,569	18,496	18,496	18,621	18,658	19,276	19,280	18,540	18,540
Calorific value of 1 lb. of oil free from water, B.t.u.	18,326	18,093	18,681	18,516	18,519	18,752	18,752	.....	.....	18,631	18,631
Efficiency of boiler and furnace, per cent	83.3	75.4	83.17	81.4	75.5	83.53	78.86	81.9	79.5	81.76	83.74
Net efficiency (deducting steam used by burner), per cent	81.3	74.0	79.8	80.2	74.8	....	...	80.3	77.9	.....	.....
Carbon dioxide (CO_2), per cent	14.3	12.1	13.5	......	.	14.3	14.6	14.0	13.5	14.5	14.5
Oxygen (O), per cent	1.8	6.8	.....	.....	.....	.....	.....	.....	.....	2.3	2.1
Carbon monoxide (CO), per cent	...	...	....	.....	.....	.....	.....	.....	....	Trace	......

* Oil as fired.

It is thus seen that with boilers of several different types and different furnace arrangements very little effort is required by operators to obtain air regulation corresponding to the test results shown in Table I.

The temperature of the escaping gases, another important item affecting the efficiency of the boilers in regular operation, depends on five things: (a) Regulation of air supply; (b) cleanliness of the boiler; (c) capacity of the boiler; (d) design of the boiler, and (e) condition of the boiler brickwork and baffles.

Flue-gas temperatures in actual practice run all the way from 400 deg. Fahr (204 deg. C.) for clean boilers operating at their rated capacity with 15 or 20 per cent of excess air, up to 800 deg. Fahr. (426 deg. C.) for dirty boilers with leaky baffles operating at 200 per cent of rating with 50 to 100 per cent excess air. A general average for boilers in regular operation is about 550 deg. Fahr. (287 deg. C.).

The following results were obtained on a 524-hp. Babcock & Wilcox boiler set with the front headers 9 ft. (2.7 m.) above the floor, equipped with a Peabody furnace. The setting was new, and the boiler had just been cleared inside and out. The boiler is equipped with soot blowers which were operated about eight hours before the observations were taken.

	A	B
Duration of test, hours	1	3
Capacity, per cent of rating (measured by steam flow meter)	110	172
Steam pressure, gage (lb. per sq.in.)	192	198
Degrees of superheat (deg. Fahr.)	75	73
Draft at damper (in water)	0 01	0 23
Carbon dioxide CO_2 (per cent)	14 4	14 3
Temperature escaping gases (deg Fahr.)	431 5	457 5

The importance of keeping a boiler clean is well illustrated by the effect on the flue-gas temperature of blowing the soot off the tubes. There is a common belief that when burning oil there is little or no accumulation of soot. This, however, is not the case; for while the quantity of soot is much less than in a coal-fired boiler, it is still an ever-present evil, and it is necessary to dust the tubes at least once a day if the best efficiency is to be obtained. The readings given in Table II, taken in regular service on an 823-hp. Stirling boiler with a Peabody-Hammel oil furnace, show that blowing the soot off the tubes resulted in reducing the exit temperature more than 75 deg. and that in five days the temperature gradually built up to more than it had been before the tubes were dusted.

TABLE II—EFFECT OF REMOVING SOOT FROM TUBES

Tubes dusted after the first set of readings and boiler operated for six days without further use of the soot blowers. (Oil fuel.)

Date, 1916	Draft (In.)		Capacity	Breeching Temp. (Deg Fahr.)	CO_2	O	CO
	Furnace	Third Pass	Per Cent of Rating				
Mar. 24, a.m.	0 08	0.35	145	650	15.5	0 5	0 0
Mar. 24, p. m.	*	*	*	*			..
Mar. 24, p.m.	0 07	0 33	143	574	14 5	2 2	0 0
Mar. 25,	0 08	0 34	141	594	14 7	1 6	0 0
Mar. 27,	0 07	0 37	144	607	15 0	1 05	0.0
Mar. 28,	0 08	0 43	146	635	14 1	2 0	0 0
Mar. 29,	0 08	0 37	142	637	14.9	1.05	0.05
Mar. 30,	0 08	0 40	142	668	15.2	1 0	0 05

* Tubes dusted.

In standby plants using oil-fired boilers contrasted with the banking of coal-fired boilers at no load the fire is put out completely, and when the steam pressure in the boiler has dropped as low as permissible the fire is relighted and the steam brought back to full pressure. During the time the fire is out the damper may be shut tight, thus materially reducing the loss of heat to the chimney during this period. Tests have shown that the oil required to keep a boiler hot in this manner amounts to from 1.5 to 3 per cent of the quantity of oil required to operate the boiler at its rated capacity. The tighter the damper the less oil will be required. In a boiler with good tight dampers the less oil will be required. In a boiler with good tight dampers the drop in steam pressure will be not more than 10 lb. or 15 lb. (0.7 kg. to 1 kg.) per hour.

Readers' Views and Comments

Need of Accurate Records on Causes of Fires

To the Editor of the ELECTRICAL WORLD:

SIR: Your editorial in the May 22 issue of the ELECTRICAL WORLD in regard to accurate reports on electrical wiring as cause for fires may give interest to the following facts.

In this town of 5,000 people three fires have quite recently been reported as caused by defective electric wiring. In the first case there was no electric wire within thirty feet of the place where the fire originated. The real cause was "booze" and cigarette stubs; in the second case the fire originated in a little catch-all cupboard over the furnace under the floor, and in the third place the proprietor of a tailor shop left his electric tailor's goose connected and went home to bed. The last-mentioned fire is the only one in which the cause could be even remotely charged to electricity.

The men who made these reports do not know the difference between a fuse plug and a spark plug and made the reports to shield the owners from their own carelessness. If all the reports referred to in your editorial are as lacking in truth as the above, a most serious injustice to the safety and reliability of electric service has been done. CHARLES T. MCCUTCHEN.

Boyne City Electric Company,
Boyne City, Mich.

Pulverized Coal for Steam Generation

To the Editor of the ELECTRICAL WORLD:

SIR: The writer has read with considerable interest the remarks published in the May 15 issue of the ELECTRICAL WORLD by T. A. Marsh, chief engineer of the Green Engineering Company. Since Mr. Marsh is directly interested in the manufacture of stokers, one can readily understand his reasons for criticising pulverized-coal-burning equipment. Any stoker concern would naturally argue along the same line, although its officials might know nothing at all about the use or cost of preparing pulverized coal.

In the first paragraph of Mr. Marsh's remarks he states that he believes it fundamentally wrong to take coal and burn it in a powdered condition. The writer takes exception to this statement, for it certainly is better and easier to burn coal in pulverized form than in lumps on grates subjected to the action of the heat.

In his second paragraph Mr. Marsh states that some accurate way of measuring the ash discharged from the stacks from pulverized-coal-fired furnaces should be found before definite statements concerning it are made. It is true that a large percentage of the ash from pulverized-coal-fired furnaces will be discharged from the stack. The percentage, however, dissipated from a first-class installation equipped with economizers and settling chambers will not be sufficient to cause a complaint, as has already been shown by installations using pulverized coal in thickly populated districts. This question of ash dissipation depends largely upon the velocity of the gases passing through the setting, and the percentage would naturally vary according to the operating conditions and the general design of the installation, the same as ash discharged from a stoker installation would vary according to the conditions under which the stoker is operated.

In the fourth paragraph Mr. Marsh states that the cement industry has more data on the subject of pulverized coal than steam producers. This statement is absolutely correct, and we do not hesitate to state that we are in touch with practically every plant in the United States and Canada and in fact have data on what is being done in connection with pulverized coal in the cement industry. We are positive that any one who at the present time is operating his coal plant at a cost as high as $1 per ton to prepare the coal is not operating efficiently, unless the particular coal plant has a very small capacity and is operated only periodically.

In order to show just what the cost of preparing coal is at the present time, we should like to state that during the month of August, 1919, at the plant of the Allentown Portland Cement Company 2,976 gross tons of coal were pulverized. The actual cost of pulverizing, in cents per gross ton, was as follows: Drying, 8.04; grinding, 8.74; operation, 0.43; power, 17.93; labor, 3.68; repairs, 7.65, or a total of 46.47 cents.

This is equivalent to 41 cents per net ton, no interest or depreciation included. This figure can be taken as representing the average cost in Portland cement plants in the Lehigh Valley district, for the quantity of coal pulverized daily from which these figures are taken is low, and no doubt in larger plants even these figures would be modified materially. The cost of preparing coal will vary primarily according to the quantity of coal pulverized daily, so that any general statements or criticisms that are made as to the cost of pulverizing coal in one plant have no bearing on the subject as a whole.

Fuller Engineering Company, H. G. BARNHURST,
Allentown, Pa. Chief Engineer.

The Rangeley Lakes Storage Reservoirs

To the Editor of the ELECTRICAL WORLD:

SIR: In your recent issue of March 20, on page 662, two photographs of "Two Sources of Potential Power in New England" appear with the statement: "These streams, the Kennebago and Cupsuptic, feed the Rangeley Lakes—a great natural reservoir that some day, like other Maine lakes, may serve as control for the flow of flash streams."

Permit me to say that the Rangeley Lakes system is and has been for several years the most highly developed system of storage reservoirs that there is in the East and probably in the whole country. This system of storage provides the Androscoggin River and the several power installations thereon—the greatest of which is at Rumford, Me.—with a stream-flow regulation unequaled anywhere in the whole United States.

To put it in more definite figures, 29,000,000,000 cu.ft. of water is stored in this system and its flow regulated over a total developed fall of more than 700 ft., or, in other words, the equivalent of approximately 350,000,000 kw.-hr. per year is given to the power plants on the Androscoggin River. C. T. MAYNARD,

Rumford Falls Power Company, Engineer.
Rumford, Me.

Station and Operating Practice

A Department Devoted to Problems of Installation,
Operation and Maintenance of Equipment for Economical Generation and
Distribution of Electrical Energy

Distributing Three-Phase and Two-Phase Energy Over Same Lines

TO MAKE both two-phase and three-phase energy available to customers who were changing over motors from two-phase to three-phase, the scheme shown herewith was adopted by the Dayton (Ohio) Power & Light Company. This changing over was made necessary in a small town which this company recently began to serve where a two-phase, four-wire system was originally installed, the standard installation of the company being three-phase. The change was made in two steps. First, the distribution system was changed to three-phase, necessitating a two-phase transformer connection at each power service; second, the motors were reconnected internally for three-phase operation.

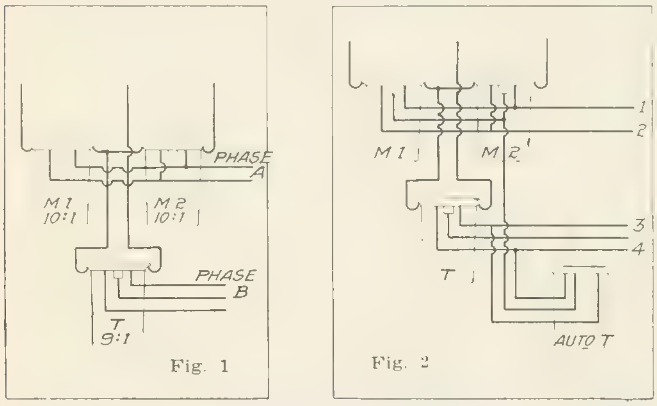


Fig. 1 Fig. 2

TRANSFORMER CONNECTIONS USED WHILE CHANGING SYSTEM FROM TWO-PHASE TO THREE-PHASE

Either two-phase or three-phase may be taken from secondary in Fig. 2.

The temporary Scott transformation from three-phase to two-phase was made easy by using the ten-to-one transformers of the old system in combination with nine-to-one transformers used by the company. The primary coils of the two original transformers were connected for 1,100 volts, and the two transformers were connected in series on the primary side and in parallel on the low-tension side, as shown in Fig. 1. This served as the main transformer of the Scott connection and for the teaser a nine-to-one ratio transformer was hung in an adjacent position and one high-tension terminal was connected between the two main transformers, the other terminal being connected to the line. The two-phase voltage with this combination was slightly unbalanced, the teaser phase being 4 per cent lower than the main phase, but this slight difference was not noticed in the operation of the motors.

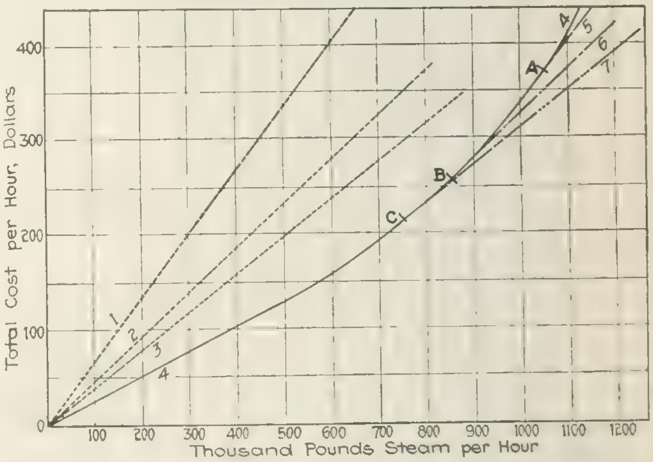
While the motors of the customers were being reconnected for three-phase operation, it was desirable to have both two-phase and three-phase energy available at the same time. This was accomplished over the old distribution lines by connecting an auto-transformer, as shown in Fig. 2, to the secondary of the connection shown in Fig. 1. This auto-transformer was an ordinary 220-volt transformer from the secondary of which a tap was brought out, giving 86.6 per cent voltage, and this tap was connected to the neutral of the main transformer while the ends of the 220-volt winding were connected to the secondaries of the teaser transformer. By this connection it was possible to operate a two-phase motor on leads 1, 2, 3 and 4 at the same time that a three-phase motor was operating on 1, 2 and 3.

This scheme operated successfully until all the motors were reconnected, when the transformer banks were changed to three-phase connections and nine-to-one ratio transformers were used to give a higher secondary voltage.

J. K. HIMES,
Superintendent of Distribution.
Dayton Power & Light Company,
Dayton, Ohio.

Charts That Show Combinations of Boilers and Stokers to Use for Any Load

IN ORDER that its boiler-room force may use the most economical combination of boiler equipment for any load, a large central station with chain grates and underfeed stokers has developed the set of curves here reproduced. These curves give cost of operating different combinations of boilers at any load and for various periods of time. The operating cost includes coal of 10,400 B.t.u. per pound (1,185 cal. per kg.) at $3.50 per



OPERATING COST CURVES FOR CHAIN GRATES AND UNDERFEED STOKERS

(1) One-hour operation at 150 per cent rating of thirty-two 518-hp. Edge Moor boilers with chain grates but without economizers. (2) Four-hour operation; same boilers and rating. (3) Continuous operation; same boilers and rating. (4) Continuous operation of twenty-four 558-hp. Edge Moor boilers with underfeed stokers and forced draft. Twenty of these boilers had economizers and four had not. This combination is most economical for continuous loads up to the point *C*. (5) Combination of the two groups of boilers for loads lasting one hour. Underfeed group should be used alone until load passes *A*. (6) Combination of both groups of boilers for loads lasting four hours. Chain-grate boilers should not be used until load gets beyond *B*. (7) Combination of both groups of boilers for continuous operation with loads in excess of the point *C*.

ton ($3.86 per metric ton), firemen at $120 per month and the maintenance of the refractories required for the different boilers for which the curves were drawn.

The curves show that for most conditions of operation the boilers equipped with underfeed stokers (No. 4) are much cheaper to operate than Nos. 1, 2 and 3, those in which chain grates are used. Curve No. 4 is not straight like Nos. 1, 2 and 3, because some of the boilers with underfeed stokers are equipped with economizers and some are not. All the chain-grate group are identically equipped. The letters *A*, *B*, and *C* on curve No. 4 indicate the points up to which the load can be most efficiently carried on the boilers equipped with underfeed stokers for two-hour, four-hour and continuous operation respectively. These three points were found in the following manner: Lines parallel to lines Nos. 1, 2 and 3 were drawn tangent to curve No. 3; then *A*, *B* and *C* were placed at the respective points of tangency.

Chicago, Ill. S. N. CLARK.

Additional Ground Wire Improves Transmission-Line Telephone

OPERATION of telephone lines run on the poles of 33,000-volt transmission lines was greatly improved by one Missouri central station by running another ground wire lower down the pole in addition to the regular overhead ground wire. The telephone line is about 4 ft. (12 m.) below the transmission line, and the lower ground wire is bracketed to the pole midway between them. Separate ground connections are run from both the upper and the lower ground wires. This lower ground wire serves as a protection from stray fields from the transmission line, thus eliminating much noise. In addition to improving the telephone service, the second ground wire protects the telephone line from falling power wires and adds materially to the strength of the line as a whole. F. C. ARTHUR,

Superintendent of Distribution.

Empire District Electric Company,
Joplin, Mo.

Troubles Caused by Shaft Currents in Generator

A MAGNETIZED generator shaft may cause two types of trouble. First, the simple magnetic effect which shows up in neighboring iron sometimes causes mechanical troubles such as heating of eccentrics and improper action of dash-pots and Corliss valve gear. Second, the shaft acts as a unipolar armature and a voltage is generated in it which is always in the same direction and depends on the amount of magnetization and on the speed. The consequent current may cause trouble in the bearings and pitting of the shaft.

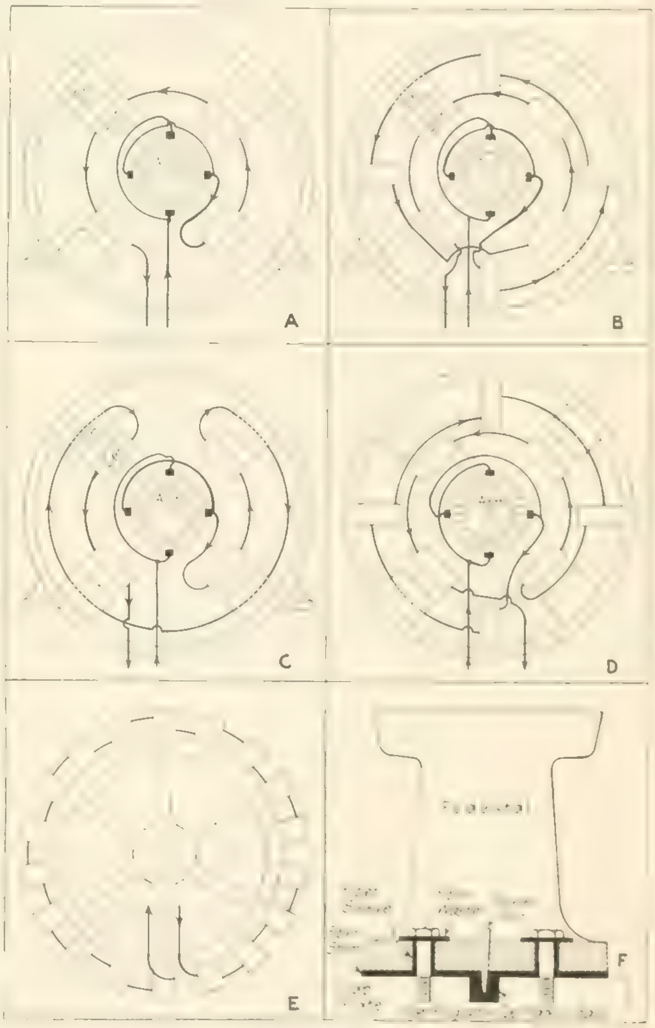
The causes of shaft magnetization are shown in the accompanying sketches. In a plain compound machine (sketch A) the series coils are usually connected in such a way that the series current makes one complete turn around the shaft. This is the simplest way to connect up the series field, and usually no damage results, as the magnetizing effect is comparatively small. This series turn causes the shaft magnetism often observed in compound machines. Interpole compound machines are susceptible to the same trouble in worse form, as in them there is the possibility of two turns around the shaft (see B), and if the series field happens to have two coils per pole connected in series there is a chance of three turns. Alternating-current generators and synchronous motors may show the same effect owing to the rotor current. (See E.)

In large high-speed machines it has been common to insulate one bearing to avoid this trouble. (See F.)

With engine-driven alternators there is no good way to insulate one bearing, but as the rotor current is not heavy enough to cause much magnetization and shaft voltage, the trouble seldom is such as to require any treatment.

In direct-current machines with stationary fields the extra connectors needed to connect the series and interpole windings in such a way as to avoid magnetizing the shaft stand still and are therefore not objectionable. A plain compound machine could be connected like sketch C. An interpole machine connected like D would not magnetize the shaft except in cases where series or interpole windings are shunted heavily, and even then it would amount to little. In direct-current machines the shunt-field current also goes around the frame once or twice and has a slight tendency to magnetize the shaft, but its effect is not heavy enough to be noticeable.

Cleveland, Ohio. JAMES DIXON.



CAUSES OF SHAFT MAGNETISM AND CONNECTIONS TO PREVENT IT

Shaft magnetism may be caused by series field connectors making one turn around the shaft as in the compound machine in "A," or making two turns as in "B," an interpole machine. In "C" and "D" are the respective methods of avoiding this trouble. "E" shows shaft magnetizing current in an alternator or synchronous motor. "F" shows a bearing insulated to prevent shaft currents.

Bonus System Increased Number of Meters Read by 50 Per Cent

THREE bonus systems for meter readers described here have proved successful in the case of the companies using them. The first is a "quantity" bonus system, by which the average number of meters read in a day has been increased over 50 per cent. This system was started in 1917 and the rates since October, 1918, have been $75 per month for a daily average of 250 meters, plus a bonus of 50 cents for each increase of one in the daily average above 250, the average to be based on the month's work and the maximum wage to be $100 per month. By this plan the daily average of 300 meters gives a bonus of $25, or the maximum wage of $100. The following deductions are made from the bonus: 50 cents for each per cent above 7 per cent on meters missed; 50 cents for each error detected on rereading the meter.

By reference to Table I the increase in the number of meters read in a month after the bonus was inaugurated will be seen. While the salary of the meter readers has been increased approximately 100 per cent over 1916, this increase would, no doubt, owing to the greater cost of labor in general, have been necessary regardless of the adoption of a bonus plan. Under the present arrangement, the regular meter readers do not as a rule read any meters missed at first call, but this work is done by two other men, who read "misses or skips" each morning and deliver bills in the afternoon. These men are at present paid a straight wage of approximately $75 per month. This arrangement was not in force during 1916, but has no effect on the previously reported daily average, which was and is now computed on the elapsed time for routes, based on an eight-hour day.

TABLE I—INCREASE IN NUMBER OF METERS READ UNDER BONUS SYSTEM

	No. of Regular Readers Employed	Meters Read by Regular Readers	Daily Average	Per Cent Missed First Call	Bonus Paid
October 1916*	8	25,464	192	5	*
October 1917	5	24,272	278	7	$70.50
October 1918	5	25,216	276	6	88 00
October 1919	5	27,679	316	7	125 00

* Bonus plan not used.

By using this bonus plan the rate of labor turnover and the number of errors in reading have been reduced. This also has an effect in making easier handling of customers' accounts in the commercial office and in decreasing complaints. The bonus applies on the combined total of gas and electric meters, but does not apply to five suburban routes that cover about twice the territory of the regular city routes. The regular city routes were analyzed as to distance covered and number of meters, and the division of routes was made as equably as possible among the various readers. The "meter read" slip is so arranged that the meter reader is furnished with the previous month's reading only and does not have the consumption for months past to guide him in case he tries "curbstone" readings. When a man is suspected of this practice a few dummy slips are inserted the next time he goes over a route. Only two readers (both extra men) have tried the practice, and they were quickly detected.

By the second system referred to above the cost of reading a meter is only 1.3 cents, although it was 1.5 cents six years ago, when the readers were on a flat salary. This decrease has taken place in spite of the great general increase in labor costs since that time. Moreover, a better class of meter readers is now attracted. The plan is simply that meter readers (who read both gas and electric meters) shall receive 1.3 cents per meter read with a penalty of 10 cents for every error. If they are on special work or absent on account of sickness, they are allowed $2 per day without any bonus. Their earnings average approximately $125 per month.

The third plan, a "quality" plan, is based on the accuracy of the readings. By this plan the same men read the meters every working day in the month and in addition to their regular salary receive a bonus depending upon the accuracy of their readings. A meter reader who is 100 per cent efficient—that is, whose readings are all correct—receives a bonus of $7.50 for the month. If his readings are from 98 to 99 per cent correct, he receives $6, and so on down to 90 per cent, as Table II shows. If a meter reader after he has become familiar with the work falls below 90 per cent, he is replaced by a new man. In addition to this bonus the meter reader at the end of the year who has the highest rating receives an extra bonus of $25. To qualify for the month rating a meter reader must have worked three-quarters of the working days in the month. If a meter reader is late in reporting ten times during the month he is not eligible to participate in the rewards.

TABLE II—BONUS FOR ACCURACY IN READING METERS

Percentage of Meters Read Correctly	Bonus per Month	Percentage of Meters Read Correctly	Bonus per Month
100	$7.50	94-95	$4 00
98-99	6.00	92-93	3.00
96-97	5 00	90-91	2.00

These systems were described by the committee on bonus systems at the Pasadena convention of the National Electric Light Association.

Value of Linoleum for Insulating Mats

LINOLEUM, because of its wearing qualities, offers some advantages for use in place of rubber for insulating mats. To overcome the tendency to curl, a hole may be drilled in the floor and a wooden plug driven in. A rounded-head oval wooden pin may then be driven through the linoleum and into the plug in the floor. Some tests by George Wall, chief operator of the Buffalo General Electric Company, made at the suggestion of the Utilities Mutual Insurance Company, indicate the dielectric strengths of various brands to be as shown in the accompanying table:

Test No.	Make			Results
1	Nairn Linoleum Co.	XX	Battleship	42,500 volts for 30 sec. without breakdown
2	Nairn Linoleum Co.	XX	Battleship	Broke down at 43,000 volts
3	Nairn Linoleum Co.	XX	Battleship	Broke down at 43,000 volts
4	Nairn Linoleum Co.	X	Battleship	Broke down at 37,500 volts
5	Nairn Linoleum Co.	X	Battleship	Broke down at 27,500 volts
6	Nairn Linoleum Co	X	Battleship	Broke down at 30,000 volts
7	Nairn Linoleum Co.	X	Battleship	20,000 volts without breakdown
8	Standard Carpet Co.	X	Regular product	Broke down at 28,000 volts
9	Standard Carpet Co.	X	Regular product	Broke down at 32,500 volts
10	Standard Carpet Co.	X	Regular product	20,000 volts without breakdown
14	S. Finck Company	X	Battleship	Broke down at 43,000 volts
15	S. Finck Company	X	Battleship	Broke down at 43,000 volts
16	S. Finck Company	X	Battleship	Broke down at 30,000 volts

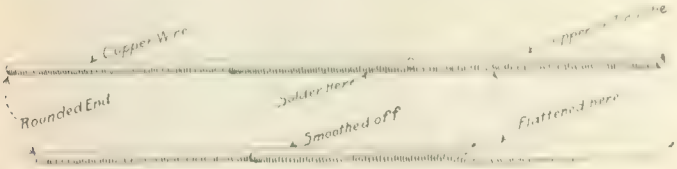
An objection that may be raised to the use of linoleum for insulating mats is that it has a greater tendency than rubber to absorb moisture, thus lowering the insulating value in moist places.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Device for Threading Sleeves on Coil Terminals

BY USE of a special threading needle described here placing cotton sleeving on the lead wires of coils is made comparatively easy and simple. It is common experience that one of the most bothersome operations in finishing form-wound or spread armature coils is that of threading the lead wires through the cotton sleeves. This is particularly true when the coil is wound with two or more wires in parallel. By use of this sleeve threader much time and trouble can be saved.



NEEDLE MAKES IT EASY TO THREAD SLEEVING OVER LEAD WIRES OF COILS

To make the threading needle a piece of copper wire of diameter equal to the inside diameter of the sleeving in use and about three-quarters as long as the sleeve is cut and polished with emery cloth. A tube which will just fit on the outside of the wire is then made from thin soft copper or tin of about the same length as the wire. After this tube is put on the wire and soldered in place it is smoothed off with a fine file and emery cloth and the end of the wire is rounded. If the sleeves are to be put upon a flat wire or several wires in parallel, the tube may be flattened to fit them.

In use the armature coil leads are inserted into the hollow end of the needle and the sleeve is slipped over the rounded point and shoved over the lead wire into its proper place, after which the wires are withdrawn from the needle. FRANK SOETE.

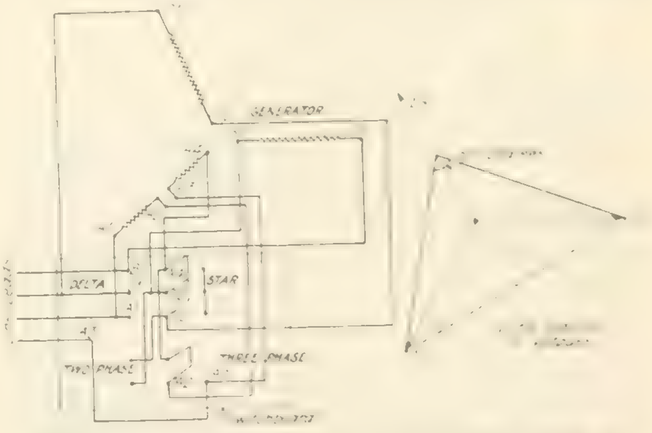
Honesdale, Pa.

Alternator for Two-Phase or Three-Phase Tests

FOR securing both two-phase and three-phase voltage one generator connected to a special small switchboard is used in an Eastern industrial plant. The method of making the connections was as follows: The alternator originally had a three-phase winding with the six leads brought out, none of which were marked. The phases were picked up by finding which pairs of leads gave a closed circuit and were then temporarily tagged *A* and *A*, *B* and *B*, and *C* and *C*. The middle point of the *A* phase was then found by counting the groups of coils in that phase. The connecting lead at this point was opened, and two leads which were permanently tagged *A2* and *A3* were brought out. The *A1* and *A4* leads were then easily found, since they formed ends of a closed coil. They were permanently tagged and the temporary *A* tags on these leads were removed. The *A4* point was considered as the star point on this leg.

To find which of the *B* legs was the star point, one of the *B* legs was connected to *A4* and the machine was run with the field excited. (*A2* and *A3* were connected together for this test.) If the voltage across *A1* and the free end of the *B* leg is 1.73 times the voltage across *A1-A4*, then the *B* leg connected to *A4* is the proper star point of the *B* leg and should be permanently marked *B2* and the free end marked *B1*. If the voltage obtained is less than 1.73 times the voltage across *A1* and *A4*, then the ends of the *B* leg should be reversed and the voltage tested again, when it should be found correct. In a similar manner the *C* legs were tagged *C1* and *C2* by connecting one end to *A4* and trying out. Having all three legs now marked, a star or delta connection can easily be made.

For the two-phase connection *C2* and *A4* are joined, and *B2* and *A2*. *C1* and *A3* will then be the legs of one of the phases and *B1* and *A1* the legs of the other phase. Drawing up a vector diagram of the voltages it is seen that the two-phase system is not exactly balanced, the two phases being 81.5 deg. apart instead of 90 deg. This is, however, close enough for ordinary purposes. An exact 90-deg. relation could be obtained by taking the points *A3* and *A1* at the proper coil, which can be calculated. It should be noted that if the coils *A1-A2* and *A3-A4* are reversed when connecting up two-phase, the result will be a single-phase system as shown by the dotted lines in the vector diagram.



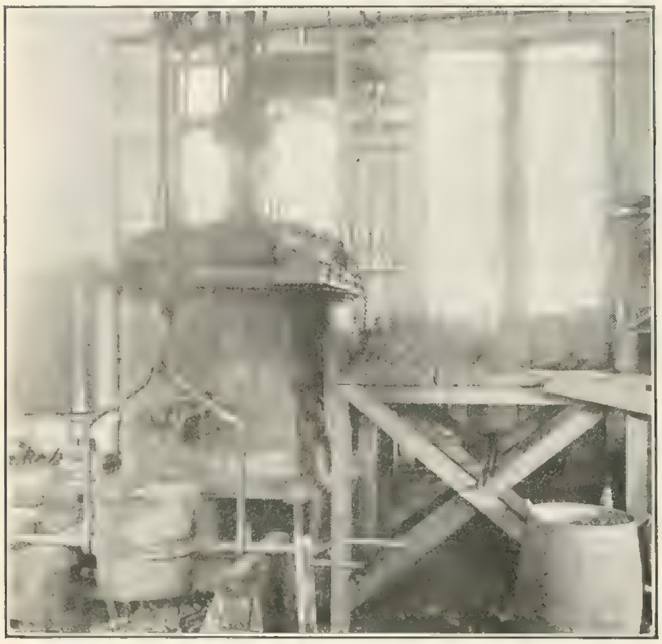
SWITCHES AND CONNECTIONS TO OBTAIN TWO-PHASE OR THREE-PHASE VOLTAGE FROM ALTERNATOR

A small switchboard of treated maple with a three-pole, double-throw switch and a two-pole, double-throw switch mounted on the machine provides a convenient method of quickly converting the machine to two-phase or three-phase delta or star. The machine has been in daily service now for more than six months and has given complete satisfaction. EUSTACE C. SOARES.

Ampere, N. J.

Manufacture of Synthetic Cast Iron in the Electric Furnace

ALTHOUGH synthetic pig iron has been produced in the electric furnace both in the United States and Canada, the production of gray iron from wrought iron and steel scrap suitable for high-grade castings on a commercial scale as described here is a recent accomplishment. Late in the summer of 1919 an experimental furnace of 1,000 lb. (1,600 kg.) capacity was installed at the Hesse-Martin Iron Works for this purpose. The furnace was of the single-phase type operating with a conducting hearth and a single electrode above the bath. The potential between the bath and the upper electrode was about 55 volts.


FURNACE USED TO MAKE CAST IRON FROM STEEL SCRAP

The metal was easily controlled as to composition and temperature of pouring. The product was of very high grade and easily machined. Analyses of several heats and physical tests are given in the accompanying tables.

ANALYSES AND TESTS OF CAST-IRON BARS MADE ELECTRICALLY FROM STEEL SCRAP.

	Test Bars, 1½ In. Diameter, Broken on supports, 12-In. Centers.			Test Bars, 1 In. x 2 In., Broken on the Flat, 24-In. Centers.				
CC	1.11	1.14	0.98	0.90	1.07	0.77	0.87	0.79
GC	1.84	1.80	2.10	2.50	1.85	2.30	1.75	2.22
TC	2.95	2.94	2.98	3.40	2.92	3.07	2.62	3.01
S	0.018	0.014	0.014	0.01	0.016	0.02	0.023	0.023
P	0.047	0.047	0.048	0.04	0.06	0.049	0.12	0.04
Si	1.87	1.87	1.75	2.01	2.25	2.36	2.50	2.03
Mn	0.58	0.62	0.62	0.54	0.54	0.54	0.56	0.56
Transverse load, lb.	3,215	3,060	3,670	3,720	3.640	3,150	3,200	3,760
Deflection	0.15	0.14	0.17	0.62	0.53	0.52	0.45	0.63

Hesse-Martin Iron Company, **W. L. MORRISON.**
Portland, Ore. Metallurgical Engineer.

Labor-Saving Hint for Erecting an Engine-Type Alternator

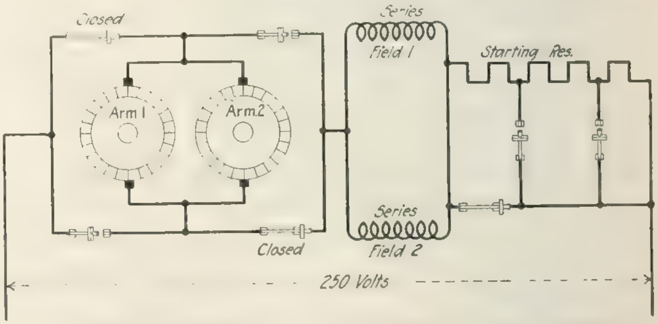
TO AVOID side shifting of the stator when erecting an engine-type alternator, the following is a useful method for replacing the stator coils removed when the stator was split for shipping. When shipping such a stator a number of coils are removed to allow the stator to be opened and shipped in separate halves. At the station where the generator is to be installed the erecting and lining up of the stator is best done before these coils are put back in place. To get access to these slots by side-shifting the stator is often undesirable. An alternative method sometimes possible is to unbolt and remove a few poles of the rotor and turn the space thus made up to the joint. This gives room to do the necessary work at the split on that side. The rotor is then turned to bring the space opposite the split on the other side and the joint coils at that side are put in. After the winding is complete the rotor can be turned to bring the open space to the bottom where the removed poles are replaced and reconnected. This is a useful trick which will often save a lot of time and work by eliminating realignment of the stator after shifting.

Cleveland, Ohio. **JAMES DIXON.**

Unstable Operation of Series Motors Mechanically Connected

SOME difficulty was experienced in a recent acceptance test in operating in parallel two 40-hp., 250-volt series motors mechanically interlocked and driving a 150-ton electric traveling crane. Investigation showed that separate connection to the lines in place of the original connections, as shown in the diagram, would avoid the trouble. Both motors are geared to separate shafts and mechanically interlocked through the medium of wheels and rail, hence they operate at identical speeds. After putting the bridge in motion, it was noticed that one motor was assuming practically the entire load while the other was only very lightly loaded, which suggested the possibility of the motors having widely different characteristics. Careful investigation, however, disclosed the fact that the trouble was not altogether due to dissimilar characteristics, but for the greater part to wrong motor connections.

When the motors were thrown on the line the field currents in each motor were the same, as the field resistances were equal and connected in parallel. However, some slight difference in construction allowed more current to flow through one armature than through the other. This caused a distortion and consequent weakening of the field flux in this motor, lowering the counter emf. and allowing still greater current to flow. As a consequence this motor carried a major part of the load. This caused unstable running and general unsatisfactory operation.



MOTORS CONNECTED SO THAT THEY DO NOT DIVIDE LOADS EQUALLY

The remedy was to connect each motor and its field across the line independently of the other, using separate contactors controlled from one master controller. With this arrangement the operation was successful.

Norfolk, Va. **TAYLOR S. BURKE.**

Two-Phase Motor Reconnected for Three-Phase Operation

IN AN article on reconnecting a two-phase motor for three-phase operation in the ELECTRICAL WORLD of May 8, 1920, page 1096, through no fault of the author, an error was made in preparing the diagram of the three-phase connection. This diagram gives a 60-deg. connection, showing one phase reversed. To correct this mistake, coil No. 2 should be connected to the star point, leaving Nos. 1, 3 and 17 for the motor leads.

115-Volt Lamps on 230-Volt Circuits in Industrial Plants

BY INSTALLING 115-volt lamps on 230-volt circuits the cost of lamps may be reduced 25 to 30 per cent in certain cases. The use of lamps of lower voltage has at least three advantages over using those of higher voltage—lower cost, greater specific output and better service performance. The following table illustrates the first two advantages:

Size of lamp in watts	300	1,000
Approximate price, 115 volts	$3.00	$7.00
Approximate price, 230 volts	$3.60	$8.40
Lumen rating, 115 volts	4,850	18,000
Lumen rating, 230 volts	4,100	16,100

Rated lumens per dollar: 115 volts, 1,617—2,571; 230 volts, 1,140—1,917.

From this table it may be seen that the prices of the lamps of higher voltage are about 20 per cent greater than those of lower voltage, while, on the other hand, the light output is less by about 8½ per cent. The resultant cost per lumen for the 115-volt lamps is 71 per cent and 75 per cent, respectively, of the cost of 230-volt lamps. The third factor is of no little importance. Owing to the construction of the higher-voltage lamps, they are in greater danger of having the filaments broken or of having the length of life reduced by the shorting out of part of the filament.

Taking an actual condition in a certain industrial plant where the writer has done illuminating engineering, there were used 492 300-watt, 230-volt lamps costing $1,103.70. To give the same light only 415 of the 115-volt lamps would have been required. The cost of the lower-voltage lamps would have been about $919.75. Of course, this total saving could not have been realized, but it indicates the importance of the consideration.

Now, while it is cheaper to use the lower-voltage lamps, the higher-voltage circuit has an advantage due to the smaller size of conductors required. For a given amount of energy to be transmitted if the voltage be increased by 100 per cent the current will be decreased in the same proportion, and therefore the conductor need be but half as great. The advantages of the lower-voltage lamps and the higher-voltage circuits may be obtained simultaneously by operating the 115-volt lamps, two in series, across the 230-volt circuit. There is, however, a disadvantage in this arrangement in that if one lamp burns out another is not lighted. The life of lamps burned in series is also somewhat less.

Generally the lower-voltage lamps are cheaper to buy, cheaper to operate, give more light, have a longer life and are more plentiful, as the higher-voltage lamps constitute only about 7 per cent of the lamps made.

Pittsburgh, Pa. D. W. BLAKESLEE.

Color Code for Different Ratings of Refillable Fuses

FOR each rating of fuse in a St. Louis plant a different color is painted on the fiber fuse case and on the fiber cross-bar of each switch on which a fuse of this rating should be used. By this scheme it is very easy to tell the rating of a fuse which has blown, and in all probability a fuse of different rating will not be used to replace it.

As a user of refillable fuses for a number of years the writer has found that it is not good practice to let more than one or two persons do the reloading, preferably only one, if the plant is not too large. In the plant mentioned the fuse links are kept in a locker and one man is responsible for all reloading. This man is required to see that all blown fuses are refilled at the time when he comes on the job and again when he goes off the job. The blown fuses are kept in a box, and two sets of each rating already loaded are kept in a drawer.

Another scheme which has saved time in tracing connections and in replacing fuses has been to stamp a number on the buses of each fuse box opposite each circuit.

Corresponding numbers are printed on a card attached on the door of each cabinet, telling what portion of the plant the circuit feeds. Thus, if the lines are dead in a certain room, by reference to this card the fuse that needs to be replaced will be found immediately.

St. Louis, Mo. G. F. KLUGMANN, JR.

Method of Mounting Four Starting Switches on One Column

BY MEANS of four strips of wood bolted to the column, as shown in the accompanying illustration, four Westinghouse No. 815 starting switches are mounted on one column in the East Springfield factory of the Westinghouse Electric & Manufacturing Company. The switches are fed through conduit which runs from above. The four strips of wood, 2 in. x 4 in. x 19 in. (5 cm. x 10 cm. x 50 cm.) in size, are placed 3¾ in. (9.5 cm.) apart vertically and 8 in. (20 cm.) horizontally. Horizontal tie rods about ⅜ in. (10 mm.) in diameter pass through the ends of each strip to hold them firmly to the column. The inside edge of each strip is slightly rounded to fit the column in order to give the strip a better seat.

METHOD FOR MOUNTING FOUR STARTING SWITCHES UPON ONE COLUMN

Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

Power-Factor Rate Filed at Providence

LOW power factor on the system of the Narragansett Electric Lighting Company, Providence, R. I., in installations of over 100 hp. connected load will be penalized as follows in a rate filed with the Public Utilities Commission:

Power Factor of Customer's Load, Per Cent	Increase of Rates, Per Cent
71 to 79	5
61 to 70	15
51 to 60	25
50 and below	50

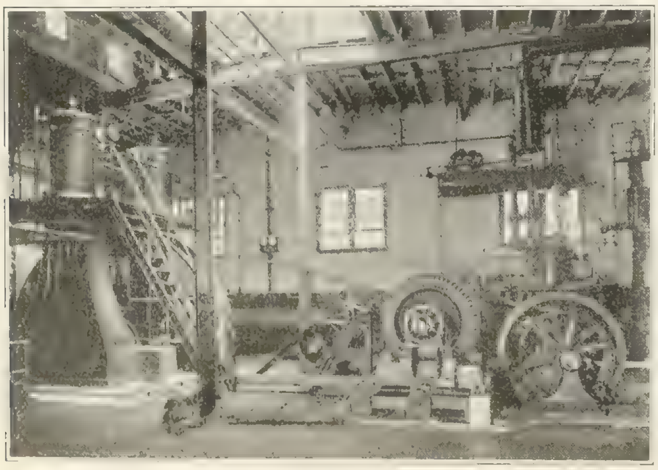
A normal power factor of at least 80 per cent is required to be maintained by the customer on week days from 7 a.m. to 6 p.m., with penalties as above stated.

Emergency Installation of Motor Shows Saving Over Gas Engine

HOW an emergency installation of a motor to replace a broken-down producer gas engine operating an ice machine increased the production of the ice plant and resulted in the ordering of a motor for permanent installation in place of the gas engine is told by Bryant White, general superintendent of the lighting and power department of the Roanoke (Va.) Railway & Electric Company, who says:

When the 200-hp. gas engine operated from a producer in the plant of the Citizens' Crystal Ice Company at Roanoke, Va., broke one of its pistons and badly damaged one of the cylinders the Roanoke Railway & Electric Company was asked to help out in the emergency. The only motor available was a 300-hp., 2,300-volt, 900-r.p.m. synchronous motor which was installed within twenty-four hours, as shown in the accompanying cut. This motor has been in operation for two months, and although it is of too high speed for this service and the starting condition is very severe, it has kept the plant running twenty-four hours a day, turning out 80 tons of ice daily, whereas the rating of the ice machine is only 60 tons.

William Zieber, general manager of the ice company, is responsible for the statement that the increase in ice production due to the constant operation of electric service, as compared with the producer and gas-engine source of power with its frequent interruptions, will pay two-thirds of the total power bill for operating the plant. This plant is a 125-ton refrigerator machine with tank capacity for making 80 tons of ice per day and 180,000 cu.ft. of cold storage. A 200-hp., 450 r.p.m. slip-ring motor has been ordered as a permanent installation.



300-HP. MOTOR DISPLACING GAS ENGINE

Hydro-Electric Energy Saves Community More Than $500,000 in Sixteen Years

THE Indian Orchard (Mass.) hydro-electric station of the United Electric Light Company of Springfield in sixteen and one-half years saved the company and community $512,018 as compared with the cost of producing energy in the steam plant of this central station. From 1903 to 1919 the average cost of the company's output generated by steam was at the rate of $0.00777 per kilowatt-hour, whereas the average cost of the output at Indian Orchard station, on the Chicopee River, was $0.002708 per kilowatt-hour. The ratio in favor of the water-power station was 2.87 to 1. The output of the hydro-electric plant in this period was 101,167,237 kw.-hr. and that of the steam plant 227,435,383 kw.-hr., the respective total costs being $274,050 and $1,767,686. During this period the yearly output of the water-power station ranged from a minimum of 3,874,275 kw.-hr. in 1904 to a maximum of 9,325,982 kw.-hr. in 1917, and the unit cost ranged from $0.007546 in 1903 to $0.00165 in 1916. For the steam plant, which is tied in with the water-power station, the yearly output ranged from a minimum of 1,654,675 kw.-hr. in 1904 to 37,111,279 kw.-hr. in 1919. In the last fiscal year, 1919, the hydro-electric output was 8,713,520 kw.-hr., costing $0,001858 per unit, and that of the steam plant 37,111,279 kw.-hr., costing $0.0076.

These data were presented before the Massachusetts Department of Public Utilities in a hearing given the United company prior to approval of a new stock issue of 8,000 shares. The United company some years ago purchased the Indian Orchard Company, a textile manufacturing concern owning various factory and water-power privileges, about 7 miles east of Springfield, and the former gas and electric light commission denied the United company authority to issue certain stock on the ground that the ownership of an industrial concern was outside of its rights as a public utility. By a special act of the Massachusetts Legislature the United company later received authority to own and operate this industrial concern.

It was shown that by the purchase the United company had headed off the threatened competition of rival interests which were seeking to exploit the Indian Orchard water power, and that under the ownership of the United company the plant had been greatly improved and developed, resulting in the production of double the energy from the available water and the co-ordination of the service of the industrial company by day and of the United company by night to secure a twenty-four-hour use of the river. This, the company maintained, enabled the savings above recorded to be realized and has meant lower prices of energy to the community than would have been the case had steam alone been available. The improvements effected at the Indian Orchard station have been described in earlier issues of the Electrical World. In granting the company's petition for stock increase the new commission did not object on the ground that the issue was related to the ownership and operation of the industrial concern.

Employee Representation in Illinois Utility

Employees and the management of the Public Service Company of Northern Illinois have created a co-operative council to come into existence on July 1. In this council representatives elected by the employees and appointees of the management are equally represented for the purpose of considering all questions of policy which may affect the employees in any manner.

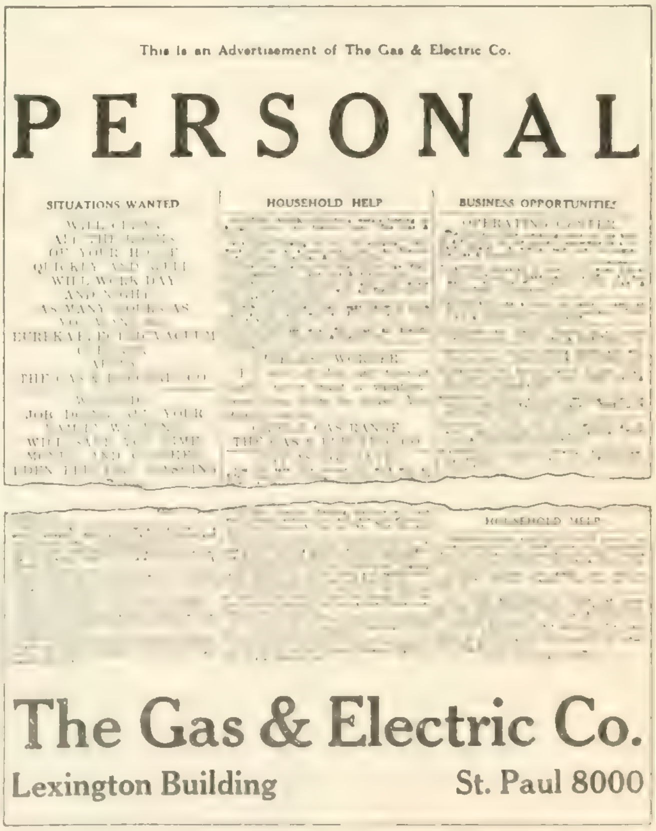
The properties of the company are divided so that there are six territorial councils, in which there is approximately one elected employee delegate for each 100 employees and not more than an equal number of delegates appointed by the company. It is provided in the constitution of the council that the elected and the appointed delegates must each vote as a unit in which the majority rules. This prevents the possibility of one elected delegate going over and voting with the appointed delegates, or *vice versa*, in order to carry a point against the combined wishes of the other delegates in his class. It is also provided that there is to be no discrimination against any employee because of his race, sect, political affiliation, membership or non-membership in any labor or other organization.

In case a territorial council cannot agree on any matter the employee or the management representatives may have the question referred to the chairman of the board of control of the company. The company is to have ten days in which either to propose a settlement or refer the matter directly to the general council, composed of an employee representative from each territorial council and not more than the same number of company representatives. Outside arbitration can be resorted to only with the consent of the representatives of both sides. If neither the board of control nor the general council is able to settle a difference in a manner satisfactory to both parties, and furthermore if either the company or its employees will not agree to an outside arbitrator, conditions are then no worse than they would have been under the old arrangement, which was devoid of any co-operative plan. However, the many opportunities for man-to-man discussion in the co-operative council are expected to result in amicable agreements being reached in every case by means provided in the constitution.

The constitution of the co-operative council was drawn up by eighteen men elected by the employees and fourteen others appointed by the management, and every word in the constitution as finally adopted was agreed to unanimously by these thirty-two men. They worked five days on the document, and J. L. Hecht, who was chairman of the convention, said that each subject was discussed until every one was satisfied as to what was the right thing to do. Furthermore, it was decided in the beginning that the co-operative council would be absolutely fair to every one and that no one should give up any existing rights.

The employee delegates who helped to draw up the constitution included five linemen, a salesman, a machinist, two service men, two gasfitters, two engineers from the general office, a wireman, a trouble man, an operator, a clerk and a collector. Some of these employee representatives were union men, but nevertheless after the second day's deliberation it was said to be impossible for an outsider to tell from the discussion which side any one man represented, especially as the employee representatives often offered more constructive suggestions than those emanating from the company's delegates. They deemed it necessary to have a clearing house in the general office to correlate the work of the six territorial councils. A committee was therefore appointed to perform this function and to supply initiative and direction where and when it may be found necessary.

Newspaper Advertising Used by Baltimore Company in Its Merchandising Campaign


This is an Advertisement of The Gas & Electric Co.

PERSONAL

SITUATIONS WANTED

HOUSEHOLD HELP

BUSINESS OPPORTUNITIES

The Gas & Electric Co.

Lexington Building St. Paul 8000

In its campaign to modernize housekeeping methods, the Consolidated Gas, Electric Light & Power Company of Baltimore, Md., has taken considerable space in newspapers. One of the interesting types of advertising which is being used is shown in the accompanying illustration.

House Heating by Electricity in Tacoma, Wash.

DATA on house heating by electricity showing connected load and energy consumed are given in the annual report of the municipal hydro-electric plant of Tacoma, Wash. Commissioner Ira S. Davisson of the city light department draws some interesting conclusions as to the possible growth of this class of business and its ultimate effect on the central station's generating and distribution systems. Concerning house heating the report says that for the last five years the rate for heating houses has been ½ cent per kilowatt-hour with a minimum charge of $9 per kilowatt maximum demand per year. Up to Dec. 31, 1919, only 547 customers had taken advantage of this rate. Of these 547 customers, 139 used the service twelve months, 35 having a yearly maximum demand of less than 4 kw. and the remaining 104 an average of 8.17 kw. The latter are residences which are virtually dependent upon electric heat and pay the city about $80 a year each. Where these same residences have ranges they pay an average of $45 a year more for their light and cooking. Where hot-water heaters are added this expense averages $30 a year additional, so that the complete electrically equipped house pays on an average $155 a year.

Heating data are as follows:

Number of customers, Dec. 31, 1919	547
Income from all customers—378 for only part of year	$19,448.25
Probable income if all were served the whole year	36,000
Total connected load of all customers, Dec. 31, 1919	3,625 kw.
Number of customers served for full year	139
Income from customers served for full year	$9,268.40
Total connected load of full-year customers	923 kw.
Average annual income per kilowatt of load	$10
Consumption by full-year customers	1,778,238 kw.
Average rate per kilowatt-hour	$0.0052
Number of customers using over 4 kw. a full year	103
Total connected load of full-year customers over 4 kw.	842 kw.
Average load of customers using over 4 kw.	8.17 kw.
Average load of all 547 customers	6.65 kw.

During the year the number of heating customers increased from 378 to 547, the increased interest in electric heating having been aroused by the high cost of fuel and the coal strike.

There has been no question that the city would be able to continue the heating rate of $9 a year as long as the light, cooking and power loads predominate, but the situation would take on a serious aspect should the heat load begin to exceed the other. This stage has not yet been reached but is approaching, the connected heating load now amounting to 3,625 kw. compared with a total load of 60,000 kw. The demand on the system, however, amounts to 2,700 kw., compared with a peak of 16,500 kw.

The distribution system is already being taxed in certain localities, and some extensive changes are being made to meet the situation. The fact that the network voltage is 4,000 and that there is no underground construction keeps distribution costs down. The cost of this heating service is now being analyzed. The present conclusions are:

(1) This load will come on gradually because the sawmill refuse will always keep fuel prices lower than the present rate and the customer's investment will keep many from wiring and getting heaters. This time element will give opportunity to develop the distribution along economical lines and keep the relation between the heating load and the total within bounds.

(2) Industrial heating and power used is going to increase as fast as residence heating so that the load factor will not be changed by this heating load.

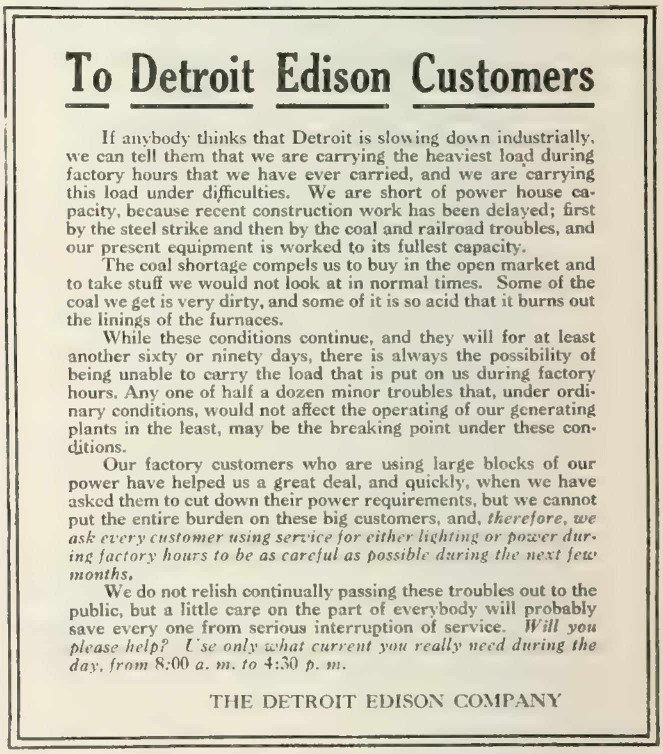
(3) The fact that more efficient methods of converting fuel into electric energy are being developed must be kept in view. As this efficiency is improved it will be more efficient to distribute heat from a central heating plant by electric wires than by pipes. Central-station heating plants can now supply a congested district cheaper than many small plants in the several buildings. The amount of fuel, trucking and labor that would be saved by supplying scattered residences with central-station heat, electrically transmitted, will be much greater.

(4) An income of $155 a year from the average residence will be enough to pay the costs and make it possible to continue the heating rate now in force, with the possible modification that the ½-cent rate will not apply until the customer first pays for a fixed amount of lighting and cooking energy at their respective rates.

The percentage of income from heating customers was distributed over the year as follows: January, 16.8; February, 12; March, 11; April, 7.7; May, 5; June, 3.2; July, 2.5; August, 2.5; September, 4; October, 8.4; November, 12.6; December, 14.3.

Detroit Edison Asks Customers' Help in Power Shortage

IN DETROIT the power shortage has become acute, and the Detroit Edison Company is carrying under difficulties the heaviest day load in its history. Factories with large power demands have cut down their requirements, and to further lighten the load all light and power consumers have been asked to curtail their use of energy during factory hours as much as possible. A frank statement of the company's position and a courteous appeal for assistance from customers are made in the accompanying advertisement, which is a type of publicity frequently used by the Detroit Edison Company in putting its problems before the public.



To Detroit Edison Customers

If anybody thinks that Detroit is slowing down industrially, we can tell them that we are carrying the heaviest load during factory hours that we have ever carried, and we are carrying this load under difficulties. We are short of power house capacity, because recent construction work has been delayed; first by the steel strike and then by the coal and railroad troubles, and our present equipment is worked to its fullest capacity.

The coal shortage compels us to buy in the open market and to take stuff we would not look at in normal times. Some of the coal we get is very dirty, and some of it is so acid that it burns out the linings of the furnaces.

While these conditions continue, and they will for at least another sixty or ninety days, there is always the possibility of being unable to carry the load that is put on us during factory hours. Any one of half a dozen minor troubles that, under ordinary conditions, would not affect the operating of our generating plants in the least, may be the breaking point under these conditions.

Our factory customers who are using large blocks of our power have helped us a great deal, and quickly, when we have asked them to cut down their power requirements, but we cannot put the entire burden on these big customers, and, *therefore, we ask every customer using service for either lighting or power during factory hours to be as careful as possible during the next few months.*

We do not relish continually passing these troubles out to the public, but a little care on the part of everybody will probably save every one from serious interruption of service. *Will you please help? Use only what current you really need during the day, from 8:00 a. m. to 4:30 p. m.*

THE DETROIT EDISON COMPANY

NEWSPAPER ADVERTISEMENT BY DETROIT EDISON COMPANY ASKING CUSTOMERS' AID IN POWER SHORTAGE

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Direct Current Compared with Three-Phase Current for Driving Steel Works Plant.—C. A. ABLETT. This comparison may be summarized as follows: The three-phase system enables power to be transmitted cheaply over long distances at high voltages, but three-phase motors are not capable of speed variation without much loss of power, unless they are of a complicated and costly type, and are not well suited to many steel works purposes. Direct current is not well adapted to long-distance transmission, but in most iron and steel works this is not of great importance. Direct-current motors are capable of wide speed variation without loss of power. This renders them suitable for steel works.—London *Electrician,* May 14, 1920.

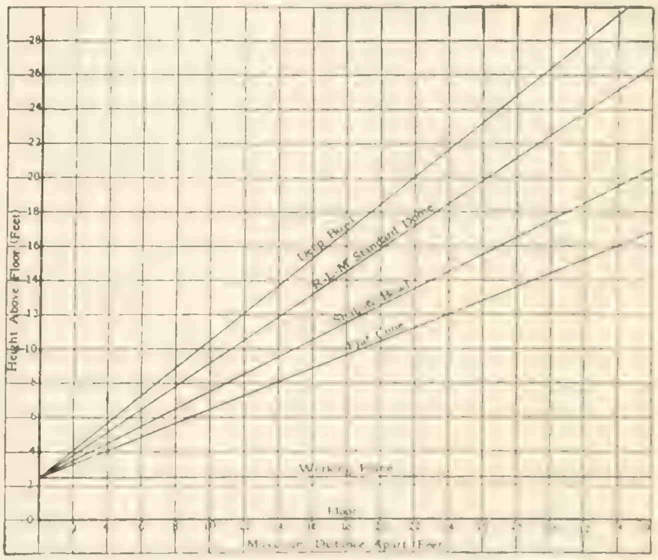
Starting Boxes for Direct-Current Motors.—F. LOPPÉ.—The author shows, by means of a series of numerical examples, that starting resistance, for cutting down the sudden current rush when starting a direct-current motor, may in certain cases be advantageously built up of resistance units successively connected in parallel instead of in series, as is usually the case. It is shown that, especially if small current steps are desirable, the weight of the resistance wire needed for a parallel-unit starting box will be considerably smaller than that of the corresponding series box, the ratio in one investigated case being 29 to 110.—*Revue Générale d'Electricité,* Jan. 17, 1920.

The Rotating Phase Advancer.—J. KOZISEK.—For the purpose of increasing the power factor of induction motors rotating phase advancers are sometimes used which consist of a stator without any winding and an ordinary direct-current armature with commutator, driven by the motor to be compensated and connected by three brushes to the rotor of the induction motor. The characteristics of this type of phase compensator are discussed in detail, particular attention being given to the question of saturation in the phase-advancer core. It is shown that certain improvements in the effectiveness of the device may be obtained by using high values of magnetic induction. Thus, in case of a core worked to high saturation, the range of unity power factor is considerably extended toward lower load values, a pronounced current minimum developing at about one-quarter of full load.—*Elektrotechnische Zeitschrift,* Jan. 15, 1920.

Lamps and Lighting

Ornamental Street Lighting.—L. A. S. WOOD.—A solution of the problem of supporting street lamps and trolley wires is offered. This new ornamental trolley pole consists of a hollow cast-iron column with brackets attached which is slipped over the existing trolley pole and is so arranged that a maximum rake in the trolley pole of 4 in. (10 cm.) can be sealed in the hollow column. Three ornamental lighting units are supported on this post. The height from the sidewalk to the light center of the top unit is 22 ft. 9 in. (6.9 m.) and the height to the light center of the side units is 18 ft. 8 in. (5.7 m.). This ornamental pole improves the appearance of the street in daylight and produces a brilliant "white-way" effect at night.—*Electric Journal,* May, 1920.

Notes on Industrial Lighting.—OTIS L. JOHNSON.—The characteristics of a good lighting system for industrial plants are outlined as follows: (1) Absence of both direct and reflected glare; (2) sufficient intensity on all working surfaces, horizontal and vertical; (3) an intensity of illumination on posts, walls and ceilings so as not to cause objectionable contrasts; (4) good diffusion; (5) light from the proper direction so as to avoid objectionable shadows. In addition to the improvements in men and women brought about by correct illumination this also results in increased production, decreased costs per unit of output, improved quality, less spoilage and fewer accidents. The author concludes that the equipment necessary for a system of lighting which complies with all the requirements of good illumination can be installed and operated for less than 1 per cent of the average workman's wage. Good illumination is, therefore, not an excessive expense, but pays large dividends in proportion to the capital investment. Charts given for use in laying out lighting systems are of especial interest.—*Electric Journal,* May, 1920.



RATIO OF MOUNTING HEIGHT TO SPACING FOR UNIFORM ILLUMINATION

A New Low-Power Lamp Rectifier of Alternating Current.—JOHN SCOTT-TAGGART.—A rectifier was designed along the lines of an incandescent lamp which could be plugged into the ordinary alternating-current supply circuits. The rectified current is in the neighborhood of 100 milliamperes. The rectifier vacuum tube operates on the principle of the Edison effect. A nickel plate was rolled into cylindrical form, and within this was placed a horseshoe filament of spiralized tungsten wire. External connections were taken from the middle point of the filament and also from the plate.—London *Electrician*, April 23, 1920.

Generation, Transmission and Distribution

Utilization of Corona Loss for Protective Purposes.—R. NAGEL.—For apparatus operating at extremely high voltages the natural corona losses represent a very effective protection against surges, simply by permitting excessive overvoltages to leak right out in the air. Through ionization of the air the effective capacity per unit length of a conductor increases greatly, when corona forms. This tends to lower the potential differences due to surging charges. The author has studied the corona phenomena of pointed conductors with a view in particular to the development of a practically useful scheme for corona protection of transmission lines of 10,000 volts up. According to a Swedish patent granted in 1911 to Centerwall, such protection is afforded by a thin wire connected in parallel to the high-tension conductor and carried in proximity to a grounded wire. An alternative scheme consists of splitting up the power conductor on short stretches into a number of parallel wires of small diameter. These suggestions are criticized, and the author instead recommends the use of barbed-wire conductors, thus taking advantage of the strong corona-forming tendency of sharp points. At 50,000 volts the corona losses on a line of commercial barbed fence wire were found to be about twenty-five times those of a similar line of smooth 5-mm. (No. 4) wire. The distance between wires was about 1.5 ft. While no corona formed below 18,000 volts, the loss on the barbed-wire line at 50,000 volts amounted to 2.5 watts per meter (0.8 watt/ft.). For practical use the author suggests special conductors of copper or aluminum provided with pointed elements of plate or wire, or for lines of larger section the use of a special barbed wire, wound around the main conductor. The line should be thus barbed on stretches about one-half mile long at points where protection is desired.—*Archiv für Elektrotechnik*, Dec. 8, 1919.

Balancing of Turbines and Propellers.—J. J. KING-SALTER.—The paper deals with the problems involved in determining the position and amount of the weight required to correct the out-of-balance, not only in propellers but in any class of turbine or electrical rotor, and gives the results of tests that have been made to endeavor to take the problem of correcting the out-of-balance from out of the realm of what was really a method of trial and error into one more nearly approaching exactitude and precision.—London *Engineering*, April 9, 1920.

Traction

Studies on Direct-Current Traction.—F. GUÉRY.—A long article on general problems in direct-current traction, such as determination of necessary power supply, utilization of the energy, and most economical lay-out of feeders, etc. The effect upon over-all efficiency of various systems of speed control and regenerative braking is discussed. The author shows how probability methods may be applied for determination of average power consumption and of peak loads due to several cars starting up at just the same time. The problem of track circuit feeder design is put on an economical basis by a modification of the Kelvin rule, but much attention is also given to considerations of maximum permissible voltage gradient along the track circuit and to corrosion difficulties.—*Revue Générale d'Electricité*, Feb. 7 and 14, 1920.

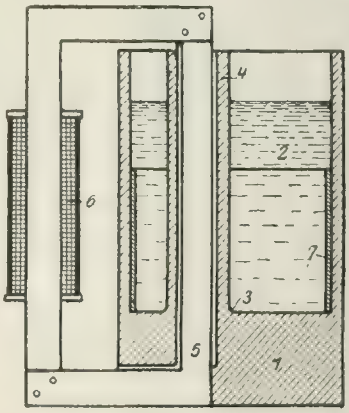
Summary of High-Voltage Direct-Current Railways.—W. D. BEARCE.—To this article is attached an extensive chart giving the details of overhead construction, power supply and rolling stock concerning fifty direct-current railway systems operating at 1,200 volts and above. This chart supersedes one published in the *General Electric Review* for November, 1916. A summary of high-voltage lines in the United States and Canada grouped according to trolley voltage is as follows:

System	Number of Installations	Miles		Rolling Stock	
		Route	Single Track	Cars	Locomotives
1,200 volts	32	1,847	2,082	604	62
1,500 volts	9	596	630	134	29
2,400 volts	2	40	144	8	37
3,000 volts	2	657	871	0	61
Total	45	3,140	3,727	746	189

—*General Electric Review*, April, 1920.

Systems, Installations and Appliances

An Electric Water Heater.—E. F. RUSS.—Description of an electric water heater whose action is somewhat analogous to that of the induction furnace. Its construction is shown in the figure. The transformer core 5 passes through a hole in the water vessel 1. The transformer secondary consists of a thin copper or brass plate, bent into cylindrical shape, which is submerged in the water and thus will give over all its Joulean heat directly to the water to be heated. The thermal efficiency of this apparatus is claimed to be almost 100 per cent, giving an unusually quick-acting and economical water heater.—*Elektrotechnische Zeitschrift*, Jan. 22, 1920.



INDUCTION HEATER

Importance of Control and Signaling Circuits in a Power Station.—PROBST.—The main power conductors in a power station are usually symmetrically and clearly arranged, so that a fault can be immediately located. But often the secondary wiring for meters, relays, regulators, etc., is bundled together in a haphazard way, making it hard to follow an individual conductor in case of trouble. The author emphasizes the importance of clearness and neatness in mounting all auxiliary conductors and shows on photographs and tracings some examples of the A. E. G. back-of-panel wiring system.—*Elektrotechnische Zeitschrift*, Jan. 29, 1920.

Electrophysics and Magnetism

Screening of Iron Parts from High-Frequency Magnetic Fields.—It is difficult to avoid iron parts in the construction of high-frequency apparatus. If subjected to rapidly alternating magnetic field, such iron masses will give rise to large energy losses due to hysteresis and eddy currents. This, however, may be avoided by screening caps of copper or zinc plate. Even a thin electrolytically applied covering often is quite sufficient in practice. Measurements on the screening effects of such metal covers were made by Preuner and Pungs (*Verhandlungen der deutschen physikalischen Gesellschaft*, Vol. 21, 1919, page 594). In this work the high-frequency resistance of a coil was measured by calorimetric methods. A core or plate of iron was placed in the field of the coil, and the difference in effective resistance was observed. While the apparent resistance of the coil was increased from two to seven times by the presence of the unscreened iron parts, the energy loss in the iron was almost entirely prevented by an electrolytic copper covering of 0.03–0.04 mm. (1.2–1.6 mils) thickness, or by a 0.1-mm. (4-mils) zinc layer. —Abstracted in *Elektrotechnische Zeitschrift*, Feb. 12, 1920.

Reactive Power and Magnetic Energy. — JOSEPH SLEPIAN.—The relation between reactive power and magnetic and electrostatic energies is stated and proved. Its utility is illustrated by deriving the connection between reactive power and the size of machines, between the magnetic energy of an alternating-current system and the field excitations of the synchronous machines therein, and by giving the physical significance of power factor under unbalanced conditions.—*Journal A. I. E. E.*, May, 1920.

Integration Method of Deriving Alternating-Current Resistance and Inductance of Conductors.—HARVEY L. CURTIS.—An integration method of deriving formulas for the alternating-current resistance and inductance of a straight cylindrical conductor by the use of both real and imaginary power series, and for a return circuit by the use of imaginary power series, together with an application to experimental results.—*Scientific Paper No. 374, U. S. Bureau of Standards*, April 7, 1920.

Electrochemistry and Batteries

The Fixation of Atmospheric Nitrogen by the Silent Electric Discharge Process—I.—C. F. HARDING and K. B. MCEACHRON.—The process of obtaining nitric acid from the air by means of the silent electric discharge has been under investigation during the course of several years at Purdue University. This paper is a preliminary report, although it is said considerable increase in yield has been obtained. The paper deals with the peculiarities of both electrical and chemical reactions, and there is considerable discussion of the apparatus and experimental methods so far used.—*Journal A. I. E. E.*, April, 1920.

The Electrodeposition of Metals.—W. E. HUGHES.—A discussion of the present status of electroplating in England with special reference to progress which has been made within the last few years. The writer deals with copper, silver, nickel, cobalt, zinc, iron, lead and other metals. He is of the opinion that the present rate of progress in the art of electroplating is not so rapid as it should be considering the possibilities in the art.—*Beama* (London), April, 1920.

Units, Measurements and Instruments

A New Form of Vibration Galvanometer.—P. G. AGNEW.—Vibration galvanometers are very useful in null measurements, but have not been much used in industrial laboratories on account of their being sensitive to external vibrations and requiring delicate adjustments. The present instrument, which has a sensitivity higher than other forms of moving-iron type but less than that of the most sensitive forms of the moving-coil type, has the advantages of sturdiness, quick responsiveness and freedom from the effects of external vibration. It consists essentially of a fine steel wire mounted on one pole of a permanent magnet and so arranged that the free end of the wire may vibrate between the poles of an electromagnet through which the current to be detected passes.—*Scientific Paper No. 370, U. S. Bureau of Standards*, March, 1920.

Telegraphy, Telephony and Signals

Guiding of Ships by Means of Submarine Cables.—R. H. MARRIOTT.—The author has devised a method of facilitating navigation of ships, particularly in fog, in dangerous passages and when entering harbor. A single-wire cable is laid along the route and anchored to the bottom. The far end is scraped free from insulation and thus acts as if it were grounded. The other end is connected to a buzzer or similar transmitter, sending out alternating-current impulses along the cable. A listening device, consisting of two large iron-cored coils (10 henries) and a pair of head-phones, is provided on board the ship. The search coils are suspended cross-ships on a framework, which can be rotated around a longitudinal axis. By tilting the coils till maximum sound is obtained in the telephone receivers the location of the cable can be easily and quickly determined. Several experiments which have been made with this system are described in the article, and a number of modifications are suggested.—*Revue Générale d'Electricité*, Jan. 24, 1920.

Miscellaneous

Electric Vaporization of Water.—If electric power is directly applied as Joulean heat, an efficiency of vaporization of more than 1.3 kg. (2.85 lb.) steam per kilowatt-hour can hardly be reached in practice. By the Wirth system of "autovaporization," however, a vaporization of 17 kg. (37.5 lb.) per kilowatt-hour may be obtained. The system has been further developed by Stodda in Zürich and is now employed by a number of Swiss soda works. The solution to be concentrated is first heated to the boiling point by steam passed through a coil of copper tubing. The vapor is pumped into a compressor, driven by an electric motor, and is compressed to about 1.2 atmospheres. The vapor then is passed through a second tube coil, submerged in the solution to be concentrated, and allowed to condense on the walls of the tube, thereby giving up its latent heat to the liquid, so that approximately the same amount of vapor is again formed.—*L'Industrie Electrique*, Jan. 25, 1920; also *Bulletin der Schweitzerischen Elektrotechnischen Verein*, December, 1919.

Manufacture of Varnished Cotton and Silk Cloth for Insulation Purposes.—A short discussion of how one British manufacturing concern produces insulating cloth of the required insulation value and with other necessary characteristics.—London *Electrician*, April 30, 1920.

News in Brief

Summary of Market Conditions and of Recent and Approaching Happenings of Importance to the Industry

NO LET-UP appears in general in the jobbing industry, although buying is lighter in some sections. Supply of goods regulates to a large extent the amount of buying today. Electrical materials have been coming in to jobbers in better quantity than a week ago, but they do not last long on the shelves. Back orders are being gradually cut down through recent receipt of shipments of pipe and flexible armored conductor, while in some quarters loom is in pretty good supply.

FANS are moving in good volume, although no long hot spell has been felt yet. Stocks are spotty and would stand a heavy drain with difficulty.

APRIL electrical exports fell off just over $1,000,000 from those of March, but the rate for the year, as shown by this first third, is over $86,000,000.

WAGE disagreements between the Amalgamated Association and the owners of union sheet and tin-plate mills loom up as a cloud on the electric sheet market. Some mills already have allotted sheet output for third quarter, but others are holding off.

MALLEABLE casting production is getting up nearly to 80 per cent capacity, an improvement over a few weeks ago. Molders, however, are still short in the industry.

FEW PRICE changes of interest are noted this week. Certain companies, however, are refusing to guarantee prices on any of their product.

A NEW ENGLAND Electrical Council has been formed to assist in co-ordinating the mutual interests of the manufacturer, jobber, contractor-dealer and central station. Representatives of each branch meet to hear the discussion of moot questions and recommend settlements.

ACUTE shortage of coal at public utility plants has caused an effort to be made to obtain from the Interstate Commerce Commission priority for coal consigned to utilities. Shutdown of some plants in New York City and elsewhere may be forced if conditions do not improve.

NEW ENGLAND industrial coal shipments went upon a preferential basis this week as the result of an order of the Interstate Commerce Commission granting priority for the transportation of bituminous coal to tidewater for transshipment by water to destinations within the United States.

AMONG bond issues announced are one of $5,000,000 for fifteen years at 7 per cent by the Cleveland Electric Illuminating Company and one of $4,000,000 for six years at 7½ per cent by the Shawinigan Water & Power Company.

INDORSEMENT of the organization plan of the Federated American Engineering Societies has been given by the Engineering Council.

A TOTAL membership of more than 300 of all classes in the North Central Electric Association, the first of the newly organized geographic divisions of the N. E. L. A. to hold a convention, was announced at its meeting in Minneapolis last week.

FIVE additional bodies, including the Electrical Manufacturers' Council and the National Electric Light Association, have been admitted to representation on the main committee of the American Engineering Standards Committee.

THE LICENSE fee of electrical contractors has been raised from $10 to $100 a year by the San Francisco Board of Supervisors, who defeated by a vote of three to one an effort to put it at $50.

A. MONRO GRIER was elected president of the Canadian Electrical Association at the annual convention held in Montreal, which was largely attended and characterized by optimism.

THE SPAN of 1,645 ft. between towers 235 ft. high which crosses the Connecticut River in the recently completed line from Hartford to Manchester, Conn., is the longest and highest in New England.

LOS ANGELES has awarded two contracts in connection with the further development of aqueduct power, one for electrical equipment to the General Electric Company and one for waterwheels to the S. Morgan Smith Company.

INCREASED rates for public utilities are being urged by the Illinois Manufacturers' Association.

A CONGRESSIONAL appropriation to investigate the water powers of Alaska is asked by the Alaska Advisory Committee in a communication to the Secretary of the Interior.

FURTHER standardization of apparatus is aimed at by the electrical apparatus committee of the N. E. L. A., which has held a meeting in Chicago to organize for work in a way that will harmonize with the new geographic divisions of the association.

ACTIVE construction has been started on the Big Creek No. 8 plant of the Southern California Edison Company. Transformers for 220,000 volts are being built.

A TEXTILE mill now being built at Danville, Va., will have an installation of 5,100 ½-hp. motors, a record number.

THE PLATFORM of the National Manufacturers' Association on industrial issues will be presented to the resolutions committee of the Democratic national convention when that body meets in San Francisco next week.

LATE on Friday afternoon of last week it was announced that President Wilson, acting on an opinion of the Attorney-General that such procedure would be constitutional, had signed the water-power bill on June 11, or ten days after its receipt by him. The bill is therefore now on the statute books, and already applications for licenses covering more than 500,000 hp. have been filed.

CO-OPERATION in formulating rules on inductive interference was furthered at a conference between representatives of the N. E. L. A., the Bureau of Standards and the American Telephone & Telegraph Company.

WIDE adoption of the standard cost-accounting system was called for by the National Electrical Credit Association at its convention in New York.

A BOND issue of $2,000,000 at 8 per cent has been made by the Idaho Power Company, an Electric Bond & Share property.

INCREASE in the electric rates of the Seattle (Wash.) municipal system has become law over the Mayor's veto. The Detroit Edison Company's new rates have gone into effect temporarily with the consent of the City Council.

News of the Industry

Chronicle of Important Events and General Activities in the
Technical, Commercial and Manufacturing Fields With Announcements and
Reports of Association Meetings and Conventions

Utilities May Get Coal Priority

INFORMATION relative to acute coal shortage at utility plants is being brought to the attention of the Interstate Commerce Commission in an effort to obtain priority of coal transportation for utilities. Not only is it impossible to store coal at this time, when coal is usually stored, but in a large number of instances utilities are running along with but a few days' supply. Unless the situation is remedied quickly, it seems certain that no small number of plants will be forced to curtail their supply of energy and in some instances to shut down entirely.

The National Committee on Gas and Electric Service, it is known, is making every effort to get a priority ruling from the Interstate Commerce Commission.

Representatives of New York City utilities met during the week to discuss the situation, and as a result two representatives of the Public Service Commission went to Washington to put the case before the Interstate Commerce Commission. That body has assured them that no public utility in New York City would have to shut down for lack of coal.

Another serious situation is the prevailing open market price for coal. J. W. Lieb, vice-president of the New York Edison Company, stated, on Tuesday, before the New York Public Service Commission, that while the utilities have contracts with different coal companies for bituminous coal, very few of them are getting deliveries up to the full contract requirements, and even where such deliveries are obtained the contracts do not cover more than 60 per cent of the coal requirements of the companies. The utilities, he stated, have been supplementing these contracts by going into the open market and purchasing coal at prices ranging from $13 to $16 a ton. Even at these high prices, Mr. Lieb said, the utilities find it difficult to get coal enough and have to bid against manufacturers and the general public to get any.

Institute Decides Against Parallel Sessions at Convention

THERE will be no parallel sessions, as was originally intended, at the thirty-sixth annual convention of the American Institute of Electrical Engineers, to be held from Tuesday to Friday next week at the Greenbrier Hotel, White Sulphur Springs, W. Va. All papers are to be presented in abstract, for which from five to fifteen minutes each will be all the time allowed. When the papers have all been presented in each session discussion will be invited.

Up to the time of going to press registrations had been received in New York from a little more than 200 members and guests. It was announced a few days ago that the Pennsylvania Railroad would put on a special car for the Institute convention on the 3:38 train out of New York Monday afternoon.

Water-Power Bill Finally Signed

WHEN Congress adjourned without the President having affixed his signature to the water-power bill it was taken for granted that the measure was lost. Under a ruling by the Attorney-General, however, his signature was affixed within the ten-day period and the bill becomes a law. It had been announced that soon after the close of Congress the Attorney-General rendered an opinion to the above effect, but it was not until late in the afternoon of June 18 that it was revealed that the President had affixed his signature to the water-power bill. The White House announcement reads as follows: "The President, having been advised by the Attorney-General in a formal opinion that the adjournment of Congress does not deprive him of the ten days allowed by the Constitution for the consideration of a measure, but only in case of disapproval of the opportunity to return the measure with his reasons to the House in which it was originated, has signed the following bills, each within the ten-day period, of course." The statement also points out that the bills not signed fail to become laws under the usual practice.

Applications for license covering more than 500,000 hp. have already been filed awaiting the organization of the Federal Power Commission. That so many applications should have been filed in so short a time after the signing of the bill is regarded as a very encouraging indication. Just when the commission will be organized is uncertain, but no action is likely to be taken until the Secretary of Agriculture returns to Washington after the San Francisco Democratic convention. The first move, however, must come from the President, who, according to the provisions of the act, must designate one of the three secretaries as the chairman of the Federal Power Commission. The secretaries in turn are expected to meet and designate the executive secretary, who in all probability will be the mainspring of the commission. It is regarded as obvious that the secretaries themselves will not devote a great deal of time to the work which will come before the commission.

The Comptroller of the Treasury has been acquainted informally with the question which has arisen as to the ability of the commission to employ personnel under the act. While the language of the act shows conclusively that it was the intent of Congress that the commission should have a technical and a clerical staff, no out-and-out provision is made for their employment. Owing to the importance of the matter, an early ruling is expected. At worst, this oversight in drafting the law can be remedied early in December. The law clearly specifies, however, that the engineer assistant to the executive secretary may be designated. Owing to the multitudinous duties which devolve immediately upon the commission, it is anticipated that the engineer officer will be designated at the earliest possible moment.

The act provides that a report must be made on the Great Falls project, on the Potomac River, by Jan. 1. For that reason the examination must be begun at a very early date.

Without question, the most serious problem facing the commission at the start of its work will be the difficulty of securing competent men. The whole foundation of the act is the matter of "net investment." This must be ascertained by an accurate system of accounting which will not run cross-wise with the accounting systems of the states. Necessarily, the man in charge of this work must be one who is familiar with state accounting methods, and, owing to the importance of this portion of the work as well as all matters pertaining to valuation, it is regarded as poor economy to attempt such work with other than comparatively high-salaried men.

Under the terms of the act, public notice must be given eight weeks before the commission can act on any application. It is probable that these notices will be made public through the field offices of the three departments concerned.

Apparently the only ones who are questioning the legality of the water-power act are those who believe that they will be injured by it. Attorneys for some of the larger investment bankers are understood to have reported favorably on its legality. From such information as has reached Washington, this phase of the matter will impede in no way the flow of capital into water-power investments.

The consensus of opinion among legal authorities in Washington apparently is that the Attorney-General is correct in his interpretation of the Constitution as to the President's authority to sign bills within the ten-day limit even after the adjournment of Congress. It is pointed out that the practice which has been observed heretofore deprives the President of his constitutional right to review legislation before affixing his signature. The practice heretofore has been such as to necessitate the President's signing "on the dotted line" any legislation which was ground out at the close of Congress without careful inspection, or else automatically vetoing it by withholding his signature.

North Central Utility Men See Need for Education of Public

PUBLIC utility men of Minnesota and North and South Dakota, meeting at the first annual convention of the North Central Electric Association, in the Hotel Radisson at Minneapolis, June 15-17, emphasized the need for education of the public to the true nature of the problems of the electric light and power industry. Insistence on the necessity of such education and on the importance of bringing the facts in a straightforward and vigorous manner before the communities served ran through nearly all the addresses.

That the fuel situation is serious in the Northwest was indicated by President Crocker, who, as reported last week, stated that deliveries since the opening of navigation on the Great Lakes have not even supplied current requirements, though demand is lightest at this season. The shortage and high cost of coal have brought to the front the necessity of developing the lignite coal supplies of Minnesota and the Dakotas.

R. F. Pack of Minneapolis pointed out the difficulties of utilities because of the lack of understanding of their problems on the part of the public and urged the importance of education and of frank, honest dealing.

An analysis of the factors affecting the price of public utility financing from the bankers' point of view, reprinted in part on pages 14 and 18, was made by Henry D. Thrall, vice-president of the Minnesota Loan and Trust Company.

RURAL ELECTRIC LINES

Rates for rural service in which a rural charge covering the amount by which the fixed charges, energy losses and operating expenses incident to rural service exceed the corresponding items for city service is a feature touched on by F. R. Winders of the Railroad Commission of Wisconsin in a discussion of rules governing rural service recently established in Wisconsin. The rural charge plus the regular urban rates constitutes the rate for service. In the discussion Lee Boyer of Deadwood, S. D., brought out the fact that practice tends toward the advancing of the total cost of construction of rural lines by the farmers and the use of a rate with a fixed charge rather than a minimum charge. The problem of handling the prorating of costs for consumers coming on after lines are built is a puzzling one, said R. M. Howard of Winona, Minn., who pointed out that from the accounting standpoint a limit must be reached and accounts closed. That revenues are not sufficient to justify service without advance of construction costs by the farmer and that contracts must be made with a definite limit and a simple method of refunding to those who financed the construction originally when new consumers are connected was contended by H. H. Henley of Minneapolis.

A paper on "Present-Day Conditions and Tendencies in the Development of Domestic Electric Cooking," by H. A. Dahl and Miss Bernice Bell of the electric cooking bureau of the Minneapolis General Electric Company, produced a sharp discussion Friday afternoon on the situation created by the swamping of the manufacturers with new business. That many central stations are receiving ranges improperly assembled and with defects of workmanship was strongly asserted. The extreme difficulty caused by the long delay in delivery of repair parts was shown, many central stations finding it necessary to manufacture their own repair elements.

At the business session Thursday afternoon a committee was appointed to keep in touch with the fuel situation and devise ways and means of meeting problems as they arise, as was also a committee to study the utilization of lignite coal and freight problems.

The officers elected were: President, T. D. Crocker, Minneapolis, Minn.; vice-president, O. A. Rofelty, Sioux Falls, S. D.; treasurer, F. C. Hoffman, St. Paul, Minn. The executive committee will comprise W. N. Ryerson, Duluth, Minn.; W. C. Blanchard, Aberdeen, S. D., and M. L. Hibbard, Fargo, N. D. Increasing of the executive committee membership to four, to allow the appointment of a representative of the municipal plants which have heretofore participated actively in association affairs, was recommended.

The convention is the first held by any of the geographic divisions of the N. E. L. A.

Rural Service and Inductive Interference Discussed by Iowa N. E. L. A.

THAT the financing of rural lines and the method of establishing rates for rural service are two of the pressing questions before Iowa light and power utilities was the consensus of opinion at the opening session of the nineteenth annual convention of the Iowa Section of the National Electric Light Association, held at Colfax, Iowa, Wednesday. The forenoon of that day was devoted to organization and appointment of committees, and nearly the entire afternoon was taken up with a lively discussion of the report of the farm-line committee. The tendency is toward the financing of lines by the farmers.

The report of the inductive interference committee was presented and discussed, attention being called to the necessity of close co-operation with the parent body. The sessions continued through Thursday and Friday.

Sectional Rules on Inductive Interference Receive National Attention

A GREAT advance in co-operation between the National Electric Light Association, the Bureau of Standards and the American Telephone & Telegraph Company was marked by a meeting Tuesday in the N. E. L. A. rooms on inductive interference. The meeting was attended by Dr. E. B. Rosa and Dr. M. G. Lloyd of the Bureau of Standards; Thomas Sproule, W. K. Vanderpool, A. E. Silver, Mr. Ware and W. J. Canada, representing the N. E. L. A., and H. S. Warren, Kenneth Wilkinson and E. B. Craft, representing the A. T. & T.

The meeting was called to discuss the situation created by the preparation in California by a committee of public utility representatives of a set of overhead-line rules which differ in some important respects from the National Electrical Safety Code requirements. Those present also came together to see what it might be possible to do with the code itself or in the way of securing increased co-operation in order to avoid any necessity for sectional rules covering the same general line. The subject will be continued further.

Engineering Council Indorses Federation

THE Engineering Council, at its regular meeting on June 17, indorsed the organization plan of the Federated American Engineering Societies. The executive committee of the council was authorized "to proffer and perform on the part of the council such assistance as may be practicable in completing the work of the organizing conference and of the joint conference committee of the founder societies in establishing the American Engineering Council" and also "to deal with any question of co-operation with the joint conference committee of the founder societies, relating to the permanent organization of the Federated American Engineering Societies, which may come up during the summer."

Finally, the secretary of council, Alfred D. Flynn, was instructed "to invite to future meetings of the Engineering Council delegates of the societies participating in the organizing conference in Washington, June 3 and 4, and editors of technical journals who may be interested."

Nine Million Dollars Issued by Two Utilities for New Construction

ANNOUNCEMENT was made this week of the issue of $5,000,000 fifteen-year 7 per cent first mortgage collateral bonds at 95½ by the Cleveland (Ohio) Electric Illuminating Company and $4,000,000 six-year 7.5 per cent secured convertible gold notes at 98.65 by the Shawinigan (Quebec) Water & Power Company.

The sale of the securities of the Cleveland Electric Illuminating Company, it is stated by Vice-president and General Manager Robert Lindsay, will provide funds for plant extensions. These additions include the installation of 25,000 kw. of generating capacity and extensions to the distributing system necessary to meet the increased demands, chiefly from manufacturing plants.

Proceeds of the notes of the Shawinigan Water & Power Company will be sufficient to pay all present floating debt, according to J. E. Aldred, president of the company, and also provide for construction work scheduled for 1920, including the construction of an additional 85-mile (136-km.) transmission line to Montreal and the installation of 50,000 additional horsepower in the hydro-electric plant at Shawinigan Falls.

Standard Service Voltage to Be Pushed by Apparatus Committee

CLOSE after the adjournment of the national convention at Pasadena the electrical apparatus committee of the National Electric Light Association was called together in Chicago by Chairman R. F. Schuchardt for the purpose of so organizing the committee and its work that it would tie in with the geographic divisions which have been made a part of the national organization. It was also desired to continue the work of the committee from last year without a break. The principal work planned for the coming year, in addition to continuing the regular program, is to aid manufacturers and central stations to a further standardization of apparatus in order to reduce its cost.

Work on transformer standardization is being continued, and by a letter vote of twenty-seven to one the committee recommended the substitution of 1.5-kva. single-phase transformers of 4,600 volts or less in place of the 1-kva. and 2-kva. sizes now in general use.

Work will be begun by the committee this year looking to the standardization of service voltage of central stations. The preparation of an operating code for major electrical apparatus will also be attempted.

The manufacturers will be urged to standardize further on the oil used in transformers, oil switches and lightning arresters.

The subject chairmen of the electrical apparatus committee are as follows: Generating stations, H. C. Albrecht, Philadelphia Electric Company; substations, H. W. Eales, Union Electric Light & Power Company, St. Louis; oil switches, accessories and switchboard equipment, A. H. Lawton, Consumers Power Company, Jackson, Mich.; transformers, G. L. Knight, Brooklyn (N. Y.) Edison Company; motor rules, H. L. Wallau, Cleveland (Ohio) Electric Illuminating Company; miscellaneous apparatus, A. S. MacDowell, Rochester (N.Y.) Gas & Electric Corporation; standardization of service voltages, M. O. Troy, General Electric Company, Pittsfield, Mass., and A. W. Copley, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Idaho Power $2,000,000 Bond Issue Bears 8 Per Cent Interest

TO INCREASE plant capacity and extend transmission system, the Idaho Power Company, one of the Electric Bond & Share properties, has just issued at par $2,000,000 of first lien and general mortgage ten-year 8 per cent gold bonds. This is the first electric light bond issue of any considerable size in which the prevailing rates for money have apparently been recognized to the extent of placing an interest rate for the issue sufficient to warrant its sale at par value. When this was brought to the attention of the officials of the Electric Bond & Share Company no statement could be elicited, for the reason, it was said, that the company did not care to go on record as saying that it was prepared to pay any stated interest rate for money.

Big Creek No. 8 to Use Transformers Built for 220,000 Volts

OWING to the insistent demand for more power, there has been a change in the plans of the Southern California Edison Company for the development of Big Creek. According to the new plans, Big Creek No. 8 will be the next plant to be put into operation, and active construction thereon has been started. It will be situated just below Big Creek No. 2 and will use the waters from Huntington Lake and Shaver Lake after they have passed through plant No. 2. After the completion of the Mammoth Pool tunnel this plant will also utilize the waters of the San Joaquin River.

The first unit to be installed will be a 30,000-hp. Francis turbine driving a 22,500-kw. generator, the turbine operating under a head of 700 ft. (210 m.). The generating voltage will be 11,000, which will be raised to 150,000 volts for transmission to Los Angeles. An interesting feature of the installation will be the construction of transformers which are being built for 220,000 volts. The plans are eventually to raise the entire Big Creek system to this higher voltage, and at that time this plant can be brought into service by simply changing the taps on the transformers.

Preliminary work has been done on the tunnel, and a large crew is to be put to work at once, as it is desired to have the new unit in operation for the summer load of 1921. This plant, with the additional machine now being installed in plant No. 2 and the new plant on Kern River, nearing completion, will give the Southern California Edison Company 75,000 kw. additional capacity.

Depreciation Charges as They Affect Freight Rates Paid by Utilities

AN INTERESTING discussion of the effect on freight rates of depreciation charges in excess of actual and necessary disbursements for maintenance of efficient operation is contained in a petition recently filed by the Consolidated Gas Company of New York with the Interstate Commerce Commission for leave to intervene on behalf of itself and its affiliated companies "in the matter of the application of carriers in official Southern and Western classification territories for authority to increase rates." Alluding to the total output of gas and electrical energy by it and its subsidiary companies and to its 1,409,774 customers, the petition of the Consolidated Gas Company points out that all the coal and much of the other materials used in the production of its commodities and the making of extensions and repairs are transported by freight, the company thus becoming one of the largest patrons of railroad transportation in the United States. Thus the petitioner and its consumers have a direct interest in the keeping of interstate freight rates on all such commodities at a point no greater "than is from time to time reasonably necessary to pay the actual cost of the rendering of adequate and efficient service by such common carriers and the maintenance and upkeep of their property in first-class operating condition and to pay a reasonable return upon their invested capital."

The petition then enters into an argument against depreciation charges being based on assumed life of equipment, holding that such charges should be restricted to those necessary to equalize from year to year the charges for extraordinary repairs and for renewals and replacements that occur irregularly.

In concluding its plea the Consolidated Gas Company asks:

> That the commission will find that for Class I carriers there are no "classes of property for which depreciation charges may properly be included under operating expenses," and that it will require that the maintenance charges for any calendar year, including charges for renewals and replacements, be stated on the basis of expenses actually incurred during that year, to the end that freight rates be placed at a level which will be fair both to carriers and to shippers, and that they be not made unduly high in order to provide for estimated charges not based on actual facts.

New England Load Dispatchers Meet

A TWO-DAY meeting was held last week, June 16 and 17, by the New England Load Dispatcher's Club, the pioneer organization of its kind. On the first day the club met at Greenfield, Mass., where Howard M. Turner, consulting engineer, Boston, spoke on "Hydro-Electric Development." On the seventeenth plants of the Turners Falls Power & Electric Company and the New England Power Company were visited, with camp luncheon at Vernon, Vt. The club was founded to promote personal acquaintance and technical co-operation among the men in immediate charge of plant and system administration in New England interconnected utilities, and it has already achieved marked progress in the efficient conduct of interconnected service. The members of the club were photographed at the Cabot station of the Turners Falls company, the largest hydro-electric plant in New England.

Active Work Planned by Canadian Electrical Association

THE Canadian Electrical Association held its thirteenth annual convention, June 16, 17 and 18, at Montreal, Que. In attendance the meetings were larger than any held within the past few years, and altogether the convention marked a new era in Canadian electrical affairs. A new constitution and bylaws in conformity with the revised constitution and bylaws of the National Electric Light Association were adopted, and it was decided to remove the headquarters from Toronto to Montreal and to engage in more energetic work under the direction of a paid secretary. Martin J. Insull of Chicago, president of the National Electric Light Association, was in attendance and in a well received address outlined the new organization of the national association and the plans for the coming year.

At the executive session held on June 18 the following officers were elected: President, A. Monro Grier, K.C., Canadian Niagara Power Company, Niagara Falls, Ont.; first vice-president, P. T. Davies, Southern Canada Power Company, Montreal; second vice-president, A. P. Doddridge, Quebec Railway, Light, Heat & Power Company; third vice-president, L. W. Pratt, Hamilton (Ont.) Cataract Light & Traction Company; secretary-treasurer, Eugene Vinet, Shawinigan Water & Power Company, Montreal. Members of the executive committee were elected as follows: One-year—A. A. Dion, Ottawa (Ont.) Electric Company; J. B. Woodyatt, Southern Canada Power Company, Montreal; F. F. Kaelin, Shawinigan Water & Power Company, Montreal; A. V. Gale, Hull (Que.) Electric Company. Two-year—R. J. Beaumont, Shawinigan Water & Power Company, Montreal; J. S. Norris, Montreal Light, Heat & Power Company; D. H. McDougall, Toronto Power Company; Charles Barnes, Toronto & Niagara Power Company. Manufacturers' representatives, two-year — Canadian Westinghouse Company, Canadian Edison Appliance Company or representatives of other Canadian General Electric subsidiary; one-year, Northern Electric Company and Lincoln Meter Company.

COMMITTEE REPORTS

The first day's session was given over to reports of committees, most of which were résumés of N. E. L. A. reports. The program of reports was as follows: Meters, E. J. Turley, Montreal Light, Heat & Power Company; prime movers, S. Svenningson, Shawinigan Water & Power Company, Montreal; electrical apparatus, J. F. Neild, Toronto & Niagara Power Company; overhead lines, R. J. Beaumont, Shawinigan Water & Power Company; commercial sales and rates, P. T. Davies, Southern Canada Power Company Montreal; accounting, C. Johnstone, Southern Canada Power Company; accident prevention, Wills Maclachlan, Electrical Employers' Association of Ontario. In addition, reports were presented by representatives of N. E. L. A. committees and by representatives of the Canadian Engineering Standards Association.

In Canada all watt-hour meters are sealed by the government for a period of five years, after which time they must be retested and resealed. The committee on meters suggested, in view of the very small percentage of meters found to fall outside the government requirements, that this sealed period be extended to eight years. It was also recommended that meters be sealed and tested *in situ* so as to avoid damage to jewels caused by the removal and shipment of the meter.

The report of the committee on prime movers covered steam and hydro-electric as well as oil-engine practice, but considering that the electric power developments in Canada are chiefly hydro-electric, from 85 to 90 per cent of the total energy generated coming from such systems, chief attention was given to that subject. The committee noted the tendency toward vertical units and the development of new high-speed runners for plants of low head. In Canada wheels have been constructed with the speed rings made so that hot water can be circulated therein and then through the guide vanes in order to obviate fragile ice troubles. Such a system has long been recommended by John Murphy of Ottawa.

The general opinion was that ice troubles can be prevented to a large extent by (1) drowning out rapids above the power site, (2) locating the development so that the prevailing winds will tend to blow the ice away from the forebay, (3) heating the racks and runners slightly above the temperature of the surrounding water, (4) keeping a careful log of weather and ice conditions and noting the relation of one to the other.

In the discussion it was brought out that many of the large hydro-electric companies possessing big wheels have made a practice during the winter of pulling the racks and letting the small pieces of ice pass through the wheels. It was pointed out, however, that this could not be recommended for the smaller companies.

The committee on electrical apparatus showed that power plants are at the present time suffering more or less from results of war-time economy and in some cases are experiencing difficulty due to delayed reconstruction work, which work must now be undertaken in the face of higher costs. It was recommended that greater use be made of standard apparatus and that service voltages be standardized to bring down costs.

In its report on overhead lines the committee called attention to the standardization work of the Shawinigan Water & Power Company and associated companies on overhead lines. The companies have standardized on 2,300-volt distribution and have printed and distributed handbooks among their engineers and operating men covering standards of low-voltage line construction in cities and towns and also covering transformer standardization. This work has had a notable effect on the amount of material carried in stock. For instance, four-pin cross-arms, heretofore carried in twelve different sizes, are now stocked in only one size. Commensurate reductions in sizes of bolts, braces and other material have also been effected.

POWER PRICES

R. J. Beaumont, chairman of the committee, also presented a short dissertation on power prices, past and present. He showed that interest on investment has increased one and one-half times, cost of material three times, as compared with the costs five or six years ago, so that the total overhead burden is four and one-half times, or 27 per cent, as compared with 6 per cent. As a result more careful and closer measurement of the maximum demand is to be expected, and hydro-electric energy will hereafter be sold on a straight unit basis rather than on a charge of so many kilowatts per month or year.

The report of the committee on commercial sales and rates was devoted to the following subjects: Electric ranges, water heaters, ovens, etc., sales of electrical appliances, brass furnaces, off-peak loads, seasonable loads and surplus power contracts, and power factor. The committee is of the opinion that the time is not far distant when kilovolt-amperes and kva. hours will be the basis of billing and 100 per cent power factor will be required.

The sub-committee on lamps of the Canadian Engineering Standards Association is composed of members representing the manufacturers, public utilities, the Department of Trade and Commerce of Canada and the Canadian Electrical Association, under the chairmanship of John Murphy, chief electrical engineer of the Department of Railways and Canals. Circular 13 of the United States Bureau of Standards has been taken as a basis for discussion in the formulation of the proposed incandescent-lamp standardization for Canada, as it is considered to be the best and most comprehensive document to work on.

On Wednesday evening a formal dinner was held in the grill of the Ritz-Carlton. Addresses were made by R. A. Ross on behalf of the city of Montreal, A. Monro Grier for the Canadian Electrical Association and Martin J. Insull for the National Electric Light Association.

Two papers were presented June 17, one by Paul M. Lincoln on "Metering the Customers' Load" and the other by J. R. Colville of the National Lamp Works, Cleveland, on "The New Viewpoint on Modern Lighting."

National Manufacturers Now Present Views to Democrats

THE nine-plank platform embodying the views of the National Association of Manufacturers on the position that should be taken on industrial questions by the political parties is to be presented to the resolutions committee of the Democratic National Convention as soon as that committee is organized in San Francisco next week. Sixteen prominent Pacific Coast manufacturers form a committee having this matter in charge.

A summary of the manufacturers' platform, which was also presented to the Republican National Convention at Chicago, but not incorporated by that body in its own platform, was printed by the ELECTRICAL WORLD for June 12, page 1385.

Seattle Municipal Rates Increased from 9 to 25 Per Cent

THE Seattle City Council on Monday passed the ordinance providing for increased rates on the municipal system over the veto of Mayor Hugh M. Caldwell. The new rates are effective July 21. Mayor Caldwell, as stated in the ELECTRICAL WORLD for last week, vetoed the measure after it had been passed by the Council, stating that an interview with Superintendent of Lighting J. D. Ross had convinced him that there was no necessity for an increase at this time.

The ordinance provides that commercial houses will pay 1 cent more for energy under the proposed schedule, the old rate being 4½ cents for the first 100 hours and the new rate 5½ cents. Energy in excess of 100 hours will cost commercial houses 1½ cents instead of the present charge of 1¼ cents. The increase in the electric cooking rate is from 5½ cents to 6 cents per month for the first 45 kw.-hr. and from 2 cents to 2½ cents for the secondary rate.

Manufacturing concerns will pay 4 cents for the first 100 hours for power purposes and 1 cent for power in excess of that amount.

According to estimates of members of the City Council, the increased rates, which are from 9 to 25 per cent higher, will result in an additional revenue of $281,639.66.

Business Men Urge Financial Relief for Utilities

EIGHT organizations, representing 16,250 business men, have appealed to the Illinois Public Utilities Commission in a joint memorial urging that action be taken by the regulatory body to give immediate relief to the utilities of the state. The memorial, which was presented in formal session before the commission by a joint committee, is signed by the presidents or other officials of the Chicago Association of Commerce, Illinois Manufacturers' Association, Chicago Credit Men's Association, Citizens' Association of Chicago, Commercial Club of Chicago, Industrial Club of Chicago, Traffic Club of Chicago and Union League Club of Chicago.

It is pointed out that, while service generally now is unsatisfactory, it will become worse unless immediate financial relief is afforded either by higher rates or in some other way. It is furthermore stated that the present condition of the financial market will automatically act to prevent any extensions other than those absolutely necessary.

Without going into the merits of any particular case, the memorial earnestly urges the necessity of immediate relief because unless prompt action is taken even the present unsatisfactory public service cannot be maintained. In conclusion the memorial suggests temporary relief as follows:

"We respectfully suggest that in all cases where it is impossible for the commission to give the case presented such an exhaustive consideration as will enable the commission to determine and prescribe a permanent rate or plan respecting the utility under consideration tentative orders be entered covering experimental or temporary periods until such time as the experience of the commission or further investigation and deliberation will enable your honorable body to do complete and full justice in the premises."

S. L. Nicholson Re-elected Chairman Manufacturers' Council

AT A MEETING of the Electrical Manufacturers' Council on June 18 the following officers were elected for the ensuing year: Chairman, S. L. Nicholson, Westinghouse Electric & Manufacturing Company; vice-chairman, Le Roy Clark, Safety Insulated Wire & Cable Company; treasurer, E. B. Hatch, Johns-Pratt Company. Frederic Nicholas was reappointed executive secretary. The office of vice-chairman is a new one, authorized by a change in the constitution approved at the meeting on June 18. It was created because of the expansion in the work of the council in connection with the establishment of headquarters in New York. Mr. Nicholson and Mr. Hatch were re-elected to the same positions which they had held.

City Council Consents to Detroit Edison Increase

THE Detroit City Council has consented to the putting of the new rates of the Detroit Edison Company into effect temporarily on July 1. The action was recommended by Henry Steffens, Jr., controller, who will proceed to make a complete examination to see if the rates are justified. His preliminary examination has revealed no reason why the temporary approval should not be granted. Alex Dow, president of the Detroit Edison Company, told the Council the new rates would net $1,599,500 a year additional revenue.

American Engineering Standards Committee Enlarged

FIVE additional bodies have been admitted to representation on the main committee of the American Engineering Standards Committee. They are the Electrical Manufacturers' Council (comprising the Electric Power Club, the Associated Manufacturers of Electrical Supplies and the Electrical Manufacturers' Club); the fire protection group (composed of the National Fire Protection Association, the National Board of Fire Underwriters, the Associated Factory Mutual Fire Insurance Companies and the Underwriters' Laboratories); the National Electric Light Association, the National Safety Council and the Society of Automotive Engineers. These, with the five engineering societies that founded the committee (American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers and American Society for Testing Materials) and the three government departments added later (Commerce, Navy and War), make a total of thirteen organizations having representation on the main committee.

It is the policy of the committee to encourage representation by groups in such a manner that a group shall represent substantially the entire field of a particular industry in order that it may "be of national scope." In the opinion of the committee the group plan makes for efficiency in standardization work.

The Electrical Manufacturers' Council has designated LeRoy Clark, A. H. Moore and C. E. Skinner as its representatives on the committee.

Elihu Thomson Lays Down Principles for Inventors

ONE of the most inspiring things about an engineering career is the continual progress in understandable science, declared Dr. Elihu Thomson, acting president of the Massachusetts Institute of Technology, in an address week before last to those graduating. Calling attention to the new vistas, theoretical and practical, which are constantly opening before the progressive student, Professor Thomson said: "Note, for example, the seemingly unlimited possibilities in wireless transmission following the creation of thermionic amplifiers, the thermionics engineering of the future. It may soon be that a station in Paris, London or Washington will talk to the whole world, and that an instrument small enough to be installed in one's study may permit us to hear what is said.

"Some untrained and uninformed minds possess the quality of originality in a considerable degree," said Dr. Thomson. "Unless tempered by sound judgment, sense of proportion and adequate knowledge, the results may be erratic. Invention in the engineering sense involves originality, but not that alone, if the results are to be of value. There is imagination more or less fertile, but with it a knowledge of what has been done before, carried perhaps by the memory, together with a sense of the present or prospective needs in art or industry.

"Necessity is not always the mother of invention. It may be prevision. As to value in invention, it is often said, and said truly, that ideas are cheap, but those which are really novel, and which will bear the cost of developing them so as to return value for the effort involved, are rare. Not all apparently good ideas, even if new, are capable of commercial development.

"Shall an invention be patented or donated to the public freely? I have known some well-meaning scientific men," Professor Thomson said, "to look askance at the patenting of inventions, as if it were a rather selfish and ungracious act, essentially unworthy. The answer is very simple. Publish an invention freely, and it will almost surely die from lack of interest in its development. It will not be developed, and the world will not be benefited. Patent it, and if valuable, it will be taken up and developed into a business."

Textile Mill Will Require 5,100 Half Horsepower Motors

A NEW record in number of individual-drive motors will be established when the mill of the Riverside and Dan River Power Company at Danville, Va., is completed. The previous record in a textile mill was 3,000 motors, while the new plant will require 5,100 motors. All of these motors will be standardized at ½ hp. and will be of the same type and make. Lockwood, Green & Company of Boston are the engineers, while the Walker Electric Company of Atlanta is handling the electrical installation. The plant should be in operation about Jan. 1, 1921.

The U. S. S. Tennessee in Commission

THE electrically propelled United States battleship Tennessee, which went into commission on June 3, is the most powerful fighting vessel in the world today. She is 625 ft. long, has a beam of 98 ft. and displaces 32,500 tons. Her main battery consists of twelve 14-in. guns, and she is protected by a belt of armor 14 in. thick. Her main engines consist of two Westinghouse turbine-generators, rated at 15,000 kv.a. each, and each of the four propellers is driven by an 8,000-hp. Westinghouse motor. Her maximum speed with full power is 21 knots.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

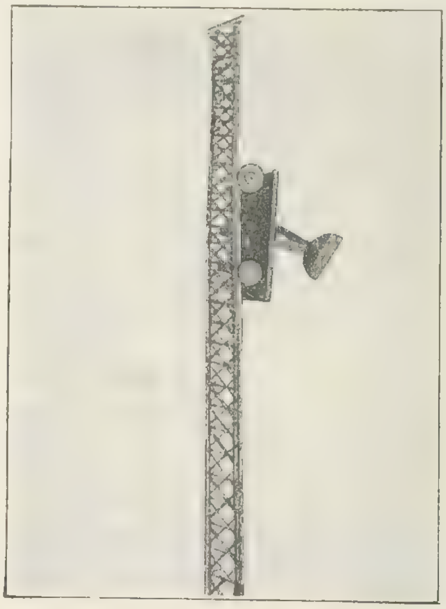
Seattle Municipal Plant Report.—According to the report made by the electrical department of the city of Seattle, a net gain was made by the department in the year 1919 of $473,955.53, but this was absorbed by construction work that was undertaken by the department at a cost of $1,000,000, leaving a deficit at the present time of approximately $580,000. The figures shown by the department's report were: Operating revenues, $2,087,563.45; operating expenses, $1,403,940.27.

Power Company Asks for 100 per Cent Increase in Rates.—A hearing in the application of the Hartford Power Company of Clay County for increased rates was held this week by the West Virginia Public Service Commission. The company, saying that it has gone into the hands of a receiver because of insufficient earnings, asked for an increase of 100 per cent in its primary charges and 125 per cent in the secondary charge. On night service it wants an increase of 25 per cent in addition to the 100 per cent in the primary charge.

Increased Cost of Water Power.—The Missouri Public Service Commission has granted the Union Electric Light & Power Company of St. Louis permission to pay the Mississippi River Power Company $277,777 more per year than has been paid for the 49,236 kw. furnished to the St. Louis company from the hydro-electric development at Keokuk, Iowa. The new rate is made retroactive to Aug. 1, 1919, and is effective for ten years from that date. The increase, which is from $16.34 to $20.55 per horsepower-year, is less than one-third as much as the contract between the two companies calls for based on the increased price of coal, but it is figured to give a fair return on the Mississippi River Power Company's investment.

Music by Wireless.—As an incidental result of research work on radio-telephony at the Bureau of Standards, it has been shown that music can be transmitted by radio without loss of quality. The possibilities in this direction are held to be great and very interesting. A concert, for instance, given in one place may be made available to those living at a distance. Experimental "concerts" are at present being sent out on Friday evening from 8:30 to 11 by the radio laboratory of the Bureau of Standards, using a wave length of 500 m. One way of transmitting music has been to place a phonograph so that the sound from it will pass into the radio transmitter. The Bureau of Standards has made an improvement upon this method. This consists in substituting the carbon microphone, which is the mouthpiece of an ordinary telephone, for the vibrating diaphragm ordinarily used on the phonograph. As a result, the phonograph sound record produces direct variations of electric current.

An Aërial Collision.—The accompanying illustration, reproduced from the London *Electrician*, shows the result of an extraordinary accident which took place during the war when a British hydroplane collided with a 440-ft. wooden-lattice tower, one of three forming part of the radio-telegraphic installation on Horsea Island, Portsmouth.



The collision took place at a height of 356 ft. and the hydroplane became firmly wedged in the mast. A sailor attached to the station rescued the pilot.

More Light on the Laying Hen.—Stimulating egg production by electricity is an old device the success of which is so well established that it is said a great many poultry dealers in all sections of the country are getting an increased output of from 35 to 70 per cent above former figures by lighting their chicken pens in the early morning hours before daylight. The general practice is said to be to light up the pens at 3:30 a.m. from Oct. 15 to Feb. 15, then at 4 a.m. for another month, after which the artificial lighting is discontinued. The average amount of lighting is put at 1 watt for every 50 sq.ft. of floor surface. That there is such a thing as overworking a willing hen, with eventual decrease of product, is, however, generally recognized by breeders. A writer in *Edison Current Topics*, the house organ of the Southern California Edison Company, points out that from the electric company's standpoint the benefits are great. The average lighting bill has been increased from $1.25 to $8 or more a month, the hours of burning are off-peak, and the service is supplied on the lighting rates.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Electric Club of Chicago.—The Tuesday luncheons of this club have been discontinued for the summer. They will be resumed in September.

A. I. and S. E. E., Pittsburgh Section.—The meeting of this section of the Iron and Steel engineers which was announced for June 12 was postponed. R. H. Keil, power engineer Jones & Laughlin Steel Company, Pittsburgh, will present his paper on "Current Limit Reactance" at the annual convention of the association in New York.

Meetings Next Week.—The Associated Manufacturers of Electrical Supplies, who convene today at New London, Conn., will hold their section meetings on Monday, Tuesday and Wednesday of next week. The annual convention of the American Institute of Electrical Engineers meets at White Sulphur Springs, W. Va., on Tuesday, Wednesday, Thursday and Friday. The Society for the Promotion of Engineering Education holds its annual meeting at Ann Arbor, Mich., on the same days.

Reorganization of Milwaukee Section, A. I. E. E.—The local dues of $1 per year, which have been collected by the Milwaukee Section of the A. I. E. E. before enrolling national members as members of the local section, will not be required after July of this year. The Milwaukee Section has been working under a plan whereby it paid the Milwaukee Engineers' Society $3 per section member per year and joined with the local engineering society in all of its technical meetings. The difference between the $1 paid by A. I. E. E. members to the section and the $3 paid by the section to the Milwaukee Engineers' Society has been made up by the annual appropriation received from A. I. E. E. headquarters. Under the new plan, which goes into effect next fall, the Milwaukee Engineers' Society will send announcements of all meetings to the entire American Institute section as heretofore and the A. I. E. E. members will continue to be invited to all the Milwaukee Engineers' Society meetings. However, the local section of the American Institute will not belong to the engineers' society in a body but the members will be invited to join the combined engineering body in Milwaukee individually at a cost of $5 per year. The initiation fee will be waived. The local members of the American Institute will no longer be asked to contribute to the Milwaukee Section, because the allowance from Institute headquarters will hereafter be used to cover all section expenses.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Reduced Rates to Allied Company Held to Be Discriminatory.—The Pennsylvania Public Service Commission has refused to approve a new schedule of rates adopted by the Home Electric Light & Steam Heating Company, operating in Tyrone, which while making substantial increases to other customers permitted the Altoona & Logan Valley Railway Company, its lessee, to receive energy at the former rates. It was contended that the railway company could procure its energy from another electric company at the old rate, but the commission held that this alleged fact did not prevent the Home company's rates from being discriminatory and ordered them revised to apply equally to all customers.

Compulsory Extension of Service.—An electric utility chartered to do business within the state without limit as to particular localities and possessing franchise rights to occupy public highways may be compelled, according to an opinion of the Missouri Public Service Commission in a complaint against the Ozark Power & Water Company, to serve a locality with which it is in proximity where such an extension of service constitutes a reasonable improvement. In accordance with this principle the commission found that where a sufficient number of consumers agree to take service at rates yielding operating expenses, depreciation and return upon investment—in the case in question 15 cents a kilowatt-hour with a minimum charge of $1.50 monthly—the company must render the service irrespective of the desires of its officers.

Average Return as Factor in Rate Fixing.—In passing upon the application of the St. Joseph Railway, Light, Heat & Power Company for increased rates, the Missouri Public Service Commission, referring to the electric service department of the utility as distinguished from the street railway, declared that an electric utility earning a return of 4.64 per cent in addition to a depreciation allowance of 3.5 per cent on the value of its property should obtain the increased revenue necessary for an adequate return through increased economy in operation and not through increased rates in a case where inadequate service has occasioned a loss in business and consequent loss of revenue and where an average return of 10.28 per cent was earned in the four years preceding the application and an average return of 9.15 per cent for a five-year period.

Proper Principles in Refunding Bonds.—Issues of refunding bonds should not exceed the total par value of the bonds refunded, according to a decision made by the Indiana Public Service Commission in an application by the United Public Service Company of Rochester, Ind., for approval of a new issue, as otherwise the mortgage indebtedness of utilities would be increased each time a refunding was negotiated. Outstanding bonds to the amount of $341,500 against property of the present value of $383,062 came much closer to the value of the property than sound financing can approve, the commission said. Bond discount should not be capitalized but amortized during the life of the bonds on which the discount is suffered.

Undesirability of Increasing Rates Where Contract Is of Recent Date.—The Missouri Public Service Commission has refused to grant relief to the St. Joseph Transmission Company, which operates between St. Joseph and Oregon, Mo., purchasing its energy supply from the St. Joseph Railway, Light, Heat & Power Company, although an increase in rates previously granted to the latter company is alleged to have operated to force the transmission company to do business at a loss. The commission's refusal is based on the fact that the contract between the St. Joseph Transmission Company and the city of Oregon was entered into as recently as January, 1918, when war conditions prevailed, and provided that the terms should not be modified or changed during the ten years which was to be the life of the agreement.

Importance of Adequate Depreciation Reserve.—In passing judgment upon the complaint of the city of Milwaukee against an increase in rates made by the Milwaukee Electric Railway & Light Company, the Railroad Commission of Wisconsin took occasion to reiterate its historic insistence on an adequate depreciation reserve, the sum set aside by the company under this head forming one of the points of attack. The commission declared that the rate of return fixed by it recognized the fact that the company will be able to invest a considerable portion of its depreciation reserve capital in permanent additions and improvements. For this reason, the commission continued, the rate of return required by the company on the fair value, which is in this case the cost new, need not be so high as would be the case were the funds for the construction of this property derived entirely from outside service. However, "it would seem to be perfectly clear that it would be inequitable to require the company to reduce the amount which it may charge to operating expenses for depreciation by the amount of interest on depreciation reserves and at the same time deduct these depreciation reserves from the amount upon which the company is allowed to earn."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Injury to Unauthorized Visitors to Plant Not Actionable.—In an action for damages for injuries received in an electric power plant owned by the village of Swanton, Vt., by a young boy while carrying breakfast to an employee of the plant, the Vermont Supreme Court held that, although hired by this employee to bring him his food, the boy was not on the premises as an invitee, expressly or impliedly, and that the owner of the plant had therefore no duty to insure his safety. The employee, although in sole charge of the plant at the hour when he desired breakfast, had no authority to invite an outsider to enter for reasons personal to himself. (109 A. 854.)

Penalty for Non-Service.—In a suit brought against the Vallejo Electric Light & Power Company under a statute since repealed but in force at the time of the failure to give service which is complained of, the plaintiff claimed the legal penalty of $50 as liquidated damages and $5 for every day that the refusal continued. The Supreme Court of California, overruling the judgment of the lower court, found against the company, though limiting the time for which damages must be paid to one year before action was brought. Whether the plaintiff had suffered loss to the amount of the penalty accrued had no bearing on the sum recoverable, which was fixed by statute at the amount named, and the fact that more than a year elapsed before suit was brought did not absolve the company from liability for the twelve months just preceding suit. (188 P. 999.)

Regulation of Public Service Commission in Ohio Affects Damage Suit in Indiana.—Suing in Indiana to recover damages for injuries received in Ohio, a freight-train conductor alleged the omission by the railroad employing him of precautions ordered by the Ohio Public Utilities Commission. The Supreme Court of Indiana ordered a new trial on the ground that the admission of the order of the Ohio commission by the trial court was erroneous. If the order was to be regarded as a general one, the court held that it was void for the reason that no legislative authority had been shown for the issue of such an order. On the other hand, if the order was specific in its nature, it had no binding force as against appellant because there was no evidence to show that the order was made after a hearing to which appellant was a party or served on appellant as required by law. (127 N. E. 146.)

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Thomas E. Murray, vice-president of the New York Edison Company, was the recipient of the degree of doctor of science from the Villa Nova (Pa.) College at its annual commencement exercises this year. Previously he had received the degree of doctor of laws from both the Brooklyn College and the Georgetown University. Mr. Murray ranks among the foremost men in the electrical industry. In addition to his association with the Edison company he is president of the Yonkers Electric Light & Power Company and vice-president of the United Electric Light & Power Company. He is a director of the Brooklyn Edison Company, the Electrical Testing Laboratories and the Manhattan Refrigerating Company, is the founder of the Metropolitan Engineering Company and of Thomas E. Murray, Inc., and has served in various capacities in virtually all of the electrical associations and engineering societies. For his research and productive work during the war he received a citation from the War Department. Mr. Murray's most noteworthy engineering achievements include the planning of the Waterside station of the New York Edison Company, the Sherman Creek and Hell Gate stations of the United States Electric Light & Power Company, the plants of the Brooklyn Edison Company and the hydro-electric development of the Chattanooga & Tennessee River Power Company. In 1910 the Franklin Institute awarded Mr. Murray the Edward Longstreth medal for his system of safety devices and protective appliances for interior electric wiring. Mr. Murray's patents number more than 350.

THOMAS E. MURRAY

Charles F. Meigs, for the past eight years manager of the electric shop in Augusta for the Central Maine Power Company, has been appointed superintendent of the Augusta district.

Robert Montgomery, who has been manager of the commercial department of the Louisville (Ky.) Gas & Electric Company for the past seven years, has been appointed manager of the investment department of the same company.

David E. Huston has been appointed superintendent of the Columbus (Ohio) municipal electric light plant to succeed Lewis I. Rowe, resigned.

V. M. Fuller, formerly engineer in charge of the electrical construction of the hydro-electric plant of the Guantanamo (Cuba) Electric Company and more lately electrical engineer of the Compañia Electrica de Alumbrado y Traccion de Santiago (Cuba), has been appointed chief engineer of the latter company.

A. Hardgrave, president-elect of the Southwestern Electrical and Gas Association, is vice-president of the subsidiary companies of the American Public Service Company and in charge of the Southwest district of the Mid-West Utilities Company, with headquarters at Dallas, Tex. Mr. Hardgrave was born in Texas in 1881 and began his career as a trainman on the Fort Worth-Dallas Interurban. In 1907 he went to Memphis, Tenn., where he worked for two years with Stone & Webster. In February, 1913, Mr. Hardgrave entered the employ of Martin J. Insull, Chicago, for whom he made engineering and valuation reports in connection with the acquisition of utility properties. Three years later Mr. Hardgrave became engineer of operation and construction of the Mid-West Utilities Company, with headquarters in Chicago. He held this position until August, 1917, when he was transferred to Dallas. At that time the Mid-West Utilities Company decided to divide its territory and centralize control of operation and construction in branch offices. Dallas was made headquarters for the States of Texas, Oklahoma and Missouri, and Mr. Hardgrave was sent to Dallas to open the office. At the same time he was made vice-president of all the subsidiary companies of the American Public Service Company.

A. HARDGRAVE

Arthur L. Kempster, heretofore traction manager of the street railways of the city of Seattle, has been appointed general manager of the New Orleans (La.) Railway & Light Company, succeeding John S. Bleecker, who has recently resigned that post, as announced in the ELECTRICAL WORLD. The lines of the New Orleans company are now in the hands of a receiver and Mr. Kempster has been engaged to study the traffic problems. A year ago he performed a similar service for the Brooklyn (N. Y.) Rapid Transit Company. Mr. Kempster has been connected with the Seattle lines since 1891, and previous to his appointment as Seattle traction manager he was manager of the Seattle division of the Puget Sound Light & Power Company. Mr. Kempster will probably return to Seattle upon completion of his duties in New Orleans.

ARTHUR L. KEMPSTER

Obituary

Edwin W. Bakus, who assisted Marconi in financing the radio-telegraph in its early stages, died in Tarpon Springs, Fla., recently, aged seventy-two. Mr. Bakus had a varied and successful career as a backer of large industrial projects at home and abroad.

Carl Paul Berger, president of the Irvington Varnish & Insulator Company, Irvington, N. J., died on June 15. Mr. Berger came from Germany at the age of twenty-nine and in a year or so started a varnish and insulator factory. He was a pioneer in the manufacture of insulation and developed the use of black varnish for cable insulation. In addition he invented special machinery for varnishing cambric, silk and paper in continuous rolls. During the war he was active in supplying insulation to the Allies. His death came as the result of an attack of influenza.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler
and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities
and Business Methods

Raw Materials in Good Supply to Fill Crane Orders

ACTIVITY in the electric crane market is beginning to ease off a bit for some producers, although others do not find this the case, and shipments of direct-current and 60-cycle alternating-current drive may be made in six to twelve weeks.

Because of the special nature of 25-cycle and 40-cycle equipment, some shops are quoting up to a year on shipments. In some quarters fairly good stocks of motors and control exist, but at the same time other producers are experiencing delays in receipt of this equipment.

Structural-steel stocks are in pretty good shape because in general this material forms the basis of the output of the other products of manufacture and fabrication of the same producers. Steel is moving in better volume now anyhow. Prices have undergone little change in the past few months, but there is a tendency upward, manufacturers say, although no definite change is anticipated at this moment.

The demand for alternating-current equipment is increasing in proportion to that for direct current, and some manufacturers' estimates place the present ratio somewhere between one to one and three to one in favor of the alternating current.

Electrical Exports for April Amount to $6,954,350

WHILE April exports of electrical goods as a whole were just under $2,000,000 less than those of the month of March, they were better than for either January or February. It will be remembered that returns for March placed that month on a very favorable footing compared with the best months of last year. Total electrical exports for 1919 amounted to $89,000,000, while the present year, at the end of the first third, is running at the rate of over $86,000,000.

In the $6,954,350 April returns, the outstanding features are seen to lie in dynamos and generators, fan motors, heating and cooking apparatus and interior wiring supplies. In these items the high month of March was surpassed. In comparison with April of 1919, increases were noted in exports of the same materials as given above, with the addition of metal-filament lamps, motors, rheostats and controllers and switching equipment.

	April		Four Months Ended April	
	1919	1920	1919	1920
Batteries	$547,430	$487,472	$1,893,386	$2,080,640
Carbons	102,642	84,967	552,033	[illegible]
Dynamos and generators	512,894	636,362	1,541,957	[illegible]
Fans	96,433	149,728	663,896	374,164
Heating and cooking apparatus	153,342	140,715	474,686	530,004
Insulated wire and cable	789,991	526,556	3,331,169	[illegible]
Interior wiring supplies	218,031	308,091	796,620	902,809
Arc lamps	2,889	699	6,105	[illegible]
Carbon filament lamps	13,100	11,514	63,838	[illegible]
Metal-filament lamps	452,151	352,669	1,859,833	1,355,105
Magnetos, spark plugs, etc.	312,188	310,744	1,169,141	1,268,402
Meters and measuring instruments	248,890	181,663	1,102,162	796,905
Motors	829,113	923,096	3,455,711	[illegible]
Rheostats and controllers	50,798	66,389	134,241	[illegible]
Switches and accessories	230,840	272,680	822,973	1,304,550
Telegraph apparatus	106,769	44,394	353,092	[illegible]
Telephones	426,373	326,497	1,228,879	1,224,591
Transformers	308,669	169,976	1,468,368	[illegible]
All others	2,349,498	1,960,139	8,979,917	8,823,451
Total	$7,732,041	$6,954,350	$29,897,607	[illegible]

For the first four months of the present year the total is only a little over $1,000,000 behind that period of last year, but noticeable gains are found in several important items. As a whole, the export situation can be considered quite satisfactory when there are taken into account the difficulties under which exports are now placed.

The figures in the table are by the Bureau of Foreign and Domestic Commerce.

Locomotive Headlight Units Gain in Industrial Field

MANUFACTURERS of steam-driven generators for locomotive headlight equipment are in general working to capacity in an endeavor to equip the steam railways before the first of July. Some roads report installations complete on all locomotives, while for others, which have been slow in placing their orders, deliveries will not be made by that date. Furthermore, a shortage in material parts has for some manufacturers held up shipments.

At the same time the demand for these steam turbine units has been increasing steadily in other fields outside that for which they were originally designed. Barges, dredges, locomotive cranes and other hoisting apparatus have proved a ready field, and their use has extended to mining and construction operations. One of the heaviest markets has been found in the oil regions, and here the applications have been more pronounced of late. In fact, so great has been this industrial field that at least one producer is making arrangements to add an industrial section to his manufacuring capacity.

Some of the 0.5-kw. and 1-kw. sets may be found in certain producers' stocks, but conditions are somewhat different as regards the larger sets. Up to 5 kw. they are being made for complete train lighting, but these have rather the least call for that purpose. It is expected, however, that these larger units will find still greater use in the industrial market.

Wage Controversy Affects Electric Sheet Allotments

ELECTRIC sheet mills are following different paths in regard to receipt of orders for shipment beyond June 30. Certain allocations of output for the third quarter have recently been made, but it has been estimated that the quantity available will meet only about half the requirements of the consumers. Where the remainder will come from is still to be seen, but it is hardly expected that production will be any better in the next three months than in the past three. At present a new freight tie-up threatens to make matters still worse. There has been some revision of prices, averaging around 15 per cent upward.

The wage agreement for sheet and tin-plate workers expires on June 30. From the deadlock which resulted from the meeting at Atlantic City last week of union sheet and tin mill owners and the Amalgamated Association, it appears that the operatives want no further conferences until the first week in September. Of course, the owners may undertake to operate as non-union concerns or to take the other course and close down.

A 20 per cent advance in base rates of scale and a six-hour day have been demanded. If a walkout is declared on July 1, shipments of sheets will be further delayed than they are now. An estimate gives the Amalgamated control of about 40 per cent of the sheet and tin-plate mills, and in this number is a certain capacity in electric sheets. What the mills will do which have not already accepted allotments of their next quarter or half-year capacity remains to be seen when there are further results from the agitation of the wage question.

Malleable Situation Better, but Labor Is Still Short

IMPROVEMENT is reported in the malleable castings field. Present production has been estimated at between 60 and 80 per cent of capacity, where only a few weeks ago reports placed it at around 50 per cent. The chief factor in keeping it down is the labor shortage, particularly in the molding department. Here there are not enough molders to keep the other departments going to capacity.

Turnover in labor is high, and because of that and the independence of the worker rejections of material and defective work have been vital factors in the cost of malleable castings. Overhead costs on mill equipment have continued regardless of the capacity under operation. Prices on the finished goods have been tending higher all spring and summer, although malleable pig-iron quotations are the same today as they were the first of March. At the same time the demand is increasing.

A coal shortage is looming up now to put a more unsatisfactory aspect on the situation, while fresh walkouts in certain railroad yards in the East contribute still further to the chances of poorer shipments of malleables. Customers are driven to use such substitutes as steel, forgings, brass and bronze for the malleables, and at present there is little difference in price, with the main item of labor overshadowing the base metal prices.

Analysis of 1919 Carbon-Filament Incandescent Lamp Exports

CARBON-FILAMENT incandescent lamp exports during 1919 were valued at $202,597, which is only 4.3 per cent of the total valuation of all incandescent lamps exported. The highest monthly value was recorded in May, amounting to $44,157, of which $36,317 was credited to China. The average monthly rate of exportation was $16,883.

Data compiled by the ELECTRICAL WORLD indicate that the value of carbon-filament incandescent lamps imported by Canada from the United States was 67 per cent more than that imported by any other country, with a total of $60,025. China and Australia were second and third, with $37,000 and $27,004 respectively. Fig. 2 shows the relative value of exports to various countries importing carbon-filament lamps the value of which exceeded $5,000. Other countries importing this class of electrical apparatus were Argentina, Peru, Chile and the Dutch East Indies, their imports being valued at $2,475, $2,462, $1,517 and $784 respectively. A detailed study of the figures indicates that no carbon-filament lamps were exported to Europe. Continental America absorbed 65.5 per cent of the total exports, and Australia and New Zealand took 16.7 per cent. The remaining 17.8 per cent went to China, the Philippine Islands and the Dutch East Indies.

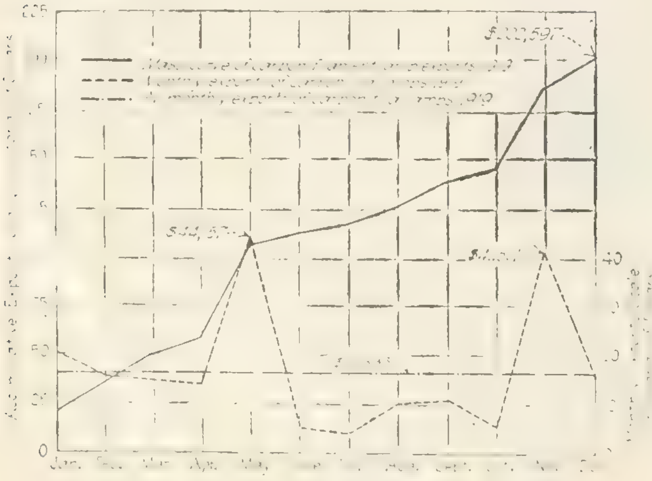


FIG. 1—MONTHLY VARIATIONS OF EXPORTS

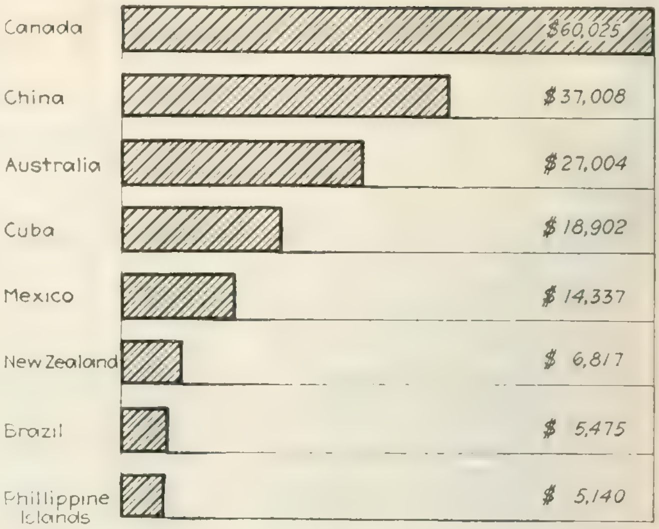


FIG. 2—ANALYSIS OF EXPORTS BY COUNTRIES

The above figures are based on export statistics issued by the Bureau of Domestic and Foreign Commerce for 1919.

Manufacturers Again Guaranteeing Against Fall in Price

AT THE close of 1918, when the armistice was signed, falling prices were looked for in many directions, and as a result there were many artificial methods employed to prevent buying from stopping. A favorite method in this connection was to guarantee the purchaser against a fall in prices.

Now that falling prices are again expected, the same uneconomical, panicky methods are again coming to light. In the appliance field the guarantee against fall in price is being used effectively to obtain fall business.

If the manufacturers by guaranteeing prices merely mean that they will pass along to the customer all saving in production costs during a certain period, there are many who will commend the action. On the other hand, it appears to be very unwise for any manufacturer to take upon himself the responsibility of guaranteeing his customers against a drop in price which probably will be brought about by conditions over which the manufacturer has no power. In this connection, a warning that agreements between manufacturers and dealers preventing the latter from reducing the selling prices of manufactured articles was unlawful was sounded last week by the Department of Justice as part of its campaign to lower the cost of living. The absence of formal contracts will not affect the provisions of the law, says the department.

District Stocks of Electric Tools in Good Shape

HEALTHY increases in the volume of sales of electric hand tools are reported from manufacturers of these specialties throughout the country. The heaviest market is found in the Central West, where automobile manufacturers are using them in ever-increasing quantities. Railway car and locomotive builders during the war placed heavy orders for this class of tool, and, because of long shipments and the general let-down in railway equipment building after the armistice, they were well supplied for the work in hand. It is expected, however, that recent plans for renewed activity in the railway field will result in further demands for electric tools. At the same time, this demand probably will be less than might at first be contemplated from reports in circulation concerning the large amount of rolling stock to be purchased.

Sales this year have been heavy, but manufacturers have been able to keep fair stocks at their distributers' warehouses. It is still possible to make up shipments on ¼-in., ⅜-in. and ½-in. sizes from district stocks, but large orders, and orders for other sizes, are requiring three to four weeks to fill. Tool factories are not producing up to full capacity in all cases, one at least being on a 75 per cent capacity and one on zero because of strike conditions at the mill. Raw material and labor shortages are responsible for underproduction, it is reported. Motors have been very difficult to obtain in some cases, but with the use of motor trucks a sufficient quantity have been picked up to keep up to production schedule day by day.

Improvement in sales is coming from the garage business, and with it an increasing demand for universal motors.

Metal Market Situation

REGARDLESS of the offerings of copper at lower prices within the last few days, the underlying feature of the market is strength. Producers are still satisfied to hold their tonnage at 19 cents for June and July and 19.25 cents for August and September delivery. They feel that there must soon be a return of large consumers into the market, although this day is being put off because of manufacturing conditions. Transportation tie-ups are a cause of the conversion of less copper into finished goods, and this is being amplified by strikes in certain brass mills.

Whatever metal has recently been sold by some small dealers at around 18 cents and 18 and a fraction at the refinery is in small lots and has virtually no effect on the general market. There is not a great deal of metal in the outside market to apply on these low prices, and already after the first sales the prices advanced an eighth to a quarter cent.

Copper in the London market at the end of last week had declined to just over £82, but this week it has returned to £86. There is little activity in the foreign market, although contract copper is going out of the country in fair-sized lots. Port strikes have little effect on this class of material.

A strengthening tin market is shown in the recovery of Straits tin within the past week. It is now quoted at 50.50 cents for spot, an advance of 5 cents over a week ago, after a decline from well above 50 cents. The supply of spot in New York is light, but the demand too is not heavy. Strikes at tin mills are recent developments of moment.

Consumers and dealers are showing considerable interest in third-quarter zinc, and labor troubles at certain mills are providing some food for thought on future supplies.

Lead prices were further lowered to 8 cents by the main producers, although the outside market is quoting one-half cent higher. Spot stocks are low.

Scrap metals have fallen off a bit, heavy copper scrap declining ½ to 15 cents, heavy lead dropping a fraction, and old zinc scrap going a quarter below 5 cents.

NEW YORK METAL MARKET PRICES

	June 15			June 22		
Copper	£	s	d	£	s	d
London, standard spot	86	5	0	86	15	0
	Cents per Pound			Cents per Pound		
Prime Lake	18 50			18 50		
Electrolytic	19 00			19 00		
Casting	17 62½			17 62		
Wire base	22 50 23 00			22 50 23 00		
Lead, trust price	8 25			8 00		
Antimony	7 75			7 50		
Nickel, ingot	43 00			43 00		
Sheet zinc, f.o.b. smelter	12 50			12.50		
Zinc, spot	7 95			7.85		
Tin	45 50			50.50		
Aluminum, 98 to 99 per cent	33 00			33.00		

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15 50 to 15 75	15 00 to 15 50
Brass, heavy	9 00 to 10 00	9 00 to 10 00
Brass, light	7 00 to 7 50	7 00 to 7 25
Lead, heavy	7 00 to 7 37	7 00 to 7 25
Zinc, old scrap	5 00 to 5 25	4 75 to 5 00

THE WEEK
IN TRADE

STOCKS in jobbers' hands are reported a little larger than last week. Here and there throughout the country fair shipments of pipe, loom, flexible armored conductor and cotton lamp cord have been received, and present embarrassments are taken care of temporarily. Meter stocks are about out, just enough being available to satisfy daily needs.

New England appears to be enjoying the heaviest volume of business and of new building of any section. The South is in good condition, too. At the same time collections are only fair, but show no cause for alarm at this time. Labor in some New England brass centers is again uneasy, and renewed walkouts of yardmen threaten shipping in the East.

NEW YORK

Jobbers' trade is on a high level, but is off somewhat from the volume of business of a month or more ago. Incoming shipments were better for a time, but the outlook is rather more unsatisfactory in light of fresh walkouts in freight yards in Baltimore, Trenton and Philadelphia.

Good sales have been made in fans, but the influence of the cool weather has been to permit jobbers to accumulate a fair stock. Even this is broken in some quarters and hardly expected to stand the strain of a real hot spell. Pipe, flexible conductor, porcelain and loom stocks are virtually depleted, while wire is in fair quantity. Cotton-covered lamp cord is found in volume in some places, but the silk variety is still low. Alterations and remodeling are holding a high place in building circles, and here and there are reported isolated large construction jobs. New residence work is off a bit. Collections are a little more difficult from the smaller companies.

Flexible Armored Conductor.—One large jobber reports the arrival of shipments ordered last October. Most distributers have no stocks on hand, while shipments arriving in driblets are cleaned out at once. Demand is as strong as ever. Prices for the two-wire No. 14 range from $115 to $121 per 1,000 ft.

Rubber-Covered Wire.—Demand is fair with good stocks on hand. Shipments are coming in fairly steady on back orders. Prices for No. 14 wire range from $11.60 to $14 per 1,000 ft., shading according to the size of order.

Rigid Conduit.—Stocks are in bad shape, with irregular shipments being applied on back orders of three to six months' standing. Demand is heavy at prices of $91 to $101 per 1,000 ft. for ½-in. black, and $197 to $220 for the 1-in.

Non-Metallic Flexible Conduit.—Demand is strong, especially in outlying districts, with virtually no stocks in sight, though occasionally distributers are fortunate enough to get in a shipment.

Lamps.—Deliveries from the factories are slow, with stocks consequently spotty. The situation has improved slightly, although 25-watt to 100-watt sizes are still hard to obtain. Demand is heavy.

Fans.—Demand picked up considerably, following the hot weather of last week.. Stocks are fair, with a shortage, however, of certain sizes. The most popular fan is the 16-in. oscillating, and a heavy run on ceiling fans is also reported.

Porcelain.—Deliveries are extremely slow, with unfilled orders running up to six months. Demand for knobs, cleats, tubes, etc., is strong, but prices are high and stocks depleted.

Safety Switches.—Jobbers report local territory as not offering so fertile a field for these switches as do other sections of the country. The market, however, is improving and local stocks are in pretty good shape.

Dry Cells.—Sales are heavy with a slight increase recently. Orders are generally filled from stock, as shipments are coming through fairly regularly. Prices are firm, with no indications of a reduction in the near future.

Bells and Buzzers.—Reports on this material vary; jobbers' shipments are being applied on back orders as fast as they arrive, while at least one manufacturer is able to fill orders from stock and quotes one week on shipments. Demand is heavy, and there seems little likelihood of price reductions.

Transformers.—Demand does not seem to abate sufficiently to permit the shipments which are coming in to form into any kind of stock.

Lamp Cord.—Shipments are extremely long under a heavy demand. Certain jobbers have some in stock.

CHICAGO

Trade conditions in this district remain so badly jumbled that an intelligent discussion is difficult. The outstanding feature is that it remains impossible to secure goods in sufficient quantities to supply the demand, in spite of the fact that new orders are being received in considerably reduced volume. Sales of street-lighting equipment, pole-line equipment and railway supplies all show a reduction, while schedule-material orders are kept low by slack conditions in the building trades.

Brisk retail trade induced last week by the sudden advent of hot weather declined as suddenly as it jumped, following the return of unseasonable cool weather. Even the ordinary "June bride" trade in percolators, grills, toasters, etc., is below expectation. Contractors are kept fairly busy on alteration jobs, as many buildings are being remodeled and refitted to fill the demand for space, which is acute in all lines.

Jobbers report that failure to receive goods is not caused by inability to move goods from factory to jobber so much as to the difficulty manufacturers face in obtaining raw materials. This seems to apply particularly to power apparatus, as shipments of motors and similar items are moving with some ease. To sum up, the trade inclines to the opinion that conditions in general are even worse than for several weeks. Naturally collections are difficult.

Motors.—No improvement is noted in the situation as regards motors. All sizes are in demand, but the heaviest call is up to 20 hp., and the gross quantity carried on back orders is steadily increasing. Manufacturers are seriously impeded by lack of certain raw materials, and the situation shows no signs of immediate improvement.

Wire.—Wire stocks, in the ordinary sense, have long ceased to exist. All dealers are receiving occasional shipments, which last only so long as it takes to distribute them on orders. Supply is sufficient in all kinds except magnet wire to avoid any serious inconvenience.

Lamp Cord.—Cotton-covered cord is in fair supply, some jobbers being able to fill orders from stock. The silk variety is unobtainable. Manufacturers of heating appliances are reported as being seriously inconvenienced in some cases by the shortage of this material.

Fans.—Heavy demand by the retail trade, which started with last week's heat wave, has returned to ordinary proportions; meanwhile some deliveries have been made to jobbers, so that situation is somewhat relieved for the time. Hot weather will mean a return to former conditions of shortage.

Weston Instruments.—Owing to difficulties in securing supplies the Weston Electrical Instrument Company is not guaranteeing prices on any instrument ordered now. Deliveries range from six weeks, on items considered standard, up to sixteen weeks for special designs.

Plug Fuses.—These are available out of stock in limited quantities only. Present quotation of $5.60 per 100 on the 5-amp. size in lots of 500 or more shows no recent change.

Knobs, Tubes, Cleats.—Prices are unchanged, and demand, owing to lack of new construction work, is sufficiently light to allow jobbers to maintain some stocks. Deliveries from factory are slow, ranging up to four months.

Tape.—Stocks of tape, both friction and rubber, are fairly well maintained. In 100-lb. lots rubber tape is quoted at 73 cents per pound.

Porcelain Insulators.—These are almost unobtainable and have been subject to sharp advances. A double-petticoat, single-groove 5,000-volt insulator is now $17 per 100, and a 6,600-volt type with top groove is $24. These prices are not guaranteed.

BOSTON

Orders continue to pour into jobbing offices without slackening, although retailers report quieter buying of appliances. Stocks are irregular, and rail shipments are not as yet up to normal. Prices are firm, barring retail cuts on hollow ware to bring out trade and dispose of older designs of material. Deliveries are growing worse on motors of 10 hp. and below, but wiring materials are coming in better. Collections are fairly good, but are being closely watched. Payment in thirty days is being demanded on electrical accessories for automobile use, sixty days being sought on other accounts. Seasonal appliances are sluggish, on account of abnormally cool weather.

Building contracts to June 18 in New England total $167,680,000 since Jan. 1, compared with $72,802,000 for the same period last year. New industrial plant work, including extensions, is very active. Labor conditions are still uneasy, with strikes in the Naugatuck Valley holding back brass production. The Lynn Works of the General Electric Company opened Monday after a half week's shutdown in which shortage of material and fuel were features, combined with labor uncertainties.

Appliances.—Jobbers are complaining of long deliveries. Some retailers are actually selling 1920 Christmas goods ordered early in the year. Retail patronage has slackened during the past fortnight.

Rigid Conduit.—A few shipments are coming in and occasional small stocks are established, only to melt away in face of the demand for smaller sizes of pipe.

Wire.—Deliveries on weatherproof are quoted from eight to fourteen weeks on a 26.5-cent base, net price. Rubber-covered wire is moving on four to six weeks' delivery, with 25 to 26 cents base quotations. Bare copper wire in larger sizes can be had in two to three weeks, but the smaller sizes are harder to obtain, magnet wire being out of stock. Bare base, 23 cents net.

Flexible Armored Conductor.—Good stocks are in hand, No. 14 single-strip selling at $110 per M in 5,000-ft. lots.

Non-Metallic Flexible Conduit.—Plenty of loom is in hand at the moment, one medium-sized jobbing house reporting 100,000 ft. on its premises. Prices are steady, 5,000-ft. lots bringing $33.50 per 1,000 ft. in the $\frac{7}{32}$-in. size and $36 for $\frac{1}{4}$-in.

Nail-it Knobs.—The famine appears to be broken. One jobber has just received 100 barrels, and quotes $35 per 1,000 in barrel lots.

Motors.—A leading distributer quotes forty weeks' delivery on 1-hp. to 7½-hp. motors, and another quotes nearly one year. Odd sizes are going fast when found. Prices are steady and the demand enormous.

Farm-Lighting Sets.—Inquiries are increasing. Bad roads and wet weather hurt spring sales. Stocks are low. A representative $\frac{3}{4}$-kw. set sells for $580 f.o.b. Boston and is quoted at three to four weeks' delivery.

Washing Machines.—Heavy sales have greatly reduced stocks, even of locally manufactured units. Galvanized-tank machines are moving a little faster than copper-lined outfits. Prices are firm.

Welding Apparatus.—Industrial demand is increasing. Deliveries are being quoted on a two to three weeks' basis.

Lamps.—Current demands are being met by splitting orders. The 25-watt size is somewhat scarce. The curve of orders continues to fall off somewhat, and vigorous efforts are being made to build up factory and warehouse stocks against fall business. Sign lighting shows new life.

Ranges.—High coal cost is reflected in good electric range sales. Stocks are low, with stiff price levels.

ATLANTA

A falling off of activities in the retail trade is reported this week, while a noticeable slackening in wholesale orders is reported by the jobbers. The volume of May orders is proving small compared with the average established for the first three months of the year. In the aggregate, however, it might be said that the wholesale and retail trade is satisfactory.

Industrial and building activity continues very good despite the high price of all building material and labor. Building permits for Atlanta for the first half of June have broken all previous records, and it is freely predicted that the building permits will pass the two-million dollar mark before the end of the month.

Jobbers report an increasing interest in all lines of electrical specialties, the demand for electric ranges being particularly heavy. A number of large cotton mills are seriously considering the installation of electric ranges in their mill villages, and if their decision is favorable, a large amount of this specialty will be required.

Collections are not so good as last week. Dealers in automobile specialties, the small contractors and the small central stations are the chief delinquents, while the large contractors and dealers are paying up promptly.

Fans.—A week of very hot weather has practically exhausted the supply of desk fans, particularly of the direct-current type, while ceiling fans have been very scarce for two weeks past. Jobbers predict a general shortage before the season has advanced materially as they expect no more fan shipments in the near future.

Distributing Transformers.—Conditions are unimproved in this line. Stocks are very spotty, and the popular sizes are practically unobtainable for quick service. Little hope is held out for immediate improvement in this situation.

Breast Drills.—Demand is on the increase and dealers report stocks moving well. Fair supplies are on hand and shipments are satisfactory.

Stamped Steel Boxes.—Shipments are arriving in fair quantities, some sizes being obtained from stock while others are as late as four weeks in shipment. The demand is still outrunning the supply, and it is not possible to accumulate any stocks of moment.

Armored Conductor.—Conditions in this line apparently have improved, though no stocks have been accumulated to date. Shipments are being received in increasing quantities, but receipts at present are absorbed by back orders on an allotment basis. Price, two-conductor No. 14, lots of 1,000 ft. to 2,500 ft., $116 per 1,000 ft.

Electric Vibrators.—A steady demand is reported throughout the territory. Stocks are in fair condition and shipments hold up well.

Washing Machines.—Stocks of washing machines continue to stand up well in the face of insistent demand. Shipments are coming through in good shape, owing largely to embargo on shipments East from factory locations, thus diverting products to Southern and Southeastern sections. List prices, standard machines, $125 to $150.

Conduit.—One jobber reports the receipt of 260,000 lb. for the Atlanta trade in the last two weeks, in assorted sizes from ½ in. to 4 in., galvanized. This shipment, in conjunction with receipts of other jobbers, has served to ease the local situation materially. Prices, less than 2,500 lb., galvanized, ½-in. $94.10; 1-in. $184.60; 1½-in., $298.70; 3-in., $830.80.

SEATTLE-PORTLAND

Trade conditions in the Seattle and Puget Sound field show little variation from those of several weeks past. Sales volumes, according to leading jobbers, have further declined, and anticipated business, particularly from logging and lumbering interests, is not materializing. It is believed that when the lumber mills make their usual midsummer shutdown in July, some sales of electrical apparatus, including fractional and larger sized motors, will be made. Retailers report that merchandising sales for the past week are still light. Activity in this district at present is largely confined to attempts to obtain goods already ordered rather than to placing new orders. Transportation troubles still perplex, although they have been mitigated to a slight degree. Maintenance of a fair semblance of stocks is next to impossible.

Non-Metallic Flexible Conduit.—Demand the past week increased, thus further depleting the already low stocks. Prices show no change.

Household Goods.—Push-buttons, annunciators, etc., recently advanced in price, but the demand in Seattle territory is showing a slight decrease. Stocks are very low and unless replenished in the immediate future will be practically exhausted.

Domestic Appliances.—An electrical demonstration week, staged by a large department store in Seattle, netted excellent results.

Meters.—In spite of the decreasing amount of residence construction, considerable difficulty is being experienced in obtaining sufficient meters to meet the demand. Some smaller sizes are still available, but shipments are lengthening for the larger types, which are quoted from four to six months.

Wire.—The shortage in popular sizes of weatherproof is still acute in Seattle and Sound cities. Stocks of larger sizes are fair. No price changes have been recorded recently. The superintendent of lighting in Seattle states that many local industries and most of the 63,000 consumers of municipal service will be automatically cut off within forty days unless additional fuel oil for the Lake Union steam auxiliary is obtained. The Shipping Board has been asked to furnish a tanker to transport fuel oil for the city's use.

SAN FRANCISCO

All California cities are making a special bid for industrial business. In this connection it is announced that Los Angeles will soon be the center of a big cotton market, the cotton being grown in the adjacent Imperial Valley. The Imperial Valley crops of all kinds, it is said, will be marketed for about $75,000,000 during the season. At the "electrical home" of the California Electrical Co-operative Campaign, opened near San Francisco, the value of numerous and well placed outlets is being forcibly impressed upon the visitors.

Household Devices.—Recent advances in the price of heating appliances are causing considerable confusion and recrimination among dealers, many of whom bought before advances became effective, and are disposed to sell at the old prices.

Ranges.—Several large government orders have been recently awarded. The city of San Francisco is in the market for a battery of six hotel ranges for its Hetch-Hetchy installation. Deliveries from the factory average about four months. Water heaters are especially slow in coming through.

Washing Machines.—Inability of certain manufacturers to make deliveries threatens a readjustment of agencies, though few changes are actually reported. Most jobbers seem anxious to retain their present lines.

Farm Plants.—Considerable stocks have accumulated on the Coast as a result of Eastern embargoes on freight, but these stocks are met by still larger demands. Considerable export business is being done, especially in the Philippines. Agents report this to be rather a dull season, as farmers have no time to talk such appliances during the period of harvesting.

Rubber-Covered Wire.—Coast stocks are exceptionally good. The call has dropped off somewhat because of the completion of outstanding wiring jobs. The present price of No. 14 single braid solid in 5,000 ft. lots is $12.30 per 1,000 ft. for California terminal points.

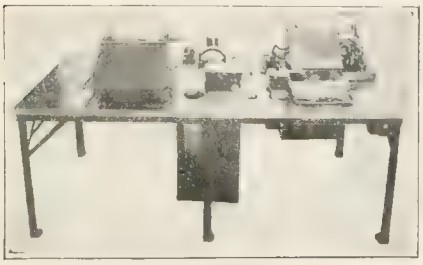
Insulating Material.—The market for such rewinding and repair specialties as mica, fiber, etc., is much quieter than in 1919. Prices are fairly steady, although a recent 10 per cent advance has been effected in micanite plates.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Automatic Printing Telegraph

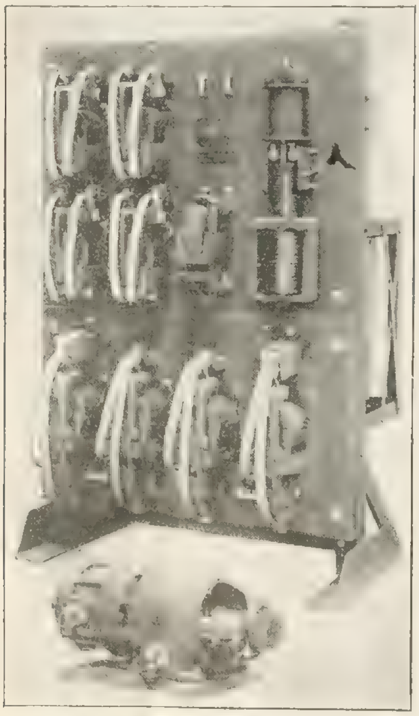
To get greater speed in duplex transmitting and receiving, the Kleinschmidt Electric Company, Inc., Brooklyn, N. Y., has improved its current model of automatic printing-telegraph apparatus to eliminate one-third the number of parts previously used. Speed of operation can be boosted up to eighty words per minute, the maker says.



FEWER PARTS USED THAN IN FORMER MODELS

Control for Alternating-Current Elevator Motors

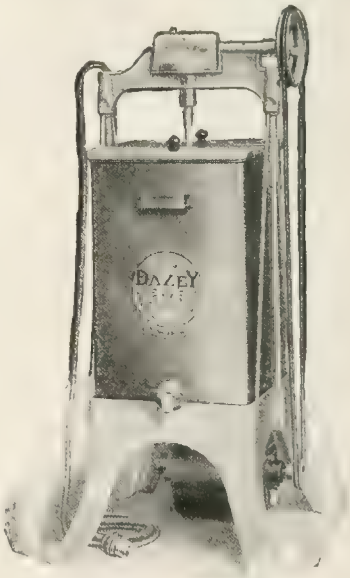
To meet the heavy requirements of alternating-current motor control for elevator service, where high speed and large capacity motors are used, the Warner Elevator Manufacturing Company, Cincinnati, Ohio, has designed its type CA controller. The contactor magnets together with the brake magnets are operated by direct current obtained from a small motor-generator set. Main-line and direction switches are operated by a self-centering car switch, and full control in both directions is obtained with three wires to the car. Direction switches are mechanically interlocked.



DIRECT CURRENT OPERATES MAGNETS FOR ALTERNATING-CURRENT MOTOR

Electrically Operated Churn

The Dazey Churn & Manufacturing Company, St. Louis, Mo., has placed on the market its motor-driven butter churn. The churn itself is similar to the company's hand-operated model. Gross capacities of these new machines are 4, 6 and 10 gal. Gears are inclosed in a removable housing.



MOTOR REPLACES FORMER HAND POWER

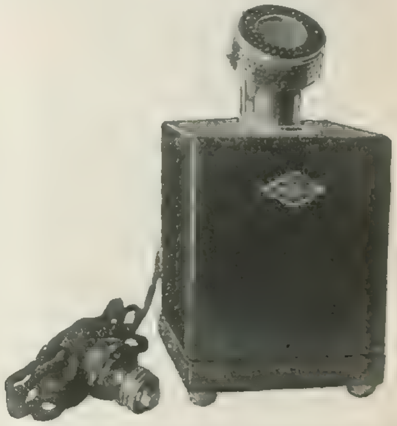
Drum-Contactor Controllers for Direct-Current Motors

The Westinghouse Electric & Manufacturing Company has designed a type S manually operated drum controller, employing practically the same principle of operation as magnetic contactor controllers. They are used for starting and adjusting the speed of shunt, series and compound-wound motors by adjusting the resistance in series and parallel with the motor armature. The contactors are operated by cams mounted on the controller shaft, and line contactors, which open and close the main-line circuit, are protected by magnetic blow-outs. Each contact element is complete in itself and can be removed as a unit. The stationary and moving contacts are identical and are interchangeable with those of Westinghouse auto-starters and magnetic-contactor controllers.

The controllers will operate when mounted in any position, as the contactors are spring-actuated and their operation is not affected by gravity. Controllers for use with crane hoists regulate the speed of the motor while lowering by dynamic or regenerative braking. The motor may also assist in the lowering.

Electric Cigar Lighter

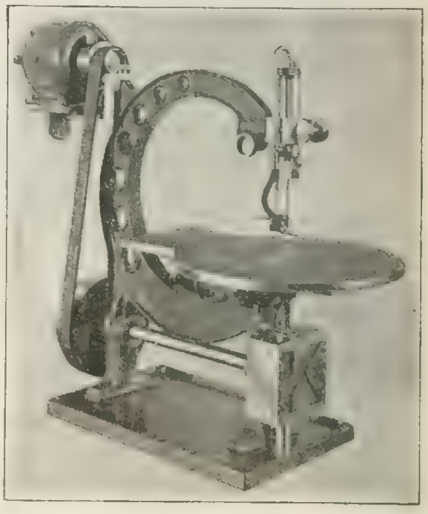
The continuous-duty type of electric cigar lighter for counter service is designed for 110-volt circuits and consumes 40 watts, according to the manufacturers, Clark, Osgood & Allison, Inc., Munsey Building, Washington, D. C. This "Duralectric" lighter uses a nickel-chromium alloy element with mica and special asbestos composition and is finished in mahogany with nickel trim.



CONSUMES 40 WATTS ON 110-VOLT SERVICE

Portable Jig Saw

A motor-driven portable jig-sawing machine is being marketed by the Clapp-Eastham Company, Cambridge, Mass. The motor is of $\frac{1}{6}$ hp. for 110-volt or 220-volt service, and a two-step pulley provides speeds of 500 and 800 r.p.m. The blower is automatically adjusted to clear the work of dust.



ONE-SIXTH HORSEPOWER DRIVE

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE MARTIN-WRIGHT ELECTRICAL COMPANY, San Antonio, Tex., electrical contracting engineers, will soon open a branch office in Dallas, Tex.

THE NORTH CENTRAL ELECTRIC ASSOCIATION MEETS.—The first convention of the North Central Electric Association, which is a consolidation of the Minnesota Electric Association and the Electric Power Association of South Dakota, was held at the Hotel Radisson, Minneapolis, Minn., June 15, 16 and 17.

THE YOST ELECTRIC MANUFACTURING COMPANY, Toledo, Ohio, has opened a branch factory in Ironville. The new works are in the Shepler paper-mill plant and will start with 100 employees.

DIENELT & EISEHARDT, INC., 1304-18 Howard Street, Philadelphia, manufacturer of power hammers, hydro-extractors, etc., has discontinued its electrical department.

WHITFIELD P. PRESSINGER, New York City, vice-president of the Chicago Pneumatic Tool Company, died June 19 as a result of complications following an operation. He was actively engaged in the pneumatic tool and allied machinery industry for many years. For seven years he was manager of the Clayton Air Compressor Company and became widely known through numerous activities in the American Society of Mechanical Engineers and the Compressed Air Society.

B. G. PRYTZ has resigned as president of the SKF Industries, Inc., New York City. He has been elected managing director of the parent company, with headquarters at Gothenburg, Sweden. F. B. Kirkbride, vice-president since the organization of the company, has been appointed president to succeed Mr. Prytz.

A. J. BIBIGHAUS, consulting engineer, has opened an office at 530 Hamilton Street, Allentown, Pa. He has been connected with several large corporations as an electrical and mechanical engineer, including Thomas A. Edison, Inc., Ingersoll-Rand Company, Phillipsburg, N. J., and the electrical department of the Bethlehem Steel Company.

J. K. ALLINE, formerly of the Electric Appliance Company, Chicago, has been appointed Iowa representative of the Packard Electric Company, Warren, Ohio.

G. B. ROSENBLATT, specializing in the commercial and technical activities of the Westinghouse Electric & Manufacturing Company in the West, with respect to metal mining and smelting, coal mining, oil and electrometallurgical and electrochemical industries, has transferred his headquarters from the Salt Lake City (Utah) office to the San Francisco office.

JOHN McC. PRICE, formerly general sales manager for the Mechanical Appliance Company, Milwaukee, has been recently appointed manager of the Chicago district office of the Industrial Controller Company, Milwaukee, Wis.

E. O. SESSIONS resigned as president of the General Devices & Fittings Company of Chicago on May 1, 1920. Mr. Sessions had not been active in the company since the beginning of the war, and he sold all of his holdings in order to devote his entire attention to the work of the Sessions Engineering Company, of which he is president.

THE GREAT LAKES ELECTRIC MANUFACTURING COMPANY, Chicago, manufacturer of small motors, generators and rotary converters for special purposes, has moved from 200 N. Desplaines Street to 11-17 South Desplaines Street, where the increased space will permit the company to triple its output.

THE DAZEY CHURN & MANUFACTURING COMPANY, St. Louis, Mo., has motionized its churns and is selling them through jobbers.

THE GENERAL LEAD BATTERIES COMPANY, Newark, N. J., announces the purchase of a two-story and three-story building of 65,000 sq.ft. area at Eightieth Street and Belt Line Railroad, Chicago, for manufacturing and storage purposes.

THE GEM ELECTRIC COMPANY, Santa Ana, Cal., has recently been organized by D. J. Keleher, formerly with the engineering department of the Southern California Edison Company, and J. F. Ireland, formerly with the American Aluminum Company of America, to do an electrical contracting business and to deal in electrical appliances and supplies.

THE CHICAGO PNEUMATIC TOOL COMPANY, Chicago, Ill., announces the election of Allan E. Goodhue as vice-president in charge of sales. Mr. Goodhue became associated with the company Jan. 1, 1919, and since May 1 of that year has been managing director of the Consolidated Pneumatic Tool Company, London, England, the English subsidiary of the company, and also director of European sales for the Chicago Pneumatic Tool Company. He was for a number of years connected with the sales department of the Midvale Steel Company and the Midvale Steel and Ordnance Company in Philadelphia, Chicago and Boston, leaving that company in March, 1918, to enter the service of the United States Government.

ALLAN E GOODHUE

THE MECHANICAL APPLIANCE COMPANY, 133 Stewart Street, Milwaukee, Wis., manufacturer of electric motors, electric controlling devices, etc., has increased its capital stock from $350,000 to $750,000. Extensions are contemplated to the main works of the company.

THE ENGBERG ELECTRICAL COMPANY, St. Joseph, Mich., has sold its plant and business to A. W. and E. C. Filstrup, who control the Covel Manufacturing Company, Benton Harbor, Mich.

THE EDISON ELECTRIC APPLIANCE COMPANY, 5660 West Taylor Street, Chicago, has awarded contract for a one-story boiler house, 63 ft. x 91 ft., to cost about $35,000.

THE ECONOMY FUSE & MANUFACTURING COMPANY, Chicago, announces the appointment of F. L. Easton as district sales manager of its Denver office, 205 Commonwealth Building, Denver, Col. Mr. Easton succeeds R. M. Olsen, who resigned recently. Mr. Easton formerly was connected with the Economy company, but more recently has been doing sales-promotion work for the Gates Rubber Company.

THE SERVICE CASTING COMPANY has recently been organized at Blanchester, Ohio, and will specialize in making small gray-iron castings for the trade. The foundry has been in operation since Feb. 1, 1920, doing contract work. The personnel consists of R. B. Huyett and Charles N. Secrist, both of wide experience in foundry and machine practice.

THE LAUNDRYETTE MANUFACTURING COMPANY, Cleveland, Ohio, has under construction a two-story-and-basement addition, 80 ft. x 140 ft. It is expected that this will enable production of its washing machines to be doubled.

THE ART LAMP MANUFACTURING COMPANY, 521 South Wabash Avenue, Chicago, has purchased a building at the corner of Throop and Fifteenth Streets, to be utilized for the manufacture of lamps.

THE UNITED STATES ELECTRIC MANUFACTURING CORPORATION, New York City, has removed its plant from 116 Duane Street to 476 Broadway.

THE RELIANCE LIGHTING FIXTURE CORPORATION, 117 [illegible] Street, New York City, has been organized to take over the property and holdings of the Reliance Electric Lamp & Supply Company. The company is considering moving into large quarters in the near future.

THE CHARLES R. ABLETT COMPANY, New York City, manufacturer of miniature and standard [illegible] has moved from 50 Church Street to 199 Fulton Street, where it will have much larger quarters, enabling the company to combine its office and warehouse under one roof.

THE RELIABLE ELECTRIC COMPANY, manufacturer of telephone and switchboard protection equipment, switches, auto fuses, etc., is now established in its new factory at 3133-45 Carroll Avenue, Chicago.

THE POWER PLANT SUPPLY COMPANY, 707 Canal Road, Cleveland, Ohio, has recently been organized to deal in power-plant equipment and [illegible] machinery. William E. Berrington is secretary and manager.

THE CALIFORNIA ENGINEERING COMPANY has opened offices at 131 Leidesdorff Street, San Francisco, Cal., for investigating and reporting on problems in civil, electrical, mechanical, hydraulic and marine engineering fields; also the organization, development and management of engineering projects. Paul B. McKee is president of the company and Paul R. Parker is vice-president and chief engineer.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., will soon award contract for the erection of an addition to its plant at Lynn, Mass., to cost about $100,000.

THE CENTRAL MANUFACTURING COMPANY, 2525 Montgomery Street, St. Louis, Mo., has recently been organized to take over the property and business of the St. Louis Washing Machine Company. The Central company is now established in its new factory. M. Cohn is president and treasurer.

GEORGE P. MILLS, formerly electrical sales engineer of the General Electric Company, Philadelphia, has joined the staff of the Electric Furnace Construction Company, Philadelphia, to take charge of and develop electrical industrial heating furnaces.

THE HAYS SCHOOL OF COMBUSTION, 1412-14 South Michigan Avenue, Chicago, has published a book entitled "Opportunities for the Combustion Expert," in which it gives consideration to the subject of preventable waste of fuel and the installation of mechanical apparatus to check the amount of fuel used.

WILLARD S. SISSON, secretary and treasurer of the D. & W. Fuse Company, severed his connection with the D. & W. on June 15. He will continue in the electrical business and will announce his plans in the near future.

Supply Jobbers' Notes

THE SIEGAL ELECTRICAL SUPPLY COMPANY, a [illegible] at [illegible] West Washington Street, Chicago, has opened a retail store at the same address. The wholesale and retail branches of the business will be conducted separately.

THE WESTERN ELECTRIC COMPANY, 195 Broadway, New York City, has taken over the distribution of the products of the King Manufacturing Company, St. Joseph, Mo., to replace the George Cutter Company's line of goods.

THE CENTRAL ELECTRIC SUPPLY COMPANY, 204 West Randolph Street, Chicago, has been organized by [illegible] Landerman, formerly of the Washington Light Company, Chicago, and Harry [illegible]don, formerly of the Peerless Light Company, New York and Chicago. The new company [illegible] electrical merchandise, including chandelier and fixture parts.

Foreign Trade Notes

SPANISH AND ITALIAN CAPITAL PURCHASES GERMAN POWER PLANT IN BUENOS AIRES. Announcement has been made recently in the Argentine press that Spanish and Italian capital has purchased the interests in Argentina of the Compañía Alemana Transatlántica de Electricidad, a German company supplying electric power to Buenos Aires.

THE SWISS ANNUAL SAMPLE FAIR. At the fourth annual Swiss sample fair, held in Basle during April, the majority of the electrical apparatus stands displayed articles for household use, especially cooking and heating devices. The coal crisis has led Swiss electrical equipment firms to develop a large number of new devices for the utilization of electricity.

THE WORTHINGTON PUMP CORPORATION is planning to make extensive additions to its plant in Berlin, Germany, to meet the increase in business expected as soon as conditions become settled in that country. The company, it is understood, has orders on hand for a year in advance, all sold in Germany.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A construction engineer in Denmark (No. 33,071) desires to purchase electric light bulbs, etc.

A merchant firm in England (No. 33,077) desires to secure agencies for the sale of electrical goods, etc.

A general merchandising company in India (No. 33,085) desires to secure an agency and purchase on its own account electrical goods, etc.

An agency is desired by an import association in Italy (No. 33,026) for the sale of electric lighting and industrial supplies, etc.

A firm of merchants in India (No. 33,035) desires to secure an agency for the sale of electrical goods, etc.

An inquirer in Peru (No. 33,062) wishes to secure prices on an electric motor to operate a machine for grinding clay, having a capacity of from 6 to 7 tons per day.

Trade Publications

THERMOELECTRIC POWER.—Bulletin No. 12, entitled "The Thermoelectric Power of Thermocouples," has been issued by the Pyroelectric Instrument Company, 636 East State Street, Trenton, N. J.

MOTORS FOR CRANE AND HOIST SERVICE.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 48119.1, describing its alternating-current motors for crane and hoist service.

SMALL ELECTRIC MOTORS.—Bulletin No. 57, issued by the Persons Electric Company, Quincy, Ill., describes its type G-I alternating-current motors and type G-D direct-current motors.

WATT-HOUR METERS.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued a miniature catalog in which it describes and illustrates its different types of watt-hour meters.

EXPANSION JOINTS.—The Griscom-Russell Company, 90 West Street, New York City, is circulating bulletin No. 1010, describing its G-R expansion joint for use on low-pressure steam lines.

FURNACE TEMPERATURES. — The Bureau of Standards, Department of Commerce, Washington, D. C., is distributing a copy of Technologic Paper No. 159, entitled "Porosity and Volume Changes of Clay Fire Brick at Furnace Temperatures."

FLEXIBLE SHAFTING.—Bulletin No. 3, entitled "Coates Flexishaft," published by the Coates Clipper Manufacturing Company, Worcester, Mass., describes flexible shafting for portable motor-driven tools.

New Incorporations

THE CONEMAUGH (PA.) POWER COMPANY has been chartered with a capital stock of $5,000 to operate an electric light and power plant in Conemaugh. L. B Saylor, Johnstown, is treasurer.

THE HUSTONVILLE (KY.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $12,000 by J. W. Hoskins, W. J. Childress and A. J. Adams.

THE OKLAHOMA ELECTRIC COMPANY, Muskogee, Okla., has been chartered with a capital stock of $10,000 by J. V. Chappel, L. O. and L. F. Hunt.

THE SUBURBAN LIGHT & POWER COMPANY, Cleveland, Ohio, has been incorporated with a capital stock of $5,000 by A. C. Pratt and others.

THE McARTHUR (OHIO) LIGHT & POWER COMPANY has been incorporated with a capital stock of $10,000 by L. W. Sprague, O. F. Pilcher, A. Will, Jr., and O. E. Vollenweider.

THE TRAVELLER'S REST (KY.) ELECTRIC LIGHT & POWER COMPANY has been incorporated with a capital stock of $3,000. The officers are H. Y. Thackston, president, and George W. Johnson, secretary and treasurer.

THE LARWILL (IND.) LIGHT & POWER COMPANY has been incorporated by George W. Stirling, Edward F. Rush and S. S. Trachsel. The company is capitalized at $15,000 and proposes to generate and distribute electricity for lamps, heaters and motors.

THE HELMS-DAM COMPANY, Fortville, Ind., has been chartered with a capital stock of $25,000 to maintain and operate water power to generate and distribute electricity. The directors are: George McCarty, Emerson Getner and William E. Morse.

THE ARIZONA ELECTRIC POWER COMPANY, Winslow, Ariz., has been incorporated with a capital stock of $200,000 to generate and distribute electricity for lamps, heaters and motors, to construct and operate telephone systems, etc. The incorporators are W. C. Quebedeaux, O. J. Faulkner and E. A. Sawyer, all of Winslow.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BOSTON, MASS.—The Edison Electric Illuminating Company, 70 State Street, is having plans prepared for the erection of a substation on Broadway.

BOSTON, MASS.—The installation of arc lights on Saratoga Street, between Breed Square and Wadsworth Street, East Boston, is under consideration.

BRISTOL, CONN.—The installation of a "white way" street-lighting system is under consideration.

NEW LONDON, CONN.—Work will soon be started by the American Bridge Company to install two electrical units in place of the steam power now used to operate the Thames River highway bridge. The cost is estimated at about $500,000.

WALLINGFORD, CONN.—Improvements and extensions are contemplated by the International Silver Company, State Street, Meriden, to its power house at the Wallingford plant, to cost about $25,000.

Middle Atlantic States

NEW YORK, N. Y.—S. W. Straus & Company are having plans prepared by Warren & Wetmore, architects and engineers, 10 East Forty-seventh Street, for the erection of a bank, office and store building on Fifth Avenue and Forty-seventh Street, to cost about $4,000,000.

YONKERS, N. Y.—The Yonkers Electric Light & Power Company is having plans prepared by William Whitehill, architect and engineer, 55 Duane Street, New York, for the erection of a substation, to cost about $150,000.

NEWARK, N. J.—M. Straus & Sons, 508 Frelinghuysen Avenue, have had plans prepared for the construction of a new power house to be used in connection with their leather works. The cost is estimated at about $30,000.

NEWARK, N. J.—Bids have been received by the Board of Education for the new Seymour Vocational School, to cost about $1,125,000, exclusive of equipment. Plans include a complete machine shop, electrical plant, etc.

NEWARK, N. J. — The erection of a power house, to cost about $20,000, at the Soho Hospital is under consideration.

PERTH AMBOY, N. J.—In connection with the operation of a new dry dock at its plant, the Perth Amboy Dry Dock Company, foot of Broad Street, contemplates the installation of electrically operated pumping machinery, valves, a yard floodlighting system, etc.

TRENTON, N. J.—Bids will soon be received by the City Commission of Trenton for the installation of a new 25,000,000-gal. pump and a new 1,000-hp. steam turbine-driven generator for the municipal waterworks.

BLAIRSDALE, PA.—Bids have been received by the Western State Hospital for the Insane, at Torrance, for the first unit of construction work on a farm colony, to cost about $150,000. Plans include the erection of administration and ward buildings, power house, etc. F. M. Crooks, Jones Law Building, Pittsburgh, Pa., is architect.

FORD CITY, PA.—Bids will be received by the clerk of the Council until June 29 for the erection of an addition to the power house. Douglas & McKnight, Columbia Bank Building, Pittsburgh, Pa., are engineers.

HARRISBURG, PA.—An ordinance providing for ten arc and sixty-five incandescent lights has been passed by the City Council.

PHILADELPHIA, PA.—Plans are being prepared by Hoffman & Henon, architects, Finance Building, for the erection of a theater and office building, to cost about $1,000,000, for the Stanley Company of America, 1214 Market Street.

YORK HAVEN, PA.—The installation of new electric machinery and other equipment at its plant is contemplated by the York Haven Paper Company.

BALTIMORE, MD. — The Consolidated Gas, Electric Light & Power Company, Lexington Building, it is understood, is planning the erection of an addition to its substation in the vicinity of Graves and Constitution Streets.

HAMPTON ROADS, VA.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., contemplates the installation of an electric underground distribution system on Block Z (Specification 4240), to cost about $38,000.

SCHOOLFIELD, VA.—A fire station is being erected by the J. A. Jones Construction Company of Charlotte, N. C., for the Dan River & Riverside Cotton Mills. Equipment to include central switchboard, battery stand and a fire-alarm system will be required.

North Central States

BAY CITY, MICH.—The Wildman Rubber Company, 816 Book Building, Detroit, contemplates the erection of the first unit of a new tire plant along the Saginaw River, to cost about $1,000,000. Plans include power house as a separate unit. The total cost of the plant is estimated at about $10,000,000.

DETROIT, MICH.—Contract will soon be awarded by Hugo Scherer, care of Louis Kamper, architect, 749 Book Building, for the erection of an office and loft building, to cost about $1,000,000. Electric lighting equipment and electric elevators will be installed.

IRONWOOD, MICH.—Bids will be received by the Board of Water Commissioners, at the office of the Ironwood Waterworks, until June 28, for centrifugal pumping equipment, six units, motor and gasoline-engine driven, to be used in connection with the erection of new waterworks.

MARQUETTE, MICH.—A new radio station will be erected on the government land between the Coast Guard station and the lighthouse point.

AKRON, OHIO.—The City Council is considering an issue of bonds to the amount of $1,000,000 for the purpose of erecting and maintaining a municipal power plant.

CANTON, OHIO. — Stockholders of the United Electric Company will vote on the question of issuing $1,000,000 preferred stock and 30,000 shares common stock, the proceeds to be used to make further improvements to the plant.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases, Room 219, City Hall, until July 2, for furnishing and installing complete in place three motor-driven vertical centrifugal pumps with motors, electrical equipment, etc. A deposit of $5 is required for plans and specifications, which may be obtained at the office of the commissioner of engineering, Room 618, City Hall.

EAST LIVERPOOL, OHIO. — Work is under way on the construction of a new $60,000 substation for the Buckeye Power Company at Second and Washington Streets. Frank Howard, Wheeling, W. Va., general superintendent of construction, is in charge.

MANSFIELD, OHIO.—Contract has been awarded to the McClintic Marshall Company, Oliver Building, Pittsburgh, Pa., by the Ideal Electric Manufacturing Company, for the erection of an office building and a factory at Mansfield, to cost about $350,000.

ECHOLS, KY.—The Louisville Gas & Electric Company plans to rebuild its power plant and coal tipple, recently destroyed by fire.

BLUE RIVER, WIS.—The Byrds Creek Electric Light & Power Company contemplates the erection of an electric transmission line from Blue River to Eagle Corners.

HILBERT, WIS.—The municipal electric light plant, it is reported, has been recently destroyed by fire.

ALGONA, IOWA.—Petition has been made to the State Public Utility Commission by the Cresco Light & Power Company for permission to erect and maintain poles, wires, electric transmission lines to serve territory adjoining Algona.

BISMARCK, N. D.—Bids will be received by the Board of City Commissioners until July 12 for the complete construction of a waterworks system. Equipment includes motor-driven centrifugal pumps, etc. A deposit of $25 is required for plans and specifications, which may be obtained from T. R. Atkinson, consulting engineer, Bismarck, N. D.

HAVEN, KAN.—New bids will be received by M. Barrachmen, clerk, until July 1, for the erection of an electric transmission line from Haven to Burton.

MOUNT HOPE, KAN.—Bids will be received by George H. Troop, city clerk, Burton, until July 1 for the erection of an electric transmission line from Mount Hope to Burton. Former bids have been rejected.

NORTON, KAN.—Contract will soon be awarded by the State Tuberculosis Hospital for the erection of a commissary building, addition to power house, etc. Plans include the installation of engine and generator, switchboard, electric cable, storage battery and electric wiring in the commissary building. The cost is estimated at about $30,000. J. A. Kimble is state manager.

Southern States

BAMBERG, S. C.—An election will be held on July 15, for the purpose of submitting to the voters an issue of $15,000 in bonds to repair and enlarge the municipal electric light plant.

COLUMBIA, S. C.—The Columbia Railway, Gas & Electric Company contemplates the erection of an addition to its local power plant, to cost about $400,000, including equipment.

ENOREE, S. C.—An electric power system to include an individual motor drive and two generators will be installed at the Enoree Mills.

GREENVILLE, S. C.—The Campedown Mills contemplate the installation of an electric power system, including individual motor drive for looms and spindles. J. E. Sirrine is engineer.

COLUMBUS, GA.—The installation of an additional unit at the Goat Rock power plant of the Columbus Power Company is being made, at a cost of about $500,000, to include the erection of a transmission line to North Highlands.

CENTERVILLE, TENN.—The erection of a municipal electric light plant to cost about $5,000 is under consideration by the city officials.

CHATTANOOGA, TENN. — The Brock Candy Company contemplates additions, to include the erection of a new power house, installation of boilers rated at 300 hp., air compressors, etc.

NASHVILLE, TENN.—Bids will be received at the office of J. W. Dashiell, secretary of the Board of Commissioners, City Hall, until June 30, for the designing, construction and erection of a 20,000,000-gal. turbine-driven centrifugal or steam-actuated equivalent condensing high-service pumping engine and two 20,000,000 gal. low-service centrifugal pumps, to be engine-driven or otherwise. Specifications may be obtained at the office of Commissioner of Waterworks, City Hall.

BIRMINGHAM, ALA.—Plans are under consideration by the Alabama Power Company for additional hydro-electric power development to include two power plants, one on the Tallapoosa River and the other on Little River near Blanche.

MONROE, LA.—Plans for the erection of a municipal electric light plant and waterworks include the installation of one 1,000-kw. and one 600-kw. turbo-generator, electrically driven pumps, etc., to cost about $225,000. The Foundation Company, 223 Broadway, New York, N. Y., are general contractors.

OPELOUSAS, LA.—Bonds to the amount of $250,000 have been voted for improvements and extensions to the electric light, water and sewer systems.

BRONCO, TEX.—The Lovington Public Utilities Company of Lovington, N. M., contemplates the construction of a local electric light and power plant.

McKINNEY, TEX.—The central generating plant of the Texas Power & Light Company, near McKinney, was damaged to the extent of $10,000 due to a gas explosion.

Pacific and Mountain States

ANACORTES, WASH. — The Empire Power Company has been recently incorporated for the purpose of developing water power at two locations, one on the Skagit River just below the Seattle power site and the other on the Cascade River, 2 miles from Marblemount. The projects are capable of developing 30,000 hp. H. A. Hull is president.

BURNS, ORE.—Louis C. Kelsey, consulting engineer of Portland and Nampa, Idaho, has been retained by the city officials to prepare plans and supervise the construction of the proposed municipal electric lighting plant.

KLAMATH FALLS, ORE.—The California-Oregon Power Company is considering the formation of a new company to take over the holdings of the corporation, financing the deal by an issue of $10,000,000 in bonds, of which $1,842,000 would be sold at once and proceeds used for improvements.

AVALON, CAL. — Application has been made by the Pacific Telephone & Telegraph Company for a franchise to operate a local telephone exchange.

BERKELEY, CAL.—Bids will be received by the Board of Education, 2133 Allston Way, until June 29, for furnishing and installing deep-well pumping head, motor, electric power connections, etc., at each of three schools.

LOS ANGELES, CAL.—The Gore Brothers plan the construction of a theater on Hollywood Boulevard, to cost about $500,000. A. B. Rosenthal, Douglas Building, is architect. The same parties contemplate the erection of a similar building at 550 South Main Street, to cost about $2,000,000.

LOS ANGELES, CAL.—Plans are under way for the installation of an ornamental street-lighting system in the Los Cerritos district, to cost about $35 000.

LOS ANGELES, CAL.—Authority has been granted to the Southern California Edison Company to issue $5,000,000 in bonds to carry on development work. The company estimates that over $8,000,000 will be necessary to defray expenses for the construction of hydro-electric plants, transmission and distribution lines up to 1921, as follows: To complete Kern River plant No. 3, northwest of Bakersfield, $1,985,000; to construct third unit in Big Creek, complete Shaver tunnel and reservoir, and Pittman tunnel, all east of Fresno, $2,108,000; to complete substation at Richgrove, $814,000; to complete transmission line from Kern River No. 3 to Richgrove, $513,000; to complete work at Eagle Rock, increasing capacity of susbtation, $312,000; installation of steam turbine at Long Beach station, $120,000; construction of general transmission and distribution system, $2,535,000.

McFARLAND, CAL.—A committee has been appointed to establish a community power plant. George Carter and Carl Mechler have urged this movement.

PASADENA, CAL.—A proposition will be submitted to the voters on July 1, to issue bonds to the amount of $500,000 to purchase the local plant of the Southern California Edison Company.

PASADENA, CAL.—A proposal to construct a new electric railroad to Los Angeles by private parties, and later be taken over by the city, has been suggested to the City Commission by Horrace M. Dobbins.

PORT COSTA, CAL.—The installation of a new electrically operated tramway system is under consideration by the Port Costa Brick Works.

REDDING, CAL.—The Pacific Gas & Electric Company contemplates the erection of a 230,000-volt transmission line from its Pitt River plant in Shasta County to San Francisco.

SAN BERNARDINO, CAL.—Plans are being prepared for the installation of a direct-connected horizontal pump and motor to be used in connection with proposed reservoir for boosting water from city wells to the mains.

SAN PEDRO, CAL.—The first unit of construction work for the Fabri-Cord Tire Company, 917 Citizens' National Bank Building, Los Angeles, is the erection of a tire factory, to cost about $280,000, including equipment. The total cost of the construction work is estimated at about $2,000,000.

BRIGHAM CITY, UTAH.—A special election will be held soon for the purpose of submitting to the voters a proposition to issue $120,000 in bonds, to be used for rebuilding the municipal electric plant to develop a maximum of 1,500 hp. electrical energy.

Canada

VANCOUVER, B. C.—Permit has been taken out by the Dominion Canners, Ltd., for the construction of a power station, to cost about $13,500.

FREDERICTON, N. B. — Kenneth Rea, architect of Montreal, Que., has recommended an addition to the Victoria Hospital, including the installation of a power plant.

PETERBORO, ONT.—The erection of a new power transmission station is contemplated by the Peterboro Utilities Commission.

TORONTO, ONT.—The Muskoka Quarries of Toronto, recently incorporated, contemplates the erection of a plant near Bracebridge and the installation of electrically driven equipment. W. E. [illegible], [illegible] Macpherson Avenue, Toronto, is president and general manager.

WOODSTOCK, ONT.—In connection with the construction of a substation on Ingersoll Avenue for the Water and Light Commission, to cost about $35,000, electrical equipment including switchboard apparatus, transformers, etc., will be required.

SHAWINIGAN FALLS, QUE.—Contract has been awarded to William I. Bishop, 822 New Birks Building, Montreal, by the Belgo-Canadian Pulp & Paper Company for the construction of a transformer house.

VERDUN, QUE.—Bids will be received until [illegible] electric plant, to cost about $38,000. A. Gyshon of Verdun is engineer.

WESTMOUNT, QUE.—J. A. Jarman, city engineer, will soon receive bids for the installation of fire and police signal systems, to cost about $10,000.

(Issued May 25, 1920)

1,341,[illegible]. TELEPHONE-EXCHANGE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed July 11, 1919. Improvements in testing circuit.

1,341,486. PROTECTIVE SYSTEM; Oliver C. Traver, Schenectady, N. Y. App. filed Oct. 17, 1919. For electric feeders of pilot-wire type.

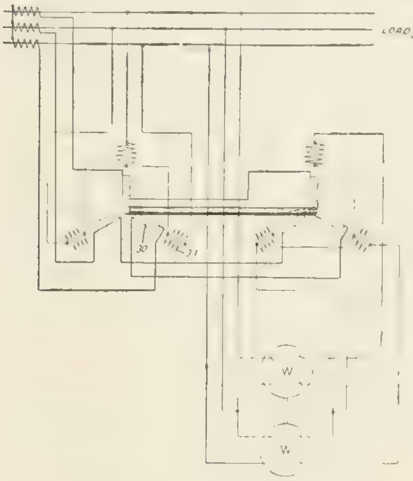
1,341,488. PROTECTIVE DEVICE; Edmund B. Wedmore, Hendon, Eng. App. filed Oct. 24, 1919. For feeders or plants of large magnitude.

1,341,492. ELECTRIC MACHINE; Pierre Bosson, Paris, France. App. filed Jan 23, 1915. For lighting railway cars.

1,341,516. CHLORINE CELL; Thomas A. Patterson, Niagara Falls, N. Y. App filed Feb. 17, 1920. To deliver pure chlorine.

1,341,558. MEANS TO BE EMPLOYED IN THE ELECTRIC WELDING OF IRON OR STEEL OR ALLOYS THEREOF; Augustus C. Hyde, Pervale, Eng. App. filed Nov. 25, 1919. Use of flux.

1,341,559. TRAINMAN'S KIT; George B. Jackson, Philadelphia, Pa. App. filed Aug. 19, 1919. Has electric lamp and colored lenses.



1,342,082 Volt-Ampere Meter

1,341,619. EXTERNAL IGNITION DEVICE FOR INTERNAL-COMBUSTION ENGINES; Herman Schlaich, Brooklyn, N. Y. App. filed Feb. 19, 1919. For lighting cigar, torch, etc.

1,341,626. PROCESS AND MACHINE FOR MAKING CERTAIN ARTICLES OF MANUFACTURE; Frank P. Kobert, Amityville, N. Y. App. filed Nov. 18, 1916. Heading, upsetting and forging machines with electric heater.

(Issued June 1, 1920)

1,341,629. ELECTRICAL RELAY; Harold W. Brown, Ithaca, N. Y. App. filed Jan. 7, 1914. Inverse-time overload trip.

1,341,647. ELECTRODE FOR SOLDERING AND DEPOSITING METALS BY THE ELECTRIC ARC; Ernest H. Jones, Islington, London, England. App. filed Aug. 16, 1919. Asbestos yarn wrapping securely attached.

1,341,650. MOTOR-CONTROL SYSTEM; Reese T. Kintzing, Wilkinsburg, Pa. App. filed Nov. 18, 1916. Prevents motor damage.

1,341,657. CONTROL SYSTEM; Frederick H. Miller, Wilkinsburg, Pa. App. filed March 2, 1917. For electric railway cars.

1,341,658. STARTER FOR INTERNAL-COMBUSTION ENGINES; John R. Millward, Newark, N. J. App. filed Nov. 19, 1913. Circuits interlock with gears.

1,341,659. ELECTRIC STARTER FOR INTERNAL-COMBUSTION ENGINES; John R. Millward, Newark, N. J. App. filed Nov. 19, 1913. Automatic coupling.

1,341,660. ELECTRIC STARTER FOR INTERNAL-COMBUSTION ENGINES; John R. Millward, Newark, N. J. App. filed Nov. 19, 1913. Automatic coupling.

1,341,677. CONTROL SYSTEM; Lynn G. Riley, Wilkinsburg, Pa. App. filed Oct. 30, 1916. For vehicles.

1,341,713. BATTERY PLATE; Otto P. Hoffman, Chicago, Ill. App. filed May 24, 1919. New design of strengthening ribs.

1,341,719. KEY SWITCH; Byron L. Moore, Buffalo, N. Y. App. filed Aug. 24, 1918. For telephone and radio.

Record of Electrical Patents

Notes on United States Patent

1,341,786. PROCESS OF RECOVERING COPPER FROM ITS ORES; Charles J. A. Dalziel, London, England. App. filed Sept. 24, 1918. Single continuous operation without filtration.

1,341,790. ELECTROCHEMICAL ANALYTICAL CONTROL; Philip E. Edelman, Minneapolis, Minn. App. filed Aug. 19, 1912. For unskilled operators.

1,341,801. GRADED-SERVICE ELECTROMECHANICAL TELEPHONE-EXCHANGE SYSTEM; Georg Heimann, Charlottenburg, Berlin, Germany. App. filed Aug. 28, 1913. Zone system.

1,341,808. METAL-WORKING MACHINE; Otto H. de Lapotterie, New Brighton, Pa. App. filed April 20, 1918. Electrical heating while upsetting, forging, etc.

1,341,810. TELEGRAPH KEY; William P. Liles, Marlow, Tenn. App. filed July 13, 1915. "Dead-man's" release.

1,341,855. ATTACHMENT FOR TELEPHONES; Sidney M. Knopf, New York, N. Y. App. filed May 2, 1918. Holds receiver.

1,341,878. TROLLEY-GUIDE BOX AND SHIELD; George W. Bolden, Philadelphia, Pa. App. filed Jan. 31, 1918. Box on trolley prevents leaving wire.

1,341,903. OVEN OR FURNACE; George M. Hollenback, Los Angeles, Cal. App. filed Feb. 7, 1920. For dental casting.

1,341,937. MOTOR CONTROLLER; Wilmer M. Shallcross, Milwaukee, Wis. App. filed March 21, 1914. Series-parallel drum controller.

1,341,939. PROCESS FOR PRODUCTION OF LOW-CARBON FERROCHROME; Hugh C. Sicard, Buffalo, N. Y. App. filed Sept. 26, 1919. Decarbonization of high-carbon ferro-chromium alloy by titanic oxide.

1,341,958. ELECTRIC SPEEDOMETER; Stover C. Winger and Adolph Rickenbacher, Los Angeles, Cal. App. filed Aug. 26, 1919. For indicating speed and mileage.

1,341,966. INCANDESCENT ELECTRIC LAMP; Shigezo Yuyama, New York, N. Y. App. filed Nov. 30, 1918. Increased vertical illumination.

1,341,994. CABINET; Olaf A. Nelson, San Francisco, Cal. App. filed March 13, 1919. Electric cooker heats when drawer is open.

1,341,997. TELEPHONE TRANSMITTER; Stephen C. Porter, Brooklyn, N. Y. App. filed April 22, 1918. Small, portable transmitter.

1,341,998. TELEGRAPH SYSTEM; Paul M. Rainey, West Hoboken, N. Y. App. filed Aug. 6, 1917. For printing system.

1,342,001. DRY CELL; Walter B. Schulte, Madison, Wis. App. filed Aug. 26, 1918. Improved terminals.

1,342,034. TROLLEY HANGER; Richard T. Todhunder, Barnesboro, Pa. App. filed March 6, 1919. Jaws tightened with conical screw.

1,342,049. SIGNAL DEVICE FOR AUTOMOBILES; Joseph Klipper, West New York, N. J. App. filed Feb. 20, 1919. Direction signal.

1,342,053. BUSHING-FORMING MACHINE; Oscar W. McKnight, Columbus, Ohio. App. filed Feb. 6, 1919. Makes porcelain bushings and tubes.

1,342,061. SWITCH AND CONTACT MECHANISM FOR ELECTRIC CURRENT-REGULATING PLUGS AND SOCKETS; Antonio Papini, Philadelphia, Pa. App. filed March 29, 1920. Key-switch mechanism.

1,342,068. ELECTRIC BATTERY; Otto E. Ruhoff, Madison, Wis. App. filed April 28, 1919. Material becomes active as it is consumed.

1,342,081. VOLT-AMPERE METER; Donald J. Angus, Indianapolis, Ind. App. filed Aug. 25, 1919. True measurement regardless of power factor.

1,342,082. VOLT-AMPERE METER; Donald J. Angus, Indianapolis, Ind. App. filed Aug. 25, 1919. True measurement regardless of power factor.

1,342,084. COMPOSITION OF MATTER AND METHOD FOR PRODUCING THE SAME; Louis E. Barton, Niagara Falls, N. Y. App. filed Sept. 4, 1919. For zirconium oxide concentrates.

1,342,111. LIGHTNING ARRESTER; Charles W. Howe, Healdton, Okla. App. filed Sept. 19, 1918. For protecting oil tanks.

1,342,179. COOLING ARRANGEMENT FOR DYNAMO-ELECTRIC MACHINES; Paul A. H. Mossay and Henry C. E. Jacoby, London, England. App. filed April 19, 1918. Air channels in yoke.

1,342,199. IMPULSE STARTER; Frederick W. Andrew, Brooklyn, N. Y. App. filed Nov. 18, 1918. For engine magneto.

1,342,209. ELECTRICAL COIL; Thomas P. Giblin, Pawtucket, R. I. App. filed Nov. 12, 1919. Inductance coils for tuning circuits.

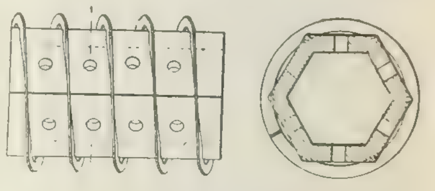
1,342,219. SAFETY SWITCH MECHANISM; Hubert F. Krantz, Brooklyn, N. Y. App. filed June 6, 1918. Prevents opening main switch when branch switch is "on."

1,342,241. SEMI-AUTOMATIC TELEPHONE SYSTEM; John Wicks, Chicago, Ill. App. filed March 21, 1918. Busy line automatically connected when it becomes idle.

1,342,242. TELEPHONE-EXCHANGE TRUNKING SYSTEM; Bernard D. Willis, Chicago, Ill. App. filed June 10, 1909. Connecting manual to automatic exchange.

1,342,250. TRANSFORMER; Vannevar Bush, Medford, Mass. App. filed May 5, 1917. Variable radio-transformer.

1,342,257. ELECTROMAGNETIC-WAVE NAVIGATIONAL SYSTEM; James Erskine-Murray and James Robinson, Biggin Hill, England. App. filed Dec. 16, 1919. Determines direction of radio waves.



1,342,310. Insulated Support for Electrical Conductors

1,342,260. TOLL TELEPHONE SWITCHING APPARATUS; Herbert M. Friendly and Archibald E. Burns, Portland, Ore. App. filed June 15, 1915. Remote control of switching.

1,342,303. INSULATED SUPPORT FOR INDUCTANCE COILS; Louis Steinberger and Guy Hill, Brooklyn, N. Y. App. filed Aug. 9, 1917. Allows free air circulation.

1,342,305. INSULATED SUPPORT FOR ELECTRICAL CONDUCTORS; Louis Steinberger and Guy Hill, Brooklyn, N. Y. App. filed Nov. 15, 1917. For radio coils.

1,342,306. INSULATED SUPPORT FOR ELECTRICAL CONDUCTORS; Louis Steinberger and Guy Hill, Brooklyn, N. Y. App. filed Jan. 17, 1918. For radio coils.

1,342,307. INSULATED SUPPORT FOR ELECTRICAL CONDUCTORS; Louis Steinberger and Guy Hill, Brooklyn, N. Y. App. filed May 18, 1918. For radio coils.

1,342,308. INSULATED SUPPORT FOR INDUCTANCE COILS; Louis Steinberger and Guy Hill, Brooklyn, N. Y. App. filed Aug. 9, 1917. For radio coils.

1,342,309. INSULATED SUPPORT FOR ELECTRICAL CONDUCTORS; Louis Steinberger and Guy Hill, Brooklyn, N. Y. App. filed Nov. 15, 1917. For radio coils.

1,342,310. INSULATED SUPPORT FOR ELECTRICAL CONDUCTORS; Louis Steinberger, Brooklyn, N. Y. App. filed Feb. 1, 1919. For radio coils.

1,342,311. INSULATED SUPPORT FOR ELECTRICAL CONDUCTORS; Louis Steinberger, Brooklyn, N. Y. App. filed Feb. 1, 1919. For radio coils.

1,342,312. INSULATED SUPPORT FOR ELECTRICAL CONDUCTORS; Louis Steinberger, Brooklyn, N. Y. App. filed Sept. 24, 1919. For radio coils.

1,342,322. FLASHLIGHT; Frank D. Boulanger, West Hoboken, N. J. App. filed Oct. 14, 1919. Opens at side.

1,342,336. ELECTROLYTIC CELL; Paul McDorman, Niagara Falls, N. Y. App. filed June 19, 1919. Gas-tight container.

1,342,394. STREET INDICATOR; S. Denver Roberson, St. Louis, Mo. App. filed Aug. 26, 1919. Notifies occupants of car name of street.

DETAILS OF TRANSMISSION SYSTEMS OF NORTH AME

Compiled by ELECTRICAL WORLD

Name of Company	Transmission Voltage Kv	Frequency Cycles	Rating of Stations kw		Date of Starting Operation	Hydro or Steam	TURBINES					GENERATORS				STEP-UP TRANSFORMERS							STEP-DOWN TRANSFORMERS							Terminal	Conditions That Determine Design as Wind Velocity, Altitude and Temp Range, Fog, Sleet, Lightning, etc	Total Length H T Single Circuit Miles at Each Voltage	Steel Towers and Wood Poles		Tower Height, Ft to lowest conductor	Total Charging Current per Wire	
			Present	Ultimate			H P	Head Ft.	R. P. M	Type	Manufacturer	Kva	Voltage	Manufacturer	Neutral Ground or No	Kva.	Phases	Connection Low Tension	Connection High Tension	Y Grounded Direct or with Resistance	Total Kva Connected to Lines	Manufacturer	Line Voltage Low Tension	Line Voltage High Tension	Connection Low Tension	Connection High Tension	Y Grounded Direct or with Resistance (Ohms)	Substations Indoor or Outdoor	Substations Rating, Kva				Crossarms, Steel or Wood	Pins—Steel or Wood—Grounded			Normal, Feet
Great Western Power Co	100 165	60 60	65 000 44 000	500,000	1908	H S	18 500 17,000	465	400 1800	Francis Parsons	I P Morris Westingh	4-10,000 3-12,500	11,000 11,000	G E. G. E & Westingh	No Yes Steam Stations	10,000 7,500	3 1	D D	D Y	No Direct	70,000 45,000	G. E. G. E.	11,000 22,000 55,000	165,000 100,000 100,000	D D D	Y D D	Direct No No	I D O.D. I D.	60,000 37,500 15,000	Big Bend-Oakland	Lightning, 100 kv 60-mi wind, 1,500 ft. el. 165 kv., 60-mi wind, ½ in sleet, 3,000 ft		Steel Steel	Steel Steel	46 45	83 amp at 165 kv 50 amp at 100 kv	750 750
Southern California Edison Co (See also 66-kv lines)	150	50	80,000 30,000	750,000	1913	H	5-22,500 2-22,500	2,123 and 1,850 800	375 600	Impulse Francis	A.C Pelton Pelton	7-17,500	6,600 10,000 and 11,000 (60 cy.)	G E and Westingh	Yes	5,833	1	D	Y	Direct	87,500 35,000 (thru 40 m. 66 kv line)	G E. Westingh.	60,000 15,000	150,000	Y D	D		I. D. I. D. Switch O.D.	96,000 34,500 15,000 (freq change)	Big Creek-Eagle Rock (at Los Angeles)	22.5 lbs wind Sleet	480-150 kv	S T	Susp	37	90	650
Aluminum Co. of America	155	60	60,000	80,000	1919	H	3 27,000	190	[illegible]	Vertical	A. C.	3-20,000	13,200	A C	Gr	9-7,000	1	D	Y	Unit	63,000	West.	13 000	50,000	D	Y	No	O.D.	42,000	Tapoco, N. C.-Maryville, Tenn ..	Wind and sleet 2,500 ft. alt 0 to 120° F	25 mi	S T steel	Steel	37		500 D C 1 250 S C.
Consumers Power Co (Incomplete)	140 11 72	60	31,000	134,000	1906	H	14,400 7,000 4,150 3,500	40 38 40 35	[illegible]	Horizontal	Leffel Leffel A C A C.	3,000 1,500 2,200 3,300	66,00 66,00 25,00 25,00	Westingh Westingh G E G E.		3-1200 3-3750 6-3000	1	D	D	No	33,800	West West G. F G. E.	19,000 6,600 22,000	66,000 140,000	D D D	D D D	No	I D	152,000	Au Sable, Battle Creek, Grand Rapids, Muskegon	Wind and sleet	1,300	S T W	Steel	40 to 160		528 S 132N
The Ohio Power Co Eastern Div (See also 66-kv lines)	132 66	60	120,000 10 600	180,000 10,000	1918 1913	S	130,000 kva				G E.	4-30,000 1- 5,000 2- 2,500	11,000 2,300 4,000	G E	Gr	60,000 31,250	1	D	Y	Gr Direct	139,500	G E and Westingh.	22,000 23 4000	132,000 66,000	D Y	D D	Y gr direct	O.D. I D.	121,000 9,000	Windsor, Washington, Wheeling Canton, etc	60-mile wind 800 to 2,000 ft alt 0° to 100° F.	55 at 132 kv 180 at 66 kv.	S T W P	14-in. steel	48 35		[illegible] 700- 200- 250
West Penn Power Co	132	60	120,000	180,000	1917	S	4 30,000	250 lb	[illegible]		G. E.	4 30,000	11,000	G E	No	3 10,000	1	D	Y	Gr Direct	30,000	Westingh	22,000	132,000	Y	D	Gr. 56 ohms	O.D.	30,000	Windsor-Washington	8-lb. wind ½ in. sleet, 0° F.	26 5	S T	Susp	41'6	51 amp at [illegible] kv	500
Utah Power & Light Co	130 44	60	45 - Total 143,000			74 H 16-S							2,300 4,000 6,600	A C. G. E. Westingh	Generally Gr. Direct	Totals 40,000 38,675	1 1 Most	D D	D Y	See Step-down Transf	74,000 Approx	Various	44,000 2,300	130,000 44,000	D & Y	D & Y	1 gr on 100 kv 1 gr on 44 kv	O.D Both	70,000 86,190	Salt Lake, Grace, Idaho Falls, Bingham, Provo Helper	65-mi wind ½ in ice at 32° F. 4,000-7,000 ft. alt.	400-130 kv 1,460-44 kv	S.T. and W P.	Susp W P	45		550 S. T. 500 W. P.
Tennessee Power Co	120	60	H 15,000 H 18 750 H 42,000 H 9 750 4S 36,000		1913 1912 1913 1916	H H H H	20,000 25,000 56,400 12,000	255 110 34 110	[illegible]		I. P. Morris S. M. Smith S. M. Smith Allis-Chalmers	2 7,500 5-3,750 10-3,133 1 9,750	6,600 2,300 6,600 6,600	G E. Westingh G E A. C.	Yes No Yes	3,133 to 12,000	Mostly 3	D D D D	D Y Y D D	Y Ground		G. E. and Westingh	2,300 6,600 11,400 13,200	120,000 66,000	Y & D D			Both Both	25 substa 113,500	Nashville, Cleveland, Knoxville, Hales Bar, Maryville, McPherson, etc	..	252-120 kv 266 66 kv	120 kv S.T. 66 kv W P	Susp	App		400-700 W P 175
Wisconsin Minnesota Light & Power Co	120 60	60 60	53,500			4-H 21-S		57 52 21				6-6,600 and smaller Units	13,200	A C.		6-7,500 15-1,000 30 Others	1	D	D			G E and Others								Wissota-Stillwater, Lacrosse, Red Wing and Wabasha	60-mile wind sleet lightning —20° to 100° F	76 115 99	S T. W P S T.		38 35 35		600 250 400
Alabama Power Co	110 44	60	67,500 58 333 12 500 2 000	80,000 58,333 12,500 2,000	1913 1917 1914 1914	H S S S H	17,500 25,000 kva 33,333 kva 6,250 kva 1,500		[illegible]	Runner	I P.M. Westingh G E G E. I P M	5-13,500 1 25,000 1 33,333 2 6,250	6,600 13,200 13,200 2,300	G E Westingh G E G. E.	Yes Yes Yes Yes	4,500 6,667 3,333 2,100 1,000	1	D D D DD D	Y Y Y D Y	Direct Direct Direct No Direct	67,500 60,000 10,000 12,600 3,000	Westingh Westingh G F G. E. G. E.	13,200 44,000	[illegible]	D D	Y Y	Direct No	O D. O D	67,000 66,000	Lock 12-Albany	8 lb. per sq.ft. wind ½ in ice 20° to 120° F.	503 mi 110 kv 660 mi 44 kv	S W W	S-Gr S-Gr	47 110 kv		600 ft
Virginia Railway and Power Co	110	60	83 750			S H H	96,900 12,900 2,500	24 65	118 [illegible]	Horizontal Single Runner	Trump Leffel	24 700-20,000	275-550 2,300 4,000 11,000 13,200	G E A. C Westingh.	In some cases	15,000	1	D	Y	Direct			2,200 11,000 22,000 13,200	110,000	D	Y	No	O.D.	15,000	Richmond-Suffolk	60-mile wind Sleet. 0° F to 100° F Lightning	88mi 110kv	Steel		45	20 amp at 110 kv	600 ft
Georgia Railway & Power Co	110 66	60	107,100 4H 85,600 2S-21,500	5H-102,100 2S-21,500	1912	H S	136,000 30,800	27 to 600	187.5 to 514	Francis S R McCormack Hercules	S. M. S. S. M. S. Holyoke	450 to 12,000	440 2,300 6,600	G. E. and Westingh	No	250 to 3,300	3 phase and Scott	D and 2 phase	110 kv. Y 66 kv D	110 kv Gr Direct 66 kv isolated	85,100	Westingh. and G. E.	38,000& 11,000 38,000 38,000& 11,000 38,000	110 110 110 66	Y & D	D	Direct Direct Direct Direct	All O D	7,500 3,000 39,500 3,000	Tallulah-Atlanta, Lindale-Tennessee	8-lb. wind ½-in. ice —10° F.	175 mi 110 kv 63 mi 66 kv	S.T. W P-S	W.	46	29 amp 110 kv	550
Lehigh Valley Light & Power Co	110	25	30 000		1913	S	40,000		1 500	Horizontal	G. E.	10,000 kva	11,000	G. E.	No	30,000	3	D	Y	Gr. through resist	30,000	G E	11,000 6,600	110,000	D	D		I D.	21,100 7,500	Hauto Siegfried, Siegfried-Bethlehem	57-mile wind ½ in ice 0° F. for No. 1 —20° F. for No. 2	24 13	S T.	S.	53		[illegible]
Northern States Power Co.	50 60 110	60	3H 62,725 1S 57 000 kva		1907 1915 1917	H H & H	25,200 10,500 and 76,000	60 18 57	277 62 120		A. C. and Wehman, S M	35,000 4,125 & 57,000 39,600	2,300 2,300 13,200	Westingh. G. E. A. C.		16,200 6,000 22,500 (Wis. Minn. L.&P Co)	1 1 1	D D D	D Y D	Y Gr Direct	44,700	G E and Westingh	13,200 13,200 & 22,000 13,200	50,000 60,000 110,000	D D & Y D	D Y Y	Gr. direct	I D O D. I D	14,400 (several) 22,500	St Croix Falls-Minneapolis, Coon Radids-Wissota, Minneapolis	700-1,200 ft. 35° to 100° F	62 410 100	Both W.P.-W. S T.	Susp Susp Susp	46 34 40		[illegible]
Pacific Gas & Electric Co.	110 104 60	60	194 875	195 875	1862 to 1916	42 13	259,134 153 100	35 to 1,531	240 to 720	Mostly [illegible]	H—Mostly Pelton, Doble and A C S G E	74-Total 312,375	Mostly 2,300 6,600 11,000	Mostly G E and Westingh	In some cases	123-250 to 4,250 Total 185,540	Mostly 1	D	Y	Gr Direct		Stanley A. C. G E Westingh	2,200 4,000 6,600 11,000 60,000	60,000 100,000 104,000	D & Y	Y	Gr. in some cases	Both	302, 506	Extensive network centering at San Francisco	0 to 5,000 alt. varied conditions	143 137 1,895	Both	Mostly steel	55		[illegible]
Niagara System (Ontario Hydro-Com.)	110 46	25	150,000 (Ontario Power Co.)	225 000 (Under construction [illegible])		H	10,000 to 18,000	183		D R Francis	J M Voith W. S. M S M. S.	7,500 15 000	12,000	Westingh Can. G. E.	Yes	15-3,500 12-7,500 10-3,500	1	D	Y	Gr. Res	175,000		13,000 26,000 66,000	110,000	D	Y		I D	163,500 31,500 (spare)	Niagara to Windsor, Guelph, Toronto, Welland-Dunnville	60 mile wind ½ in ice -30° to 110° F Sea level	432 39	S.T., 110 kv S P, 46 kv W P., 46 kv	Susp.	42		
Thunder Bay System (Ontario Hydro-Com.)	110	60	21,000 kva	63,000		4	2-12,500	70	120	S R Francis	I P M	2 10,600	12,000			4-8,000	1	D	Y		32,000		4- 4,000	63 5 (Each transf.)		Y		I D	12,000	Cameron's Poolen, Nipigon River Port Arthur	60-mile wind ½ in ice —60° – 110° F	69	W P	Susp	24		
Mexican Northern Power Co.	110	60	26 000	—	1914	H	10,000	230	350	Horizontal	Esch Wyss	7,800	4,000	G. E.		2,500	1	D	Y	Gr Res	22,500	G. E.	13,200	110,000	D	Y				Boquila, Parral, Chihuahua, Mexico		314	S T	Susp			
Mississippi River Power Co	110	25			1913	H				Vertical	I P M					9,000	3	D	Y	Gr Direct	22,000	G. E.	66,000 33,000									255	S T				

RTH AMERICA AT AND ABOVE 44,000 VOLTS

ECTRICAL WORLD

		TRANSMISSION LINES																												LIGTNING PROTECTION		
		Steel Towers and Wood Poles				Span					Conductors									Insulators							Overhead Ground Wires per Tower					
																Clearances—ft.				On Straight Runs		Strain										
elocity, Altitude and Temp. Range, Fog Sleet, Lightning, etc	Total Length H.T. Single Circuit Miles at Each Voltage	Crossarms, Steel or Wood	Pins—Steel or Wood—Grounded	Tower Height, Ft to lowest conductor	Total Charging Current per Wire	Normal, Feet	Maximum Feet	Normal Sag, Feet	Normal Tension, Pounds	Circuits per Tower	Section—Gage or Circ Mil	Material	No of Strands	Arrangement	Spacing, In	To Ground	To Highway	To Tracks	From Line to Telephone	No of Units and Type	Manufacturer	Units and Type	Manufacturer	Arcing Horns or None	Voltage Regulation of Line for Load Specified	Rating of Synchronous Condensers Connected to Line	Mat and Size	Number	Number of Ground Connections	Type, Alum Cell, Horn, Resistance, etc	Setting of Gaps in	Manufacturer
g, 100 kv ind, 1,500 5 kv, 60- nd, ½ in. ,000 ft		Steel Steel	Steel Steel	46 45	83 amp at 165 kv 50 amp at 100 k	750 750	[illegible] 2,740	15 15	3,500 2,200	1—165 Kv 2—100 kv	414-940 C M 3/0	Al. steel Cu	37 7	△ vert	192 (ave) 120	30 36	34 34	34 34	20	10—No. 11,535 10—No 1,053	O.B. Thomas	2string (12) yoke 9	O.B. O.B.	Static Shield none	10% with 60 kw. with Conden	45,000 kw	165 kv 100 kv. ½ in steel	None 1	At each tower	None None		..
s wind ect	480- 150 kv	S T	Susp	37	90	600	70		80 ° F 3,130 (ice) 4,740 (no ice)	1 1	605,000 C.M. and 78,500 C.M.	Al.steel and steel	54 A. 7 steel	Horiz plane	207	25	Legal	Legal	Legal	9—10 in. No. 2,565 6,000 5,996	Locke	2 Strings 11—10 in same	Locke	Horns at both end of string	11% at 57000 kw., 30,000 kva condenser 85 P.F. load	30,000	½ in 7-strand S M steel	1	Each tower	Al.	Main 14 in Aux 10½ in and main 17½ and 13 aux pr hse	G E. and Westingh
nd sleet ft alt 20° F	25 mi	S T steel	Steel	37		800 D.C. 1,250 S.C.	500	12	3,300	2 1	500,000 cm	Al.	30 Al 19 steel	Single horiz double vert	210 96 min	25	30		65	10 susp 12,535	O B	1—No. 12,535	O B.	Horns			½ in. Steel	1	Each tower S C one D C	Al		G.E.
nd sleet	1,300	S T. W	Steel	40 to 160		528 S 132				1	1/0 No. 2	Cu.	7 6 Solid	△	144 96					10 Susp.	O B	10 Susp.	O.B.	None				1	Each tower	Al	varys	G E
e wind 2,000 ft t 00° F.	55 at 132 kv 180 at 66 kv	S T W P	14-in. steel	48 35		300 700- 200- 250	[illegible]			2—132 kv 1—66 kv	200,000 C M 4/0, 3/0, No 1 and No. 2	Cu. Cu clad Al steel	3 to 9	variable	132 kv 144 in, 12 ft vert 20 ft horiz 66—72 in v	27	40		About 9 min	10—No. 9,194 5—No. 9,194	O.B. O.B.	12—No. 9,194 6—No 9,194	O B. O B.	Horns		15,000	½ in Galv steel extra strength	2 1	Each tower every 5th pole	Al cell		G E
wind sleet. F.	26 5	S.T.	Susp	41'6	5.1 amp at at 66 kv			10 5	1,950	2	4/0	Cu.	7	Vert. Offset	162—vert. 22 ft horiz	35	40	45	116	11—No. 12,464	O.B.	13—No. 12,464	O B.	None	10% 30,000 kw 80 P F 66 kv	3,000	½ in high str steel	2	Each tower	Al		Westingh
wind at 32° F. -7,000 alt.	400-130 kv 1,460-44 kv	S.T. and W P.	Susp W P.	45		650 S.T. 500 W P.		3 5 80° F	3,000	2—130 kv 1 and 2 44 kv	250,000 various	Cu. clad	12	2 vert. planes various	156 vert. 265 horiz.	25 25	30 25	30 30	10 6	10-No. 12,464 9-No 10,566 3-No. 12,464	O B O B and Thomas O B	2-No. 12,464 1-No 10,566 4-No 12464	O.B. O.B.-T O B	Some		15,000—130 kw 2500-44 kv.	½ in extra gal. S.M.	2 S T. 1 W P	Ea tower & Pole	Electrolytic some horn gaps No res		G E Westing
..	252-120 kv 266 66 kv	120 kv S.T. 66 kv W P	Susp	40 App		[illegible]				1 and 2	Mostly 400,000 and 2 0	Al. Cu		Hor. pl Vrt. pl offset vrt Triangle	120 kv.—Ave. 120 in ad.con 66 kv. about 90 in						O B		O B.				120 kv ½ in and 5/16 in steel, 66 kv. ½ in steel, No 8 copper-clad	1	Each tower	Electrolytic		G E and Westingh
ind sleet, ting 100° F	76 115 99	S T W P S T		38 35 35		[illegible]				1 1 1	2 0 No 2 No 4	Cu								10—5—Susp and pin Ditto	O B. O B O B			Horns Horns Horns	10% 30,000 kw 10% 10%		½ in. S.M stee ½ in S M stee ½ in S M steel		Every 1 000 [illegible] tower			
r s ½ ft nd ice 120° F.	503 mi 110 kv 660 mi 44 kv	S W W	S-Gr S-Gr	47 110 kv				13	1,400	2—110 kv 1 and 2 44 kv.	2 0 No 4	Cu Cu.	7 1	Vert pl △	120 in 60 in	26	30	30	10	7 Sus. 12,464	O B	No 12,464	O.B.	Horns	Lock 12—Gadsden 8% at 6,000 kw 85 P F	10,000 kva.	½ in steel	2		Al Cell	H gap 7 in S gap 5 in G gap 6 in	G E Westingh.
nle wind eet 100° F tning	88 mi 110 kv	Steel		45	20 amp at 110 kv	600 ft		15	1,500	1	1 0	Cu	7	Modified delta	8 ft 10 ft	30	40	40	20	9 Susp No 12464	O B O B	9 No 12,464	O B	Horns	10% at 10,000 kw 80 P F 10% 16,000	525 kw 2,400 k va Syn motors	High strength galvanized strand	1	Each Tower	[illegible]	[illegible]	G E.
wind ice 0° F.	175 mi 110 kv 63 mi 66 kv	S T. W.P.-S.	W.	46	29 amp 110 kv	550	[illegible]	8	2,100	2 1	4 0 2 0	Cu steel and Al.	7	Towers vert pole horiz. and △	108 72	25	32—40	32 min	17—towers 6—poles	Towers, 8—12,464, 4—2,052, 5 poles, 4-12,464	O B Thomas J D O B	10—12464 5—12464	O B. O B.	Horns	10% 16,000 kw 80 P F	7,800	⅜ in steel on towers	2	Each tower	Al Cell	[illegible] in	G.E.
le wind ice or No 1 for No 2	24 13	S T	S	53		575 600	[illegible]	20 8 26	1,930 1,625	2 1	250,000 C.M ½ in	Cu Steel	7	Two vert planes One vert plane	Vert. 10 ft. Hor 19 ft 3 in	29	30 29	31 [illegible]	11	7—No. 5 757 7—No. 12,464	Locke O B	8 Discs	Locke O B	None			½ in S M	2	[illegible] tower	Al Cell		West G E.
200 ft 160° F	62 410 100	both W P-W. S T.	Susp Susp Susp	40 34 40	...	400 500 500-600	1,200			1 1 1	4 0 3—No. 8 2 0	Cu Cu. Cu.	19 3 19		84 81 120	30 25 25	35 32 32		53 60 160	3—12,464 5 J D, 6—12,464 5—J D 8 12,464	O.B. J D O B. J.D. O.B.	One extra disc in each case		None	10% at 15,000 kw 8 P F 13% on 60 kv 18,000 8 P E	None	½ in galv steel	2	On towers	Al		Westingh G E
000 alt. r d it ons	143 137 1 895	Both	Mostly steel	58		800	4,000	20 5	15,116 lbs. per sq in	and 1	Wide Range	Cu (hemp) Al Al. steel	1—37	T—vert P—[illegible]	72—60 kv 120-110 kv	30	30	34		Great variation									None	Horn	2 in 3 in	Made by Company
e wind ice 110° F level	432 39	S.T., 110 kv S P., 46 kv W P., 46 kv	Susp.	42 27		550 and 650 250	900 250	16 4	1,500 2,200 1,120	1 and 2 1 and 3	6 0 5/0 4 0	SRAC SRAC Cu	30 Al 7S 6 Al 7S 19 Cu	△ △	96—120 102 48—67	24	24	35	10	8—No 1,426 3—12,464 3—12,465	Can Porc O.B. O.B.	0—1,725 or 12,464 3—12,464	Can Porc O B. O B	Horns	8 7% at 31,700 kw 80 P F	9,000	5/16 in Steel	2 1	Each tower	Al Al		Westingh G E
le wind ice 110° F	69	W P.	Susp	24		325	500	4 ft 9 in	850	1	4 0	S R Ac	6 Al. 7 S		134 162 103	20	24	35	10	7—No. 1,725 12,464	Can Por O B	9—No 1,725 12,464	Can Porc O B		7 5% 15,000 kw .80 P F		5/16 in steel			Oxide Film		G E
	314	S T.	Susp	65		575	1,100			2	4 0	Al	7		120 Vert 122 slant					5 7	Locke O B.	9	O B							Oxide		
	288	S T.	Susp	50	22	800	3,300			2	300,000 C M	Cu.	19	Vert. Offset	120	30	30	30		7	Locke O B.	8	Locke O B		15% 30,000 kw P F 1		½ in. steel	1		Al		G E

k 12 Albans	8 lb per sq ft wind ½ in ice 20° to 120° F	503 mi 110 kv 660 mi 44 kv	S W W	S-Gr S.-Gr	47 110 kv		600 ft		13	1,400	2—110 kv 1 and 2 44 kv	2 0 No 4	Cu Cu	7 1	Vert pl △	120 in. 60 in	26	30	30	10	7 Sus. 12,464	O B	8 No 12,464	O B.	Horns	8% at 6,000 kw 85 P F	10,000 kva	1 in steel	2		[illegible]	[illegible]	G. E. Westgh.
hmond Suffolk	60-mile wind Sleet 0° F to 100° F Lightning	88 mi 110 kv	Steel		45	20 amp at 110 kv	600 ft	1,200 ft	15	1,500	1	1 0	Cu	7	Modified delta	8 ft 10 ft	30	40	40	20	9 Susp No 12464	O B O B	9 No 12 464	O B	Horns	10% at 10,000 kw 80 P F 10%, 16,000	525 kw 2,400 k va. Syn motors	High strength galvanized strand	1	Each Tower	Al Cell	[illegible]	G. E.
allulah-Atlanta, Lindale-Tennessee	8-lb wind ½-in ice 10° F.	175 mi 110 kv 63 mi 66 kv	S T. W P -S	W.	46	29 amp 110 kv	550	1 20	8	2,100	2 1	4 0 2 0	Cu steel and Al	7	Towers vert pole horiz. and △	108 72	25	32 40	32 min	17 - towers 6 poles	Towers, 8 - 12,464, 4 2,052, 5 poles, 4-12,464	O B Thomas J D O B	10 -12464 5 -12464	O B O B	Horns	10% 16,000 kw 80 P F	7,800	⅜ in steel on towers	2	Each tower	Al Cell	[illegible]	G. E.
[illegible] Siegfried Siegfried-Bethlehem	57-mile wind ½ in ice 0° F. for No. 1 20° F for No 2	24 13	S T	S	53		575 600	2 0	20 8 26	1,930 1,625	2 1	250,000 C M ½ in	Cu Steel	7	Two vert planes One vert plane	Vert. 10 ft. Hor 19ft 3in	29	30 29	31 37	11	7 No 5 757 7—No. 12,464	Locke O B	8 Discs	Locke O B	None	—		1 in S M	2	In tower	Al Cell		West G. E.
St Croix Falls-Minneapolis, Coon Rapids-Wissota, Minneapolis	700-1,200 ft —35° to 100° F	82 410 100	both W P -W. S.T.	Susp Susp Susp	40 34 40	...	400 500 530- 600	1,20			1 1 1	4 0 3—No 8 2 0	Cu Cu Cu	19 3 19		84 81 120	30 25 25	35 32 32		53 60 160	3—12 464 3 J.D. 6— 12,464 5 J D 8 12,464	O.B. J.D. O B J D. O B	One extra discs in each Case		None	10% at 15,000 kw 8 P F 13% on 60 kv 18,000 8 P F.	None	1 in galv steel	2	On towers	Al		Westgh. G. E.
Extensive network centering at San Francisco	0 to 5,000 alt. varied conditions	143 137 1,895	Both	Mostly steel	58		800	4,000	5	15,116 lbs per sq in	and 1	Wide Range	Cu (hemp) Al Al steel	1 -37	T -vert P — △	72—60 kv 120 110 kv	30	30	34	8	Great variation									None	Horn	2 in 3 in	Made by Company
Niagara to Windsor Guelph Toronto Welland-Dunville	60 mile wind ½ in ice —30° to 110° F. Sea level	432 39	S T, 110 kv S.P., 46 kv. W P, 46 kv	Susp.	42 27		550 and 650 250	900 250		1,500 2,200 1,120	1 and 2 1 and 3	6 0 5/0 4.0	SRAC SRAC Cu	30 Al 7S 6 Al, 7S 19 Cu	/ △ △	96 -120 102 48—67	24	24	35	10	8—No 1,426 3—12,464 3—12,465	Can Pore O.B O B.	10—1,725 or 12,464 3 -12,464	Can Pore O B O B	Horns	8 7% at 31,700 kw 80 P F	9,000	5/16 in Steel	2 1	Each tower	Al Al		Westgh G. E.
Cameron's Poolen Nipigon River Port Arthur	60 mile wind ½ in ice —60° + 110° F	69	W P	Susp.	24		325	500	[illegible]	850	1	4 0	S R Ac	6 Al 7 S	△	134 162 103	20	24	35	10	7— No 1,725 12,464	Can Por O B	9 -No 1,725 12 464	Can Pore O B		7 5% 15,0000 kw 80 P F		5 16 in steel			Oxide Film		G. E.
Bo[illegible]la, Parral, Chihuahua Mex		314	S T	Susp	65		575	1,100			2	4 0	Al	7		120 Vert 122 slant					5 7	Locke O B	9	O B		—					Oxide		
Keokuk-St Louis		288	S T	Susp	50	22	800	3,300			2	300,000 C M	Cu	19	Vert Offset	120	30	30	30		7	Locke O B	8	Locke O B		15% 30,000 kw P F 1		½ in steel	1		Al		G. E.
Great Falls, Anaconda	4,000-8,000 ft. alt 40° to 40° F-60 mile Wind		W P		35	45	440	1,000		1,800	1	4/0		12	Horiz plane	126	25	30	35	15	6-10 in	O B	6-10 in	O B	No	15%	None	½ in S M steel	2	Each tower	Al	10 in	G. E Westing
Network 100		1,165 980	S T S T -W P				500 150	2,600 500				2 0 4 to 4 0	Cu and Al	7 Solid										All Standard Makes									
Shoshone-Boulder		180 mi	S T		50 40		750	2,250		1,250	1	No 1 No 0	Cu	7	Horiz plane	120 in	30	35	35	50	5— No 47,047	Hewlett	5- 0 in discs 47 047	Hewlett	Arc Points	10%		None			Al Cell	[illegible]	G. E.
Bleuett - Methuen, Methewen - Henderson-Goldsboro	8-lb wind ½ in ice 0 F	175 120	S T W P	Susp Susp	45 45		680 350		5	1,280 800	2 1	1 0	Cu	7	( ) △	108 vert 72 102	27 25	27 25	30 30	12 10	7— No 1,113 4 — 1,113	Thomas Thomas Hewlett	8— Hewlett 5 Hewlett	G E	A few			5 16 in steel 5 16 in steel	1 1	Each tower Each pole	Al Al		[illegible]
Shawinigan Falls, Montreal..		174	S T	Susp	70		520	1,40			2	250,000 C M	Al	19	Vert	96					7	O B	8	O B				½ in steel	2		Al	G. E.	[illegible]
at Rock	60-mile wind 1,000 ft alt 10 to 100 F	60	S T S A	S-gr	42		500	900			1	2 0 1,0 2	Cu		∠	126	40	40	40	12	5— 2335-A 10,566	Locke O B	2,335A 10,566	Locke O B	Horns	10% 7,500 kw 85 P F	1,000	5/16 in Steel	1	Each Tower	[illegible]	[illegible]	G. E Westing
Watertown, West Allis	50-mile wind sleet 30° to 100° F.	86	S T		40		550	67			2	1 0	Cu	7	Vert	72	25	32	40	20	4— No 11,535	O B	5 No 11 535	O B	Horns	4 8% at 14,000 kw 90 P F	None	½ in Copper Clad	1	Each tower	Al	5	G. E
Chester, Philadelphia	0° F ½ in ice 8 lbs, wind pressure	28	S T		48	2 8 at 66 kv	500	57		1,200 lbs at 70° F	2	2 0	Cu	7		90	35	40	31 ft	8 ft	8— 12,464	O B	9 12 464	O B	Horns	11.6% at 15,000 kw 85 P. F.	None	5/16 in C C C Steel 7 Strand	2	1 per tower 1 per Pole	Al	60 kv	G. E
Turners' Falls, Springfield, Mass	60 mi wind and sleet 200 ft alt 20°-100 F	192	S T		45	12 at 66 kv	500	600	[illegible]		2	1 0 2 0	Cu	7	( )	144	30	40	40	20	4 Hewlett 1054	Thomas	5 Hewlett 1,054	Thomas	Horns	10% 30,000 kw at 8 P. F	None	½ in Steel	1	Each Tower	Al	Spark Gaps, 4	G. E
Power stations and sub-stations	0° F ½ in ice 8 lb wind	91	S T		41		830	2 13	[illegible]	4,590 max	2	4 0	Cu	7	( )	84	25	30	30	8 or more	5susp	J D O B	6 Strain	O B J D	Horns	— —	30,000	½ in Copper- Clad	2	Each tower		[illegible]	Westingh
Underwood, Wash -Portland, Ore	½ in ice 50 mile wind —10° F	65 mi	Wood	Wood ungr	37	13 6	300	1,290	2 4	5,650		301,600 C M	A -steel	6-Al 7 steel	△	84	33	38	42	8	No 360 Pin type	Locke	No 274	Locke	None	15%	6,000 Mot. Gen. 17,000 Turbo Gen-	None			[illegible]	Gen End	1
Iron River, Mich -Crystal Falls, [illegible] Loretta, Mich -Niagara, Wis	Recommendation Joint Committee Eng. Societies	50	S T	Steel Gr	40		525	92		1,900	2	1/0 Al Steel	6 Al 1-S	6 Al	2 Vert	72 vert 12 ft horiz	23	30	35	10	4 -2 335 5 10566	Locke O B.	5 2,335 6 10,566	Locke O B	Arcing Rods	5% at 6,000 kw .85 P. F	None	No 2 Cu Clad Solid Steel	2	Each Tower	Al [illegible] Iron Wire	[illegible]	Westingh
San Diego-Capistrano	Coast winds Salt spray 32° to 100° F.	77	Wood	Susp	35	15	440	3,060	8	800	1	No 1	M H D Cu	7	△	80 86 117	27	30	34	8	6—3,538 or 5,996	Locke	7-3,538 or 5,996	Locke	None	13% at 6,000 kw. at 95 P. F.	Freq. ch. and Gens Used	None			Al (1 Sph Gap [illegible] Gap)	1	Westingh
Providence Fall River, Warren branch	60-mile wind ½ in ice —20° to 100° F.	38	S T	S P Gr	35	10	500	900	15	2,000	2	1 0	M H D Cu	6	2 vert planes	120	30 min	30	40	20	5 No 25,017	O B	6 - 25,017	O B	No.	10% at 15,000 kw .85 P F.	None	None			Oxide Film	A 1½ in	G. E
Cedars-Montreal, Soulanges, Montreal	65-mile wind ½ in ice —20° to 100° F.	27 28	S P -W A W.P -W A	Wood No Wood No	36 30	6 45 6 3	234 110	880 880	1 3	2,770	1 1	0 742 diam 2 0	Al Fe Cu Hempcore	28 Al 7 steel 6	Vertical Triangle	60 60	25	25	35	7	Pin No. 10,748 No 351	O B Locke	6— No. 1135	O B.	.	12 6% at 15, 000 kw, 0 8 P F, 11 3% at 15,000 kw .8 P. F.	None	No 7 Iron	2	Each Pole	Al and Horns	[illegible] Horns 5	G. E G. E.
Boise Le Grande, Idaho Falls, etc	60-mile wind 3,000 ft. alt. —30° to 115° F Lightning	534 at 44 kv 286 at 66 kv	W P W.A.	S.P.			225 300				1	No 4 2 0	Cu Al	7		60 85 44 kv 84-96-66 kv. 84-96-66 kv	28	30	37	6	3-44 kv 5-66 kv	O.B Locke Thomas	4-44 kv. 7-66 kv	O B Locke Thomas	No		3,000	3/16" S M steel	1	Every third pole	Al		G. E Westing
Vernon, Wooster Millbury, Pawtucket [illegible] Shelburne, Hoosac, Adams Bennington, etc	½ in sheet 8-lb wind -20 100 F 0 2,000 ft alt	252	S T -S A W P -S A Gr		38 40 47 25		S T 400 550 P 200	1,940 600	Towers 11 to 17 and 21 Poles 3	450, 400 and 800 400	Twrs 2 P [illegible] 1	2 0 No 1 and No 2 1 0	Cu Cu Steel Al	6 3	△△ 2 Vert planes △	60 120 Vert 192 horiz 72 and 84	21	25	30	8	Pin No 360 3, 4, 5 and 6 No 2335 4 No 25 017	Locke Locke O B	2 pin No 360 4, 5, 7 No 2 335 5-25,017	Locke Locke O B	None		30,000	No 4 & ½ in Cu-clad ½" and 5/16" S M galv	1 on tower [illegible]	Each tower	Al cell oxide film [illegible]		G. E Westing

Wisconsin-Minnesota Light & Power Co	120 60	60 60	53 500			4-H 21-S		57 52 21	120			6-6,600 and smaller Units	13,200	A C		15-1,000 30 Others	1	D	D			G. E. and Others								Wissota-Stillwater Lacrosse, [illegible]	[illegible] 20° [illegible]	[illegible]		
Alabama Power Co	110 44	60	67,500 58,333 12,500 2 000	80,000 58 333 12,500 2,000	1913 1917 1914 1914	H S S S H	17,500 25,000 kva 33 333 kva 6 250 kva 1,500		100 1,800 1,800 1,800 150	"V" Runner	I P M. Westingh G E G E. I P M	5 13,500 1 25,000 1 33,333 2- 6,250	6,600 13,200 13,200 2,300	G E Westingh G E G E	Yes Yes Yes Yes	4,500 6,667 3,333 2,100 1,000	1	D D D DD D	Y Y Y D Y	Direct Direct Direct No Direct	67,500 60,000 10,000 12,600 3,000	Westingh Westingh G. E. G. E. G E.	13,200 44,000	110 000 110 000	D D	Y Y	Direct No	O D O D	67,000 66,000	Lock 12-Albany	[illegible] 20° to 120° F	[illegible]	[illegible]	
Virginia Railway and Power Co	110	60	83,750			S H H	96,900 12,900 2,500	24 68	118 5 360	Horizontal Double Runner	Trump Lefell	24 700-20,000	275-550 2,300 4,000 11,000 13,200	G E A C Westingh	In some cases	15,000	1	D	Y	Direct			2,200 11,000 22,000 13,200	110,000	D	Y	No	O D	15,000	Richmond-Suffolk	60-mile wind 0° F to 100° F Lightning	[illegible]	[illegible]	
Georgia Railway & Power Co	110 60	60	107,100 4H-85,600 2S-21,500	5H-102,100 2S 21 500	1912	H S	136,000 30 60	27 to 600	187 5 to 514	S F Francis O R M Cormack H Hercules	S. M S. S M. S. Holyoke	450 to 12,000	440 2,300 6,600	G E and Westingh	No	250 to 3,300	3 phase and Scott	D and 2 phase	110 kv. Y 66 kv. D	110 kv Gr Direct 66 kv isolated	85,100	Westingh. and G. E.	38,000& 11,000 38,000 38,000 11,000 38,000	110 000 110 000 110 000 66,000	Y & D	D	Direct Direct Direct Direct	All O D	7,500 3,000 39,500 3,000	Tallulah-Atlanta, Lindale-Tennessee	8-lb. wind [illegible] —10° F.	75 [illegible] 53 66	W P	A
Lehigh Valley Light & Power Co	110	25	30 000		1913		40,000		1 500	Horizontal	G. E.	10,000 kva	11,000	G. E.	No	30,000	3	D	Y	Gr. through resist	30,000	G. E.	11,000 6,600	110,000	D	D		I D.	21,100 7,500	Hauto Siegfried, Siegfried-Bethlehem	57 mile wind [illegible] 0° F for No 1 —20° F for No 2	24 13	S T	S
Northern States Power Co	50 60 110	60	3H- 62,725 1S 57 000 kva		1907 1915 1917	H H & H	25,200 10,500 and 76,000	60 18 57	277 62 120		A C and Wehman, S M	15,000 1,125 & 57,000 39,600	2,300 2,300 13,200	Westingh G E A C		16,200 6,000 22,500 (Wis. Minn. L&P Co)	1 1 1	D D D	D Y D	Y Gr Direct	44,700	G E and Westingh	13,200 13,200 & 22,000 13,200	50,000 60,000 110,000	D D & Y D	D Y Y	Gr direct	I D O D I D	14,400 several) 22,500	St Croix Falls-Minneapolis, Coon Rapids-Wissota, Minneapolis	700-1 200 ft 35° to 100° F	82 41 16	Both W P -W S T.	[illegible]
Pacific Gas & Electric Co	110 104 60	60	194,875	195 875	1862 to 1916	42 10	259,134 151,100	55 to 1,531	240 to 720	Most [illegible]	H—Mostly Pelton, Doble and A C S G E	74- Total 312,375	Mostly 2,300 6,600 11,000	Mostly G. E and Westingh	In some cases	123-250 to 4,250 Total 185,540	Mostly 1	D	Y	Gr. Direct		Stanley A. C. G. E. Westingh.	2,200 4,000 6,600 11,000 60,000	60,000 100,000 104,000	D & Y	Y	Gr in some cases	Both	302, 506	Extensive network centering at San Francisco	0 to 5 000 alt. varied conditions	143 137 [illegible]	Both	[illegible]
[illegible] System Ontario Hydro-Com	110 46	25	150,000 (Ontario Power Co)	225,000 (Under construction) [illegible]		H	10,000 to 18,000	183		D R [illegible]	J M Voith W S M S M S	7,500- 15,000	12,000	Westingh Can. G. E.	Yes	15-3,500 12-7,500 10-3,500	1	D	Y	Gr Res	175,000		13,000 26,000 66,000	110,000	D	Y		I D.	163,500 31,500 (spare)	Niagara to Windsor, Guelph, Toronto, Welland-Dunville	60 mile wind ½ in ice —30° to 110° F Sea level	432 34	S T , 110 k [illegible] W P [illegible]	[illegible]
Thunder Bay System (Ontario Hydro Com)	110	60	21 000 kva	63,000		4	2-12,500	70	120	S R Francis	I. P. M	2 10,600	12,000			4-8,000	1	D	Y		32,000		4-4,000	63 5 Each transf		Y		I D	12,000	Cameron's Poolen, Nipigon River Port Arthur	60-mile wind [illegible] —60° + 110° F.	69	W P	[illegible]
Mexican Northern Power Co	110	60	26,000		1914	H	10,000	230	360	Hor	Esch Wyss	7,800	4,000	G E.		2,500	1	D	Y	Gr Res.	22,500	G. E	13,200	110,000	D	Y				Boquila, Parral, Chihuahua, Mexico		314	S T.	[illegible]
Mississippi River Power Co	110	25	112 500	225,000	1913	H	10,000	32	57 7	Vert	I P M W S M.	9,000	11,000	G E		9,000	3	D	Y	Gr Direct	72,000	G. E.	66,000 33,000 13,200	95,000	D	D				Keokuk-St Louis		288	S T.	[illegible]
Montana Power Co	[illegible]	60	212,000		1912	H	15,000	105		Singl	S M S	12,500	66,00	Westingh	No	12,500	3	D	Y	No		Westingh	2,300	00,000	D	Y	Gr direct	I D	28,800	Great Falls, Anaconda	4,000-8,000 ft. alt —40° to 90° F-60 mile Wind		W P	
Southern Power Co.	100 44	60	280 900 8H 244,400 4S-36,500		1905	45 H 4 S	5,200- 17,500	20 137	97 360	SR, Ch, R	I P M A C. Holyoke S. M. S. Westingh. G E.	750 to 14,000	2,300 6,600 11,000	A. C. G. E. Westingh		2,000- 14,000	1 and 3	D	D and Y		148,000 at 100 kv 161,700 at 44 kv.	G. E. A. C. Westingh.		00,000 44,000				Both	126,100 145,390	Network 100		1 165 980	S T. S T -W P	
Colorado Power Co	100	60	2 12 000		1910	H H	2- 9,000 2-10,500	165 1,825	400 400	D R I Ir	A C I P M.	Boulder 2-5 000 kv Shoshone 2-7,200	4,000 4,000	G. E. G. E.	Yes Yes	3-3,300 3-3,300	1 1	D D	D Y	No	25,000 kw	G. E.	13,800 6,900 13,800 11,000	90,000 90,000 90,000 90,000	D D D D	D D D D		I D. I D. I D. I D.	6-2,500 3-1,500 6-100 3-750	Shoshone-Boulder		180 m.	S T	
Carolina Power & Light Co.	100 66	60	32 000		1911	H	3-5,200 3-5,900	47	164	D R I	S. M S.	3-4,150 3-6,230	4,000	G. E.	No	6-6,250	3	D	D		37,500	G. E.	60,000 22,000	00,000 60,000	D D	D D		O.D. O.D.	33,300- 100 kv 20,000 60 kv	Bleuett - Methuen, Methewen - Henderson-Goldsboro	8-lb wind ½ in ice 0 F	175 120	S T W P	[illegible]
Shawinigan Water & Power Co.	100	60	45,000	80,000	1911	H	18,500	145	225	Hor	I P M.	15,000	6,600	Westingh		14,000	3	D	Y	Gr Res.	28,000	G. E.	12,800	00,000	D	D				Shawinigan Falls, Montreal		174	S T	Susp
Columbus Power Co	66 66	60 60	6,000 11,000 9,000	60,000 30,000 30,000	1906 1913 1906	H H S	8,000 14,500 12,000	40 70	200 & 225 200 & 225 1,800	D I H Vert	Holyoke-W. S. M. S M. S.-A. C. G. E.-A. C.	17— 1,000 to 7,500	5,500 11,000 12,000 2,300	Stanley Westingh G. E. A. C.	No	8,000 3,200	3 2 3	D Scott	D		11,750	G. E. Westing	11,000	66,000	D	D	No	I D	4,000 3,750 4,000	Goat Rock Newman	60-mile wind 1,000 ft alt 10° to 100° F	60	S.T S A	[illegible]
The Milwaukee Electric Ry & Light Co	66	25	16,000	Stations owned by other companies			1909																13,200	66,000	D	Y	No	I D.	22,000	Watertown, West Allis	50-mile wind sleet 30° to 100° F.	86	S T.	
The Philadelphia Electric Co	66	60 25	60,000 76,000 80,000	120,000 76,000 80,000	1917	10S	12,000 to 35,000		720 to 1,200 and 1,500	Ver L	G. E.	12,000 to 15,000	6,000 and 13,200	G. E.	Not gr and gr. with 4 and 8 ohms	6-5,000	1	D	D	No		Westingh.	13,200	66,000	D	D	No	O D	30,000	Chester, Philadelphia	0° F ½ in ice 8 lbs wind pressure	28	S T.	
Turners Falls Power & Electric Co	66	60	45,000 4,500 22,000		1916 1905 1918	H H S	65,000 6,500 32,000	60 40	97 3 4-200 2 257 1 420	S R 4 3	I P. M. Francis Crocker G E	14— 500 to 15,000	6,600 2,300 13,200	G E. G. E & A C G. E.	Yes No Yes	55,500 3,000 37,500	1 3 1	D D D	D D Y	No No Direct	96,000	G E. G E. Westingh.	13,200 4,600 5,500 2,300	66,000 66,000 66,000 66,000	D D D D	D D D D	No	O.D O D I D. O D.	87,750 28,000 15,000 8,500	Turners' Falls, Springfield, Mass	60 mi wind and sleet 200 ft. alt 20°-100 F	192	S T	
Duquesne Light Company	66	60	153,650	453,650 (1920)	1901	S						12— 1,500 to 60,000	11,000	Westingh	Gr through Transformer bank	80,000	1	D	Y	Gr. with resist	86,000	Westingh	22,000	66,000	Y	D	Gr. with resist	O.D	3-1,500 3-3,125 6-3,125 3-4,166 6-4,166	Power stations and sub-stations	0° F ½ in ice 8-lb. wind	[illegible]	S T	
Northwestern Electric Co	66	60	12,000 5 000 10 000		1913 1914 1919	H S S	2-4,500 2 3,800 1-10,000	168	360 1,800 1,800	D R Fra Curtis Curt	A C. G E. G. E	2-6,000 2-3,500 1-10,000	2,300 2 400 6 600	A. C. G E. G E.	No No Yes	6-2,000	1	D	Y	No	12,000	G. E.	11 000 11,000	66,000 66,000	Y D	Y D	No No	I D I D	450 12,000	Underwood, Wash -Portland, Ore	½ in. ice 50 mile wind —10° F	[illegible]	Wood	Wood
Peninsular Power Co	66	60	5,500 5,500 3,500	5,500 5,500	1913	H H S	9,300 9,300 4,700	42 60	257 240	D R S I Ver	Jos Leffel Westingh	3-1,175 2-1,475 2 2,100 1-2,500	6,600	Westingh	Gr	5,000 5,000 3,750	1	D	D	No	13,175	Westingh.	13,200 6,600 2,200	66,000	D	D	With resist	I D.	3,750 750	Iron River, Mich -Crystal Falls, Mich -Loretta, Mich -Niagara, Wis	Recommendation [illegible] Eng. Societies	50	S T	[illegible]
San Diego Consolidated Gas & Electric Co	66	60	11,750		1918	S	2-6,000 1-3,000		1,800	C	G. E.	2-5,000 1-2,500 1-1,550	2,400	G E.	No	6,000 3,000	1	D	Y	Gr. Direct		Westingh Moloney	12,000	66,000	D	Y	Gr. direct	O D.	1,500 300 6,900	San Diego-Capistrano	Coast winds Salt spray 32° to 100° F.	77	Wood	[illegible]
Narragansett Electric Lighting Company	66	60	50,000	135,000	1919	S			3,600	D	Westingh	5— 3,500 to 45,000	2,300 11,000	Westingh.	No	4-5,000	3	D	D	No	20,000	G. E.	11,000 22,000 4,000	66,000 66 000	D D	D D	No No	O D. O D.	10,000 15,000	Providence-Fall River, Warren branch	60-mile wind [illegible] 20° to 100° F	35	S T	[illegible]
Montreal Light & Power Consolidated	66	62 5	120,000 kva 10,250 kva.	180,000 kva 10,250 kva	1914 1906	H H	129,600 16,050	30 50	55 6 237	S R Francis Vert D R Francis Horiz	W S M and I P M A C and W. S. M	12 - 10,000 3-3,750	6,600 4,000	G. E. Westingh.	No. No	6-5,000 6-8,000 6-2,500	1	D D D	D D Y	No No No	93,000	G E and Westingh	13,200 13,200	60,000 44,000	D D	D Y	No No	I D. I D.	30,000 150,000	Cedars-Montreal, Soulanges, Montreal	65-mile wind [illegible] —20° to 100° F	27 28	S P -W A W P W A	[illegible]
Idaho Power Co.	44 and 66	60	34,640 2,775 (leased)		1916	H	55,260 4,800 (leased)	18 to 190	90- 600	Reaction	S M S, Leffel A. C. I. P. M. W S M Pelton Platt, Trump	32 300-5,500 Total [illegible],000 kw	440 2,200 6,600	G E Westingh. A. C	In some cases	42- 250 to 2,000	1	D	D ex 1 bk	Gr Direct	29,300	G E. Westingh A. C	2,200	44,000 66,000	D & Y	D	Gr. Dir	I D and O D.	18,165	Boise Le Grande, Idaho Falls, etc	60-mile wind 3,000 ft alt —30 to 115 F Lightning	[illegible]	W P W A	[illegible]
New England Power Co	66	60	7-H 59,500 1-S 18,000	87,000	1909	23 H 2 S	69,760 23,500	34 to 235	133 to 300 3,600 and 1 800	3R Vert 2R Horiz 1 P Horiz	S M S W S M A C Westinghouse G E	28 units Total 79 050	2,200 2,300 13,200 11 000	G E and Westingh	No	33 units 87 250	3 and 1	D	Y and D	Gr Direct	87,250	G. E A C Westingh	2,300 6,600 13 200 22 000 33 000	66 000 ex	D	Y & D	Gr Dir	3 I D 9 O D	147 000	Vernon, Wooster Millbury Pawtucket, Shelburne Hoosac Adams, Bennington, etc	[illegible]	[illegible]	S T [illegible] W P [illegible]	

The Ohio Power Co. (Central Div.). (See also 132 kv. lines)	66	60	32,375 kva 3,000 kva			S-H-	29,375 kva 3,000 kva	40		Jouval-Girard	G. E. A. C. . . .	3-6,250 2-3,750 1-3,125- 3-1,000	4,000 Y	A C and G. E.	Gr Direct	24,750	3 and 1	Y	D	Gr Direct	24,750	Westingh G E	4,000 2,300	66,000	Y D	D	Gr Dir	O D.	25,625	Logan, Lancaster, Newark, Tiffin, Bucyrus, Freemont	[illegible]	262	W P			
Connecticut Light & Power Co	66	60	29,875 23,400 7,500	31,200	1910 1919 1904	S H H	5-1,500 to 12,500 kva. 3-7,800 6-1,250	74 104	3,600 and 1,800 250 400	S R Vert Horiz	S M S	Same as Turbines	2,300 6,600 1,100	Westingh and G. E.	No	22,500	1	D	Y	Gr. Resist	22,500	G. E. and Westingh.	6,600	66,000				O D.	22,500	Stevenson-Waterbury	60 mi. wind and sleet [illegible]	29	[illegible]	[illegible]	[illegible]	
West Kootenay Power & Light Co., Ltd	60	60	21,000	21,000	1897	H	28,000	70	180	3R Francis	I. P. M. A. C.	2-5,625 2-7,500	2,500	Can G E	No	27,000	3	D	D	No	31,900	G. E. Westingh. A C Jeffery	440 600 2,200	60,000	D	D	No	I D.	15,000 4,500 4-3,750	Trail, Northport, Greenwood	[illegible] 5,500 [illegible] 45 to 102 F	[illegible]	[illegible]	[illegible]	[illegible]	
Winnipeg Electric Railway Co	60	60	14,000	14,000	1906	H S	21,000 13,000	42 180 lbs	200 1,800	Francis-Curtis	S. M. S. Can G E	23,000	2,200	Can G E	No	1,800 800	1	D	D		21,000	Can. G. E.	2,200 13,200 22,000	60,000	D	D	No	I D.	21,000 3,000 6,000	Pinawa, Winnipeg	60-mi. wind 45 to 100 F	65	[illegible]	[illegible]	[illegible]	
Sierra Pacific Electric Co	60	60	5 700 to 2,500 Total 8,600		1899	H	2,400 3,000 3,200 2,40 1,200	85 115 96 88 42		McCormick Type B Victor Francis New American Type F-Twin	S. M. S. Platt Iron A. C. Dayton Globe A. C.	2-750 1-2,500 1-2,400 2-750 1-700	550 2,200 2,200 2,200 2,200	G. E Westingh G E G. E G. E.	Yes Yes No Yes Yes	1,800 2,250 3,000 1,650 2,250	3	Y D D Y	D	None	10,450		2,200	60,000	D	D	No	I.D.	1,666 1,500	Verdi-Bluestone	60 mi. wind and sleet 20 to 100	64	2-[illegible] W	[illegible]	[illegible]	
Adirondack Electric Power Corporation	60	40	6,000	8,000	1905	S	8,000		800 1,200	Vertical	G. E.	2-1,500 2-3,000	2,200	G. E.	No	1,500 1,000	1	D	Y	Gr Direct	12,000	G. E.	2,200 4,400 430 370	60,000	D	Y	Gr dir	I D and O D	5,750	Amsterdam, Little Falls, Utica to Clark Mills, Clark Mills Oneida	[illegible] 0 F	69	W P-W [illegible]	[illegible]	[illegible]	
Texas Light & Power Co	60	60	23,000 17,000 25,000		1913	S	400 to 20,000		3,600 (Max)		G. E. Westingh	300 to 18,000	2,300 to 4,100	Westingh	On. 4,100 Yes	12,000	3	Y	Y	Gr Direct	43,980	G E.	33,000 22,000 2,300	60,000	D & Y	D & Y	Gr dir	Both	69,358	Paris-Rockdale	10 to 105 F [illegible]	673	[illegible]	[illegible]	47	
California-Oregon Power Co	60	60	260 to 10,000 Total 18,820	40,000	1912	13 H	300 to 7,000	20 to 730	200 to 514	Impulse and Francis	Pelton Stillwell Bierce Joshua Hendy A C McCormick	225 to 12,500 Total 23,550	2,300	G. E. and Westingh	No	27-100 to 4,165	1	D	Y	Gr Direct	41,100	G. E. and Westingh	2,300	66,000	D	Y	No	O D	22,962	Prospect to Gold Ray, Ore.-Copco to Kennett, Calif	60 mi. wind and sleet 2,000 to 4,000 ft. alt. −10 to 100 F	143	W [illegible] W [illegible]	[illegible]	55	
Southern California Edison Co. . . . . (See also 150 kv. line)	60	50 and 60	161,600 (present plants)		1905	2 S 2 H	2-16,800 3-63,000 (total) 4-6,700 5-2,700	878 262	750 750 250 231	Vertical Vertical 4 Impulse 4 S. Francis Impulse Multi-nozzle	G. E. G. E. A. C. Pelton Doble	2-12,000 1-20,000 1-15,000 1-12,000 4-5,000 5-2,000 kw	9,000 11,000 2,200 2,200	G. E. G. E. A. C. Bullock	No Yes No No				Y	Gr. Direct	161,000			60,000	D	Y	Gr. dir.		. . .	Extensive network	Many kinds of construction varying with climate and other conditions	1,830	S T and W P	H [illegible]		
Niagara, Lockport & Ontario Power Co	60	25	30,000 27,000 9,000 120,000 Int'l Pwr Co																				11,000 33,000, 6,600	60,000				Both	30,900	Lockport, Rochester, Syracuse Altman	15-lb wind with ½ in. ice at −40°F	300 (ap)	S T & W P		[illegible]	
Western Power Company of Canada	60	60	27,000	72,000	1911	H	3-13,000	90	225	Francis	Escher, Wyss	3-10,000	4,400	Can. G. E.	Yes	10-3,000	1	D	D		30,000	Can G E	12,000	60,000	D	D		I.D	18,000 9,000	Stave Falls, Billingham Horns Payne	40-mile wind, ice, snow and fog	85	S T W [illegible]	S P [illegible]	4[illegible]	
Toronto Power Co	90 [illegible]	25	80,000	85,000	1914	H	13,000 to 15,000	133 to 135			Esch Wyss I. P. M.	7,500 10,000	12,000	G E.	No	6,000 2,700	1 1	D D	Y D	Gr. Direct	51,000	G. E.	12,000 12,000	90,000 60,000	D D	Y D	Gr. Dir.	I D.	36,000 24,000	Toronto Torwald Welland		160-90 kv 20-60 kv	S T S T & W P	[illegible]	32	[illegible]
The Southern Sierras Power Copany	88	60	3,375 2,000 11,250	25,750 kw leased from Nevada-California Power Co	1912	H H H S S	2,500 2,800 2,850 4,000 6,750	375 375 220	[illegible]	-Impulse action pulse	Doble Pelton Pelton-Doble A. C. G. E.	1,500 1,875 2,500 5,000 6,250	2,200 2,200 6,600	Bullock Westingh. A. C. A. C. G. E	No No No	1,000 750 4,000	1 1 1	D D D	Y Y D	Gr Direct Gr Direct	3,000 2,250 12,000	Westingh. Westingh. A. C. and Westingh	33,000 15,000 55,000	88,000 55,000 88,000	D D D	D D D		O.D O D O D	22,500 9,450 18,000	Bishop San Bernardino San Bernardino Yuma	70 mi. wind [illegible] 1,000-4,500 alt 0-120°F 10-130 F	478 mi. 88 kv. of single cir. and 225 mi. of 155 kv	S T-S A W P-W A	[illegible]	[illegible]	[illegible]
Appalachian Power Co	88	60	25,000		1912	H H S	15,000 9,000 18,000	50 40		Francis	I P M.	4-4,000 3-3,000	13,200	G. E.	No	4-6,000 3-6,750	3 1	D	D	No	42,250	G. E.								Bluefield Switchback Coalwood Byllesby Roanoke, etc		315 mi.	Wood	Susp [illegible]	32	
Mexican Light & Power Co	85	50	58,500	100,000	1910	H	7,000 13,000 to 14,000	1,200 to 1,300	[illegible]	Vert	Esch Wyss	7,500 12,500	4,000	S.-S. G. E.		2,000 6,000	1	D	Y	Gr. Direct	70,000	G E	3,000	81,000	D	Y				Necaxa Mexico City Mexico		338	S T		40	
St. Lawrence Transmission Co.	80	60	3,000 20,000 9,000	4,500 30,000 9,000	1913 1919 1917	H	4,000 22,000 11,200	46 183 82	[illegible]	Runner Runner Runner	S. M. S. A. C. A C	2-1,500 2-10,000 2-4,500	4,400 13,200 4,400	G E. A. C. G. E	No Gr No	29,500	3	D	Y		54,000	G E								Higley Falls Massena, Ogdensburg	8 lb wind ½ in. sleet 40 to 100 F	63 mi	Steel Tower Wood Wood	Susp Gr	35	
City of Winnipeg	70 66	60	30,000	80,000	1911	H H H	5-5,200 3-6,800 3-6,800	46 46 46	164 [illegible]	Horiz	Boving Escher Wyss. Boving	5-3,000 3-6,000 3-6,500	6,600 6,600 6,600	Vickers Can Westingh Can. G. E.	Yes	6-3,000 1-9,000 3-6,000	1 3 1	D	D		27,000	Can Westingh.	12,00	66,000 70,000	D	D	No.	Both	22,000 kva 600 and down	du Bois Winnipeg	½ in. sleet 8b wind	78	Steel towers and arms	Steel gr	41	15 [illegible]
Penn Water Power Co.	70	25	83,500 AC 1,000 D C.	113,500	1910	H	5-13,500 2-17,000 1-16,500 2-1,000 D C	53 62 63 53	[illegible] 24	Francis Francis Francis S R Francis	I P M	4-10,000 1-7,500 2-13,300 1-12,000	11,000	5-G. E. 3-Westingh.	No	1-7,500 6-10,000 2-12,500	3	D	Y	Gr with Res	92,500	5-G. E. 4-Westingh.	13,200	60,000	Y	D	No.	Indoor	72,500 kva	Holtwood Baltimore	690 ft. alt. 25 to −40° C Wind 15 lbs. sq. ft. ½ in. ice at −25°C	160	S.T. S A	[illegible]	40	[illegible]
Guadalajara, Mexico	70	50	8,000	8,000	1911	H	4,000	215	375	Horiz	Esch Wyss.	3,500	10,000	Siemens-Schu		4,000	3	Y	Y	No	12,000	S. S.	20,000 3,000	70,000	Y	Y			.			360	S T		59	
Pacific Power & Light Co	60	60	34,200			24 H 3 S		Var's	Various	Impulse and Reaction	Various	27-Total 34,200 2,000 Belongs to N.W.E.Co)	2,300 6,600	G. E. A. C. Bullock Westingh	No	27,975	3 and 1	D	Y	Gr Direct at Pasco	27,975	Various	2,300 6,600 66,000	66,000 66,000 110,000 (to Inter-m'tain	D	Y	1 gr	Both	21,775	Yakima, Pasco Walla Walla The Dalles, Hood River		445	W.P W.A.	S P		
Guanajuato Pwr. & Elec. Co. & Michoacan Pwr. Co. .	60	60	5-15,500	15,500	1903	7-H	2,000 to 6,000	164 and 656	300 and 514	Pelton Francis	Pelton A. C. I. P. M.	1,250 to 3,500	2,300	G. E.	No	7,000 3,240 6,900	1	D	Y	Direct Gr	19,870	G. E	33,000 15,000 2,500	60,000	D 3 Ph	Y 3 Ph	Gr. dir.	I D	13,970	Platanal to San Luis Potosi Botello to Ponos	Wind 65 mi Alt 9,000 ft 34° to 1° C No fog, no sleet	417	S T Steel	[illegible]	36	
Washington Water Power Co	60	60	114,500			H S	100,500 kw S-14,000 kw	50 to 170		D.R Francis	I P.M. mostly	2,000 to 15,000	2,300 4,000	G.E.		90,000 approx	3 and 1	D	Y	Gr. dir.	90,000 approx	G E		60,000				Both	.	Spokane, Long Lake Little Falls, Burke, Colfax, Lind, Newport	8 lbs wind ½ in ice -30° to 120° F	50-S T 580-W P	S T. W P	[illegible]	[illegible]	
Portland Railway, Light & Power Co.	57	60	9,250 7,500 4,000 9,900 2,500 11,250		1910 1905 1911 1911 1912 1912	H S S H S H	16,500 10,000 8,000 18,900 3,350 19,200	130 81 320	400 1,920 1,800 240 1,800 514	D R Victor Curtis Curtis D. R Francis Parsons S R Francis	Platt Iron G E. G E. A C. Platt Iron Wellman-Seaver-M	2,000 to 7,500	11,000 2,300 5,500 6,600	G.E. A C Westghse	No	850 to 3,750	1 and 3	D	Y	Gr dir	41,650	Stanley G E Westghse	23,000 11,000	57,100	D	Y	Gr dir	I D and O D.	43,150 kva. 300-11,000	Portland-Generating Plants	70 mi wind 25°—100° F	166	St-S and W P-W	W P [illegible]	45	
Snow Mountain Water & Power Co.	55	60	6,400	15,000	1908	H	16,000	472	420	Francis Victor	Platt Iron	3-2,000 1-2,750	2,300	Westghse A C		4-2,000	1	D	Y	Gr dir.	6,000		2,300	55,000	D	Y		I D.	450	. . . .		93	W P-W	[illegible]		
Western States Gas & Electric Co	55	60	4,500 2,250 27,000 2,250		1910	H S H S	H-8,100 H-8,100 S-3,010	586	H-300 S-900	Doble Pelton Curtis Vert	Pelton W W	H-5,625	2,300	Westghse G E		7,975	1	D	Y	Gr dir	7,975	Westgh	4,400 2,200 4,400				Gr dir	2 O D 12 I D	27,650	North Placerville-Stockton	40 mi. wind 0-2,000 ft. alt		W P			

	Logan Lancaster Newark, Tiffin, [illegible] Fremont	60-mile wind 800 to 2000 ft alt 0 to 100° F	262	W P		35		150 -250		Variable	Variable	1	No 1	Cu	3	Δ	72-96-120	27	40	31	9	5- No 9194	O B	6 - No. 9,194	O.B.	Horns		Provided by customers	S T. W P	1 & 2 1	Each tower every 5th pole	Al		G E
00	Stevenson-Waterbury	60-mi wind and sheet Rolling country	29	S.T.	Susp	40		550	[illegible]	2%	1,400	1 (2ult)	2/0	Cu	7	Vert offset	96				22	5	J D	2 strings of 7	J D		5% 20,000 kva. .8 P.F.		¾ in gal. steel	2	Each tower	Al	Sphere gaps 4	Westingh
50	Ira, Northport Greenwood	50-mi wind and sleet 1,500 to 5,500 ft alt -45° to 102° F	96	W T Wood	Steel No	40		150	1,600	4		1	92,000 C M	Cu hemp core	6	△	72	20	25	30	6	Pin 341	Locke	None		None	10% 15,000 kw 85 P.F.	None	None			Al	2 in	Can G E
00	Pinawa Winnipeg	60-mile wind 45 to 100° F	65	S.T S Pipe	Steel Gr.	40	13	500	1,200	14	8,500	2	2/0	Cu	7	△△	60	26	26	34	10	Pin 10,748	O.B.	None		None	10% 21,000 kw 85 P.F.	None	None			Multi-gap		Can G E
00	[illegible]	0-mi wind and sleet 20° to 100°	64	W 2-pole W.	Steel No	40		400	1,100			1	No 4	Cu	7	Horiz.	144	40	40	50	12	3- No 10566	O.B.	4 No 10,566	O B	None		600	No			Al		G E
50	Amsterdam, Little Falls, Utica to Clark Mills, Clark Mills Circuits	¾ in ice 8-lb wind 0° F	89	S.T. W P-W A	Steel Pins not gr. on W P	50 29		300 550 250	600 60 335	4 15	1,200 400	2 1	3/0 No 1	Cu (also hemp core) Al-St	7 6 6	△	72	25	30	30	6	Pin 12,552 10,577	O B O.B	7-12,464	O B	None		None	⅜″ S M steel 7-strand	1	Each tower	Oxide film	G E instructions	G E
58	Par -Rockdale	10° to 105° F sleet	673	Both	Both	47	121	600	700	40 12	1,200	2	1/0	Cu	6 & 3	Vert plane	96	30	40	35	6	5-10 in discs	O B Thomas G. E.	6-10″	O.B Thomas G E	Horns	10% 12,000 kw. .9 P.F. 32 mi.	4,000	7-strand Extra galv ⅜″ S M steel	1	Each tower	Electrolytic	Resist gap 3″ Gr gap 3″	G E
62	Prospect to Gold Ray, Ore -Cape to Kennett Calif	60-mile wind and sleet 2,000 to 4,000 ft alt -10 to 100° F	143	W P W.A.	Steel not gr	35	28	200	[illegible]	3	450-No 2 900-2/0	1	2/0 No 2	Cu Cu	6 1	△	84	30	35	35	10 15	3- No. 2335	Locke	4 No. 2,335	Locke	None	Capco 18% 9,000 kw 90 P.F. Prospect 8% 4,800 kw 85 P F	None	None			Al	Varied	G E and Westingh
	Extensive network	Many kinds of construction varying with climate and other conditions	1,830	S.T. and W P	H'dw'r connect'd ground'd at guyed poles							1 and 2	No. 2 to 4/0	Cu Cu and Al								3 to 5 10″ discs.		4 to 6 (8 max) 10″ discs					87 mi. have gr. wire	1	Each tower or pole	Al	According to climatic conditions	G.E and Westingh
00	Lockport Rochester Syracuse Auburn	15-lb wind with ½ in ice at —40 F	300 (ap.)	S T & W P		49	40	550 and 220		3% Al 7% Cu at 60° F		1 and 2	642,000 C M 428,000 214,000 4/0	Al Al Al Cu		△ ⊾	84 horiz 72 vert	28	28	30	12	No 7742 No 358 5-susp	O.B Locke			Horns			None			Electrolytic	150% Normal Voltage	
00 00	Star Falls- Bellingham Horns Payne	40-mile wind, ice, snow and fog	85	S T W P	S P not gr	40		66 200	50 0	12 40	41	2 1	1/0 and No. 1 (equiv)	Cu hemp core) Al- St	6		84	28	28	40	20	3- No 10 566	O B	4 — No 10 566	O.B	None	10% at 10,000 kw. .8 P.F. 31 miles		¾″ galv steel (towers)	1	Each tower	Al		Can Westingh
00 00	Toronto Torwald Welland		160 90 kv. 20- 60 kv	S T S T.&W P	S-Gr. Steel	65- 52	9 at 90 kv	650 400	60	3½% at 70° F		2	190,000 C M	Cu	7	△	96-72	28	28	30				4 to 7 discs	Locke Can Porc J D	No	10% 18,000 kw .9 P.F	1	¾″ Steel		Every tower	Horn	6 5½	G. E
600 450 000	Bishop San Bernardino San Bernardin Yuma	70 mi wind ¾ in ice 1,000 4,500 alt 0 120 F 10-130° F	478 mi- 88 kv of single circuit 225 mi of 155 kv	S.T.-S A. W P-W A.	S Pins Bonded- not gr	44 to lowest arm 30	68 amp- 88 kv 42 amp.- 55 kv	[illegible]	7 [illegible]	10½ at 70° 2′-3″ at 70°	1,500 at 70° F. 620 at 70° F.	2-88kv 1-55kv	4/0 3/0	Al.-Steel Al	6 Al. 7 Al	△	134 240 72	30 27-32	30 30	34 34	(Not on twrs) 8	7—No 5,996 and 6—Pin No. 351	Locke J D Locke	8-5,996 and and 4-5,996 (also double pin)	Locke J.D Locke	None None		10,000 (turbo gen) 2,000 kva.	1″ S.M steel None	1 None	Each tower	Electrolytic Horn gap— No resist Multi horn gap with resist	9″ 5½″, 6½″ and 7½″	G.E Bowie
	Bluefield Switchback Coalwood Byllesby Roanoke etc		315 mi	Wood	Susp not gr	32		[illegible]	0		100	1	1/0	Al	7		96-120	25	25	42	12	5-1,053	Thomas O B J D	6-1,053	O.B-J D	No		10,000	¾″ steel	1	Every pole	Al	6′ to 8′	GE
	Necaxa Mexico City Mexico		338	S.T.		40 5	134	[illegible]				2	4/0	Cu (hemp)	6	△	72	26 5	25	50		3-Pin	Thomas	3-Pin	Thomas							Al		G E
	Higley Falls Massena, Ogdensburg	8 lb wind ½ in sleet -40 to 100° F.	63 mi.	Steel Tower Wood Wood	Susp Gr	35 ft		500 ft.				2 on S T 1-W.P	3/0	S.R Al	7		108 in.	28	30	30	10	5 6 No. 5,800	J D Locke	6 7	J D Locke	No No		9,000 kva.	⅜ in S M	2	Each tower	Al cell	Medium	G E
900 and	du Bois Winnipeg	½ in sleet 8b wind	78	Steel towers and arms	Steel gr	41 ft	18 amp	60 ft		17.5 ft. at 60° F	3,745 lb per sq.in.	2	278,600 C.M	Al	19	△	72	20	25	35	50-100	Pins No 1,810	Can Porcelain Co	7	Can Porcelain Co	No	10% 11,250 kva.	12,000	No			Al cell Impulse gap	3½ in	Can Westingh
500 va	Holtwood Baltimore	690 ft alt 25 to +40° C Wind 15 lbs sq ft ½ in ice at —25°C	160	S.T. S.A.	S-gr.	40 ft	3.5 amp at 70 kv	510 ft		20	500	2	300,000 C M	Al.	19	Vert plane approx	84 and 108	20	20	30	15	7-10 in. 5-11 in	O B (95%) J D (5%)	8-10 in 6-11 in.	O.B. J.D.	Horns	11% at 15,000 kw 90% P F		⅜ in. galv. steel	L 12-1 L 56-2	Pipe gr at each tower	Al at stations	3½ in	G E
			360	S T		59		645	[illegible]			2	99,000 C.M.	Cu		△	185					3	Hermsdorf	6	Hermsdorf					1		Horn and Res		S S
775	Yakima, Pasco Walla Walla The Dalles, Hood River		445	W P W.A.	S P.							1	52,630 and 211,590 3/0 to No 1	Al. Cu		△ Mostly △	Various	25	21	30	15-18	5-10″ Pin		6-10″		No		5,000	⁵⁄₁₆ in Extra gal S.M.	1	Each pole	Al		G E Westingh
3,970	Pastanal to San Luis Potosi Botello to Ponos	W [illegible] 65 mi Alt 9,000 ft 34° to 1° C No fog, no sleet	417	S.T Steel	Steel	36		460 820	492 1,600	11 to 14		1 & 2	No 4 to 2/0	Cu	6 7 19 Solid	▽ Vert pl Horiz pl	59.8 in. min.	23			8 2 16 4	Pin and 2 & 3 Susp.	Thomas G E, O.B. Hewlett Locke	Pin 2, 3 and 4 susp	Thomas G E O.B. Locke	No		0	⁵⁄₁₆ and ¼ steel	1	At sta	Al Resis	¾	G E
	Spokane, Long Lake Little Falls, Burke, Colfax, Lind, Newport	8 lbs wind ½ in ice —30° to 120° F	56- S T. 580- W P	S.T. W P	Susp S P.-gr	51		750				2 S T. 1 W P	270,000 Various	Al. Cu, Al, and Cu-clad		Vert. offset-S.T. Triangle and horiz.	84 48-84		25	30	4-7	4— No. 10,566 Pin	O.B. Locke Thomas and O B	5 No 10,566	O.B.	Horns			⅜″ and ½″ gal. S.M.	1	Each tower	Al		G E
43 150 300 11,000	Portland- Generating Plants	70 mi. wind 25°—100° F.	166	St-S. and W P-W	W P.- Steel ungr	48	6 8	500	560	14		2	250,000 C M	Cu	19	Vert	72	34			None	3— No. 10,566	O.B.	4 — 10,566	O.B.			None	¾″ 7-strand S.M. steel	1	No	Al	Mfg spec'd	G.E. and Westingh
450			93	W P- W	Steel ungr			250	1,000				105,500 C.M. 1/0	Al. Cu	7	△	72					Pin No 351	Locke	No. 5,090	Locke							3-pole Type C		Bowie Sw. Co

		Winnipeg		78																															
Indoor	72,500 kva.	Holtwood Baltimore	690 ft. alt. —25° to +40° C Wind 15 lbs/sq. ft. ½ in. ice at—25°C	160	S.T. S.A.	S-gr.	40 ft.	3.5 amp. at 70 kv.	510 ft.	1,280 1750- River crossing	20	500	2	300,000 C.M.	Al.	19	Vert. plane approx.	84 and 108	20	20	30	15	7-10 in. 5-11 in.	O.B. (95%) J.D. (5%)	8-10 in. 6-11 in.	O.B. J.D.	Horns	11% at 15,000 kw. 90% P.F.	....	½ in. galv. steel	L. 12-1 L. 56-2	Pipe gr. at each tower	Al. at stations	3½ in.	G.E.
....	....	....	....	360	S.T.	....	59	....	645	1,000	....	....	2	99,000 C.M.	Cu	....	△	185	....	....	....	....	3	Herms- dorf	6	Herms- dorf	....	....	....	....	1	....	Horn and Res.	....	S.S.
Both	21,775	Yakima, Pasco Walla Walla The Dalles, Hood River	....	445	W.P. W.A.	S.P.	..	....	..	....	....	....	1	52, 630 and 211,590 3/0 to No. 1	Al. Cu	....	Δ Mostly △	Various	25	21	30	15-18	5-10" Pin	....	6-10"	....	No	....	5,000	5/16 in. Extra gal. S.M.	1	Each pole	Al.	....	G.E. Westingh.
I.D.	13,970	Platanal to San Luis Potosi Botello to Ponos	Wind 65 mi. Alt. 9,000 ft. 34° to 1° C No fog, no sleet	417	S.T. Steel	Steel	36	....	460 820	492 1,600	11 to 14	....	1 & 2	No. 4 to 2/0	Cu	6 7 19 Solid	▽ Vert. pl. Horiz. pl.	59.8 in. min.	23	....	....	8.2 16.4	Pin and 2 & 3 Susp.	Thomas G.E., O.B. Hewlett Locke	Pin 2, 3 and 4 susp.	Thomas G.E. O.B. Locke	No	....	0	5/16 and ¼ steel	1	At sta.	Al. Resis.	½	G.E.
Both	....	Spokane, Long Lake Little Falls, Burke, Colfax, Lind, Newport	8 lbs. wind ½ in. ice —30° to 120° F.	56- S.T. 580- W.P.	S.T. W.P.	Susp. S.P.-gr.	51 ..	....	750 ...	....	....	....	2 S.T. 1 W.P.	270,000 Various	Al. Cu, Al., and Cu-clad	....	Vert. offset- S.T. Triangle and horiz.	84 48-84	....	25	30	4-7	4— No. 10,566 Pin	O.B. Locke Thomas and O.B.	5— No. 10,566	O.B.	Horns	....	....	⅜" and ½" gal. S.M.	1	Each tower	Al.	....	G.E.
I.D. and O.D.	43,150 kva. 300- 11,000	Portland- Generating Plants	70 mi. wind 25°—100° F.	166	St.-S. and W.P.-W.	W.P.- Steel ungr.	48	6.8	500	560	14	....	2	250,000 C.M.	Cu	19	Vert.	72	34	....	....	None	3— No. 10,566	O.B.	4— 10,566	O.B.	....	....	None	⅜" 7-strand S.M. steel	1	No	Al.	Mfg. specif.	G.E. and Westingh.
I.D.	450	....	....	93	W.P.- W	Steel ungr.	..	....	250	1,000	....	....	....	105,500 C.M. 1/0	Al. Cu	7	△	72	....	....	....	....	Pin No. 351	Locke	No. 5,090	Locke	....	....	....	....	....	....	3-pole Type C	....	Bowie Sw. Co.
2 O.D. 12 I.D.	27,650	North Placerville- Stockton	40 mi. wind 0—2,000 ft. alt. 20° to 110° F.	206	W.P. W	W.P.	..	15	175	265	14 to 15 in.	50	1	No. 1	Al.-Steel	20	△	84	25	30	33	20	Pin No. 351	Locke	....	....	Horns	12% 10,000 kw. .8 P.F.	None	None	....	....	Electrolytic	....	Westingh.
I.D. & O.D. I.D. & O.D.	11,700 2,400	Bishop-Tybo Bishop-Silver Lake Silver Lake-Hawthorne	....	312- 55 kv. 54- 88 kv. 70- 55 kv.	W W W	Steel- ungr. Susp. hard- ware gr. Steel- ungrs.	30 40 30	32 at 55 kv. 15 at 88 kw.	317 528 317	857	8	1,500 at 70° F.	1 1 1	3/0 and No. 2 4/0 Nos. 2 & 4	Cu and Al. Al.-Steel Cu	7 6 Al. 7	△ Hor. pl'n △	72 138 72	28	30	34	..	Pin No. 351 6 susp. Pin No. 351	Locke J.D. Locke	No. 351 7 susp. No. 351	Locke J.D. Locke	None	....	....	None	None	None	Al. cell and series horn gap with resist.	3¼ 2¾", 3½", 4¼"	G.E. Bowie
I.D. I.D.	83,000 83,000	Seattle, Renton, White River, Tacoma Olympia Everett	60 mi. wind 10° to 85° F. 600 ft. alt.	410	S.T. W.P.	Steel	42 S.T. 30- W.P.	....	90 to 250	800	Variable	....	2	4/0 equiv. 2/0 No. 4 ½ in.	Cu. Al. Al. Cu St.	1	△	84 72 and 48 (S)	25	34	34	7	Pin No. 159	Pittsb.	3-10"	J.D.	Horns	....	....	None	....	....	Al.	3"	Westingh. G.E.
O.D.	5,000	Ellsworth Veazie	....	25	W.P. W	Steel ungr.	25	....	100	808	....	....	1	No. 3	Cu	Solid	△	36	25	30	30	12	Pin No. 5005	Locke	5— No. 2,984	Locke	None	7% 4,800 kva. .8 P.F. without trans.	None	None	....	....	Al.	....	G.E.
....	7,500	Various Lines	30 lbs. wind ½ in. ice	236	S.T. and W.P.	....	T.43 P.21	16 amp. per mile	350 140	500 200	9 5	....	1	No. 2	Cu	1	△	60 60	43 21	43 25	43 25	7	Pin No. 492	Can. Porcelain Co.	No. 194	Can. Porcelain Co.	....	....	....	5/16" S.M. steel strand	1	1	Al.	4"	Can. G.E. Can. Washington
O.D.	6,000 6,000 6,000 12,000 12,000	Detroit-Monroe, Superior, Bloomfield Utica, Port Huron	60 mi. wind and sleet —20° to 120° F.	215	W.P. W	W	Pls. 40- 50 ft.	....	176	200	3	415	1	1/0	Cu	7	△	72	25	30	30	5	Pin 3-part	O.B. W.	3-7½ in. Hewlett	G.E.	None	....	1,500	5/16" gal. steel	1	Every 4th pole	Al.	....	Westingh.
....	3,750	Morrisburg- Cornwall	60 mi. wind ½ in. ice 30 to 110° F. Sea level	26	W.P.	W.P.	29'- 4"	....	176	176	17"	400	1	3/0	Al.	....	Triangle	66 112 118	24	24	35	10	Pin No. 1159	Can. Porc.	....	....	....	....	....	5/32" steel	....	....	Al.	....	Can. Westingh.
O.D. Switch	....	Hamilton, Brantford Welland St. Catherine	—10° to 100° F.	176	W.P.	S.&W.	60- S.T. 35- W.P.	....	200 125	....	....	....	1	6-No. 6 (hemp)	Cu	6	Triangle	60 vert. 80 horiz.	30	40	30	10	Pin	Can. Porc. O.B.	Susp. Type B	Can. Porc.	No	....	6,700	No. 6 duplex	1	Each tower	Electro- lytic	....	Westingh.
....	....	Roosevelt-Phoenix Roosevelt-Miami South Consolidated-Mesa Mesa-Sacaton Phoenix-Glandale Goldfield-Superior	80 mi. 10° to 150° F. No sleet Bad lightning	162	S.T. S.P. W.P.	....	20- 50 in mts. 50 in des.	....	S.T. 800 S.P. 330 W.P. 175 and 220	1,400 440 250	....	....	2-1	2/0 No. 1 No. 6 No. 4 No. 1	Cu	6 Solid 7 7	Towers vert. plane Poles △	Towers 72 Poles 48 and 60	22	30	30	8	3— No. 2,335 or 5,800	Locke	4— No. 2,984	Locke	None	....	....	⅜" S.M. galv. steel strand	2	Each tower	Al.	2½"	G.E. and Westingh.
I.D.	16,000 1,800	St. Timothee- Montreal	75 mi. wind —20° F. 1 in. ice	27	S.T. S.A.	Steel gr.	52	....	500	615	17	....	2	2/0	Cu	19	△△	72	35	40	40	81 in.	Pin No. 360	Locke	5— No. 11,535B	O.B.	None	7.9% 20,000 kw.	....	No. 4 copper-clad steel	1	Each tower	Al.	2⅜"	Westingh. G.E.
O.D.	2,500 3,800 3,000	Calremont, Cavendish, Springfield, Mendon Rutland, etc.	....	109	W.P. S. and W.	Steel mostly gr.	18	....	135 250 140	150 275 150	1½ 4 1½	....	1 2 2	4 2 6	Cu	1 1 and 6 1	Horiz. plane Triangle vert. plane	35.5-68 30-48 48 24-30	20-25	30	35-40	5 and 4	Iron thimble Smith Grip No. 345 3-piece pin	Thomas Thomas Locke	....	....	....	10% .80 P.F. normal load	....	....	....	....	Oxide film	1¾"	G.E.
I.D.	2,300	Kingston- Napanee	....	25	W.P.	Susp.	..	....	..	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
I.D. and O.D.	31,630 720	Eastern Ontario	60 mi. wind ½ in. ice —30° to 110° F.	370	W.P.	W.P. and Susp.	26'	....	325	350	4'-9"	850	1	2/0 3/0 4/0	S.R. Al.	6 Al. 7S.	Δ	11'-4" 5'-4" 11'-8"	20'	24'	35	10	3—No. 1725 1,159 (pin) 25,264 (pin) 11,623 (pin)	Can. Por. C.P. O.B. O.B.	4— No. 1,725	C.P.	Horns	....	1,250	5/16" steel	....	....	Al. horn gap and graded res.	....	Can., G.E. and Can. Westingh.

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City of Winnipeg	70 66	60	30,000	80,000	1911	H H H	5-5,200 3-6,800 3-6,800	46 46 46	164 138.5 150	Horiz.	Boving Escher Wyss. Boving	5-3,000 3-6,000 3-6,500	6,600 6,600 6,600	Can. Westingh. Can. G. E.	Yes	6-3,000 1-9,000 3-6,000	1 3 1	D	D	.....	27,000	Can. Westingh.	12,000	66,000 70,000	D	D	No.	Both	kva. 600 and down	du Boco Winnipeg	½ in. sleet 8b. wind	78	Steel towers and arms	Steel gr.	61 ft.	18 amp.
Penna. Water Power Co	70	25	83,500 A.C. 1,000 D.C.	113,500	1910	H	5-13,500 2-17,000 1-16,500 2-1,000 D.C.	53 62 63 53	94 116 94 240	D.R. Francis D.R. Francis S.R. Francis S.R. Francis	I. P. M.	4-10,000 1- 7,500 2-13,300 1-12,000	11,000	5-G. E. 3-Westingh.	No	1-7,500 6-10,000 2-12,500	3	D	Y	Gr. with Res.	92,500	5-G. E. 4-Westingh.	13,200	60,000	Y	D	No.	Indoor	72,500 kva.	Holtwood Baltimore	690 ft. alt. —25° to +40° C Wind 15 lbs/sq. ft. ½ in. ice at—25°C	160	S.T. S.A.	S-gr.	46 ft.	3.5 amp. at 70 kv.
Guadalajara, Mexico	70	50	8,000	8,000	1911	H	4,000	215	375	Horiz.	Esch. Wyss.	3,500	10,000	Siemens- Schu.	....	4,000	3	Y	Y	No	12,000	S. S.	20,000 3,000	70,000	Y	Y	......	.....	......	......	......	360	S.T.	......	59	......
Pacific Power & Light Co	66	60	34,200	....	....	24 H 3-S	......	Var's	Various	Impulse and Reaction	Various	27– Total 34,200 2,000 Belongs to N.W.E.Co)	2,300 6,600	G. E. A. C. Bullock Westingh.	No	27,975	3 and 1	D	Y	Gr. Direct at Pasco	27,975	Various	2,300 6,600 66,000	66,000 66,000 110,000 (to Inter- m'tain	D	Y	1 gr.	Both	21,775	Yakima, Pasco Walla Walla The Dalles, Hood River	......	445	W.P. W.A.	S.P.	..	
Guanajuato Pwr. & Elec. Co. & Michoacan Pwr. Co	60	60	3- 15,500	15,500	1903	7-H	2,000 to 6,000	164 and 656	200 and 514	Pelton Francis	Pelton A. C. I. P. M.	1,250 to 3,500	2,300	G. E.	No	7,080 3,240 6,900	1	D	Y	Direct Gr.	19,870	G. E.	33,000 15,000 2,500	60,000	D 2 Ph.	Y 3 Ph.	Gr. dir.	I.D.	13,970	Platanal to San Luis Potosi Botello to Ponos	Wind 65 mi. Alt. 9,000 ft. 34° to 1° C No fog, no sleet	417	S.T. Steel	Steel	36	......
Washington Water Power Co	60	60	114,500	....	....	H S	100,500 kw. S-14,000 kw	50 to 170	.....	D.R.Francis	I.P.M. mostly	2,000 to 15,000	2,300 4,000	G.E.	....	90,000 approx.	3 and 1	D	Y	Gr. dir.	90,000 pprox.	G.E.	.....	60,000	..	..	......	Both	......	Spokane, Long Lake Little Falls, Burke, Colfax, Lind, Newport	8 lbs. wind ½ in. ice —30° to 120° F.	56- S.T. 580- W.P.	S.T. W.P.	Susp. S.P.-gr.	51 ..	....
Portland Railway, Light & Power Co	57	60	9,250 7,500 4,000 9,900 2,500 11,250	....	1910 1905 1911 1911 1912 1912	H S S H S H	16,800 10,000 8,000 18,900 3,350 19,200	130 81 320	400 1,920 1,800 240 1,800 514	D.R.Victor Curtis Curtis D. R. Francis Parsons S. R. Franc	Platt Iron G.E. G.E. A.C. Platt Iron Wellman-Seaver-M	2,000 to 7,500	11,000 2,300 5,500 6,600	G.E. A.C. Westghse	No.	850 to 3,750	1 and 3	D	Y	Gr. dir.	41,650	Stanley G.E. Westghse	23,000 11,000	57,100	D	Y	Gr. dir.	I.D. and O.D.	43,150 kva. 300- 11,000	Portland- Generating Plants	70 mi. wind 25°—100° F.	166	St.-S. and W.P.-W.	W.P.- Steel ungr.	48	6.5
Snow Mountain Water & Power Co	55	60	6,400	15,000	1908	H	16,000	472	420	Francis,Victor	Platt Iron	3-2,000 1-2,750	2,300	Westghse A.C.	....	4-2,000	1	D	Y	Gr. dir.	6,000	....	2,300	55,000	D	Y	......	I.D.	450	....	....	93	W.P.- W	Steel ungr.	..	......
Western States Gas & Electric Co	55	60	4,500 2,250 27,000 2,250	....	1910	H S H S	H-8,100 H-8,100 S-3,010	586	H-300 S-900	Doble Pelton Curtis vert.	Pelton W.W. G.E.	H-5,625 2,825	2,200	Westghse G.E.	....	7,975	1	D	Y	Gr. dir.	7,975	Westghse	4,400 2,200 4,400 11,000	55,000	D	Y	Gr. dir.	2 O.D. 12 I.D.	27,650	North Placerville- Stockton	40 mi. wind 0—2,000 ft. alt. 20° to 110° F.	206	W.P. W	W.P.	..	15
Nevada-California Power Co	55	60	6,000 6,750 6,000 10,000 3,000		1905	H	3-3,950 3-3,360 2-1,300 3-2,600 1-8,000 1-8,000 1-2,500 1-2,500	850 725 980 1750 660	300 300–450 400–300 300–400 400	Impulse	Pelton Doble Henry Pelton-Doble	3-2,500 3-2,500 2-940 & 3-1,875 1-500 & 1-6,250 2-1 875	2,200 and 2,300	Westghse C. Wheeler National Bullock G.E. A.C.	No.	3-2,000 3-9,000 3-2,000 9-500 6-500 3,200	1 1 1 1 1 3	D D D D D Y	Y Y Y Y Y D	Gr. dir.	15,000 to 88'kv 13,500 to 66 kv 3,200 for inter- con- nection	Westghse G.E. Westghse Stanley G.E. G.E.	6.600 11,000	55,000 55,000	D Y	Y Y	Gr. dir. H.T. dir. L.T. res.	I.D. & O.D. I.D. & O.D.	11,700 2,400	Bishop-Tybo Bishop-Silver Lake Silver Lake-Hawthorne	....	312- 55 kv. 54- 88 kv. 70- 55 kv.	W W W	Steel- ungr. Susp. hard- ware gr. Steel- ungrs.	30 40 30	32 at 55 kv. 15 at 88 kv.
Puget Sound Power & Light Co	55	60	116,000	146,000	1912	H S	120,600 32,836	255 440 865	225 to 360 720 and 1,800	Impulse Francis Vertical tandem Turbine,Corlis.	Doble-I.P.M. Platt Pelton A.C., G.E. Mc. Int. & Seym.	16- 1,500 to 16,000 Total 106,200	2,000 2,300 6,600 13,800	Westghse G.E.	No.	6-2,500 4-2,917 7-3,333 3-9,000 9-2,333	1	D	D	No.	98,000	G.E. and Westghse	2,200 13,800	50,000 50,000	D D	D D	No.	I.D. I.D.	83,000 83,000	Seattle, Renton, White River, Tacoma Olympia Everett	60 mi. wind 10° to 85° F. 600 ft. alt.	410	S.T. W.P.	Steel	42 S.T. 30- W.P	......
Bar Harbor & Union River Power Co	50	60	5,250	5,250	1910	H	1,870 1,700 3,800	60	300 277 200	S.R.Francis	S.M.S.	1-1,000 1-1,250 1-3,000	2,300	G.E. Westghse	No.	1,667	1	...	D	No.	5,000	G.E.	6,600	47,500	D	D	No.	O.D.	5,000	Ellsworth Veazie	....	25	W.P. W	Steel ungr.	25	......
Southern Canada Power Company, Ltd	48	60	10,000	20,000	1905	H	3-1,350 2-3,750 1-300	57 30 31	360 100 292	27 in. horiz. 9 ft. 2 in. sing. vert. 36-in horiz.	Jenckes Boving Jenckes	3-940 2-3,125	2,300	Can. G.E. Can. Westghse	No.	1,500 1,500 3,000	3	D	D	......	6,000	Can. G.E. Can. G.E. Can. Westghse	2,200	4,800	D	D	......	.....	7,500	Various Lines	30 lbs. wind ½ in. ice	236	S.T. and W.P.	......	T.43 P.21	16 amp. per mile
Detroit Edison Co	48	60	105,000 123,000 4,000 4,775	300,000	1917	S S S H	....	..	.....	....	....	48 kv. line not con. direct to gen. bus.	......	....	....	2,000	1	D	Y	Gr. dir.	30,000	G.E. and Westghse	24,000	48,000	D	Y	No.	O.D.	6,000 6,000 6,000 12,000 12,000	Detroit-Monroe, Superior, Bloomfield Utica, Port Huron	60 mi. wind and sleet —20° to 120° F.	215	W.P. W	W	Pls. 40- 50 ft.	......
St. Lawrence System (Ontario Hydro-Com.)	46	60	....	....	....	..	....	..	.....	....	....	....	......	....	....	......	..	...	..	......	.....	....	46,000	110,000	..	..	......	....	3,750	Morrisburg- Cornwall	60 mi. wind ½ in. ice 30 to 110° F. Sea level	26	W.P.	W.P.	29'- 4"	......
Dominion Power & Transmission Co	45	66⅔	62,100	....	1898	H S	45,000 20,000	265 ..	286 2,000	Francis- Parsons	Westghse	6-6,400 kw. 3-2,500 kw	2,400	Westghse	Gr.	4-3,200 5-2,500 6-3,200	1	D	D	No.	44,500	Westghse	2,400	45,000	Y	D	Gr. dir.	O.D. Switch	......	Hamilton, Brantford Welland St. Catherine	—10° to 100° F.	176	W.P.	S.&W.	60- S.T. 35- W.P	......
Salt River Valley Water Users Association	44	25	10,000 2,000 850 3,750 600	....	1909	H	15,840 2,800 1,450 6,000 1,040	80–225 31 19 111 40	300–500 166 150 94 300	S.R. D.R. D.R. Impulse D.R.	S.M.S. S.M.S. S.M.S. Pelton S.M.S.	5-1,060 1-5,000 2-1,000 2-425 6-875 1-600	2,300 2,300 2,300 11,000 11,000 2,300	G.E. G.E. G.E. G.E. Westghse G.E.	No. No. No. No. Gr. No.	18-350 12-500 6-333	1	D	Y	Gr. dir.	14,298	Wagner A.C. G.E.	Sold at line voltage	44,000	..	...	......	....	......	Roosevelt-Phoenix Roosevelt-Miami South Consolidated-Mesa Mesa-Sacaton Phoenix-Glandale Goldfield-Superior	80 mi. 10° to 150° F. No sleet Bad lightning	162	S.T. S.P. W.P.	......	20- 50 in mts. 50 in des.	......
Canadian Light & Power Co	44	60	20,000 kva.	50,000 kva.	1911	H	7,200	50	150	2-D.R. Francis 2-Twin volute	I.P.M. S.M.S.	4-5,000	2,300	3 Can. A.C. 1 Can. G.E.	No.	4-5,000	3	D	D	No.	20,000	3 Can. A.C. 1 Can. G.E.	13,200 2,200	44,000	D	D	No.	I.D.	16,000 1,800	St. Timothee- Montreal	75 mi. wind —20° F. 1 in. ice	27	S.T. S.A.	Steel gr.	52	......
Vermont Hydro-Electric Corporation	44	60 and 26	2,600 1,800 800 1,200 300	....	1913 1903 1909 1911	16 H	400 to 1,800	19 to 480	170 to 750	Francis	Pelton, S.M.S. Dayton Globe Stillwell Bierce Trump	400-1,250	2,300 13,200 11,000	G.E. Fort Wayne Minneapolis Rife	None	3-500 6-400 2-1,000 3-250	1	D	D	......	6,650	G.E. G.E. Moloney	11- 2,300 3- 13,200	44,000	D	D	......	O.D.	2,500 3,800 3,000	Calremont, Cavendish, Springfield, Mendon Rutland, etc.	....	109	W.P. S. and W.	Steel mostly gr.	18	......
Civic Utilites, Kingston, Ontario (Connected to OntarioHydro-Elec. Com.)	44	60	4,000	....	....	....	....	..	.....	....	....	500	2,300	Can. G.E.	No.	......	...	...	..	......	.....	....	2,300	44,000	..	..	......	I.D.	2,300	Kingston- Napanee	....	25	W.P.	Susp.	..	......
Central System (Ontario Hydro-Com.)	44	60	23,875 kva.	....	....	H	35,550	..	.....	Francis	....	23,875	2,400 and 6,600	Can. G.E. and Swedish G.E.	....	30,795	...	D	Y	Ungr.	40,795	....	2,400 4,160	44,000	D Y	Y ...	....	I.D. and O.D.	31,630 720	Eastern Ontario	60 mi. wind ½ in. ice —30° to 110° F.	370	W.P.	W.P. and Susp.	26"	......